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Inquiry into

# The Development of Northern Australia

submission from

# East West Line Parks Ltd


PROJECT IRON BOOMERANG
east west line parks limited

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# 1.0 Executive Summary

Dear Select Committee Members - 30th January 2014

*Project Iron Boomerang* links the Pilbara iron ore mines in Western Australia with the Bowen Basin coal mines in north Queensland via an east west Transcontinental Corridor. Accommodated in the Transcontinental Corridor is a world's best practice heavy haul railway which takes full payloads each way over a 3,370 Km journey (coal to iron ore - iron ore to coal) to value adding first stage steel manufacturing Steel Parks at Abbot Point Qld and Newman WA.

Highlights of the seven year study on *Project Iron Boomerang* study indicate that:

- The Corridor is a multi-user, multi-purpose, open access infrastructure corridor that will contribute to a significant reduction in the long term environmental impact on land, natural fauna and flora and economic and social impacts on the agricultural sector and rural and indigenous communities generally.
- *Project Iron Boomerang* will provide productivity gains and value-add Australia's coal and iron ore by 50% to make and export 44 million tonnes per annum (mtpa) of quality slab steel equivalent to A$22 billion per annum delivered to east Asia and A$11 billion value adding per annum
- The rule of thumb generated economic benefit is usually 3 to 1 in dollar terms for every dollar of steel produced[1]. The outcome is A$22 billion of steel, plus A$66 billion of directly related economic generated benefit for a total of A$88 billion pa.
- *Project Iron Boomerang* Phase 1 when commissioned in 2022 indicates an uplift of approximately 8% to the 2013 GDP of US$1,488 billion[2].
- Our study predicts 35,000 directly related permanent jobs will result with 20,000 at Abbott point and 12,000 at Newman WA and rest around Australia.
- 75,000 thousand peak construction jobs will be required to deliver the project over a seven to eight year period for *Project Iron Boomerang* Phase 1.
- A beneficial outcome of our seven year intensive study is a Boomerang Class roll on roll off ("RO-RO") slab steel and container vessel which is patented worldwide in 2013 - another key innovative feature of *Project Iron Boomerang*.
- These full payloads each way RO-RO ships indicate productivity gain savings could approach A$2 billion per annum Australia in sea freight logistics based on 50 Boomerang class ships required for 44 mtpa of steel exported per annum. A major benefit to overcoming our current hurdle as the "tyranny of distance continent."
- Against current operating practice for world steelmaking - *Project Iron Boomerang* offers a world productivity gain of 20 - 30%.

We commend this study as a major catalyst, one we are sure will help define and drive the future of Australia's North above the Tropic of Capricorn.

Shane Condon
Managing Director and Founder
East West Line Parks Limited

David Dundas Trude
Chairman
East West Line Parks Limited

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[1] Tata Steel Consulting UK and Nomura Research Institute Japan

[2] Please refer to http://www.dfat.gov.au/geo/fs/aust.pdf

# 2.0 Introduction

This submission is evidence based and contains a substantial body of knowledge not in the Public domain. The content is an outcome of our seven years of research and development on the *Project Iron Boomerang* study and was prepared solely for the Parliamentary Select Committee for the inquiry into *The Development of Northern Australia* as we believe that it is in the Public interest. East West Line Parks Ltd[3] ("EWLP") in creating this submission has drawn from our experiences in developing *Project Iron Boomerang*. *Project Iron Boomerang* was established for the sole purpose of developing the business model of producing first stage steel in Northern Australia. This submission includes facts, opinions and arguments and recommendations for action; we have taken care to ensure the submission was prepared in context to the Terms of Reference.

The ensuing content describes how *Project Iron Boomerang* resonates and aligns in context to developing the northern region of Australia, the regions which lie north of the Tropic of Capricorn, spanning Western Australia, Northern Territory and Queensland. Prior to the Committee delivering its final report and recommendations to the Parliament on or before July 2014 EWLP want the Committee to appreciate what we have learnt from our research and development efforts, and through the discovery process, the new knowledge, the learning outcomes acquired over a period of seven years as we have sought to develop a formula in order to bring to financial close, the Business Model of producing first stage steel that will be utilised in the mass markets of Asia and elsewhere on a sustainable basis.

This submission describes the enormous potential to be reaped on the realisation of *Project Iron Boomerang;* a Project that is located above the Tropic of Capricorn and has preoccupied EWLP's resources and energies since 2006. After seven years of research and development we are of the fundamental view that *Project Iron Boomerang* has the inherent attributes to catalyse the development of northern Australia. In the ensuing evidence based submission we would optimistically hope the joint select committee will arrive at a concurrent view, and that we are not articulating because of the steadfast belief in "a good idea"; but there is a substantial body of evidence acquired through the efforts of EWLP that provides the strongest of indicators that we need to jointly pursue the reality of *Project Iron Boomerang* because it is in the National interest to do so. We hope this submission is the spark that stimulates the Nations productive interest; in that Australia needs to capitalise on its assets and be more than a mine. Australia needs a new productive direction[4] and *Project Iron Boomerang* has arrived to catalyse and transform the northern region of Australia, and the Nation.

The submission was prepared by EWLP as Proponents for *Project Iron Boomerang*. Since 2006 EWLP has invested in excess of $A 10 Mn into developing the Economic and Financial Model and the Business Case of *Project Iron Boomerang*.

We disclose that on the 28th November 2013 EWLP submitted the Transcontinental Corridor project, a subproject of *Project Iron Boomerang* for listing on Infrastructure Australia's Infrastructure Priority List. In the Infrastructure Australia submission we listed the components that are Commercial in Confidence; the main reason for Commercial in Confidence is *Project Iron Boomerang* is wholly private sector and the Infrastructure Priority List process submission contains core intellectual property that represents a substantial body of knowledge not currently in the public domain.

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[3] A listing of the EWLP board and executive management team is available at this link and the project management team at this link
A list of the shareholders is provided at Appendix 1

[4] Beyond the Boom: Australia's Productivity Imperative - McKinsey Global Institute, August 2012 - Refer to Appendix 12

We have mentioned the "Transcontinental Corridor" subproject and now describe what it is and how it contributes to realising the vision of *Project Iron Boomerang*.

The Transcontinental Corridor is approximately 3,370 Km[5] will be used primarily to site initially, a single track standard gauge, heavy haul railway system with 250 Km of passing loops and a carrier grade high availability communications network, in part consisting of a fibre core and a wireless overlay network for train control and general communications. This involves the construction of a multiuser, multi-purpose, open access infrastructure corridor nominally 200m in width[6] from the Abbot Point State Development Area (or adjacent land) to the terminus at Newman, Western Australia. The primary purpose of the Transcontinental Corridor is to provide an efficient rail freight system from the east coast to a Steel Park at Newman and iron ore from the west coast to a Steel Park located at Abbott Point, Queensland.

The method of transportation will be a new transcontinental heavy haul railway. The economics and cost benefits of a heavy haul railway are supported because the notional alternative, coastal shipping around Australia is economically and environmentally inferior[7] to a heavy haul railway in many aspects. The costs of building inwards loading port facilities in already overcrowded and congested out loading ports that are not currently meeting expansion growth needs is a major constraint issue.[8]

EWLP is the Proponent of the Transcontinental Common User Infrastructure Corridor ("Transcontinental Corridor"). The Transcontinental Corridor is a subproject of the master project code named *Project Iron Boomerang*. EWLP proposes to facilitate and coordinate the design and construction of the railway and associated infrastructure within the Transcontinental Corridor which will incorporate high efficiency 40 tonne load per axle rolling stock [9]and freight operations to serve the needs of Steel Parks, the stranded mines, and the local and indigenous communities en route the Transcontinental Corridor. The Proponent has invested in significant intellectual property in relation to the design and operation of the Transcontinental Corridor and the heavy haul railway and the supporting infrastructure to optimise the efficiency of heavy haul freight operations and scheduling between the Steel Parks. This will in turn facilitate financial investment decisions which can further enable the "stranded" mining projects en route to be realised.

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[5] This track distance of 3370 km, on a preferred 3120 km route (based on aerial surveys and desktop GIS audit taking into account the gradient, geographic considerations, and known environmental and cultural sites, between Moranbah in Queensland to near Newman in Western Australia plus 250 km between Moranbah to Abbot Point) was verified by Quantm. Baker, R. Quantm Report. East West Line Park Rail Corridor Identification Pre-Feasibility Study March 2007 [5]p2. Please refer to Appendix 11

[6] The initial Qantm Report, (Baker, R. Quantm Report. East West Line Park Rail Corridor Identification Prefeasibility Study. March 2007) suggested that a 50 m wide corridor would be sufficient for the rail (p7). However a width of ~150m to 200m will provide a buffer enabling the open access corridor to be also used for water, energy and information and communication technology infrastructure and access maintenance, to support the emerging Northern Regional Development zone. This wider width has been the basis for planning since late 2011. (P.Hammond, Engenium report. "EAST WEST LINE PARKS" Project Iron Boomerang General Arrangement Infrastructure Corridor section".PIBSKEG0041, November 2011 - please refer to Appendix 2)

[7] Calculations demonstrating the cost efficiencies of using rail versus coastal shipping are provided in the PIB Prefeasibility Study Report, Alternative Coastal Shipping Solution, Appendix A: Spreadsheets, October 2008. Section AP6: The primary author of this appendix is Ross Hunter, an internationally recognised expert in rail construction. Please refer to Appendix 13

[8]Evidence of the magnitude of the port loading capacity problem on a real time basis is provided by Monson. See http://www.monson.com.au/wpcontent/uploads/Portsummary1311011. xlsx

[9] Independent documentation of the increased rail freight efficiencies of the 40 tonne wagons and environmental impact advantage of using covered wagons is provided in Ernst & Young + Everything Infrastructure Comparative Economic Study of the Galilee Infrastructure Corridor FINAL Report August 2012 and comparative simulations providing further independent validation of the efficacy of 40 tonne wagons is provided by Calibre Operations Ltd. EWLP additional simulations and capacity assessment supplemental report CARP 11069-REP-Z-0, August 2012. Please refer to Appendices 20 and 7 respectively.

EWLP is building one of Australia's largest multi-faceted infrastructure projects. At financial close *Project Iron Boomerang* will be amongst Australia's largest infrastructure projects. The master project is code named *Project Iron Boomerang*. *Project Iron Boomerang* consists of many sub projects which will revolutionise global steel manufacturing. It is the Transcontinental Corridor that EWLP seeks to have listed on the Infrastructure Priority List, the Transcontinental Corridor underpins the steel manufacturing complexes on the east and west coast of Australia. In the Transcontinental Corridor a purpose built heavy haul transcontinental railway line will link Australia's two great ore bodies for steelmaking, iron ore from the west coast and metallurgical coal from the east coast. The transcontinental railway will be dedicated to carrying resources efficiently from one side of the country to the other between the first stage iron and Steel Precincts.

The infrastructure, services and resource linkages will support and fuel two Steel Precincts, one on each coast, which will manufacture slab and coil steel for export. Project Iron Boomerang delivers triple bottom line benefits[10] (financial, environmental and social) that are very positive to all participants, particularly steelmakers. The major benefits of Project Iron Boomerang are consistent with a Comparative Economic Study conducted by Ernst & Young and Everything Infrastructure Pty Ltd, which compared the initial 650 Km[11] of the 3,370 Km Transcontinental Corridor against other proposed Galilee Basin rail lines[12] determined that:

1. The Corridor achieves major financial, environmental and community benefits by:
    - 1.1. bypassing community areas;
    - 1.2. minimising impact on agricultural land;
    - 1.3. minimising the length of corridor in flood plain areas;
    - 1.4. provide a single alignment solution, at around AUD 7.00 per tonne, indicates 50% to 55% efficiency against the alternative dual alignment solution;
    - 1.5. utilising standard gauge which performs more efficiently than narrow gauge on a cost per tonne basis; and
    - 1.6. subject to further validation of wagon design (a programme has been commissioned and is now underway), providing a 40 tonne axle load wagon which outperforms 32.5 and 26.5 tonne axle load wagons delivering fully optimised freight efficiencies and productivity gains[13].

EWLP rationale for pursuing the Transcontinental Corridor for listing on the Infrastructure Priority List is multifold and we list those reasons below:

- *Project Iron Boomerang* provides enormous benefits across Northern Australia is privately funded; But endorsement and support by the Australian Government is needed to raise the

[10] These triple bottom line benefits have been confirmed through assessments made through the consensus of recognised world experts in steel making, rail construction, finance, environmental and social impact evaluation domains and through contracted inputs and evaluations by organisations who are likely to bid on components of the project. These sources will be footnoted under discussions of specific impact.

[11] Refer to Appendix 8 - EWLP Initial Advice Statement Galilee Infrastructure Corridor Project 8 Mar 12 FINAL. pdf page 4

[12] Advice from McKinsey & Co and Goldman Sachs on a process to achieve financial close for Galilee Miners and PIB lead to engagement with Mining proponents and was supported at that time by the Qld State Government Coordinator General

[13] Refer to Appendix 19 - Ernst & Young + Everything Infrastructure Presentation of Comparative Economic Study Galilee Infrastructure Corridor Project 2012, Page 27. Comparative simulations providing further independent validation of the the efficacy of 40 tonne wagons is provided by Calibre Operations Ltd - please refer to Appendix 7.

necessary capital. The *Project Iron Boomerang* business model, first and foremost is a Steelmakers Project. Steelmakers, the ultimate beneficiaries of *Project Iron Boomerang*, are being asked to be the principal funders of *Project Iron Boomerang* ;

- Infrastructure Priority List listing is a tollgate on the critical path to realise the master PIB project. During the last six years the majority of the world's Steelmakers have signed confidentiality agreements and are in general agreement with the economic and financial models.[14] In particular China, Japan and Korea steel makers exhibit the most interest in participating in *Project Iron Boomerang* as stakeholders. While we have continuing dialogue they have many queries chief amongst them being ***" ... is there Australian government support for Project Iron Boomerang ?..."***[15] This critical question is partially answered should the Transcontinental Corridor be listed on the Infrastructure Priority List;
- the very nature of *Project Iron Boomerang* requires agreement and active participation by foreign governments, at the highest levels. The question of Australian government support is answered in full with active participation and engagement by the Australian government and we envisage the support of the below Australian government lead departments:
  - Department of Industry;
  - Department of Infrastructure and Regional Development; and
  - Department of Foreign Affairs and Trade
- Infrastructure Priority List submissions to Infrastructure Australia follow a prescriptive process that has Auditor General oversight. Projects are assessed as being in one of four stages, according to the Infrastructure Australia criteria *Project Iron Boomerang* self-assessed as "Real Potential". The next stage is "Threshold" and the final stage is "Ready to Go". At "Ready to Go" stage *Project Iron Boomerang under* the current project timeline, would have been on a 3 year journey with Infrastructure Australia, and EWLP would have expended approximately $A 150 Mn to understand the known unknowns. At the end of this journey *Project Iron Boomerang* would have been identified as a project of national significance and be eligible for Division 415 or otherwise known as the tax loss incentive for infrastructure projects, and;
- as technical advisers to the Australian government, Infrastructure Australia has the inherent capability of providing inter jurisdictional support and a coordination point for Queensland and Western Australia State Governments, the Northern Territory Legislature and the Commonwealth of Australia.

## 2.1 Transcontinental (Common User Infrastructure) Corridor Advantages

In addition to those outlined above, the following reasons support the potential for development of the region's mineral, energy, agricultural, defence and other industries that serve the manufacture of first stage steel and catalysing mining enterprise en route the Corridor:

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[14] The following steelmakers have not only signed the confidentiality agreement, but over a five year period, have provided data increasing the precision of cost/benefit calculations under different technological advances and under different world supply and pricing conditions: Arcelor Mittal Steel,Hebei Steel,Nippon Steel & Sumitomo Metal, Baosteel, POSCO, Hyundai Steel, Dongkuk Steel, BlueScope Steel, Jiangsu Shagang, Wu steel, Angang Steel, Maanshan, Nanjinzhao Group, EUnited, Formosa Plastics Group, Meijin Energy, JFE Steel, ESSAR Group, Bhushan Steel & Strips Limited. Based on 2012 data, collectively, these firms account for over 43% of the world steel output. (MetalBulletin Company data base report, www.mbdatabase.com June 2013, p 5).

[15] Foreign steelmakers and Chinese steel makers in particular, because of state ownership and substantial long term support from their Government, are reluctant to commit without endorsement by their Government and Australian Government entities. The Australian Government will necessarily be involved. This theme has been consistently voiced by the major steelmakers in China, Korea, Japan and India since 2006, when the PIB project was first developed and continues in 2013, to be voiced as a necessary step for more than a small initial investment by them.

1. In addition to facilitating a core freight corridor for iron ore and metallurgical coal, the Transcontinental Corridor will be available for infrastructure owned and operated by a number of entities which will provide a range of products to many members of the public and industry sectors.
2. The Transcontinental Corridor is of economic significance[16] to Western Australia, South Australia, Northern Territory, Queensland and the nation, in that it will:
   a. contribute to the Australian Government's Infrastructure Policy;
   b. contribute to domestic capital formation; and
   c. shape infrastructure planning and development, and significantly facilitate further economic development in Northern Regional Australia
3. The capital investment required to establish the Transcontinental Corridor will predominantly consist of the purchase price of the land or rights of way across land and works on land to enable development of various forms of transport and other infrastructure within the Transcontinental Corridor. However, the capital investment involved in establishing rail infrastructure, utility services, pipelines and information and communication technology conduits within the Transcontinental Corridor is expected to exceed US$18 billion.
4. Approval of the Transcontinental Corridor (which includes the first 650 Km a.k.a. the Galilee Infrastructure Corridor ("GIC")) a multiuser, multi-purpose, open access infrastructure corridor will contribute to a significant reduction in the long term environmental impact on land, natural fauna and flora and economic and social impacts on the agricultural sector and rural and indigenous communities generally[17].
5. The Transcontinental Corridor will facilitate the cost efficient freight of cargo for the benefit and needs of multiple economic sectors, including the mining sector[18], the agricultural sector[19] and the horticulture sector.
6. The Transcontinental Corridor will function as a continental trade corridor for Northern Regional development and will be a foundation customer for the proposed facility at the Port of Abbot Point and provide an anchor at Newman.
7. The Transcontinental Corridor will have the capacity to provide for water, energy and information and communication technology infrastructure to support the emerging Northern Regional development policy in Queensland, Northern Territory and Western Australia and contribute to better utilisation of, and returns on investments in, existing

[16] The range of potential beneficiaries is extensive. An example of the breadth and depth of these benefits can be found in a Qld Government sponsored Independent report by rail engineers Kellog, Brown and Root, 2012 held commercial in confidence by the Qld government.

[17] Refer to Appendix 14- EPBC Act 1999 Referral of Proposed Action EWLP Limited GIC Appendix 31 July 12.pdf

[18] PIB is also a Galilee proponent as the first 650 Kms is part of the 3,370 KM Transcontinental Corridor. The Galilee Basin will remain undeveloped for two key reasons. The current preferred corridors nominated by the Queensland State Government (Adani, Hancock GVK and Aurizon as proponents) are 1) a high environmental and 2) a high commercial risk. A solution that is consistent with the PIB model has been developed by McKinsey & Co and supported by Goldman Sachs it also the solution for developing the Galilee Basin. Refer to Ernst & Young + Everything Infrastructure Comparative Economic Study of the Galilee Infrastructure Corridor FINAL Report.pdf. Refer to Appendix 20

[19] Consistent with the endorsements from the mining and steelmaking sectors, the Agricultural sector has been a very strong advocate of PIB. (personal communication to Shane Condon, PIB from Peter Anderson, Central Queensland Agforce Chair), 2012.

infrastructure, including that established by Government Owned Corporations.[20]

8. While the Transcontinental Corridor project will not directly generate royalties or export duties to governments, it will generate major investment and economic returns through the development of sector opportunities for upstream industry and downstream processing industries which will in turn contribute royalties as well as revenue by way of taxes and charges for State and Commonwealth Governments; and as a project within the master project, *Project Iron Boomerang.*[21]
9. *Project Iron Boomerang* will generate significant national export revenue.
10. The Transcontinental Corridor project will generate significant regional and local employment in construction and through mobile employment of key construction workforce teams from site to site. Permanent employment opportunities, particularly for indigenous workers, will centre on track and rolling stock maintenance and train and infrastructure operations and maintenance. Additionally, the Transcontinental Corridor project will contribute to long term employment sustainability in the regions for existing industry sectors and will open up employment opportunities from upstream and downstream development realised by existing and potential industries utilising the Transcontinental Corridor.
11. Finance for the construction of the Transcontinental Corridor project will be sourced through alliance partners, third party investors and financial institutions. Negotiations are underway to achieve the capital raising requirements of the Transcontinental Corridor project and further details can be provided upon request, with the consent of relevant parties. However, this Project is a standalone project and financial support from the Commonwealth Government **is not** being sought for the Transcontinental Corridor planning and acquisition.
12. The Project is of strategic significance[22] to multiple localities and local government areas of Queensland – Whitsunday, Isaac, Charters Towers and Barcaldine Regional Council Local Government Areas.
13. The Project includes support for the Government's Policy on Strategic Cropping Lands[23] and contributes to local economies.
14. This Transcontinental Corridor proposes an optimum economic freight efficiency heavy haul rail freight solution and will have far less social and environmental impacts than lower efficiency rail freight.[24]

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[20] The development of these capacities is central to the vision of the Australian Government. http://www.liberal.org.au/2030visiondevelopingnorthernaustralia. This platform statement forecasts the white paper currently being prepared by Government. Negotiations are continuing with Government Owned Corporation, State governments and the Northern Territory to identify needs that can be served effectively by the corridor infrastructure.

[21] Independent estimates of the contribution to the economy from turnover from 22 million tonnes of semi finished steel products at each end alone, was $20 billion per annum. Refer to Appendix 18 - Presentation by NRI and TSC SmaRT Complex of Project Iron boomerang: Realisation of a Sustainable Industrial and Residential Complex in Queensland, Australia" 18 June 2013.

[22] C2C Submission to the Minister May 2011.pdf, 120511 GETTING IT RIGHT submission.pdf, and Isaac Regional Council Subm8141657550001.pdf - Refer to Appendices 3, 4 and 5

[23] A detailed analysis of the proposed QLD corridor section's consistency with Strategic Cropping Land legislation is provided in the Referral of Proposed Action EWLP Limited GIC Appendix 31 July 12.pdf. - Refer to Appendix 14

[24] Refer to Appendix 20 - Independent evidence of the economic and environmental benefits of using heavy rail (40 tonne load per axle rolling stock) is summarised in Ernst & Young and Everything Infrastructure August 2012. The report by Calibre gives a finer grain analysis of the advantage of heavy rail. Refer to Appendix 7 - Calibre Operations Ltd. EWLP additional simulations and capacity assessment. Supplemental report CARP 11069-REP-Z-005, August 2012.

15. The strategic significance to Australia includes establishing infrastructure which anticipates continued growth in accordance with the Australian Government's 2030 Vision[25] for Developing Northern Australia.
16. The Transcontinental Corridor falls within the development application process pursuant to the Sustainable Planning Act 1999 and would involve multiple separate applications to ten (10) local governments and multiple aboriginal land trusts and a Referral to the Commonwealth Government pursuant to the Environment Protection and Biodiversity Conservation Act 1999[26]. The timelines involved in separate applications, referrals and decision making processes and unpredictable timing of appeals processes would potentially render the project non-viable if unable to meet or achieve project and commercial timeframes, as required by the alliance partners and potential investors.

The proposed heavy haul transcontinental railway of 40 tonne load per axle from Abbott Point in Queensland to the terminus in Newman, Western Australia in a proposed transcontinental common user infrastructure corridor is supported because the notional alternative of coastal shipping around Australia is both economically and environmentally inferior[27].

The mandated rail geometry is flat grade of 1:320 to enable optimum economic efficiency of the Heavy Haul rail. The transcontinental corridor is nominally 200 metres wide[28] and accommodates robust carrier grade cellular wireless overlay network for train control and management. The proponent is a licensed carrier[29] under the Telecommunications Act and intends to offer Carrier grade communications to local and indigenous communities, and mining enterprises enroute the Corridor.

The railway and rolling stock to be undertaken by EWLP involve an investment, in today's dollars, of US$18.259 billion. The steel smelters are to be owned and constructed by participating steelmakers, which will require an overall total investment of around US$24 billion. In addition, there will be investments in shared industrial services directly related to the functioning of the steel smelters. We estimate that the total supporting infrastructure investment directly related to the PIB development will be in the vicinity of US$50 billion, with the majority funding emanating from overseas participants.

Whilst *Project Iron Boomerang* is a very large project of national or even global significance, it is not overly ambitious. The project phase one development case provides 44 million tonnes per year of production out of a forecasted worldwide steelmaking capacity need in excess of 1.3 billion tonnes per annum. *Project Iron Boomerang* is targeting less than 3% of projected global capacity

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[25] A white paper on the Government's vision is forthcoming. The press release signalling its likely content provides a basis for the gains to be made through the proposed rail infrastructure to add significant value to the policy. This link refers.

[26] Refer to Appendix 14 for the first 650 Km of the 3,370 Km Transcontinental Corridor Referral of Proposed Action EWLP Limited GIC Appendix 31 July 12.pdf

[27] Calculations demonstrating the cost efficiencies of using rail versus coastal shipping are provided in the PIB Pre Feasibility Study Report, Alternative Coastal Shipping Solution. Appendix A: Spreadsheets, October 2008. Section AP6: The primary author of this appendix was Ross Hunter, an internationally recognised expert in rail construction. These figures have since been validated by various subject matter logistics experts in logistics including TSC and NRI.

[28] Please refer to Appendix 2

[29] License # 312, issued 14 September 2011

growth, or in China 2012 steel production terms, around 6% of their capacity.[30]

## 2.2 Key Value Drivers

The key value drivers of *Project Iron Boomerang* relate to efficiencies in the supply chain, Steel Park economics and environmental benefits[31].

- Reduce transport and other supply chain tonnage by consolidating major raw material inputs (by 2.5 times) and maximise back loading transport rail and eliminate sea freight inefficiencies (coking coal railed west and iron ore railed east);
- Develop synergies in colocation of raw material production by making available large Steel Park sites suitable for the consolidation of industry;
- Facilitate construction of high efficiency steel smelters using world class technology;
- Provide benefits of colocation of steel smelters, shared services and efficiencies in managing energy inputs and outputs;
- Deliver major global environmental benefits by improving transport efficiencies, modern first stage steel production techniques and efficient cogeneration energy utilisation;
- Deliver significant economic benefits to Australia through investments that will exceed $50 billion, value adding of resources, job creation, and sustainable economic activity.

The first requirement for *Project Iron Boomerang* to be a viable project is that it delivers significant advantages and benefits to the participating steelmakers. The extensive analysis conducted in the Pre-Feasibility Study and subsequently updated with input from Tata Steel Consultants indicates that the capital expenditure required to construct a first stage steel smelter facility will be reduced by US$1 billion for each smelter as against a standalone mill in an OECD country.

The fob cost of slab steel production of a tonne of slab steel for delivery to an East or South Asia second stage steel mill will be reduced by over 30%. The economic advantages of *Project Iron Boomerang* are compelling and justify proceeding to further analysis. The project's concept and strategy prospects currently indicate that *Project Iron Boomerang* at such a sustainable scale can be one of the most sustainable cost competitive locations on earth to make first stage steel products.

# 3.0 Background to *Project Iron Boomerang*

First and foremost *Project Iron Boomerang* is a steel maker's project and is wholly private sector.

*Project Iron Boomerang* is the code name for the master project which consists of many sub projects when brought into reality will revolutionise global steel manufacturing. The Transcontinental Corridor project is one of the sub projects of *Project Iron Boomerang.* The vision of *Project Iron Boomerang* will underpin and be an enabler, if not the fast acting catalyst for *The Development of Northern Australia,* above the Tropic of Capricorn. Our assertion for the foregoing is the Transcontinental Corridor project is both a critical path and the primary tollgate to advance *Project Iron Boomerang*. The Transcontinental Corridor will accommodate a purpose built heavy haul transcontinental railway line that will link Australia's two great ore bodies for steelmaking, iron ore from the west coast and metallurgical coal from the east coast. The transcontinental railway will be dedicated to carrying resources efficiently from one side of the country to the other

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[30] These steel production figures are taken from the China Iron and Steel association 2012 report in 2012, the steel production in China was 716.54 million tons.

[31] The evidence for these drivers is summarised in Independent reports by Tata Steel Consulting- Refer to Appendices 9, 10 and 16

between the first stage iron and Steel Parks to be located at Abbott Point in Queensland [32]and Newman in the Pilbara, Western Australia.

*Project Iron Boomerang* has been specifically developed by EWLP to explore the economic feasibility of establishing semi-finished steel production in Australia, close to the major raw materials inputs. The project can provide significant economic advantages to the steelmakers, the Financial Model has been developed to prove the theory and over the last six years the world's Steelmakers have accepted the economics that underpin this Financial Model. Should the enablers of this Project be in place the advantages are sufficient to enable the steelmakers to fund *Project Iron Boomerang*.

We do not anticipate an equity involvement in the project by government. However a critical ingredient *Project Iron Boomerang* needs from the government is the political will to assure Australia is behind bringing the vision of *Project Iron Boomerang* into reality. This is not an assumption on our part; This is a conclusion after years of meetings with the executive management teams of the world's top steelmakers.

## 3.1 Developing the Northern Regions of Australia

Our focus is on the Northern Australia Region and in the process of transforming the economic base from only being that of a "mine pit to port" basis to that of a sophisticated value adding manufacturing of first stage steel products. While the best practise steel making technology associated with this initiative results in fewer people in the steelmaking process due to advances in automation, the consequence of the scale of operations created from the by-products of the steelmaking process will support a substantially larger workforce. It is estimated by our consultants Tata Steel Consulting and Nomura Research Institute that 40,000 permanent workforce will develop around the auxiliary services needed to support the Steel Parks.

*Project Iron Boomerang* an infrastructure and manufacturing project will develop a steel industry of international significance in Northern Australia and transform the region from a mining centric industrial base to that of manufacturing and exporting first stage steel products and the creation of auxiliary supporting industries.

The project includes the building of significant infrastructure including a transcontinental heavy haul rail line within a Transcontinental Corridor linking the Bowen Basin metallurgical/coking coal mines in Central Queensland with the Pilbara iron ore mines of Western Australia. EWLP proposes to establish a Steel Park within the Abbot Point State Development Area (APSDA), linked by the rail corridor to a similar facility in the Pilbara, each of which will manufacture 22 million tonnes of slab steel products annually for export from its adjacent coastline.

TATA steel Consulting – UK (TSC), a leading consultant to the world steel industry, examined the 2007 Pre-feasibility Study at a deeper level, based on current market conditions[33]. They reconfirmed 32 *Project Iron Boomerang*'s strong economic case to develop a more competitive steel manufacturing industry in Northern Australia than anywhere else in the world. *Project Iron Boomerang* will be Australia's largest infrastructure and manufacturing project, involving Capex of approximately $16 billion for the steel complexes, and approximately $18 billion for the transcontinental rail crossing. The value of high quality slab steel products exported from APSDA to the world's expanding markets will exceed $22 billion annually. In addition, secondary industries established downstream on the back of surplus heat and energy from the steel complexes, including cement manufacturing, biofuels and bio plastics, will be capable of

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[32] For detail please refer to Appendices 15 and 17 - General Arrangement for Project Iron Boomerang at Abbott Point and Combined Smart Materials Concept and *Project Iron Boomerang* RFI response to APSDA for APX - February 2013

[33] Tata Steel Consulting, EWLP Steel Complex Report Aug 2012, Newport, Wales, UK - Refer to Appendices 9 and 6.

generating products for export with a value of approximately $10 billion annually[34].

The proponent is continuing to strongly pursue the planning and development of the required infrastructure, manufacturing plants and associated facilities while at the same time securing necessary investment and ongoing technical input from steel manufacturers. The proponent has developed strong relationships including confidentiality agreements with the leading steel manufacturing companies in Japan, Korea, China and India and Australia[35] and is pursuing the ongoing development of the project with the following primary committed logistics, construction and planning providers.

1. TATA Steel Consulting, UK - (TSC) a leading consultant to the world steel industry, who are providing independent validation of the models against world best practice.
2. Nomura Research Institute (NRI) - a leading Japanese consulting firm, who has signed a business agreement and is jointly developing and modelling the non-rail components of the *Project Iron Boomerang* project.
3. Engenium – One of Australia's leading heavy haul rail designers who as partners, *Project Iron Boomerang* Shareholders and are represented on the EWLP board of Directors provide value input into the design of the rail.
4. Leighton Contractors - an international large infrastructure/ project contractor and *Project Iron Boomerang* Shareholder.
5. HMA Consulting - Founding *s*hareholder and National power consultants.
6. XStrata Coal (now Glencore) - Founding *s*hareholder and on EWLP board of Directors.

By consolidating international supply chain logistics *Project Iron Boomerang* will change forever the current industry paradigm that Australia chooses only to export its world class coking coal and iron ore and import steel rather than 'value add' to its raw materials domestically. In doing so, *Project Iron Boomerang* will also replace the need to ship more than twice the export tonnage of raw materials with the consolidated export of finished steel slab product[36], thereby improving national productivity and generating significant economic benefits to Queensland, Western Australia and the nation as a whole.

With a strong focus on productivity, long term sustainability and energy efficiency, TSC has assessed the proposed steel plant meets world's best productivity benchmarks for slab steel production with a labour input of 0.25 man-hours/tonne compared to a typical world figure of 0.5 man-hours/tonne. TSC estimates the energy consumption of the facility to be approximately 16 GJ/tonne of slab[37], which is of the order of 20% better than typical worldwide practice. Further, it will also deliver an environmentally sound plant with low emissions to the atmosphere by world standards[38]. These environmental benefits on a world scale add to the substantial savings in

[34] NRI, Feb 2013

[35] These include: BlueScope Steel, Baosteel, Hebei steel, Jiangsu Shagang, Wu steel, Angang Steel, Maanshan, Nanjinzhao Group, EUnited, Formosa Plastics Group, Meijin Energy, Nippon Steel & Sumitomo Metal, JFE Steel, POSCO, Hyundai Steel, Dongkuk Steel, Arcelor Mittal Steel, ESSAR Group, Bhushan Steel & Strips Limited.

[36]The actual advantage of shipping slab steel over shipping the raw ingredients that are used in its production is closer to 2.5:1. The raw material weight to produce 44 million tons of slab requires 66 million tons of iron ore plus 40 million tonnes of coking coal plus 8 million tonnes of limestone and other raw materials that go into the production and shipping of 44 tonnes of steel slab.

[37] Refer to Appendix 9 - Tata Steel Consulting, EWLP Steel Complex Report Aug 2012 Newport, Wales, UK. see points 5 and 6 in the executive summary and page 75 of the full report.

[38] Refer to Appendix 9 -Tata Steel Consulting, EWLP Steel Complex Report Aug 2012 Newport, Wales, UK. See summary figure page 84.

greenhouse gas emissions from the supply chain consolidation that accrues by shipping finished slab steel outside Australia, rather than shipping more than double the volume of iron ore and coal as raw materials.

The focus on long term sustainability and energy efficiency brought into play collaboration between TSC and NRI, to develop sustainable uses for surplus gas, energy and heat from the steel complex. This collaboration has identified the potential to develop significant secondary industries including cement manufacture, biofuels and bio plastics which would naturally follow the establishment of the steel complex. *Project Iron Boomerang* would create the world's first sustainable industrial and residential complex located in Bowen areas Queensland, sustaining upwards of 40,000 people[39] who will be drawn to the region's new found industrial profile.

The improved efficiency of the supply chain will deliver triple bottom line benefits in terms of improved environmental outcomes through lower carbon emissions and economic dividends flowing from its competitive efficiency advantage. Separate from the sound economic case for *Project Iron Boomerang*, the proponent notes the economic benefits that will accrue to the nation from the transcontinental rail line which were documented in a joint study by Ernst and Young and Everything Infrastructure Pty Ltd[40] commissioned by EWLP. The study has demonstrated that the proposed rail corridor and 40 tonnes load per axle heavy haul rail line provides by far the most efficient freight solution for coal from Queensland's Galilee and Bowen Basin to Abbot Point, even as a standalone project without any reliance on *Project Iron Boomerang*'s own tonnages.

*Project Iron Boomerang* will deliver:

- a nation building opportunity to leverage domestic raw materials into a modern, internationally competitive steel industry on a significant scale;
- Australia's largest infrastructure and manufacturing project;
- Improved supply chain cost efficiencies and technology transfer benefits through partnerships with international steel companies with access to world's best technologies;
- Improved resource management/consumption sustainability;
- reduced carbon emissions on a global scale;
- facilitation of significant secondary industries at the APSDA and Newman;
- significant regional domestic employment in both construction and operational phases;
- Increased diversity of economic activity in the APSDA, Newman and the Northern Region, and;
- a transcontinental, standard gauge rail line with 40 tonne axle load efficiency which will open up the enormous economic potential of stranded inland mineral reserves.

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[39] Refer to Appendix 18 - page 6 SMaRT Complex Information Pack Booklet Feb 2013.pdf

[40] Refer Appendix 20 - Ernst & Young + Everything Infrastructure Group Comparative Economic Study of the Galilee Infrastructure Corridor FINAL Report August 2012 Pages 2 and 27

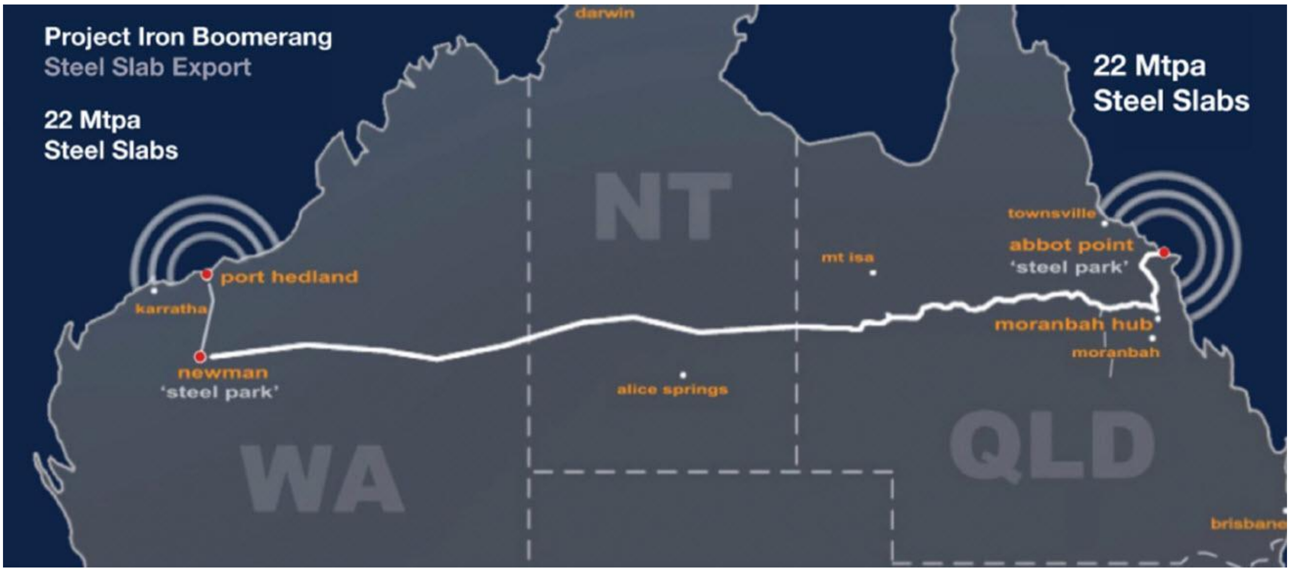


**Figure 1: Locational Overview of Project Iron Boomerang**

EWLP has progressed its planning for *Project Iron Boomerang* to the stage where it needs to secure suitable land within the Abbot Point State Development Area to establish the Queensland Steel Park.[41]

*Project Iron Boomerang* will contribute to significant northern regional development in Queensland and Newman, Western Australia. It will continue to deliver nation building benefits to the State and the Commonwealth for the long term and, accordingly, deserves the State's and Commonwealths' strong support when allocating land appropriately within the APSDA and Newman.

The proponent considers that a spirit of openness in discussions about land use at APSDA and development of suitable facilities at the Port would arrive at a suitable accommodation for all concerned and confirms its strong desire to continue to participate with the State in such discussions until a satisfactory solution is reached. This approach is being used with the Northern Territory and West Australia in transforming the region.

### 3.1.1 Developing the Northern Region of Australia - Communications Infrastructure

EWLP is a licensed carrier (number 312) under the Telecommunications Act. EWLP plans to implement a robust carrier grade terrestrial based (diverse fibre paths) with a cellular wireless overlay communications network that offers high capacity carriage services (fast internet and mobile data) to the EWLP *Project Iron Boomerang* railway train operators as well as emerging enterprises on the transcontinental common user corridor illustrated below.

Amongst other bulk cargo trains six daily *Project Iron Boomerang* bulk cargo trains will be in concurrent operation on the rail on their 44 hour transit journey time. Trains of coal, and iron ore trains 4 Km in length and 44,500 tonnes that need to operate safely and efficiently. To meet this need the trend in Australia and overseas is to implement 'in cab' train communication platforms, and the co-dependency is the critical reliance on a modern terrestrial based wireless communications infrastructure for the EWLP railway to operate safely and efficiently. The communications network will be implemented as a modern digital, highly available and reliable service for the entire transcontinental railway route ensuring constantly available communications to simplify railway operations management and mitigate risk.

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[41] Refer to Appendix 17 - detailed response provided to Qld DSDIP in February 2013 please refer to Combined SMC and PIB RFI response to APSDA for APX February 2013.pdf

EWLP plans to implement an international standard cellular wireless overlay network supplying mobile telephony and internet to service the railway route, and as a licensed carrier offer carriage services to nearby enterprises EWLP communications network connects people, equipment and systems across the entire EWLP *Project Iron Boomerang* railway organisation and other nearby external parties e.g. Shire Councils, Indigenous Communities and Mining enterprises.

The transcontinental railway route will traverse mineral and energy deposits and provide a transport route to market for the previously stranded Mining sites and a supply chain route for emerging sustainable Energy development. Mining tenements and sustainable energy hubs will be able to rapidly develop due to the quality of the communications and internet services and the transcontinental railway.

The architecture of the EWLP communications network is scalable to offer enterprises a high availability network for carriage services such as cellular mobile services, telecommunications, and internet via cellular mobile data as well as high capacity optical fibre. EWLP will proactively offer to all enterprises carriage services i.e. communications and sites to rapidly commence operations regardless of the remoteness and minimal supporting infrastructure.

Resource tenements that are not within the immediate vicinity to the transcontinental railway, and require a transport route to market can be catered to by extending a rail spur from the east west transcontinental rail corridor to their proposed mine site.

The communications architectural base line [42] allows straightforward extension of the high availability communications network to the adjacent or remote emerging mine sites utilising a combination of optical fibre, and cellular communications may be readily extended in the rail corridor spur to the mine development site. At specific intervals within the rail spur corridor extension, equipment shelters that house the communications equipment amplifiers and signal regenerators will dot the rail corridor.

The equipment shelters will be designed to be passively cooled, ballistic and IP66 rated and optimally will be perimeter security fenced. Housed within the equipment shelters are the base station controllers for the cellular wireless, digital radio amplifiers and repeaters for the backhaul digital radio, transmission switches for the optical fibre, optical fibre terminating equipment, and standby battery power and security surveillance. To sustain the high availability rating, component equipment is duplicated and maintained in hot standby mode[43].

### 3.1.2 Developing the Northern Region of Australia - National Energy Market

Energy Efficiency will be maximised in purpose designed Steel Parks, through cogeneration and utilisation of waste heat and treatment of volatile gases from both the coke and steel mill making process. This will produce substantial surplus electricity for sale, which emulates world's best supply chain emissions control and utilisation practices.

Additional benefits will in part be linked to future national, global and bilateral agreements potential carbon credits. The energy equation for the *Project Iron Boomerang* development is driven by the relative availability of coal for coking and thermal purposes in Queensland and the availability of gas in Western Australia (WA).

The relatively small size of the connected demand for electricity in WA, and the large market available from the National Electricity Market (NEM) in Queensland encourages the development of coking plant and heat recovery generation in Queensland rather than WA. The sale of electricity

[42] Initial desktop study by Huawei in 2011 of the first 1,000Km is the basis for the architectural design of the Carrier grade cellular wireless overlay network.

[43] Standard Carrier architecture for n+1 redundancy, when off the grid, remote, desolate placement for sensitive infrastructure

in WA is likely to yield a higher price. The larger sales in Queensland will require intelligent selling arrangements to manage the price and volume risks associated with the national market pool and the relatively short term contracts market.

The cost of electricity network infrastructure required to connect the quantity of electricity likely to be produced will be significantly less in Queensland because of the close proximity of the smelter park to a major transmission network node at Strathmore. In WA, the economics of displacing relatively small quantities of isolated load will determine the quantity of electricity that can be sold into that market.

The conclusion is that the coking plants, based on capability to dispatch electricity generated, should be considered for Queensland and the blast furnaces should be shared between Queensland and WA. This will result in some imbalance in the material flows between WA and Queensland and therefore the overall *Project Iron Boomerang* will require optimisation.

Electrical Infrastructure and demand for electricity is unlikely to be a constraint in Queensland for export and sale of electricity. The detailed economics of connecting isolated electrical loads will be important to establish the optimum energy balance in WA.

The energy study has been prepared based on HMA consulting's knowledge[44] of the energy industry in Australia as well as the energy infrastructure in each region. The aim of the study was to provide validation of the fundamental feasibility and natural advantages of the *Project Iron Boomerang* proposal. The study does not provide a recommendation on the optimum energy configuration, or other detailed solutions, but provides investigative support to the *Project Iron Boomerang* concept, and illustrate the feasibility and conceptual value of the project.

TSC has provided the below validation on the usable energy for export to the national grid and TSC estimate power generation of 1290 Mw with a contribution 670 Mw base load exported to the national grid. If all the additional energy saving measures above could be realised this would change to around 1580 Mw plant with 960 Mw going to export.

Revenues for the export generation would be (based on 90% capacity factor) $530 Mn in QLD and $1210 Mn in the Pilbara, combining these figures and equating to cost per tonne of slab it is equivalent to nearly $40 per tonne of slab across both facilities[45].

## 3.2 Expanding Australia's Productive Capacity

The Steel Parks' at the completion of Stage 1 (44 mtpa of first stage steel for export to Asia) will introduce a level of productive capacity of 500% of first stage steel due to state of the art Steel making technology being deployed at Abbot Point and Newman. The heavy haul railway (40 tal) increases the productive capacity of the Transcontinental Corridor in context to the national freight network introduces an efficiency factor of 50% when compared with 32 tal and 60% when compared with the 26 tal of the narrow gauge Qld rail network.

The efficiency factors were corroborated in the Comparative Economic Study of the Galilee Infrastructure Corridor by Ernst & Young and Everything Infrastructure Pty Ltd. This study analysed the cost of delivering per tonne of coal from mine pit to port comparing 40, 32 and 26 tal and proponents Corridor alignments.

In a similar vein the 44 mtpa of steel products shipped from the Steel Park will be exported to their

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44 HMA is a specialist electrical networks consulting business, focused on developing strategies to manage the connection f large load and generation projects to the electricity supply network. HMA also has considerable expertise in energy market and fuel sectors and provides strategic advice for the feasibility evaluation of generation and heavy industry projects.

45 Refer to Appendix 10 - Project Iron Boomerang Tata Steel Consulting Prefeasibility Study Report February 2012.pdf

foreign destinations utilising the purpose built steel ship specifically designed for roll on roll off operations. The ship is a sub project of *Project Iron Boomerang* and is provisionally patented; it is a first of its kind, designed from the ground up for efficiency; e.g.

- the loading process is automated requiring four stevedores for loading and unloading operations;
- ship loading time is 48 hours for 76,000 tonnes of steel product. and;
- adjustable decks for carrying containers on the inward return leg to Australia and slab steel and coil on the outward leg to Asia.

## 3.3 Increasing Australia's Productivity

When fully operational (circa 2022) *Project Iron Boomerang* will increase Australia's productivity in the vicinity of 10% contribution to GDP by virtue of the Steelmaking operations and the auxiliary supporting industries. Contributing to productivity but not currently factored in are the below:

1. Transcontinental heavy haul railway will provide a route to market for the development of the current raft of stranded mines that are within striking distance of the Transcontinental Corridor.
2. The digital communication infrastructure needed to support the railway will be utilised to automate remote mining operations that would be otherwise uneconomic for FIFO operations.
3. The Steel Parks are exothermic and generate 1600 Mw of low cost base load power available to the National Energy Market

## 3.4 Diversifying Australia's Economic Capabilities

*Project Iron Boomerang* strongly resonates with the Australian government's policy of regional development and diversifying Australia's economic capabilities. In the first instance all the infrastructure development i.e. the Steel Parks and the Transcontinental Corridor geographic positioning is north of the Tropic of Capricorn. Due to the scale of the activities in *Project Iron Boomerang* it will further diversify Australia's economic capabilities.

## 3.5 Building on Australia's Global Competitive Advantages

Australia was established as a colonial outpost and it was built on a sheep's back and export of primary produce to the world. In the last 50 years we have leveraged the export of Education and whatever we could dig out of the ground to sell to our neighbours while the Asian economies chose to modernise. The idea that Australia should value add iron oxide has been around since the 1930's. That Australia should value add iron oxide by producing first stage steel, until very recently the conditions precedent to do so and the hard yards to achieve that goal has not been evident and that has changed with the modernisation of the Asian economies. With the coalescence of recent events it is opportune to prick the Nation's conscience and spark the Nation's interest to head down a sustainable and prosperous path by engaging in a Nation building project that we have code named *Project Iron Boomerang*.

There is little doubt that economically the 21st century will be owned by the Asian economies, and we need to play our part in this more effectively than we have done to date. Australia is uniquely positioned to be both a partner to Asian progress as they make haste to modernise and increase their standard of living commensurate with what the western world has enjoyed for a century. For *Project Iron Boomerang* to be more than a Vision we need to do more than be a mine. Since 2006 EWLP has invested in *Project Iron Boomerang* for the sole purpose of developing a formula in order to bring to financial close, the business model of producing first stage steel that will be utilised in the mass markets of Asia and elsewhere on a sustainable basis.

## 3.6 Economic Benefits of *Project Iron Boomerang* to Australia

*Project Iron Boomerang* will provide many economic advantages to the economy of Australia. The benefits directly related to *Project Iron Boomerang* include:

- private investment in infrastructure;
- job creation, skills and training; and
- generational long term and sustainable business activity.

The infrastructure investment is anticipated to be in excess of $50 billion and should occur over the next eight to ten years. The forecasted construction workforce for the rail corridor alone will be in excess of 6,822 person weeks over an extended period, along with a permanent indirect workforce of 2,000 to 3,000 workers at each precinct given the auxiliary projects. The operations of the railway, Steel Parks, steel smelters and ancillary services should also generate a significant level of economic activity in Western Australia, Northern Territory and Queensland. The time dimension on these job and economic activity benefits is expected to be over at least 70 years.

In addition to the direct economic impacts of *Project Iron Boomerang*, there are many advantages that will occur to the benefit of businesses outside of *Project Iron Boomerang*, and thus to both the great economic benefit of Australia and to its major trading partner nations.

### 3.6.1 Railway related

The transcontinental railway has substantial reserve capacity, with only three loaded trains operating per day in each direction for the Project Case of five smelters in each Steel Park. Additional rail activity would be at low marginal costs. The railway will pass close by many known resource deposits that have not been economical to mine. Some of these mines will be opened once access through *Project Iron Boomerang* is established. *Project Iron Boomerang* will also provide the opportunity to effectively value add and beneficiate lower grade magnetite iron ore reserves to effectively blend with the major hematite ores, without the added transport penalty involved in exporting these ores to an overseas smelter.

The development of an transcontinental railway will enhance the operations of the Adelaide – Alice Springs – Darwin Line. An expected *Project Iron Boomerang* 5% total phase 1 rail freight deviation to this line will more than increase by three times the current business. We anticipate that this will be particularly advantageous for rail transport to Darwin. There are also likely to be opportunities for economising on facilities and costs by cooperation between the two companies. An obvious example would be in service delivery and refuelling.

Establishing the transcontinental railway will also establish the Transcontinental Corridor. There are many benefits that may evolve from the existence of such a corridor including the transport of water, communications infrastructure and the transmission of energy.

### 3.6.2 Steel Park related

The Steel Parks are very large industrial parks (960 hectares) with the basic infrastructure in place. Power, water and roads will be developed as part of the precinct development. This creates opportunities for complementary industries to locate in the Steel Parks. The expansion of the Steel Parks to accommodate such businesses would have low marginal cost.

A key consideration in the Steel Park planning is to maximise the energy efficiency of the steelmaking process. A large power cogeneration plant is proposed as an integral element of the coke production process, using surplus heat and burning the released volatiles to produce electricity for internal precinct use, and for export to external users. A detailed report from HMA Consulting in respect of energy related aspects of each precinct has been completed and is included in the Pre-Feasibility Study Report.

Opportunities exist within both Queensland and WA to value add from efficient utilisation of cogeneration surplus heat for production of electricity for base load power sale, and to replace existing high cost gas or diesel fired electricity generation in the Pilbara.

A particular attraction in the Pilbara will be providing base load power for the beneficiation of iron ores, and for use in power for running slurry or water pipelines. *Project Iron Boomerang* provides the opportunity for substantially improving the sustainability of the Pilbara iron ore deposits, by providing access to surplus power from the Newman Steel Park for beneficiation upgrading of the very large magnetite deposits by blending with the depreciating primary hematite deposits in the region. For instance, local beneficiation of these ores, using the surplus power will provide complementary sustainable economic benefits by permitting more precise overall chemical balance and blending with the hematite ores, to operational cost and quality steelmaking advantage and make these ore bodies more usable and sustainable.

### 3.6.3 Environmental Benefits of *Project Iron Boomerang* to Australia

The construction of a transcontinental railroad and ten steel smelters with associated infrastructure will inevitably introduce some local environmental impacts that are negative, but there will also be positive environmental and economic impacts. *Project Iron Boomerang* is developing plans to mitigate the negative impacts. Most importantly, the negative local impacts are far outweighed by the favourable global impacts against the current operating systems.

Coke plants and steel smelters have potential for high local impacts, but sound management should mostly exceed current legislation emission standards, water quality and solid wastes. It is the aim of *Project Iron Boomerang* to develop, lead and set leading world's best practice in this area. The *Project Iron Boomerang* shared services and supply chain consolidations concept and strategy combine to make this prospect most achievable, practical and most importantly, collectively and cooperatively cost affordable.

Proximity of the Abbot Point precinct to the Great Barrier Reef and the coastal wetlands, adds a further sensitivity to managing the environmental impacts at these locations. The comprehensive Environmental Impact Study will assist in determining the requirements to manage, mitigate and/or eliminate environmental issues and to aid in determining the necessary conditions for environmental planning approvals. Our preliminary planning provides for full collection, treatment and reuse of all process water and rainfall runoff from the smelter park sites to prevent contamination of local waters and groundwater. The smelter parks and railway are located in sparsely populated regions, and will have minimal impact existing land uses and populations. Development will have low to medium environment impacts, which are readily manageable with current expertise and practices.

The sensitivity of some relatively fragile arid environments along the rail corridor will need to be managed carefully during the construction phase. Significant alignment planning undertaken to date, however, indicates that the railway requires limited major earthworks to achieve the required grading, and that construction impacts will be relatively low.

A key consideration in the precinct planning is to maximise the energy efficiency of the steelmaking process. A large power cogeneration plant is proposed as an integral element of the coke production process, using surplus heat and burning the released volatiles to produce electricity for internal precinct use, and for export to external users. A particular attraction in the Pilbara will be providing base load power for the beneficiation of iron ores, and for use in power for running slurry or water pipelines.

Another environmental consideration is the availability and effective management of water used in the production processes and maximising the total recycled use of this water. The proposed use of large quantities of groundwater to mine iron ores in the Pilbara should help reduce the negative desert environmental impacts of disposing of this water on the surface.

By locating the first stage production in Australia, the volume of shipping from Australia will decrease significantly. Rather than ship iron ore and coal to overseas steel smelters, the 100 million tonnes of iron ore and coal are transformed to 44 million tonnes of slab steel, which is then shipped overseas for further processing. The consolidated takeout factor of locally consuming 116 million tonnes per year of steelmaking ores is 72 million tonnes of infrastructure not needed; Ships, trains wharves in both sending and receiving countries. This reduces the strain on infrastructure and resultant expenditure overexposure, and therefore financial risks overexposure.

In addition to the environmental and economic advantages of the reduced shipping volumes, *Project Iron Boomerang* will also reduce the need for port expansions in Australia and overseas. A further advantage to the Australian environment is the reduction in the amount of shipping that exposes the Great Barrier Reef to degradation or the possibility of a disaster.

Whilst the construction and operation of *Project Iron Boomerang* has some local negative environmental impacts that need to be effectively managed, the global environmental benefits are expected to be positive and extremely significant. Great progress is continuously being made in steelmaking environmental emission outcomes.

*Project Iron Boomerang* will deliver major global environmental benefits from improved transport efficiencies (especially avoidance of bulk ore carriers), modern first stage steel production techniques and efficient energy utilisation. The advantage of co locating smelters in shared service Steel Parks provides for superior environmental outcomes that are achievable and more affordable.

Environmental approvals will include consideration under the Commonwealth Environment Protection and Biodiversity Act, 1999 (“EPBC Act”) and various state legislation and regulations relating to the natural environment, wildlife conservation, water, air and land conservation.

The environmental benefits include an estimated reduction in carbon emissions of 8.7 million tonnes annually. An economic dimension to emissions control is rapidly emerging. Carbon credits are a part of the international emissions trading schemes that are being developed. These schemes provide a way of moving the control of greenhouse gases into markets, and will be investigated during the Feasibility Study. EWLP intends to explore the potential for participating in such schemes as they develop.

*Project Iron Boomerang* could be well pleased with the aspirational environmental credentials. It provides a large and positive impact. Environmental laws will be regarded as the minimum standard; With international best practice standards used as a consideration to continually improve our performance and set new national and global standards for environmental outcomes.

### 3.6.4 Global Environmental Benefits

Whilst the construction and operation of *Project Iron Boomerang* has some local negative environmental impacts that need to be effectively managed, the global environmental net benefits are expected to be positive and extremely significant.

The major benefits include:

- Proper planning of the smelter Steel Parks to maximise environmental benefits from synergies between the various production processes, and particularly their energy inputs/outputs, and opportunity to use natural gas and coal seam methane gas as primary energy sources;
- Improved environmental outcomes by ultimately replacing inefficient steel smelters elsewhere with current, much lower environment impacting technology, purpose designed

to achieve best practice environmental performance (rather than the bolt on upgrades common with existing long-life coke ovens and steel smelters );

- Presence of sufficient production scale in the smelter parks to allow effective greenhouse gas capture and potential for $CO_2$ sequestration as this technology is proven, and the economic environment for its implementation is provided, including any carbon credit schemes; and
- Transport logistics efficiencies of *Project Iron Boomerang*, with reduced transport energy use and accompanying greenhouse gas emissions reductions (from consolidation and maximising back loading).

The global environmental benefits of the project are expected to be very large compared to the local environmental impacts. Realisation of the benefits will require the involvement of Commonwealth and State Governments affected to allow proper inter jurisdictional recognition and realisation. The emergence of markets for the trading of carbon credits will facilitate this benefit.

*Project Iron Boomerang* will have significant positive environmental benefits. The transportation efficiencies translate to substantial reductions in the use of fuel and there will be efficiencies in managing energy inputs/outputs. The $CO_2$ savings are estimated as 8.7 million tonnes annually. In addition to the favourable implications for the environment, the development of emissions trading markets and schemes is estimated to result in savings of US$4 per tonne of slab steel.

### 3.6.5 Improving Social Equity, and Quality of Life

*Project Iron Boomerang* is to be a privately funded development, but it will provide a wide range of social benefits to the local communities, regions, states/territories, and the Commonwealth. The sustainable economic activities that will result from *Project Iron Boomerang* will provide commensurate income for the Federal and State Treasuries from corporate income tax, personal income tax, capital gains tax and import tax. The arrangements for railway passage and precinct land rights will generate economic activity cash flows to the governments, landowners and Aboriginal Land Councils.

The economic activity generated by *Project Iron Boomerang* will then create many opportunities for new capital investment, development, employment and growth in the regions. The Transcontinental Corridor will pass close to the settlements of Kynuna in Western Queensland, and Ti Tree, approximately 170 km north of Alice Springs on the Adelaide Darwin Railroad. The towns are both on major highways. The locations are proposed to be utilised as important railroad infrastructure maintenance centres, crew change points, and Ti Tree would be the major intermediate locomotive refuelling and service depot. The developments and employment opportunities are expected to have a very positive permanent impact for all communities and for Aboriginal communities. Whilst the growth in jobs is significant, we recognise that it will put demands and strain on community and regional infrastructures (roads, schools, etc.). We return to this issue in the section below on areas of facilitation and cooperation *Project Iron Boomerang* will require from governments.

Australia is rich in natural resources. Among the key resources in abundance are iron ore and thermal and coking coal; The key feedstock for steel. Queensland has an abundance of coal, while Western Australia has an abundance of iron ore. Australia has a small population with limited steel production, so these resources are shipped internationally to be used as inputs to steel production.

Strong growth in raw steel production and consumption, driven by the rapid industrialisation of China and India in particular, is expected to continue. This will necessitate substantial investment in new steelmaking capacity. Australia plays the significant leading role in the seaborne steelmaking supply chain key materials, with an estimated 40% of the world's high grade iron ore and 60% of the world's coking coals.

The current supply chain for the production of steel has a number of negative features. With respect to Australia's resources, the current arrangements require the shipment of iron ore and coking coal to overseas locations where the resources are processed. The transportation costs to the steelmakers are considerable, with mostly empty returns for the world's biggest trains and ships; Transport is thus somewhat inefficient and environmentally damaging, and opportunities for adding value in Australia to the resources are lost. Processing these primary ores in first stage mills near the source, these ores are consolidated more than 2.5 times before shipment.

*Project Iron Boomerang* has been specifically developed by East West Line Parks Ltd ("EWLP") to explore the economic feasibility of establishing semi-finished steel production in Australia, close to the major raw materials inputs. The project can provide significant economic advantages to the steelmakers, the Financial Model has been developed to prove the theory and over the last six years the world's Steelmakers have accepted the economics that underpin this financial model. Should the enablers of this Project be in place the advantages are sufficient to enable the steelmakers to fund *Project Iron Boomerang*. We do not anticipate an equity involvement in the project by government. However a critical ingredient *Project Iron Boomerang* needs from the government is the political will to assure Australia is behind bringing the vision of *Project Iron Boomerang* into reality. This is not an assumption on our part; this is a conclusion after years of meetings with the executive management teams of the world's top steelmakers.

To the benefit of Australia and its major trading and investor steelmaking nations, *Project Iron Boomerang* can deliver economic, social and environmental advantages on a scale of national and global significance. We will set out in this report how the project provides nation building advantages on all dimensions. In addition, the efficiency and environmental attributes of the project are globally significant.

The Pre-Feasibility Study provides strong evidence that the construction of first stage smelter Steel Parks offers many cost effective investment capital and operational scale savings of consequence, and that a dedicated railroad with all supporting infrastructure is feasible and economically profitable for the steel makers and investors.

The details contained within this submission (and its referenced documentation) on *Project Iron Boomerang* should aid Infrastructure Australia in achieving its strategic nation building vision and objectives to:

- expand Australia's productive capacity;
- increase Australia's productivity and to significantly value add the mine and farm,
- Australia's natural resources;
- diversify Australia's economic capabilities, and enhance international relationships with our major trading partner nations.
- build on Australia's global competitive advantages developing leading world's best practice;
- develop our cities and regions;
- significantly reduce global greenhouse emissions; and
- improve economic, social equity, and quality of life in the Northern region.

## 4.0 Project Iron Boomerang

The *Project Iron Boomerang* asset life is in excess of 100 year's. There is a clear global need for additional global steelmaking capacity in particular for the other 4.3 Billion people in Asia that are modernising. *Project Iron Boomerang*, being located in Australia, is uniquely suited to meet a portion of that demand as a result of five major advantages.

- proximity to the major global markets for steel, particularly in Asia;
- availability, reliability, and sustainability of major quality steelmaking raw material inputs;
- competitive supply chain for these resources;
- availability of large sites to accommodate the smelter Steel Parks; and
- stability and low sovereign risks involved in long term major investments.

The *Project Iron Boomerang* business case is focused on facilitating the construction of ten 4.4 million tonnes per year steel smelters, mills at each end) producing a total of 44 million tonnes per annum of slab steel. Iron ore and metallurgical coal will be transported to common points for processing iron ore will be transported to Queensland to be combined with the coal, while coal will be transported to Western Australia to be processed with the iron ore.

The steel smelters will be constructed in industrial Steel Parks in Queensland (Abbot Point) and Western Australia (near Newman in the Pilbara). EWLP will develop the Steel Parks to accommodate the steel smelters. Participating steelmakers will construct, own and operate the steel smelters. In addition to the investments of EWLP and the steelmakers, there are a number of support services which can be shared to great advantage under the precinct model. These include ore stockyard and blending facilities, ore stockpiles (iron ore and coal), stacker/reclaimers, conveyor, coke oven batteries, electricity production, water and other utilities, and steel slab export facilities. We anticipate that these will be undertaken by a range of infrastructure third party companies and investors.

## 4.1 Project Stages

There are five stages to the development of *Project Iron Boomerang*.

**Prefeasibility:** establishment of project concepts and operational requirements, financial models and major steelmakers and/or investor commitment to the Feasibility Study;

**Feasibility Stage:** proof of concept and definition of project operational requirements, detailed project scoping, preliminary engineering environmental impact assessment, cost estimates, market viability, planning and other regulatory approvals, risks assessments, management and allocation strategies, and confirmation of the business case;

**Commitment and Financial Closing:** gain commitments from steelmakers, reach necessary agreements with governments, develop major procurement contracts and call tenders for EPCM and/or DCM contracts, and completion of due diligence processes;

**Implementation:** acquisition of land and passageway rights, engagement of project managers, detailed engineering and environment management plans, procurement of design and construction, procurement of rolling stock and precinct plant and equipment; and

**Operations:** commissioning and commencement of operations.

We have concluded the Pre-Feasibility Study and are in the process of obtaining funding to proceed with the Feasibility Study via a Private Placement Memorandum utilising a convertible note structure. *Project Iron Boomerang* has benefited from three fiscal years of applying the R&D Tax Incentives. We are now into our fourth fiscal year of benefiting from the R&D Tax Incentive that sustains EWLP's cash burn rate on four core R&D experiments, they are:

1. Transcontinental Corridor Determination Process

2. The Steel Park Process;
3. Covered Aerodynamic Coal and Iron Ore Wagon; and
4. Roll On Roll Off ("RORO") Slab and Coil Steel Ship

To achieve P90 (Infrastructure Australia requirement for Stage 7), and the equivalent private sector stage is bankability and that occurs on the completion of the Bankable Feasibility Study ("BFS") and is an essential milestone to initiate the negotiations for Financial Close. To achieve P90 or BFS approximately A$150 million expenditure and under the current Project timeline approximately 3.25 years prior to financial close and start of construction. The participating steelmakers and supporting investors with minority interests will be the primary funding sources for the BFS.

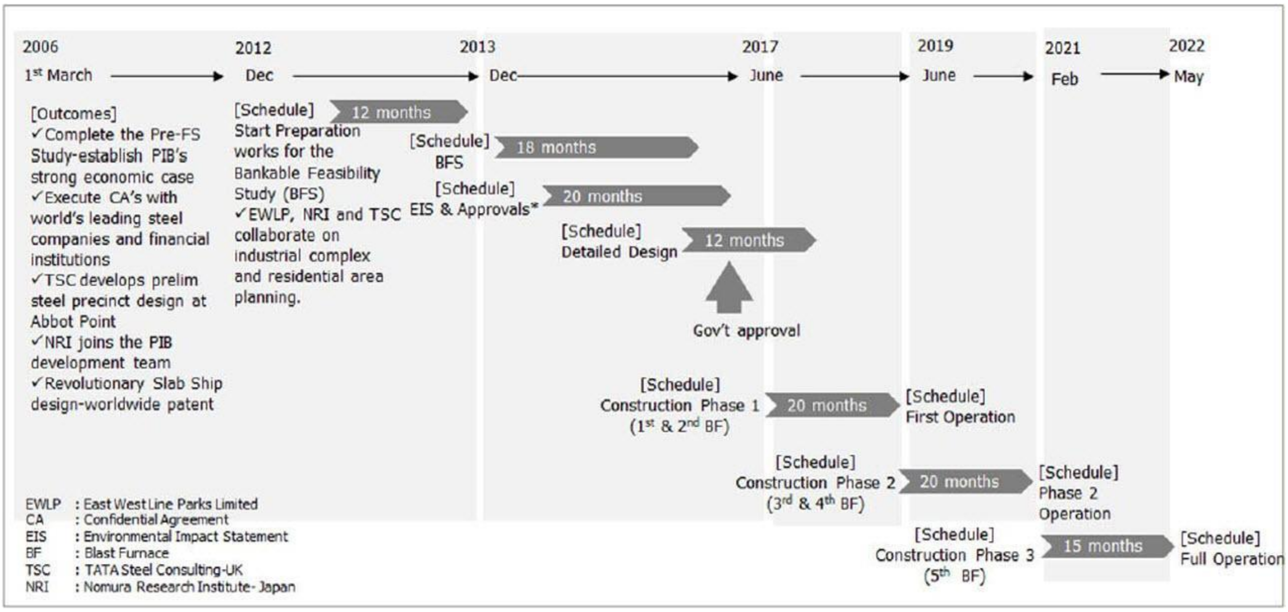
Eventual public listing will open up the projects ownership and investment to all Australian and International stakeholders.

## 4.2 Team Capability

EWLP has established a management group of experienced senior executives and specialists with many years of leadership and management experience. The senior management group has worked for major international and domestic companies across a number of different industry sectors and major projects including banking, consulting, finance, government, logistics, transport, supply chain management and information technology and communications. They have demonstrated superior capabilities, analytical, business and managerial skills at strategic levels in the requisite functional areas and will lead and conclude the project through the next phase, the Bankable Feasibility Study, and subsequent development plan stages, through to administration and operations, phase five.

## 4.3 Timeline of the Project

The timeline for the project is shown below. The bankable feasibility study should be completed by the end of 2017. Presuming that the bankable feasibility study confirms the benefits of *Project Iron Boomerang*, we will undertake the support of the participating steelmakers through equity contributions. Construction will then commence. The railway and the first four steel smelters will be completed in late 2021. The first rail shipments of iron ore and coal will then occur and steel mill production will begin. The first shipments of steel slabs overseas for further processing will occur in December 2022. The construction of the remaining eight steel smelters will continually progress in stages with final completion scheduled for 2026. Beyond the completion of *Project Iron Boomerang* as it is currently being scoped, it is likely that there will be ongoing developments in the use of the railway, including the duplication Phase 2 development of the smelter parks.




## 4.4 Timeline of *Project Iron Boomerang*

The Pre-Feasibility Study Report [46]is available to the Parliamentary Committee as a separate document submission, sets out in detail the projects economic advantages. The remainder of the Pre-Feasibility Study report focuses on the economic, social and environmental efficiency features of *Project Iron Boomerang* to Australia and the world.

## 4.5 Project Evolution and Finance

*Project Iron Boomerang* is wholly private funded. Initial sources of funding are from shareholders[47]. Next stage funding arrangement is underway via a Private Placement Memorandum seeking to raise a minimum of A$15 Mn via a convertible note.

In context to the Transcontinental Corridor and the PIB heavy haul rail the Benefit Cost Ratio is positive, and that is calculated only on *Project Iron Boomerang* tonnages an. The Benefit Cost Ratio is translated into an NPV equivalent on the Transcontinental Corridor rail component. Please refer to the Financial Model which encompasses the Transcontinental Corridor component and refer to sheet "Financed Income (Rail)" cell B69. This sheet is the cash flow analysis including interest and tax, the focus of this sheet is on ROE to shareholders.

## 4.6 Supportive Role for Governments

The key areas where *Project Iron Boomerang* will seek government cooperation and assistance include:

- Project of National Significance and Project of Irrevocable National Merit
    - Underway via current process of Infrastructure Australia and the Infrastructure Priority List submission 28 Nov 2013.
- Planning corridor and environmental approvals;
- Land acquisition;
- Project business environment; and
- Government support services from:

[46] Refer to Appendix 13

[47] See Appendix 1 for the shareholder list

- Department of Industry
- Department of Infrastructure and Regional Development
- Department of Foreign Affairs and Trade

There are four Australian governments involved (Commonwealth, Queensland, Western Australia and the Northern Territory) as well as numerous Local Authorities, Statutory Agencies, and Aboriginal Land Councils. In addition, the very large scale and global nature of the project will involve other national Governments in terms of trade matters, investment and global environmental outcomes.

## 4.7 Planning and Environmental Approvals

The project requires large construction workforces for an extended duration. Following current policy and practices, five year working visas will be sought for needed for relocated permanent specialised skilled workers from overseas.

*Project Iron Boomerang* entails major capital investments in the railroad and steel smelters by foreign owned companies, as well as in the long term operation of these industrial plants, primarily as value adding to basic major resource exports. Critical to attracting this investment and to the project proceeding are the obtaining of the various government progressive approvals and having in place the appropriate business policy settings to provide maximum certainty and timing over the project life cycle.

## 4.8 Land Acquisition

The land tenure and acquisition process for the rail corridor and smelter park Steel Parks will be subject to negotiation and agreement with the Queensland, Northern Territory and Western Australian Governments. The bulk of the rail corridor land is existing leasehold, vacant crown land, or Aboriginal reserve, and subject to native title considerations under the Native Title Act 1993 and relevant state legislation. Long term leases (99 year plus) or freehold titles in favour of *Project Iron Boomerang* are sought. The Queensland Government has acquired Abbot Point State Development Area. We will request from Western Australian Government that the Newman Steel Park be accommodated in a similar area.

We request that the Australian Governments involved (Commonwealth, Queensland, Northern Territory and Western Australia) follow similar procedures used to establish the environmental impact for the implementation of the Darwin Alice Springs rail line. This precedent included:

- Establishing an overall Framework Agreement with Governments and Land councils;
- Sacred site clearance and long term railroad corridor leases were negotiated within this framework with all affected parties including Aboriginal Land Trusts and Communities;
- Access rights were negotiated by Governments involved (Northern Territory, South Australia, and Commonwealth);
- Upon completed negotiations, conditional access rights were handed over to the consortium that owned and operated the line; and
- Environmental issues were identified and resolved.

A fully inclusive process of consultation and negotiation with the traditional owners of the land, assisted by each of the Governments, is proposed to facilitate agreement on the rail corridor and precinct lands.

Recent major mining and infrastructure projects in northern Australia have been able to progress more quickly when the key stakeholders are included in the negotiations from the beginning, and their historical traditions and roots are recognised. The aims of these negotiations with traditional owners will be to create long term benefits that will positively impact on current and future generations.

## 4.9 Project Business Environment

The project and business model involves major investment by foreign owned steelmakers in the *Project Iron Boomerang* and in their own smelters and supporting industry. Foreign Investment Review Board approval of this investment is required for the project to proceed. Such approvals will be sought individually by each foreign owned company participating in the project.

The project will involve major procurement of plant and equipment and associated materials that cannot be supplied by Australian suppliers (due to availability, scale and technology). The biggest single threat to the project viability is the much higher construction and fabrication costs in Australia, compared to Asian and South American competitors in particular. This will be coupled with the skilled labour limitations in Australia, and the relative remoteness of the major construction sites at Abbot Point and Newman. Maximum tariff concessions and/or enhanced By-law Schemes covering the imported materials, equipment and prefabricated pre assembly modules is essential to minimise any competitive disadvantage.

## 4.10 Government Support Services

The project will require significant community infrastructure in regional centres, particularly at Bowen and Newman, with lesser requirements at a number of other support centres, to support the large construction workforce and permanent employees. Major investment by Government Owned Trading Corporations will also be required to meet the requirements of the project.

Support from Government in the timely provision of essential services to support the local communities and Local Authorities is requested. This includes availability of developed sites for housing, water supply and sewage, roads, power, telecommunications, schools, and so on.

The project credentials for positive global environmental outcomes and major investment and regional job creation, should ensure strong bipartisan support for the project from all levels of government in Australia.

Current problems, issues or challenges that EWLP considers will limit the ability to achieve the goals and objectives are listed below:

1. The situation assessment is the costs of building inwards loading port facilities in already overcrowded and congested out loading ports that are not currently meeting expansion growth needs is a major constraint issue. The method of transportation will be a new transcontinental railroad. The economics and cost benefits of a heavy haul railway are supported because the notional alternative, coastal shipping around Australia in many aspects is economically and environmentally inferior to a railroad.
2. The situation assessment is unrelieved and exacerbated should all blast furnaces be located at either Abbot Point or Newman.
3. The extent and nature of *Project Iron Boomerang* necessitates a particular form of non-capital investment and that potentially is the appointment of a Special Minister of State whose role is to prioritise and coordinate the Australian government departments and develop the special relationships required with the Minister's counterparts in the Asian governments, in the first instance with the Ministers' counterparts in China, Japan and Korea.
4. We note the Special Minister of State is likely to be an ongoing role as the *Project Iron Boomerang* business model is modular, scalable and extensible. We point out that 4.3

Billion[48] people live in Asia and we note that Asian economies, in particular Indonesia, Vietnam and others are in the throes of modernisation and lack the basic steelmaking ingredients, technologies and skills and are prospective participants.

5. To achieve the goals and objectives of *Project Iron Boomerang* is required to obtain the following from Infrastructure Australia:
    a. listing on the Infrastructure Priority List;
    b. recognition as a project of national significance; and
    c. recognition as a project of irrevocable national merit.
6. Once the requirements under points 3 to 5 above have been satisfied, *Project Iron Boomerang* will require the following matters to be addressed to assist *Project Iron Boomerang* in achieving its goals and objectives in a timely and cost effective manner:
    a. streamlined foreign investment assessment and approval process, keeping in line with the requirements under the Foreign Acquisitions and Takeover Act 1975;
    b. *Project Iron Boomerang* will also require a large number of 5 year renewable high skilled employment visas to adequately provide for the skilled labour requirements; and
    c. streamlined environmental assessment and approval process applied to *Project Iron Boomerang*, similar to the endorsement and support given for the building of the Darwin to Alice Springs Railway Line. The national interest established protocols and criteria applied to the Darwin to Alice Springs Railway Line may be considered as illustrative of principles that could be applied to *Project Iron Boomerang*. The difference between the Darwin to Alice Springs Rail Line and the *Project Iron Boomerang* proposal is that *Project Iron Boomerang* will not require funding from Federal, State or Territory Governments.

The Financial Model is a prescriptive approach that caters for all variables that underpin the Business Model. The Financial Model contains all the artefacts of the Business Model. The Financial Model has evolved over seven years of iterative research and consultation with subject matter experts in their field of domain competence. The Financial Model has a multitude of purposes; Two elemental aspects one of which is investor focus on the ability to achieve 15% ROI and underpinning the ROI are the key beneficial estimated outcomes for the Steelmakers. First and foremost *Project Iron Boomerang* is a Steelmakers project.

[48] http://www.worldpopulationstatistics.com/asia-population-2013/

# Appendix 1


PROJECT
IRON BOOMERANG
east west line parks limited

27th November 2013

**EWLP-Shareholders List(as of October 2013)**

Directors

David Trude, Greg O'Rourke, Shane Condon, Stephen Bridger

| Name | Shareholder Name |
|---|---|
| James Bruce Handford | James Bruce Handford |
| Richard Shane Condon, Managing Director | Richard Shane Condon |
| James Bruce Handford | J B Handford Pty Ltd ATF Handford Family Trust Number 1 |
| Gordon & Fiona Thomson | GB & FA Thomson Pty Ltd ATF Diverse Investments Super Fund |
| Professor Art Shulman | Rosenshul Superannuation Fund |
| Robert G Bowman and Donanne J Bowman | Robert G Bowman and Donanne J Bowman |
| David Russell, Barrister of Law | Wyree Investments Pty Ltd ATF For The R C Ware Settlement |
| Professor Clement Tisdell | Clement Allan Tisdell |
| Saul Eslake, Chief Economist | Eslake & Arenella Superannuation Fund |
| Anton Michielsen, Transport Director | Anton Ludwig Michielsen ATF RAAP Michielsen Family Trust |
| Ross Hunter, Director of Ranbury | RCH Management Pty Ltd |
| Steven Bridger | Xstrata Coal Queensland Pty Ltd |
| David Sourbutts, Director | Lightshare Investments Pty Ltd |
| Paul Raftery | Haughton Holdings Pty Ltd as Trustee for the LLF Fund |
| Professor Art Shulman | Rosenshul Superannuation Fund |
| Junwon Lee, Manager | Junwon Lee |
| Yi-Ling Chan | Yi-Ling Chan |
| Fei Meng, Marketing Manager (Asia-Pacific) | Fei Meng |
| Professor Robert G Bowman | Robert G Bowman |
| Harwin Singh | Sidhu Super Pty Ltd In Trust for Sidhu Super Fund |
| John G O'Brien, Managing Director & Joseph O'Brien, CEO | Defiance Energy Pty Ltd aft Energy Assets Disc Trust |
| James Yerbury, Northern Regional Rail Manager | Leighton Contractors Pty Ltd |
| David Porter, Joint Managing Director | Ranbury Management Group Pty Ltd |
| Stephen Kennedy | Stephen Kennedy |

27th November 2013

# EWLP-Shareholders List(as of October 2013)

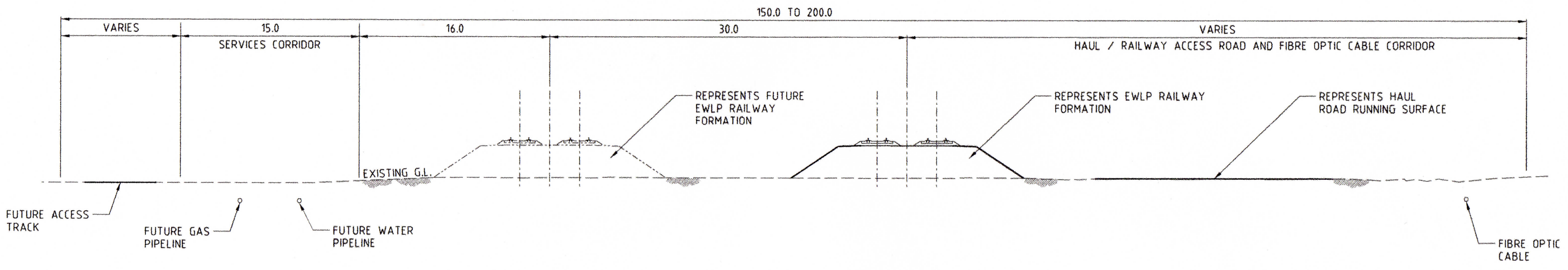
## Directors

David Trude, Greg O'Rourke, Shane Condon, Stephen Bridger

| Name | Shareholder Name |
|---|---|
| Haruhiko Kinase, Business Development Manager (Asia/Japan) | Haruhiko Kinase |
| Graham Tew, Principal Research Fellow | Monash Investment Holdings Pty Ltd |
| Russell Imaoka | Trimble Navigation Ltd |
| Wendy Violet Belham | Wendy Violet Belham c/o Belham Enterprises [ABN 95129391644] |
| Matthew Magin, Business and Stakeholder Manager | Matthew Magin |
| Stewart Hagan, General Manager of Industrial Minerals | Metallica Minerals Limited [ABN 45076696092] |
| Daniel Dezentje | Daniel Dezentje ATF |
| Tom James | Gateway Consulting Pty Ltd as Trustee for James Asset Trust |
| Gregory & Lisa Bowman | Gregory J and Lisa H Bowman |
| David Trude, Chairman of E. L. & C. | Dastru Superannuation Pty Ltd as Trustee for Tramex Superannuation Fund |
| Daniel Dezentje | Daniel Dezentje ATF Nos Anges Trust |
| Matthew Magin, Business and Stakeholder Manager | Matthew Magin |
| Jonathan Kang | Jonathan Jung Han Kang |
| Phil Shapiro, Project Director | Mocuity Pty Ltd |
| Rod Welford | IRP Investments Pty Ltd >Rod Welford< |
| David Trude, Chairman of E. L. & C. | Tramex Pty Ltd as Trustee for Tramex Trust |
| Susan Van Djik | Susan Van Dijk |
| Gordon Thomson | Diverse Business Services Pty Ltd |
| Saul Eslake, Chief Economist | Saul Eslake |

# Appendix 2


PROJECT IRON BOOMERANG
east west line parks limited




## TYPICAL EWLP INFRASTRUCTURE CORRIDOR SECTION

DIAGRAMMATIC

NOTES:
1. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.

PROJECT IRON BOOMERANG
east west line parks pty ltd



| REV | DATE | DRN | DESCRIPTION | CHKD | APPR | PROJ |
|---|---|---|---|---|---|---|
| A | 01.11.11 | PH | ISSUED FOR INFORMATION | | | |

DRAWING REVISION

| | DATE | NAME |
|---|---|---|
| DRAWN BY | 01.11.11 | P.HAMMOND |
| CHECKED BY | | |
| APPROVED BY | | |
| ENG MGR | | |

SCALE: DIAGRAMMATIC — FORMAT SIZE: A4

engenium
ENGENIUM PTY LTD
Level 8, 178 St Georges Tce
Perth WA 6000 Australia

EAST WEST LINE PARKS PTY. LTD.
PROJECT IRON BOOMERANG
GENERAL ARRANGEMENT
INFRASTRUCTURE CORRIDOR SECTION

DRAWING No. PIB-SKE-G-0041 - FIGURE 3 — REV. A

# Appendix 3


PROJECT IRON BOOMERANG
east west line parks limited

# Corridor
# to
# Coast

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## Galilee Network

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Our Focus is the Environment: Our Goal is a Single Corridor

*Items for Discussion*
*with*

*Treasurer & Minister for State Development & Trade*
Andrew Fraser MP

*Co-ordinator General*
Keith Davies

*__Steering Committee:__*

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## 1.0 Corridor to Coast

As landholders we are charged with the responsibility of managing our country in a sustainable way. There is an expectation that the government will do the same with the State. Concerned about the long term future of the State beyond current industry and political trends and preferences we have formed Corridor to Coast (C2C), representing over 100 rural holdings. We are currently focussed on the development of the Galilee/Bowen Basin and the possible impacts with particular emphasis on potential threats to the environment and prime agricultural land; consequently to our businesses and the future health & prosperity of Queensland.

Corridor to Coast's immediate concerns relate specifically to the amalgamation of five proposed rail infrastructure corridors into a single multi user facility. Engineering plans need to be built on strong and accurate physical data relating to the direct impacts on the surrounding environment. Particularly the impacts hydrology will have given the extremely flat nature of the landscape in many sections of the current corridor proposals. Slight variations in data will have a profound effect across a large area.

We urge the government to "develop a whole farm plan" - a Strategic Assessment that minimises dissection and degradation of the landscape. This assessment needs to look at the entire coal basin and coordinate development on all fronts, which might include alternative routes that proponents (Hancock Prospecting, Waratah Coal, East West Line Parks, BHP and the Adani Group) have not yet considered. This infrastructure should have the ability to service other existing industries like grain, cotton, cattle and small crops as well as any future rural enterprises – to build the state, and create a win/win for all entities. This report will highlight the issues raised by growers and offer some long term suggestions to how the State Government can cultivate Queensland's future. Services and synergies of C2C are available to assist wherever we can.

Corridor to Coast sees this development as a great opportunity to create an infrastructural project that proves to the world that Agriculture, Mining and the Environment can work together to enhance productivity mindful of preserving the ultimate natural resource, our landscape.

*Illustration 1: Wheat crops in the Kilcummin area that will be impacted by rail design*

## 2.0 Background Information

- Waratah, Hancock and Adani have all used the same Quantum modelling program to identify their final alignment. These alignments may not necessarily be in the best interests of the State
- Each alignment has been chosen according to individual proponent parameters. These do not include hydrology/farming and grazing impacts, therefore are not considering all possible implications on the surrounding environment.
- At least three of the proponents plan to use three different axle load limits for track construction.
- Consider the impact on surrounding businesses and mitigate this by aligning the corridor within existing mining leases for as far as possible before impacting on the greater business sector (as with Adani's proposal).
- Look to address all community concerns when considering the final alignment. eg. If considering East West Line Parks project, look to move rail corridor outside of Collinsville with a view to moving other rail infrastructure to share this alignment in the future.
- 'Fast tracking' would help to give all stakeholders some certainty for the future, but should NOT be done at the expense of proper and thorough environmental investigations.
- A greater investment in the proper construction of the line will ultimately create a long term cost saving.

## 3.0 Maps of Current Infrastructure Proposals Supporting the Galilee Basin

Please note following map (or attached map in electronic version). Current data on the BHP rail proposal was not available for inclusion in this document at the time it was produced.

## 4.0 Hydrology

Rail lines crossing the Belyando River Catchment Area will face varying degrees of hydrological difficulties. This information has been transmitted by several landowners to representatives of both Hancock and Waratah Coal.

### 4.1 Background

It would appear that the Hancock corridor has proceeded to design phase along a proposed (IFS declared) alignment whose primary route determination was derived from altitude and with regard to degree of slope, which overlooks the obvious; the flattest area is of course straight across the floodplain and wetland area.

The watercourse in question at times has flows exceeding 15km in width. The watershed of the Belyando/Suttor system represents 57% of the catchment area for the Burdekin Dam and contributes 30% (or 2 309 480 Ml/annum) of the stream inflows (Burdekin Water Planning Advisory Committee, 1999). The soil structure is extremely fragile when disturbed, with high concentrates of sodium. The value of native and improved pastures to the beef cattle and grazing industry (which is immense) relies on both the presence of flood-out zones and its (the flood water's) speedy departure.

The above is information that should guide the placement of a single corridor. However only after the alignment was finalised (and initial designs were generated), and at the urging of affected landholders did Hancock agree to an independent review of the rail design. Unfortunately this was not extended to the alignment of the corridor.

### 4.2 Independent Review Findings

The independent review found that:

- The ability to allow natural flows to continue to occur across the flood plain during small and large events is going to be a challenge.
- The lack of knowledge of the flow characteristics across the flood plain needs to be addressed.
- A better understanding of catchments upstream of the Rail line to determine flows and velocities is needed.
- A more detailed assessment of the use of pipes, culverts and bridges on the flood plain to understand the velocity and flow direction impacts downstream and upstream.
- The rail design must take into consideration any disturbance on the flood plain including road and excavations.

### 4.3 Independent Review Recommendations

- The interim Hydrology report then went on to recommend that Hancock:
- Attain a better understanding of the sub catchments
- Widen the Lidar survey across the flood plain to better understand its flow paths and points of concern.
- More detailed modelling of the stream flows and volume is needed.
- The new modelling is to reflect the information gained from the landholders.
- An improved rail design that better reflects the current flood plain flow paths and

volumes to ensure longevity of the rail line and grazing systems.

- Road design along the rail line as well as land disturbance across the flood plain needs to be evaluated for possible impacts.
- Assessment of the soils across the flood plain.
- More detailed mapping of property infrastructure, including houses, so that it can be accessed for possible impacts.
- The above information has been presented to highlight the rushed, unco-ordinated approach that has been taken with respect to one of the three corridors. Computer generation and satellite imagery only provides certain aspects of the real hydrological situation on the ground. As identified in the independent hydrological report landholders information needs to be utilised to formulate a best case, single corridor scenario.

**Photographs in Appendix A highlight the flood out capacity of some of the major watercourses impacted by the proponents proposals.**

## 5.0 Potential Future Development Options

### *5*.1 Farming

- The Belyando/Mistake Creek floodplain area has large areas of alluvial soil types capable of supporting irrigation development as classified on the Queensland Soil Maps and identified in 1999 by an Engineering Services study into the water infrastructure options and related issues in the Burdekin River Catchment. Such developments already exist in the area and support grain yields of up to 6-10t/ha. Given that the study identified over 500 000 hectares of arable land in the Belyando/Suttor sub catchment the potential for future development needs to be considered. This may include the development of a new grain depot if the rail corridor is positioned taking grain freight into consideration.
- THIS HIGHLIGHTS THE CRITICAL IMPORTANCE OF DETAILED, ACCURATE HYDROLOGY DATA. Failure to properly construct a rail corridor and mitigate flooding impacts will negate the development potential of this area before it even has the opportunity to begin. Given current world food concerns it would seem prudent to keep the options open for long term potential cropping areas.
- A critical shortage of rail freight for the existing Mt McLaren grain depot could be eased. The number of trucks required to transport grain to port would be greatly reduced taking pressure off local and state controlled roads that are clearly struggling to cope.

### *5*.2 Grazing

- Central Queensland produces approximately 35% of Queensland's beef supply with an annual turn-off in the Northern and Central regions estimated at over 1.4 million head. Rail freight has the capacity to de-centralise the processing industry from the south by servicing existing meatworks facilities, potentially opening up opportunities for new processing facilities and the development of a live export facility at Abbot Point in the future. Local industry representatives estimate the Clermont/Alpha/Jericho/ Emerald/Capella areas contribute up to 350,000 head per annum. Transporting these cattle by train would take approximately 5000 B-Double trucks off the roads each year.

### 5.3 Fuel and Freight

- Upgrades to the existing Gregory Development Road would allow for the movement of goods / fuel from the north taking pressure off the already congested eastern (Peak Downs Hwy) and southern (Capricorn Hwy) routes.
- Fuel can be transported in triple road trains ex Townsville via the bypass that skirts the city as opposed to the B-Doubles used ex Mackay that run through the centre of the accommodation area reducing both transport costs and risk to public safety.
- Develop a connection highway between the Gregory Development Road and Capricorn Highway, potentially beside the rail corridor, to facilitate this freight movement from the north.
- Utilise the rail facility to transport mine supplies, including wide and/or over height loads to remove the stress on both the road infrastructure AND travellers trying to navigate the road network.

### 5.4 Tourism and Decentralisation

- An improved road network would service and encourage greater tourism trade.
- Better road access to larger centres would make living in the areas where the work is more attractive to the large workforce required to service this expansion.
- Better road access adds to the win/win for the locals being affected by the development and general operation of the Galilee Basin.
- Consider the possibility of a rail passenger line to transport workers from the coast to the mining developments or along the East West Line Parks proposal as a tourism opportunity?

## 6.0 Summary of Corridor to Coast Concerns

### 6.1 Fire Risk

It is well known and widely accepted that trains start many fires. No matter what precautions railway operators take, overheated brakes, failing wheel bearings or just discharge from the locomotives' exhausts start many fires. In 2010 one landholder in the Lillyvale mining area near Emerald was called out to four fires along the coal line on his property in just one week. This frequency has profound potential for environmental damage when extrapolated along the length of the line

The coal dust contamination of the surrounding areas along the lines makes grass unpalatable to livestock and naturally adds a huge amount of fuel to these fires. The cost of building suitable firebreaks and their ongoing maintenance is significant to each landholder. The potential damage to the ecology of the region both on private land and on the many National parks in the area is enormous.

We do recognise that the mining companies need to transport their coal from the Galilee Basin to the eastern seaboard. However by allowing more than one corridor from the one mining area to the same port is just magnifying damage to our fragile ecosystem and unnecessarily increasing the imposition on landholders.

**6.2 Subdivision of Leases**

As all property boundaries are not symmetrical, and proposed rail corridors are not designed to follow those boundaries, it is inevitable that various sized portions of land will be left isolated from the main portion of some individual properties. Whilst that circumstance may be manageable for some properties and in some situations, there will be many cases where this will be impractical and unmanageable, and in some cases the financial capacity of that property will be compromised and may become unviable. A solution to this problem must be found before any new rail corridor is enacted. There must be an opportunity for re-alignment of boundaries, or a subdivision of land.

We are advised that this matter can be achieved on freehold lands, through Regional Government bylaws, but this needs clarifying for all parties concerned.

We are also advised that subdivision of leasehold land is not possible under present government regulation. If this is the case regulation needs amendment to reduce the impact on land holders, by allowing the restructuring of untenable parcels of land. If this is not the case, clear and concise details of how this restructure may be achieved needs to become available.

If land leases are not able to be modified, the excision of land for rail lines is in direct conflict with the new Delbessie Agreement conditions and the recently enforced Environmental Reef Management Protection Scheme (ERMPs).

**6.3 Native Title**

Leasehold lands across Queensland are all subject to Native Title restrictions.

Leases are considered by law as one parcel of land. If landholders wish to improve title on any portion of that land, native title must be extinguished over the whole of that lease.

If railway corridors are to be taken through that same lease, native title must be extinguished; therefore it is logical that native title must be extinguished for the whole of that lease before any lands can be removed from that lease.

**6.4 Level Crossings**

Initial crossing designs from proponents indicate that level ('at grade') crossings with lights and possibly boom gates are the preferred option. C2C dismisses this form of crossing as unsafe and unmanageable in the long term. This will be critical within the next ten years when current mining exploration in the Galilee Basin reaches full capacity.

Property management requires workers to frequently cross the line on horseback, motorbikes, tractors, trucks, heavy machinery and on foot. Livestock will also need to be crossed at different times. Larger operations will have to cross upwards of one to two thousand head of cattle at a time. The frequency of trains on a duplicated line in a single corridor will make it difficult and incredibly dangerous to attempt these crossings 'at grade'. Over or under passes should be the standard for every crossing to mitigate all risks associated with people, animals and trains working at the same level.

***6.4.1 Train Frequencies***

The following figures have been provided by the Department of Infrastructure and Planning's website and by some of the companies themselves. These figures are for full production within the next ten to fifteen years.

| | |
|---|---|
| Alpha Coal | 30 million tons per annum |
| Kevin’s Corner | 30 million tons per annum |

| | |
|---|---|
| Carmichael Coal | 60 million tons per annum |
| Galilee Coal | 40 million tons per annum |
| South Galilee Coal | 20 million tons per annum |

BHP is also proposing a rail line for its northern Bowen Basin coal mines to Abbott Point. Their full production figures have been estimated at 20 million tons per annum. This product could also be transported on a Galilee Abbott Point Rail Line.

A total delivery figure for a Galilee Abbott Point Rail Line will be in excess of 200 million tons per annum and does not include future exploration.

Hancock Coal proposes to transport 25,000 tons per train moving 100 kilometres per hour on a standard gauge line.

To move 200 million tons of coal per annum would require 8000 loaded train movements a year or 16,000 including returns. This equates to 44 train movements per day or one train every 33 minutes 24 hours a day for every day of the year. Operating a rural business with these sorts of movements would be near impossible without overpasses or underpasses for access across the line.

## 6.5 Dust/Noise/Vibration Impacts

### *6.5.1 Dust*

This information has been collated from a number of sources. C2C are aware that some proponents are indicating that the carriages they intend to use are designed differently to QR carriages, however there is only modelling data available at this point. This needs to be verified with physical data. As this will not be available until the carriages are operating stakeholders can only calculate damages on the limited data on record. Proper monitoring sites need to be established along the final route to gauge emissions accurately.

- Coal dust causes fires
- A report suggests that ballast must be reclaimed to reduce impact on the environment (As has been a case where the coal lays 100mm thick along railway lines in central Queensland) (Environmental Protection Agency)
- Dust contaminated grass is unattractive to cattle therefore reducing their food intake contributing to lower weight gains
- Contaminated water run-off accumulates in water holes and stock dams (It has been quoted that the gullies run black after the first couple of storms in the Nebo area)
- Coal dust contains heavy minerals, which may result in contamination of beef destined for export. This is unacceptable in the beef industry and can lead to cattle being condemned.
- Spillage increases with the speed of the trains
- Air temperature also increases spillage
- Coal dust escaping from loaded wagons can foul the Ballast along the railway lines and can lead to significant track structure damage.
- Wheel action is a main cause of high dust levels
- Wagon induced turbulence
- Pollution from coal effects all major body organ systems and contributes to four of the five leading courses of mortality in US.
- The health burden of coal in Australia is estimated conservatively at 2.6 Billion a

year (Doctor for the Environment Australia)

**Unhealthy for Humans; Unhealthy for Livestock and wildlife**

#### *6.5.2 Coal Escaping into the Environment*

Wagon Surface 80%
Parasitic Load 4 %
Door leakage 6 %
Spill Coal Corridor 9 %
Residual coal in unloaded wagons 1 %
(Qld Rail, 2008)

#### *6.5.3 Dust/Vibration Impacts*

- Grandin and Deeson note the 'place specific fear memories' of livestock (and wildlife given that are all sensory) where an animal will fear returning to an area where a 'frightening experience first occurred' (eg loud noise or rapid train movement). This causes stress to livestock (low weight gains) and coupled with dust contamination makes land adjacent to railway lines less productive. (Grandin and Deeson, 2008)
- Management practices will have to change to accommodate the above effects. eg. running breeders where bullocks should be fattened causing inefficiency and inappropriate use of land; fencing 'long paddocks' alongside rail corridor to force grazing would result in a reduction in grass, but weight gains would also be greatly reduced.
- Vibration can cause dam walls and ring tanks to burst.
- As the corridors run North East and the prevailing winds are South Easterly the worst possible impact from dust and noise will occur; in places huge environmental damage will occur from corridor to corridor.
- Diesel emissions from combustion locomotives is a notable environmental contaminant (Katestone Environmental Pty Ltd, 2009).

### 6.6 Impacts on Landholders Surrounding the Corridor

Current legislation does not bind proponents to enter into discussions with property owners who neighbour the rail corridor, but do not have land resumed beyond an agreement regarding the boundary fence (and some proponents feel that this is not necessary either). The environmental, hydrological and financial effects on these properties will be equal to those on the other side of the fence. Amendments need to be made to legislation to ensure the right to run a productive and profitable business is protected for landholders in any way by the corridor. Hydrological impacts to the environment further up and down stream of the corridor should also be included in these amendments.

### 6.7 Quarrying Rights

It is apparent that some alignments have been designed with access to gravel for construction along the proposed corridor as a design parameter. Clarification is needed for growers who have deposits on their leases as to their rights and actions that can be taken to properly quarry gravel resources whilst minimising environmental damage and protecting the integrity of overland flows etc.

### 6.8 Dewatering of Aquifers / Aquifer Cross Contamination

#### *6.8.1 Dewatering of Aquifers*

Construction information for the Hancock line indicate that up to 22.22 megalitres of water will be required per kilometre during the building phase. It is assumed other proponents will have similar requirements. Hancock have indicated that this water will be drawn from existing and newly created water sources including bores. Some areas of the catchment rely solely on underground water sources and the huge draw on these has the potential to permanently damage and dewater these aquifers. Alluvial aquifers close to the surface are likely to be recharged via direct infiltration of precipitation and from hydraulic connection with surface water bodies in good seasons. However aquifers below 60 metres have entire clay formations above them and are not likely to be recharged as simply. As there is no or very limited hydraulic conductivity data for some areas of the proposed alignments access to these aquifers needs to be carefully considered and monitored.

#### *6.8.2 Aquifer Cross Contamination*

The majority of deeper aquifers, particularly in the Suttor/Eaglefield catchment have high levels of salt. Care must be taken during any bore construction that contamination of fresh water aquifers by saltly aquifers does not occur.

### 6.9 Long Term Maintenance

As part of the Infrastructural Facility of Significance conditions, proponents must gift the rail corridor to the State upon its completion. Who then is responsible for the ongoing maintenance of the corridor and any other issues that arise as rail traffic increases?

### 6.10 Redundancy Management

To date there has been no redundancy plan made clear in any of the proponents submissions to the Co-ordinator General. This needs to be addressed prior to the construction of the corridor. C2C are requesting some clarification as to who will be responsible for the maintenance and decommission of the final corridor in the long term. Stakeholders along the Greenvale line are experiencing serious environmental damage where the line infrastructure has been removed but the ballast remains. Unmaintained culverts and the gradual erosion of the ballast is having a major effect in the area and is a concerning safety issue.

## 7.0 Sunwater Pipeline

- The long term effect of Phase 2 of the Sunwater Connors River Dam pipeline will not be as invasive as a rail corridor, providing it is correctly placed in its alignment.
- Given the water requirements indicated for the rail construction phase and the limited availability of water along the corridor, it seems it would make sense to run the pipeline along the same easement as the rail corridor for as much of the distance as possible.

## 8.0 Conclusion

- Landholders are NOT adverse to the construction of infrastructure to support the development of the Galilee Basin.
- Legislation does exist to compel mining entities to use a single corridor (Mass Transferred Infrastructure Project).
- We are looking to State Government to facilitate the amalgamation of the five separate corridors, Sunwater pipeline, roads, any other infrastructure that needs to be constructed to support the growth of the minerals industry and future gas field development. This needs to be done taking ALL factors into consideration including hydrology, the environment, effects on pre-existing businesses, placement of existing rail infrastructure (QR lines), long term utilisation requirements for new and existing proponents and the potential for development of other industries.
- A single corridor will minimise the catastrophic impact on the environment, waste less food producing land, reduce the risk of fire, reduce the effect on hydrology (including landholder maintenance times for flood fencing), reduce the incidence of stock losses, increase the financial bucket for construction allowing for mitigation measures such as over/under passes to be constructed on all properties and public roads and reduce the number of businesses negatively affected by the corridor's construction.
- This infrastructure, of benefit to Queensland into the future and beyond the life of coal developments, is a rare opportunity for this Government, and should not be dictated by a single element. We are all shareholders in the great state of Queensland and look to you for strong and visionary leadership on this issue to ensure our long term investment and passion for regional Australia is rewarded.

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***Appendix A:*** **Aerial Photographs of River/Creek Systems within the Belyando Catchment**

*Illustration 2: Belyando River at Islay Plains in January 2008*

*Ilustration 3: Belyando River Floodplain at Bygana 2008.*

*Illustration 4: Eaglefield Creek in Pasha. The Hancock Line proposes to cross this creek within this area.*

*Illustration 5: Woolshed at Wentworth 2008. Creek runs at right angles to the road (road appears to be a watercourse in the image).*

*Illustration 6: Cattle some distance from the crossing attempting to wade Diamond Creek. This water feeds in to Logan Ck / Belyando System and remained at these levels for 5 weeks in 2011.*

*Illustration 7: Diamond Ck at Marracoonda yards, 2008. Water joins Logan Ck in Avon in the background.*

# Appendix 4


PROJECT
IRON BOOMERANG
east west line parks limited

# *GETTING IT RIGHT!*

**'Corridor to Coast – The Galilee Network' (C2C) respectfully submits updated views to the Deputy Premier and the Department of State Development Infrastructure and Planning on the development of a single transport infrastructure corridor from the Galilee Basin to Abbott Point:**

C2C members remain concerned and frustrated by the waste in time and resources by many over the past 3 years. The ultimate goal of one multi-user corridor in the best possible alignment will mean even greater losses and disruption for those landholders eventually impacted by the determination of the corridor. Time taken now to establish the best possible outcomes will represent savings in the future.

C2C assumes that Minister Seeney has thoroughly studied the submission prepared for the meeting with the Coordinator General, Mr Keith Davies last year. The group also makes the assumption that the Minister has been informed of the issues raised at the C2C meeting with the Coordinator General and departmental staff on 30 June 2011 in Clermont.

Most important are the serious flooding problems which relate to all proposals that attempt to cross the Belyando/ Suttor River flood plains. These flooding issues were clearly evident to all participating in the visit, and the predictions and concerns of C2C members have proved to be conservative in light of the 2012 rainfall events.

The Minister must also be aware of the presence of and involvement in these meetings of representatives of all proponents at that time. Choosing to ignore the advice of C2C members, proponents have continued to pour their resources into fundamentally flawed projects. C2C has little sympathy for their wasted expenditure, but accept that the previous government in Queensland should not have allowed IFS status to be issued for these projects. (The government also chose to ignore C2C's advice against this.)

It is not only rail corridor proponents who have wasted 'significant resources'. For the past three years the approximately 100 landholders who happen to be on one or more of the proposed corridors have also wasted considerable resources on a project that has nothing to do with their core business and they are equally disappointed in the continuing delays in resolving these disruptive and costly impacts on their families and businesses. Compensation discussions entertained by this government must allow landholders equal rights to fair treatment for lost time and expenses! C2C request and expect to be included in any ongoing discussions.

C2C highlight further developments since June last year:

- Hydrology - Hancock/GVK has produced hydrology work that provides little comfort for affected landholders. Much of the work lacks reliable historical floodplain records and is based on limited data from individual streams with little appreciation for the combined effects of flooding across the catchments. There have been serious anomalies in the proponent's understanding of the effect small increases in flood levels will have on the extent of degradation to both pastures and infrastructure for agriculture. Because of the extreme flatness of these flood plains and the slow movement of water, even small water level rises can drastically impact vast areas of pasture lands for longer periods of time.

Without continuous bridging, no amount of pipes through the levee banks required for rail construction will be able to solve this problem.

- Recent flooding - In the rainfall events of the **2012 wet season**, some properties along the Waratah proposal recorded flood heights more than **1 metre higher than any previous levels.** This again exposes the recklessness of using short term records for development design.

  On 15th and 16th March 2012, C2C hosted a visit from Mr Ted Parish, Rural Advisor for the Premier's Department to again inspect the proposed rail routes and provide an updated, independent assessment for the incoming government. He was able to view some of our areas of concern and has written a comprehensive report of his tour. If this has not already occurred, C2C would request the Minister and departmental officers hold urgent discussions with Mr Parish, to gain further insight into the problems that all proposed corridors will confront.

- Engineering design - On inspection of engineering plans for the Hancock proposal, one landholder has found **inaccuracies of about 600 mm (2 feet) over a distance of 1.8 km**. As anyone with a basic understanding of hydrology would be aware, on the expansive flood plains of these river systems, such inaccuracies could prove to be disastrous!! There has also been no recognition of road user concerns over the use of level crossings. Surely our society must recognise the continued rail crossing fatality record and affirm that over-pass or under-pass facilities must become standard practice.

- New Players - Since the time of C2C's previous submission, new proponents for both mining and infrastructure corridors have emerged. There is now a high likelihood of a continuous network of mining operations from south of Alpha to north of Carmichael, with both the Vale and Macmines operations likely to progress, all on the western side of the Belyando River.

  It is not feasible for all coal to be railed south to Alpha then North to Abbott Point. Recognised as environmental suicide to allow multiple crossings of the Belyando/Suttor river systems, the only logical conclusion is to rail coal North through the Galilee Basin and cross the river systems **ONCE,** where all the waters have come together.

  This would indicate that of all proposals at this point in time, only the original northern route from Adani, or the new "Iron Boomerang" proposal (with it's western route most favourable), are capable of satisfying alternate land use or environmental requirements.

- Visionary Planning - In the recent State elections, one of the platforms espoused by the LNP to win government was ***"to double agricultural production by 2040" -*** a noble endeavour that becomes more difficult as more agricultural land is taken for mining. One of the visionary discussions raised previously by C2C was the enormous intensive agricultural potential of the Belyando River floodplains. In a departmental study conducted in the early 1990s, an area of approximately 500,000 hectares was deemed suitable.

  Minister Seeney would also be aware that Sunwater is investigating a 1.5m diameter pipeline to take water from the Burdekin Dam and new Connors River Dam to supply the

Galilee coal mines. This is expected to supply 25,000 ML of water per year, with Hancock listed as requiring 20,000 ML and 500 ML for the town of Alpha. This leaves just 4,500 ML to satisfy the rest of this massive mining expansion - all for **an initial cost estimate of $650M**. C2C continues to urge investigation of constructing a dam in the ranges South from Alpha, for both mining and potential irrigation of the Belyando flood plain. It seems an extremely energy inefficient process to allow this water to flow down to the Burdekin Dam only to then pump the water back to the headwaters to be used.

Federal Opposition's Water & Infrastructure Taskforce have recently been studying the Gulf regions for agricultural **potential**. It would be in the interests of the Queensland economy to also investigate this region's irrigation capacity, with potential for federal support, once a change in government occurs at the national level. This potential would clearly be jeopardised if the present corridors across the flood plains are allowed to proceed, as can clearly be demonstrated from the highly successful irrigation scheme funded and developed by the Hall family at "Willesley" and "Laurel Hills" north of Clermont.

Costly Mistakes - Advice from C2C has consistently been to place any transport corridors outside the Belyando/Suttor flood plains and this has been consistently ignored. Much investigative work remains to be completed, including accurate on-ground engineering work, complete and accurate hydrology studies, compensation discussions for presently unknown impacts on alternate land use and environmental degradation and the continuing expenditure that will be required as new mining operations come on line.

Better governance by the previous administration would have reduced the considerable expenditure by proponents and landholders to date, by directing the resources to a common worthy goal.

The fiasco of the Traveston Dam shows the cost the State may inherit from poor initial planning. Population centres like Emerald, Theodore, Roma, St George, Withcott, as well as rail and road infrastructure in areas like Rolleston and Comet here in Central Queensland, would have benefitted greatly in both minimising ongoing costs and improving reliability if more time had been spent in the initial development phase to **"get it right first time."**

C2C again offers our commitment to Government to assist in achieving this outcome. The precious commodity of our time would be available to host another visit to this region by the Premier, Deputy Premier, Coordinator General or anyone in this government, to engender a better understanding of potential environmental and agricultural infrastructure damage and to facilitate correct decisions for the long term future of this region and the State of Queensland.

We request the opportunity for C2C to remain an integral part of the decision making process.
C2C – The Galilee Network will continue efforts to ensure there is

**'ONE CORRIDOR CONSTRUCTED IN THE BEST POSSIBLE PLACE'**

John Burnett
Dyan Hughes
On behalf of the C2C Steering Committee

# Appendix 5


PROJECT
IRON BOOMERANG
east west line parks limited

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OFFICE OF THE MAYOR

*Your Ref No.: 2012/6489*

**Email to:** jordan.crabbe@environment.gov.au

14 August 2012

Manager of Commonwealth Referrals (EPBC Act)
Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
Canberra ACT 2601 Australia

Dear Sir/Madam

**RE EAST WEST LINE PARKS LIMITED/TRANSPORT - LAND/ABBOT POINT TO ALPHA/ QLD/GALILEE INFRASTRUCTURE CORRIDOR PROJECT**

I refer to the application by East West Line Parks Limited to build a rail corridor to service the Galilee Basin.

Substantial portions of this rail corridor are planned for the Isaac Regional Council area, and particularly the most sensitive areas.

I believe this application must be viewed in the context of the other rail proposals for the region and not in isolation.

I have had many representations from concerned landholders in our region about the alternatives to this proposal, namely the GVK Hancock proposal and the QR National Adani proposal. These two corridors are now the preferred corridors for the Queensland State Government.

Based on the information I have seen, I believe that this East West Line Parks Limited proposal represents the best possible outcome for the environment, landholders, communities, the mining industry and all three levels of government.

1. **Better for the government:** because delivering lower below and above rail costs, means the price per tonne for transport to port is cheaper for miners. That means better financial viability for smaller mine proposals and a more likely royalty stream from those mines;

2. **Better for the environment:** because it uses covered wagons, that do not drop 1-2% of their coal dust load on land and waterways along the corridor (some of which is defined as strategic cropping land in alternative proposals);

3. **Better for land holders:** because it protects prime agricultural land by avoiding strategic cropping areas, avoids massive flood zones; spur lines appear shorter; meaning less impacts for land holders;

4. **Better for communities:** because the train trips per week are substantially less than GVK Hancock and QR National combined, meaning less community and landholder disruption.

5. **Better for the mining industry:** A single user corridor that avoids the heavy development costs of large flood plains will likely be cheaper, and a recent study by the proponent suggests that their proposal is up 55% cheaper than the two main alternatives, delivering a lower price per tonne to port. This point is important given the downward pressure on thermal coal prices because efficiencies give our region the best possible chance of making more mine proposals more viable which increases the likelihood of a royalty revenue stream from those mines.

**I would like to qualify my remarks by saying that the best possible way to determine if this proposal is more appropriate, would be in the form of a public inquiry into its implications.**

**This would provide a significant opportunity for all parties to understand the comparative strengths and weaknesses of all proposals, so that our communities can have faith that the best outcomes can be achieved in light of all the facts.**

In my view, it is not appropriate for all levels of government to be imposing a rail corridor on the region that best suits the needs of single proponents as opposed to the best interests of the environment, the broader community, industry and landholders.

When better solutions are available, particularly those that appear to meet the needs of all stakeholders, those proposals deserve to be investigated thoroughly, and compared comprehensively, in the public interest.

In my view, the decisions made in relation to the Galilee Basin will shape our region for a generation, and if the wrong decisions are made the implications could have a profound effect on the region's capacity to grow sustainably.

Should you wish to discuss this matter further please contact the undersigned on 0749 414 524.

Yours faithfully

ANNE BAKER
**Mayor**

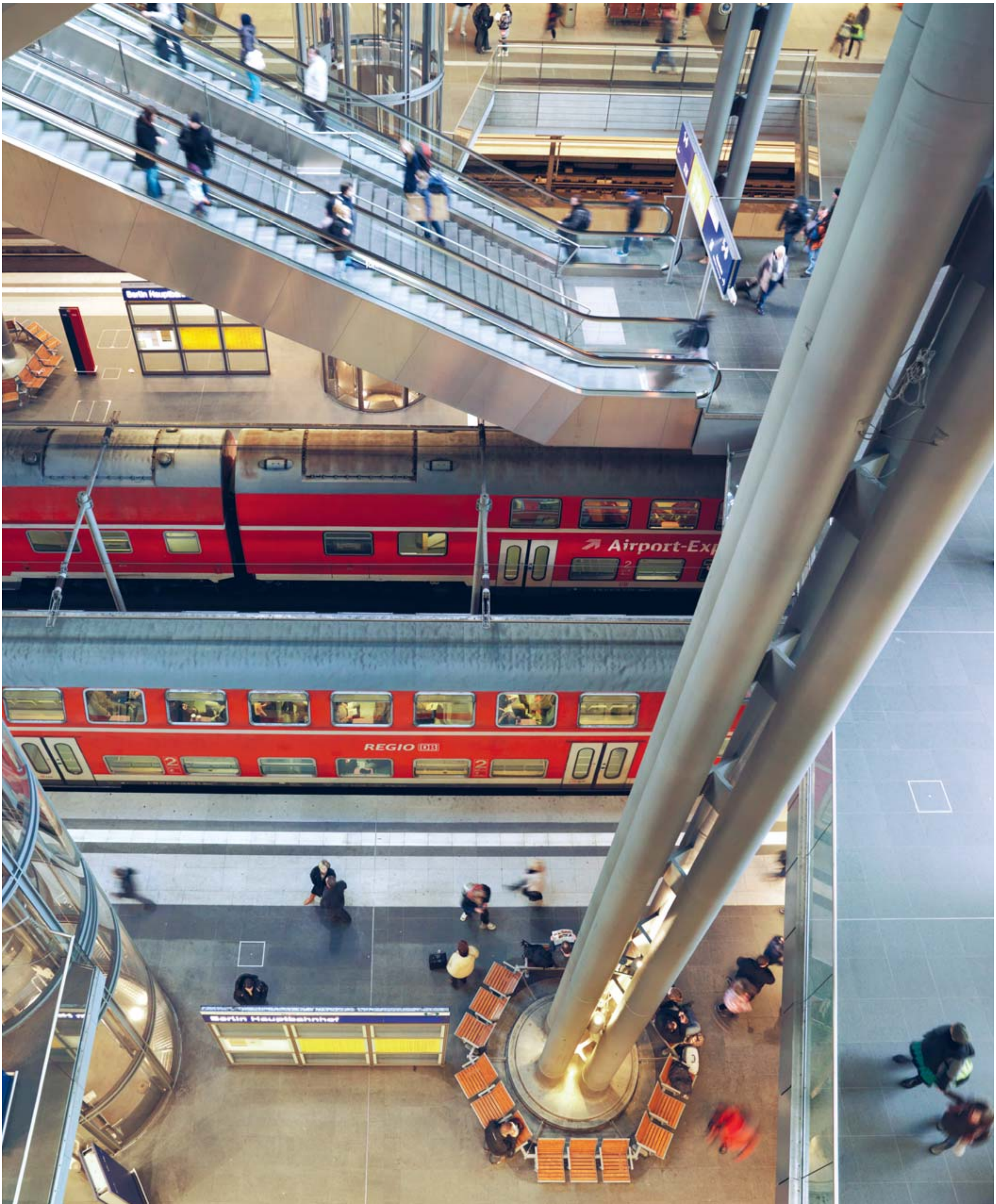
# Appendix 6


PROJECT IRON BOOMERANG
east west line parks limited

worldsteel ASSOCIATION

# SUSTAINABLE STEEL

## At the core of a green economy



# CONTENTS



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# MESSAGE FROM THE CHAIRMAN AND DIRECTOR GENERAL

Steel is at the core of a green economy, in which economic growth and environmental responsibility work hand in hand.

The steel industry believes that sustainable development must meet the needs of the present without compromising the ability of future generations to meet their own needs. Within this, a green economy delivers prosperity for all nations, wealthy and poor alike, while preserving and enhancing the planet's resources.

Steel is essential to the technologies and solutions that meet society's everyday needs – now and in the future. Steel is central to our current transport systems, infrastructure, housing, manufacturing, agriculture, water and energy supply. It is also critical to the sectors and technologies that will enable and drive a green economy.

Renewable energy, resource-efficient and energy-efficient buildings and low carbon transport, infrastructure for fuel efficient and clean energy vehicles and recycling facilities – all of these things depend on steel.

In addition, many of the challenges posed by population growth, urbanisation, poverty reduction and mitigation of natural disasters can best be met by steel.

Steel's two key components are iron – one of Earth's most abundant elements – and recycled steel. Once steel is produced it becomes a permanent resource because it is 100% recyclable without loss of quality and has a potentially endless life cycle. Its combination of strength, recyclability, availability, versatility and affordability makes steel unique.

While the steel industry is energy and carbon-intensive, significant progress has been made to reduce steelmaking impacts. Research and development investment is ongoing. Steel's versatility and recyclability have also brought about countless innovative steel applications that, when seen from a product life cycle perspective, provide savings that neutralise and often far outweigh the initial material production impacts.

Steel's durability also allows for the reuse of countless products, which is enhanced through proper design. This saves natural resources.

In this report, we will share with you:

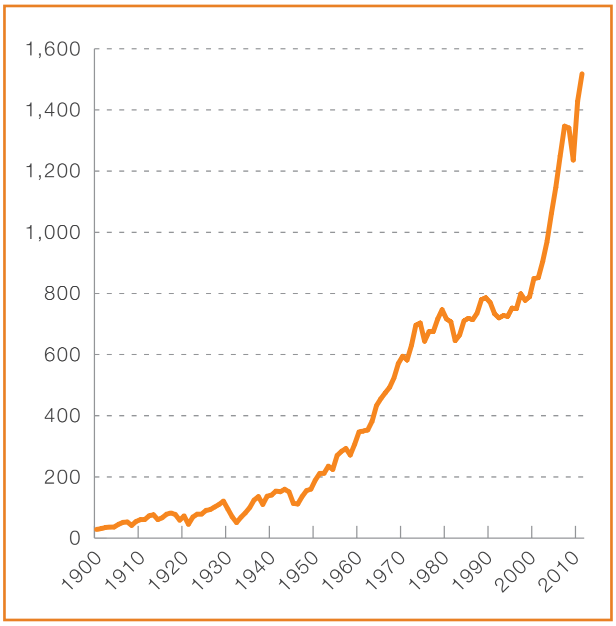
- how steel enables economic growth and will enable a green economy that meets society's needs in a sustainable way
- innovative steel solutions that maximise energy and emission savings over product life cycles while maintaining affordability and the highest safety standards
- the progress the steel industry has made over the past 20 years in its environmental and safety performance
- action being taken by the industry to ensure continued improvement
- what government and policymakers can do to help us to strengthen steel's contribution to a green economy.

We recognise that continued engagement and collaboration with our stakeholders are essential as we strive to fulfill our vision of a sustainable steel industry in a sustainable world. We welcome your ideas and feedback.

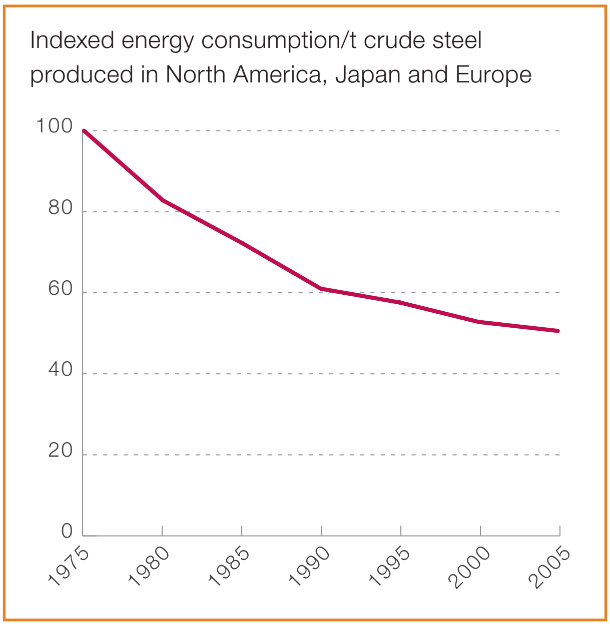
Dr Xiaogang Zhang
worldsteel Chairman and
President, Anshan Iron & Steel Group Corporation

Dr Edwin Basson
Director General
worldsteel

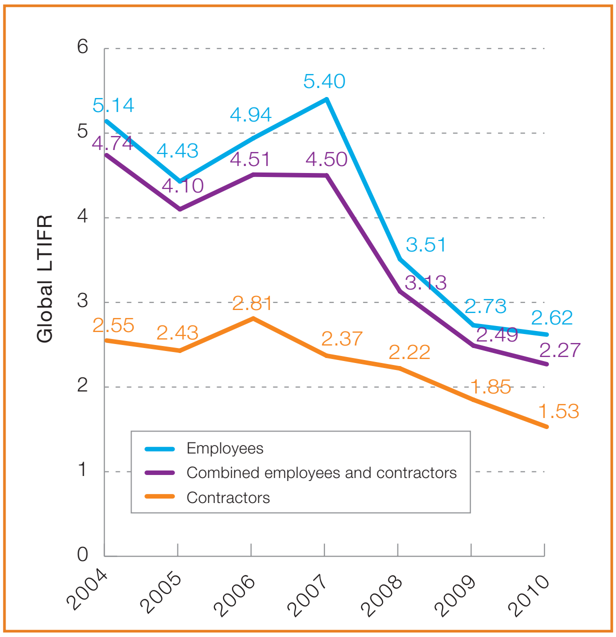
## World crude steel production, 1900-2011 (Mt)




## Energy use




## Lost-time injury frequency rate (LTIFR)




## Global steel use

**215 kg**

of steel was used per capita in 2011, worldwide.

## $CO_2$ emissions

**1.8 t $CO_2$/t crude steel**

based on route-specific $CO_2$ intensities for three steel production routes: basic oxygen furnace, electric arc furnace and open hearth furnace; and weighted based on the production share of each route.

## Employees

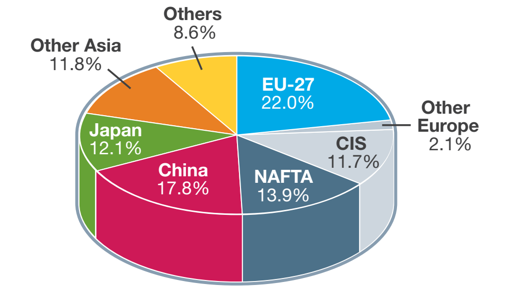
**More than 2 million**

people are employed by the steel industry directly.

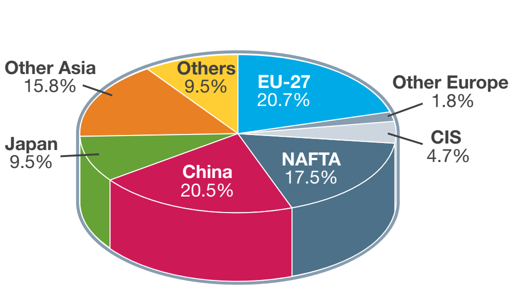
## Major steel-producing and steel-using countries

### 2001

Production:
World total: 851 million tonnes crude steel

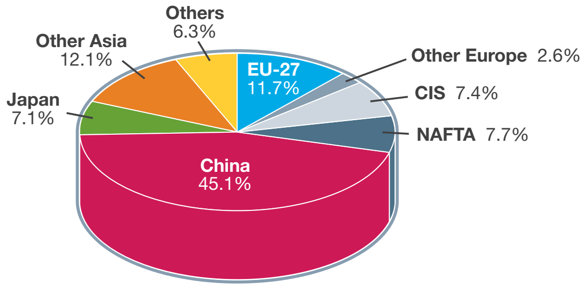



Use (finished steel products):
World total: 769 million tonnes crude steel

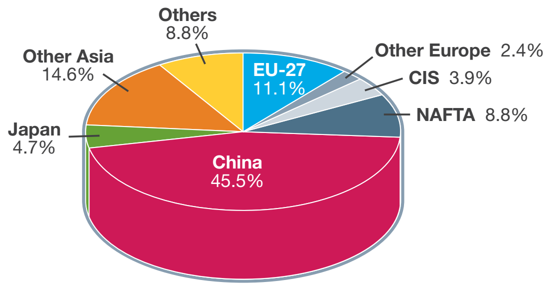



### 2011

Production:
World total: 1,518 million tonnes crude steel




Use (finished steel products):
World total: 1,371 million tonnes crude steel




## Environmental management system certification

**89%**

of steel industry employees and contractors work in EMS-registered production facilities (EMAS or ISO 14001).

## Steel recycling

**Over 22 billion tonnes**

of steel has been recycled worldwide since 1900 owing to steel's 100% recyclability.

## Material efficiency

**98%**

of the raw materials used to make crude steel are converted to products and by-products. The industry's goal is zero waste.

## Investment in new processes and products

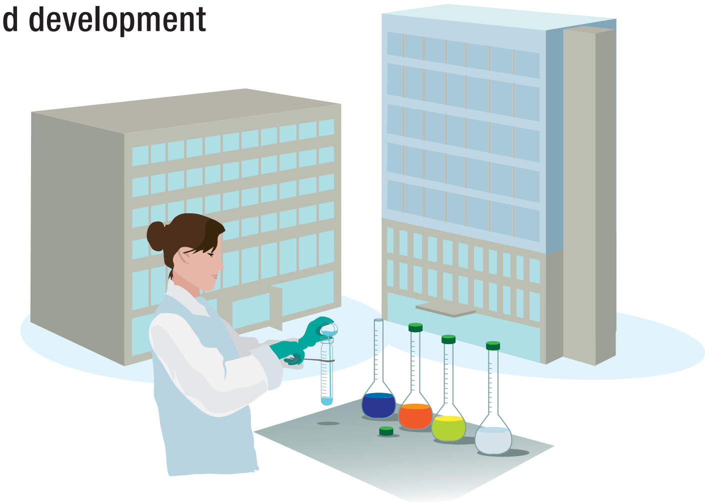
**8.8%**

of revenue. Includes investment in R&D and capital expenditure.

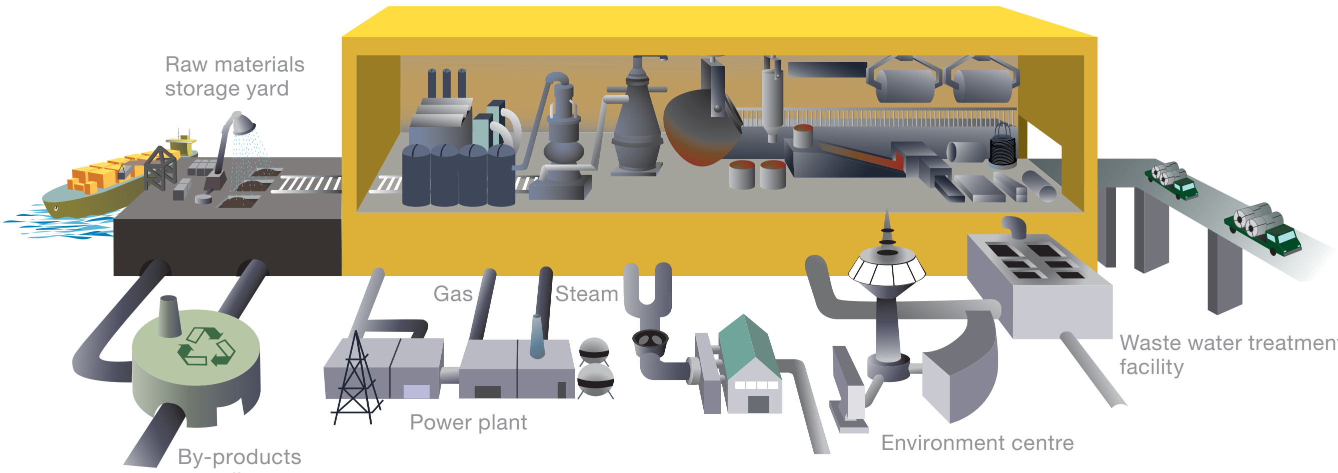
# HOW WE USE STEEL

## Use by sector in 2011

### Research and development

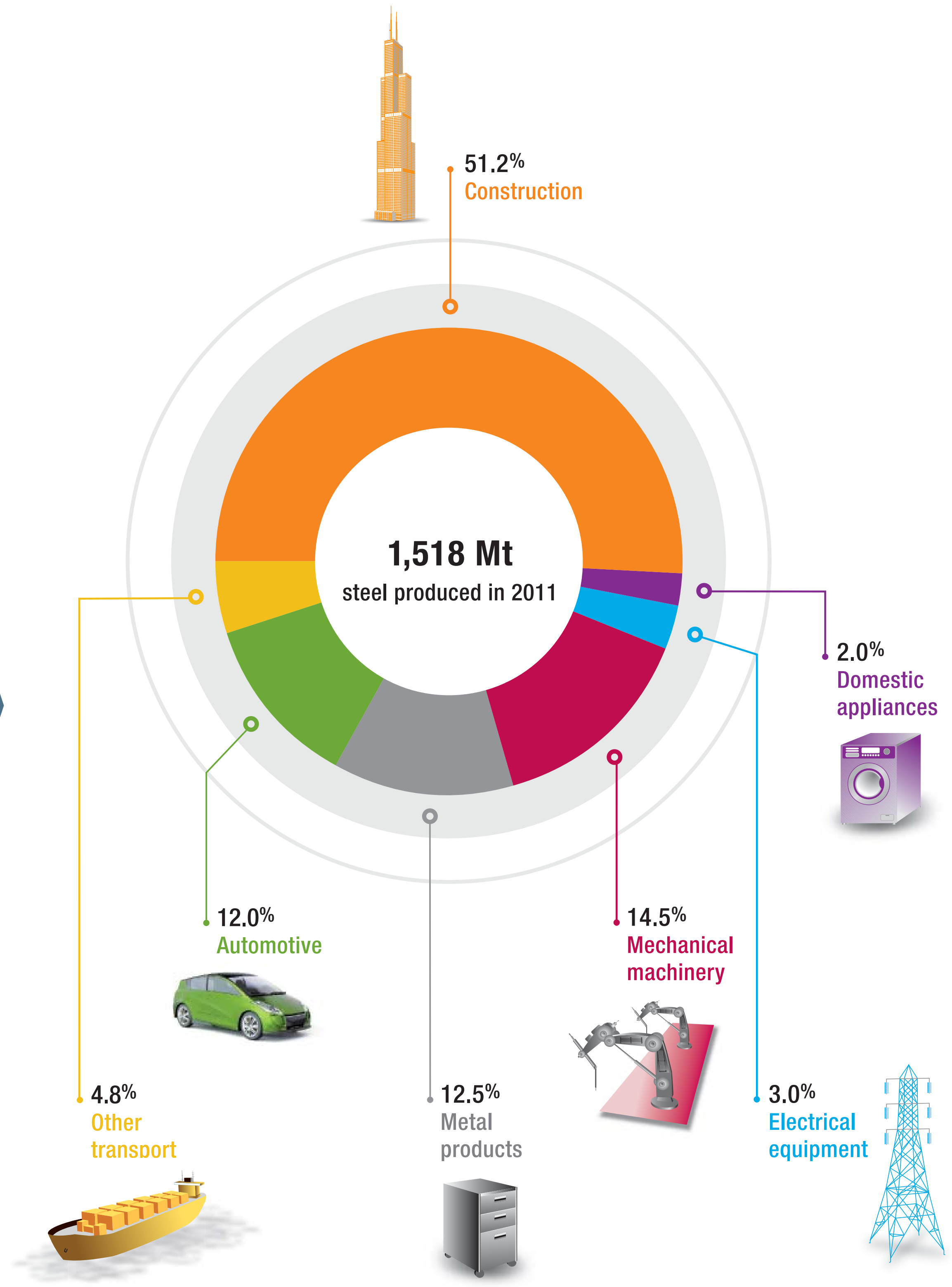


### Steelmaking facility




## Steel is everywhere in our lives




51.2%
Construction
1,518 Mt
steel produced in 2011
2.0%
Domestic appliances
3.0%
Electrical equipment
14.5%
Mechanical machinery
12.5%
Metal products
12.0%
Automotive
4.8%
Other transport

## Steel enables economic growth

Steel has enabled our modern way of life. It has helped lift societies out of poverty, spurring economic growth, and continues to do so around the world today.

Iron, steel's precursor, fueled the industrial revolution starting in 1750, enabling manufacturing equipment in factories and rail transport. Modern steelmaking was developed 150 years ago with the invention of the Bessemer process allowing for the affordable mass-production of steel (an iron alloy). This set off a second industrial revolution, and sustained economic growth.

**Today, steel is one of the most common materials in the world. We rely on it for our housing, transport, food and water supply, energy production, tools and healthcare. Nearly everything around us is either made of steel or manufactured by equipment made of steel.**

Steel is inextricably linked with economic growth and prosperity, as shown in Figure 1. This figure estimates stocks of steel per person, based on their current wealth (GDP per person), and suggests that as a person's income increases they build up their stock of steel, which then tends to reach a plateau.

Table 1 (see p. 9) demonstrates that steel stocks range from 0.1 tonnes per person for the poorest nations to over 13 tonnes per person for Japan, with the world average at around 2.7 tonnes per person.

Figure 2 demonstrates typical distribution of steel use in developed countries.

Developing societies require steel to build new roads, railway lines, buildings and bridges. They also need it to lay new pipelines for gas, water and sanitation and to build factories and machinery.

Once basic infrastructure needs are met and GDP continues to rise, the demand for consumer goods such as washing machines and refrigerators increases, as does the need for mobility via trains, buses and automobiles – all of which require steel for their production and related infrastructure (stations and fueling). Urbanisation is also enabled by steel – e.g. allowing for high-rise buildings.

As suggested in Figure 1, steel stocks per person, or the demand for steel in developed societies tends to plateau as a certain level of wealth is reached and the need for new infrastructure and buildings are satisfied. Per capita demand tends to remain high in areas with high industrial production, contributing to sustained economic growth.

Figure 1: Steel stocks in-use vs GDP for different countries[1]

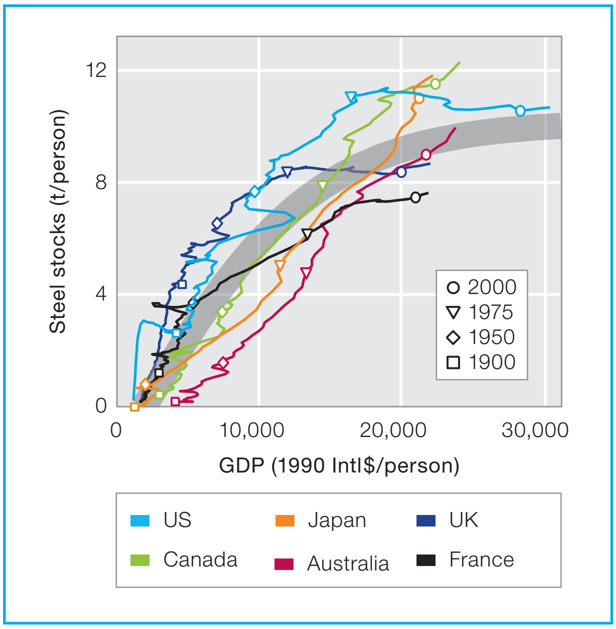


Figure 2: Typical steel use in developed countries[2]

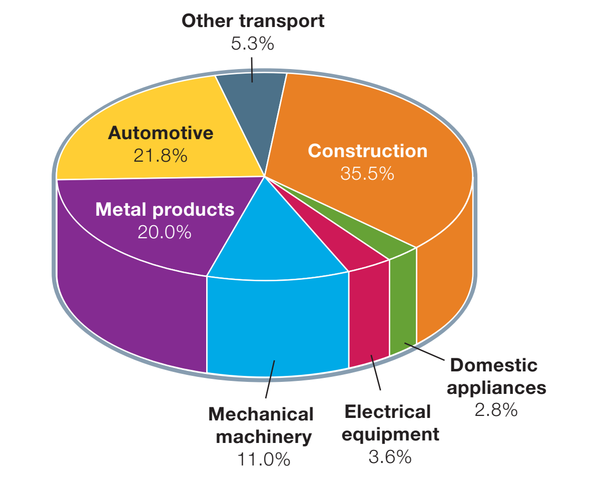
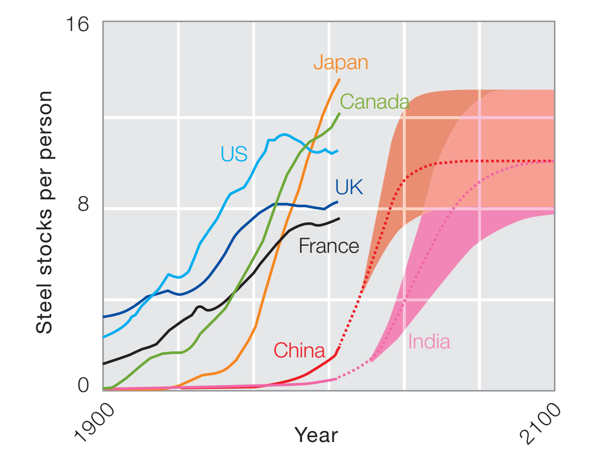



Figure 3: Past and forecast steel stocks in China and India[3]




For example, steel demand is high in South Korea due to the country's high level of steel exports in steel-containing goods such as ships and cars. It is also high in Japan because of shipbuilding, engineering and automotive – it remains a big net exporter of automotive vehicles. Steel is also required in both of these highly urbanised countries for high-rise buildings that are earthquake resistant.

Table 1: Steel stocks in-use for selected countries, 2005[1]

| Country | Steel stocks (tonnes/person) |
|---|---|
| Argentina | 4.1 |
| Australia | 9.8 |
| Bangladesh | 0.1 |
| Brazil | 3.1 |
| Canada | 12.1 |
| China | 2.2 |
| Congo, DRC | 0.1 |
| Egypt | 1.1 |
| Ethiopia | 0.1 |
| France | 7.5 |
| Germany | 9.0 |
| India | 0.4 |
| Indonesia | 0.3 |
| Japan | 13.6 |
| Mexico | 4.8 |
| Nigeria | 0.1 |
| Pakistan | 0.1 |
| Philippines | 0.1 |
| Russia | 4.6 |
| South Africa | 3.0 |
| South Korea | 7.9 |
| Spain | 8.7 |
| Thailand | 2.2 |
| Turkey | 4.2 |
| United Kingdom | 8.5 |
| United States | 10.5 |
| Vietnam | 0.1 |
| World average | 2.7 |

## Steel is unique and ever-evolving

Steel's two key components are iron, one of Earth's most abundant elements, and recycled steel. Once steel is produced it becomes a permanently available resource because it is 100% recyclable and has a potentially infinite life cycle. This infinite recyclability without loss of properties, combined with its strength, versatility, availability and affordability make steel unique.

There are thousands of different types of steel, designed to meet the specific needs of end users. Many products in use today were developed over the past 10 years.

**Steels are alloys based on iron. Depending on the desired properties – such as strength, ductility, and stiffness – a multitude of other elements can be present in small amounts.**

The variety of steels is not only defined by chemical composition, but also by a variety of microstructures on a nano and sub-nano scale. This leads to an impressive range of achievable properties and ensures that there is much scope to continue developing new, innovative, lightweight and high-strength steels.

Stock levels for steel in China and India in particular are expected to grow significantly by 2050 – as shown in Figure 3 – to meet their growing need for buildings, infrastructure and transport in a sustainable way. There will also be strong growth in steel production in other areas of the world where steel will be vital in raising the material and social welfare of developing societies.

Steel will continue to be needed in both developed and developing countries in advanced and new applications that support sustainable development and thereby, a green economy.

# Steel supports the green economy

We have many challenges to overcome as a global society. We are faced with resource shortages, water and land stress, environmental degradation and climate change. There are also many needs to be met – from poverty eradication to mitigation of natural disasters. The challenges are magnified by a population set to grow from the present 7 to 9 billion by 2050, accompanied by rapid urbanisation. It is clear that things cannot go on as they have, and that we must transition to a green economy in which economic growth and environmental and social responsibility work hand in hand.

The steel industry believes that sustainable development must meet the needs of the present without compromising the ability of future generations to meet their own needs. Within this, a green economy delivers prosperity for all nations, wealthy and poor alike, while preserving and enhancing the planet's resources.

The transition to a green economy is already underway[4] and presents countless opportunities for positive change.

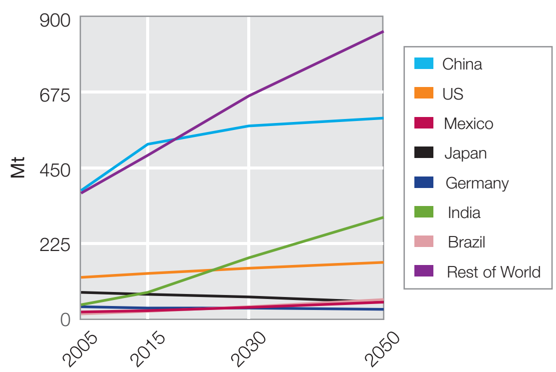
**Steel has an essential role to play in this transition and in sustaining a green economy.**

Steel is critical to the sectors and technologies that will enable and drive a green economy. Renewable energy (see p. 33), resource and energy efficient buildings (see p. 27), low-carbon transport (see p. 31), infrastructure for fuel efficient and clean energy vehicles (see p. 31) and recycling facilities all depend on steel. These sectors will also provide employment opportunities, as does the steel sector itself.

The steel industry employs more than 2 million people directly around the world, with a further 2 million contractors and 4 million in supporting industries. Considering steel's position as the key product supplier to industries such as automotive, construction, transport, power and machine goods, the steel industry is at the source of employment for many more millions of people.

Global steel use has grown more than seven-fold since 1950. By 2050, steel use is projected to increase by 1.5 times that of present levels, to meet the needs of our growing global population. Figure 4 shows a forecast of steel consumption by region.

Figure 4: Past and forecast steel consumption[5]




In addition to providing employment and steel products that will enable a green economy, the steel industry is also working to make improvements in its own sustainability performance.

### Our efforts are focused on:

- further reducing the environmental footprint of steelmaking (see p. 16)
- ensuring world-class safety performance (see p. 22)
- supporting the application of steel in products that reduce life cycle $CO_2$ emissions, such as AHSS in vehicles (see p. 31)
- promoting life-cycle thinking and intelligent product design to allow for dematerialisation and expanded reuse (see p. 14, 29)
- further improving end-of-life steel product recovery and recycling rates (see p. 13).

## Steel solutions in a green economy: wind turbines

Steel is a key material in providing solutions for clean energy delivery. It is essential to wind power generation. Every part of a wind turbine depends on iron and steel. Onshore wind turbines require an average of 180 tonnes of steel per MW, while offshore wind turbines require an average of 450 tonnes of steel per MW.[6]

Wind could provide a quarter of the world's electricity by 2050 if current growth rates continue – requiring an additional 1,000,000 onshore and 100,000 offshore turbines.[7] Steel will be essential not only in building these turbines, but also in the transmission and distribution of the electricity produced and in supporting applications.

**Over 20 years, a 3 MW wind turbine can deliver 80 times more energy than was used in its production and maintenance.[8]**

At the end of its life the wind turbine can be remanufactured for reuse, extending the useful life of the turbine (see p. 15), and eventually recycled. Steel is 100% recyclable without loss of properties.


http://worldsteel.org/publications/bookshop

# Steel production

Globally, steel is produced via two main routes: the blast furnace-basic oxygen furnace (BF-BOF) route and electric arc furnace (EAF) route, which are shown in Figure 6. Variations and combinations of production routes also exist.

The key difference between the routes is the type of raw materials they consume. For the BF-BOF route these are predominantly iron ore, coal, and recycled steel, while the EAF route produces steel using mainly recycled steel and electricity. Depending on the plant configuration and availability of recycled steel, other sources of metallic iron such as direct-reduced iron (DRI) or hot metal can also be used in the EAF route (see p. 18 for raw material inputs by route.)

About 70% of steel is produced using the BF-BOF route. First, iron ores are reduced to iron, also called hot metal or pig iron. Then the iron is converted to steel in the BOF. After casting and rolling, the steel is delivered as coil, plate, sections or bars.

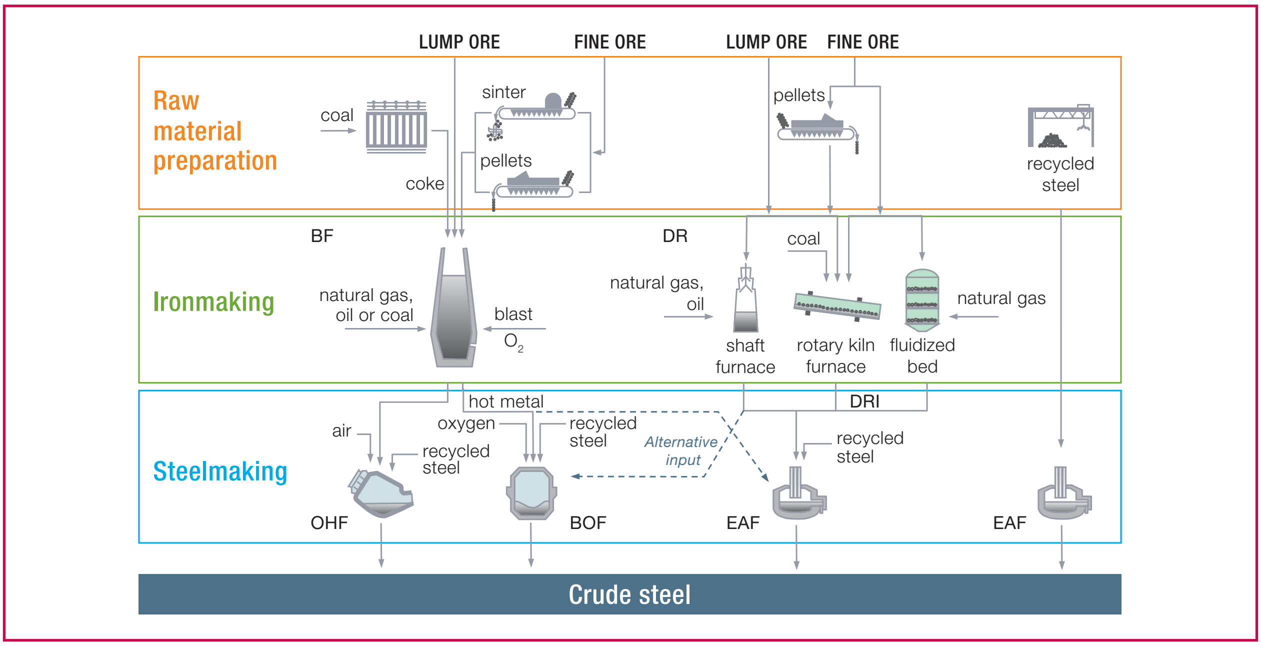
Steel made in an EAF uses electricity to melt recycled steel. Additives, such as alloys, are used to adjust to the desired chemical composition. Electrical energy can be supplemented with oxygen injected into the EAF. Downstream process stages, such as casting, reheating and rolling, are similar to those found in the BF-BOF route. About 29% of steel is produced via the EAF route.

Another steelmaking technology, the open hearth furnace (OHF), makes up about 1% of global steel production. The OHF process is very energy intensive and is in decline owing to its environmental and economic disadvantages. Only four furnaces of this type are known to be in operation.

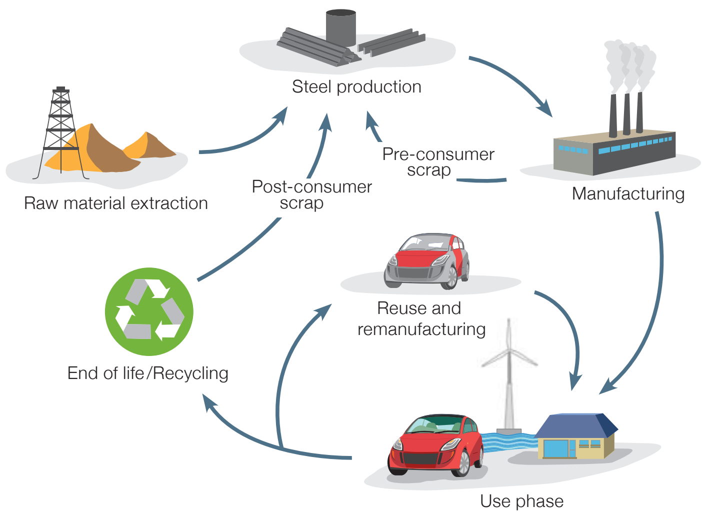
Most steel products remain in use for decades before they can be recycled. Therefore, there is not enough recycled steel to meet growing demand using the EAF steelmaking method alone. Demand is met through a combined use of the BF-BOF and EAF production methods.

All of these production methods can use recycled steel scrap as an input. Most new steel contains recycled steel.

Figure 6: Steel production routes



## Steel's life cycle




# Steel recycling

Steel is 100% recyclable, which means it can be reprocessed into the same material of the same quality again and again. Also, it is easily recovered by magnetic separation.

**Once steel is produced, its life cycle is potentially endless, making it a permanent resource for society – as long as it is recovered at the end of each product life cycle.**

Recycling is especially important in a green economy because it conserves valuable resources and prevents useful materials going to landfill sites as waste. There are two main sources of recycled steel, also called steel scrap: excess material from steel production and downstream manufacturing (pre-consumer scrap), and steel at the end of a product's life (post-consumer scrap).

100% of scrap from steel production and downstream processing is collected and recycled directly into steel production. Post-consumer scrap has to be collected and prepared (for example by shredding and baling). Because of the high value of steel scrap, there are also economic incentives that help to maintain high recycling levels.

Post-consumer steel product recovery rates vary across regions and sectors. A recent worldsteel review of these rates for various sectors is shown in Table 2. Recovery rates differ from recycling rates. For example, while about 85% of automobiles are recovered for recycling, nearly 100% of the steel in these recovered vehicles is recycled, thanks to steel's magnetic properties and the ease of magnetic separation.

In addition to steel industry efforts, there are also joint activities with other metal industries, research institutes and academia to identify losses throughout the life cycle and see how they can be minimised to further improve steel recycling rates.[9]

**Steel is the most recycled industrial material in the world, with over 500 Mt recycled annually, including pre- and post-consumer scrap.**

Recycling accounts for significant energy and raw material savings: over 1,400 kg of iron ore, 740 kg of coal, and 120 kg of limestone are saved for every tonne of steel scrap made into new steel.

Table 2: Post-consumer steel product recovery rates by sector

| Sector | Recovery rate 2007 (%) | Recovery rate 2050 (%) | Life cycle in years |
|---|---|---|---|
| Construction | 85 | 90 | 40-70 |
| Automotive | 85 | 90 | 7-15 |
| Machinery | 90 | 95 | 10-20 |
| Electrical and domestic appliances | 50 | 65 | 4-10 |
| Weighted global average | 83 | 90 | N/A |

# Reuse and remanufacturing

## Steel product reuse

Steel's durability enables many products to be reused. This extends the product life cycle and therefore conserves resources. Design is critical in saving resources and enhancing product reuse. Consequently, many steel companies and steel product manufacturers are increasingly designing products for reuse.

Reuse is the best form of recycling as little or no additional energy is required for reprocessing.

For example:

- Steel construction components – roofing and wall elements, structural beams – are reused and increasingly being designed for reuse (see p. 28, 29).
- Steel barrels, or drums, have a typical life of six months. If they are used 10 times, however, that lifespan can be extended to five years.
- Automotive steel parts that are undamaged from vehicles that have reached the end of their useful lives are sold by car dismantlers as spare parts for vehicles still in use.
- Rail track is regularly reused by swapping over the left and right rails on a track. When no longer suitable for main-line use, rails can be tested for cracks and then reused on secondary lines with lower traffic. They can also be recapped or redesigned to extend their useful life.[5]
- Ships can be dismantled and steel parts can be re-rolled for reuse as rebar for construction. Steel shipping containers can also be reused and converted into buildings.[10]
- Older wind turbines in more mature markets that are replaced with newer, more powerful ones can be shipped to other locations for reuse.[11] Remanufacturing the used wind turbine extends the life of the wind turbine even further.

Increased reuse of products will play an important role in sustaining a green economy.

In the future, manufacturers of steel products may also have an important role to play as certifiers of used steel products before they go to market, ensuring the integrity and safety of the product.[5]

Governments could support increased reuse by:

- providing clear guidelines on certification for product reuse
- supporting voluntary codes and standards on product durability within industrial sectors, and
- raising consumer awareness about the benefits of reuse.[5]

## Steel product remanufacturing

Remanufacturing is the process of restoring durable used products to like-new condition.[12] It involves the disassembly of a product, during which each component is thoroughly cleaned, examined for damage, and either reconditioned to original equipment manufacturer specifications or replaced with a new part. The product is then reassembled and tested to ensure proper operation.

It differs from recycling in that the value added during original fabrication, including labour, energy, and equipment expenditures, is conserved. This added value is lost in recycling, which reduces the product to its material components and requires additional labour, energy, and machinery. Remanufacturing also differs from repairing, which is a process limited to making the product operational as opposed to thoroughly restoring it.[13]

Remanufacturing extends the overall product life cycle and saves valuable resources. Many steel products lend themselves to remanufacturing, taking advantage of the durability of the steel components. Although mostly invisible to consumers, remanufacturing is already commonplace and will likely become more widespread in a green economy. It offers products that are not only greener, but also less expensive for consumers.

A wide range of steel products is already remanufactured. This includes machine tools, electrical motors, automatic transmissions, office furniture, domestic appliances, car engines and wind turbines.

### Engine remanufacturing

A life cycle assessment study shows that remanufactured engines can be produced with up to 83% less energy than the energy needed to produce a new engine (see Figure 7), and emitting up to 87% less carbon dioxide. Consumers can also save up to 53% on cost over a new engine with the purchase of a remanufactured engine. In the study, the iron and steel components made up about 78% of the mass of the modeled engine.[14]

### Wind turbine remanufacturing

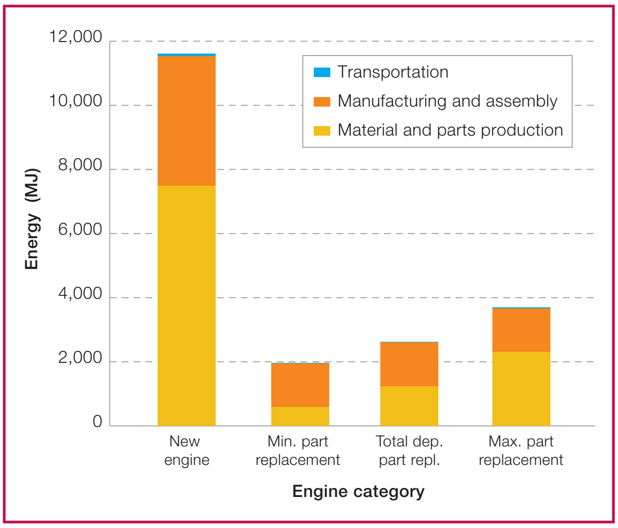
Steel is essential to wind power generation, as every part of the turbine depends on iron and steel (see p. 11). Wind turbines have an average lifetime of 20 to 30 years. Wind farms in mature markets tend to be 'repowered' to increase capacity – a process in which the older turbines are replaced by fewer, newer, more powerful turbines. In Germany, for example, 116 wind turbines with a total rated capacity of 56 MW were dismantled and replaced by 80 turbines with a total rated capacity of 183 MW in 2010.[15]

The older turbines can be remanufactured for use on other sites requiring less capacity or in newer markets, thereby extending their useful life.[11] If properly remanufactured, the wind turbine can last another 20 years.[16]

Remanufacturing also provides the option of keeping the same wind turbines on site. Some remanufacturers even offer on-site service – reducing service time and cost[17] (which can be less than half the cost of a new one[16]) – and full warranties on the remanufactured turbines.[18, 19]

Wind turbine remanufacturers also offer the market sizes no longer provided by the world's major manufacturers[20] or individual wind turbine parts with the same warranty as new parts that are up to 25% less expensive.[21]

Figure 7: Total life cycle energy consumption for new and remanufactured engines[14]



# Working to make steel even more sustainable

## Reducing steel's environmental footprint

Steel manufacturing has a variety of impacts on the environment. The main impacts come from the use of energy and raw materials, which result in emissions such as carbon dioxide ($CO_2$), sulphur oxides ($SO_x$), nitrogen oxides ($NO_x$), dust to air as well as water usage and associated emissions.

Measures taken by steel companies to minimise and reduce steel's environmental footprint are described in this section. This section also describes many ongoing joint industry efforts.

## A global life cycle inventory database to assess steel's footprint and create more eco-efficient products

worldsteel has been collecting life cycle inventory data from its members since 1995. The data consist of 'cradle-to-gate' environmental inputs and outputs including

- resource use (raw materials, energy and water)
- emissions to land, air and water

for various steel products (for example, 1 kg of hot rolled coil produced) and is available on a global or regional basis. The data can also include the benefits associated with recycling the steel at the end of a product's life.

This data can be used to perform life cycle assessment (LCA) studies on steel-containing products, based on an internationally standardised methodology (ISO 14040 series). LCA studies help to fully understand the environmental impact of a product by providing a full picture of where environmental burdens occur along the product life cycle including production, use and end-of-life (recycling or disposal).

LCA studies enable informed material selection decisions and more eco-efficient products by identifying potential areas to reduce the product's environmental footprint.

## Environmental management systems

An EMS helps an organisation to monitor and improve its environmental performance and to increase its operating efficiency.

**According to worldsteel's sustainability statistics, in 2010 approximately 89% of steel industry employees and contractors worked in EMS-registered production facilities (EMAS or ISO 14001 certification), up from 85% in 2004.**

## Water management

Proper water management is part of an effective EMS. It also plays a critical role in the viability of steel plants, especially in regions of water scarcity. Water issues and how they are managed at specific plants vary greatly due to local aspects such as water availability, water quality, plant configuration and legislation.

The steel industry uses saltwater, brackish water and freshwater. Water is used mainly for once-through cooling – over 81% in relation to total intake.[22] In general, sea water is the preferred option for this process due to availability and costs and it is returned directly to the source with no tampering in quality at all. In much smaller volumes, water is found throughout the steelmaking process for cooling or heat transfer of heat processing equipment. Water is also required for descaling, dust scrubbers and other processes.

A recent worldsteel member survey showed that average consumption and discharge for integrated steel plants are 28.6 $m^3$/tonne steel and 25.3 $m^3$/tonne of steel, respectively. For the EAF route the average is 28.1 $m^3$/tonne steel for consumption and 26.5 $m^3$/tonne of steel. Water consumption and discharge are close to each other and few losses occur in the process, indicating an overall efficient use of water. In most cases water loss is caused by evaporation.[22]

Using advanced technologies, steel plants in areas of water scarcity are able to recycle and reuse around 98% of their water.

## Air quality

A key aspect of steel industry environmental protection is to minimise emissions to the air. Emission sources are mapped and monitored. Process improvements can then be identified and implemented with the goal of reducing emissions.

Control mechanisms to reduce emissions can include[23]:

- baghouse/filtration systems
- chemical treatment
- thermal oxidisation
- scrubber systems
- dust suppression.

worldsteel leads working groups covering various aspects of air quality to facilitate improvements and the spread of best practice throughout the industry.

### Case study
### Responsible Steel

In Australia, the Steel Stewardship Forum is developing a credible and independently verifiable steel certification scheme, called Responsible Steel. Its aim is to minimise impact and improve performance throughout the steel value chain, from mining to scrap recovery.

In a transparent and accountable manner, Responsible Steel would:

- ensure responsible ethical, social and environmental practices throughout the value chain
- enable industry to demonstrate openness, responsibility and improvements
- reinforce and promote consumer and stakeholder confidence in products containing steel
- set operational excellence goals, driving better performance within industry
- enable selection of suppliers and materials throughout the supply chain based on their sustainable performance in addition to technical performance
- reduce reputational risks.

Responsible Steel is expected to be up and running by 2017.

Steel Stewardship Forum
Responsiblesteel

# Responsible resource management

## Raw material and energy efficiency

The steel industry is highly efficient in its use of raw materials with the technology available today. Key contributing factors to efficiency include high material efficiency rates, co-product use and recycling and steel recycling (see previous chapter).

Key raw materials needed in steelmaking include iron ore, coal, limestone and recycled steel. Inputs for the two main steel production routes (see p. 12) are described below.

The integrated (BF-BOF) route typically uses 1,400 kg of iron ore, 800 kg of coal, 300 kg of limestone, and 120 kg of recycled steel to produce 1,000 kg of crude steel.

The electric arc furnace (EAF) route typically uses 880 kg of recycled steel, 16 kg of coal and 64 kg of limestone to produce 1,000 kg of crude steel.

Detailed inputs and outputs are included in worldsteel LCI data for steel products (see p. 16).

worldsteel members report that 98% of the raw materials used to make crude steel are converted to products and by-products, meaning that very little waste goes to landfill.[24] The industry's goal is zero waste.

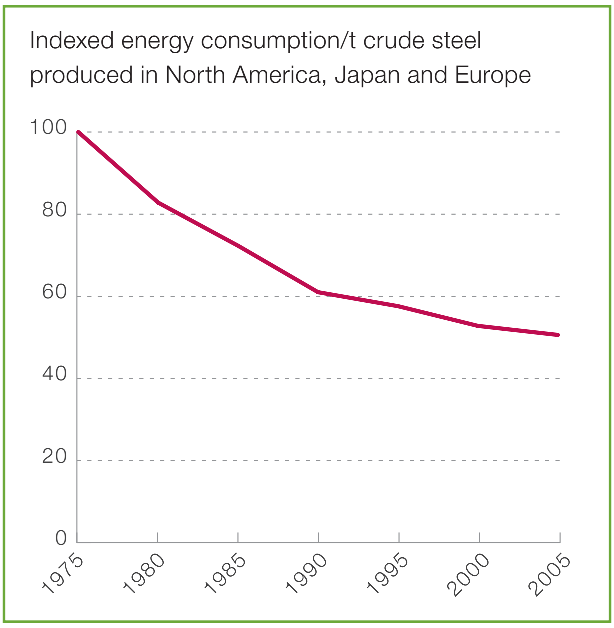
The efficient use of energy has always been one of the steel industry's key priorities. Cost is a key incentive for this, considering that energy purchases account for 20-40% in basic steel production.[25, 26]

One worldsteel study estimates that steel companies have cut their energy consumption per tonne of steel produced by 50% over the past 35 years (see Figure 8).

While existing production technologies are already very efficient, every steel company is at a different point of maturity and development. There are still potential improvements to be made through:

- Technology transfer – continued sharing and implementation of best practice.[25]
- Optimisation of operations and controls – including less electricity to power motor drive systems (MDSs). MDSs are needed in pumps, fans, forming and machining, handling equipment and compressors – and estimated to use 19% of primary energy in making steel products – including downstream manufacturing.[5]

Figure 8: Energy use in steelmaking[47]



## Co-product use and recycling

Recovered co-products (a term used interchangeably with by-products), can be recycled during the steelmaking process or sold for use by other industries. Use of co-products supports the sustainability of the steel industry. It prevents landfill waste, reduces $CO_2$ emissions and helps preserve natural resources. The sale of co-products is also economically sustainable. It generates revenues for steel producers and forms the base of a lucrative worldwide industry.

Some companies report a co-products utilisation and recycling rate as high as 99%.[27]

The main co-products from iron and crude steel production are slags, process gases, dusts and sludges[28]. More than 400 million tonnes of iron and steel slags are produced each year. Slags are a mixture of silica, calcium oxide, magnesium oxide, and aluminium and iron oxides. During smelting, slagging agents and fluxes (mainly limestone or dolomite and silica sand) are added to the blast furnace or steelmaking furnace to remove impurities from the iron ore, steel scrap and other ferrous feeds. As the slags are lighter than the liquid metal, they float and can be easily removed.

There are three main types of marketed ironmaking or BF slags, categorised by how they are cooled: air-cooled, granulated, and pelletised (or expanded).

Air-cooled slag is hard and dense and is especially suitable for use as construction aggregate. It is also used in ready-mix concrete, road bases and surfaces, roofing and mineral wool (for use as insulation).[29]

Granulated slag forms sand-sized particles of glass and is primarily used to make cementitious material.

Slag can also help bring down the cost of cement. For example, in the US it sells for 20-25% less than Portland cement.[29]

Slags are recognised as marketable products. The worldwide average recovery rate for slag varies from over 80% for steelmaking slag to nearly 100% for ironmaking slag. There is still much potential to increase the recovery and use of slags in many countries, especially for environmental and economic benefits.

One of the main barriers to using some steelmaking slags is their high content of free lime, which is not ideal for construction applications. Various technologies are under development to improve lime separation. Once separated, free lime can be used as fertiliser, in cement and concrete production, for waste water treatment, and in coastal marine blocks that encourage coral growth.

Gases from ironmaking and steelmaking, once cleaned, are used internally, reducing the demand for externally-produced electricity. Coke oven gas contains about 55% hydrogen and may prove an important hydrogen source in the future.[25] It can be fully used within the steelmaking plant, and can provide up to 40% of the plant's power.[30]

The dust and sludge removed from the gases consist primarily of iron and can be used again in steelmaking. Iron oxides that cannot be recycled internally can be sold to other industries for various applications, from Portland cement to electric motor cores.

The EAF route may create zinc oxides that can be collected and sold as a raw material. In the BF-BOF route, cleaning the coke oven gas creates valuable raw materials for other industries including ammonium sulphate (fertiliser), BTX (benzene, toluene and xylene – used to make plastic products), and tar and napthalene (used to make pencil pitch which in turn is used to produce electrodes for the aluminium industry, plastics and paints).[30]

# Investment in low-carbon steelmaking breakthrough technologies

## $CO_2$ emissions in the steel industry

According to the Intergovernmental Panel on Climate Change (IPCC), to keep the worldwide temperature increase below 2.4°C, global $CO_2$ emissions have to be significantly reduced by 2050.[31]

The greenhouse gas of most relevance to the world steel industry is carbon dioxide ($CO_2$), as it makes up approximately 93% of all steel industry greenhouse gas emissions.[32] $CO_2$ emissions vary by production route. On average, 1.8 tonnes of carbon dioxide are emitted for every tonne of steel produced.[33] The iron and steel industry accounts for approximately 6.7% of total global $CO_2$ emissions.[34]

Steel use is projected to increase by 1.5 times by 2050 from present levels (see p. 11), hence, $CO_2$ emissions could increase by the same amount. However, recognising that climate change is a key priority, the industry is determined to take action to significantly reduce its emissions.

$CO_2$ generated by the steel industry results mostly from the chemical interaction between coal and coke (carbon) and iron ore in a blast furnace. This process is called ore reduction and produces hot metal which is then converted to steel. There is no large-scale commercially available substitute for carbon in steelmaking.

Technological advancements over the past 25 years have enabled substantial reductions in $CO_2$ emissions from steel production. These advancements include:

- energy efficiency in the steelmaking process
- improved steel recycling rates
- increased recycling and utilisation of co-products from steelmaking
- extensive process automation for precise control of steelmaking processes.

Modern steel production processes are now very close to their theoretical minimum $CO_2$ intensity per tonne of steel output. While further medium-term improvements will be made through technology transfer and spread of best practice, to make a significant difference in $CO_2$ intensity in the long term, new low-carbon breakthrough steelmaking technology is required (see next page).

## Climate Action programme

In line with its priority to reduce $CO_2$ emissions and to set a baseline to benchmark improvements, the industry established a $CO_2$ data collection programme in 2008. It is open to all steel-producing companies in the world.

The measurement framework covers all key points that influence $CO_2$ emissions and energy use.[35] worldsteel analyses the data and prepares a report for the participating companies. The report enables a company to see how each of its plants compares to others worldwide.

The database now holds $CO_2$ and energy intensity data for 30% of global steel production capacity.

The Climate Action programme, which was started in 2009, recognises participating steel producers.

## Low-carbon steelmaking breakthrough technologies

In 2003, worldsteel launched a $CO_2$ breakthrough coordination programme to exchange information about carbon-lean steel production technologies.

Research and investment is taking place in:

- the EU (ultra-low $CO_2$ steelmaking, or ULCOS, supported by 10 EU companies and miners)
- Japan (Course 50, Japanese Iron and Steel Federation)
- the US (the American Iron and Steel Institute)
- Canada (the Canadian Steel Producers Association)
- South America (ArcelorMittal Brazil)
- South Korea (POSCO)
- China (Baosteel) and Taiwan, China (China Steel)
- Australia (BlueScope Steel/One Steel and CSIRO coordination).

Investment levels in the various programmes vary, with the highest to date being in the EU's ULCOS I (US$95 million) and ULCOS II (more than US$630 million) programmes. Japan's Course 50 programme is fully government funded and cost US$126 million for step 1 (2008-2012) and US$189 million for step 2 (2013-2017). In total, about US$1 billion has been invested in these R&D projects to date.

**The programmes have identified the most promising steelmaking technologies that potentially reduce $CO_2$ emissions by more than 50%. Research is now focused on feasibility at various levels of production, from laboratory work to pilot plant development, demonstrators and eventually commercial implementation.**

A significant amount of $CO_2$ will still be produced if carbon is used as the reducing agent for iron ore. One technique for dealing with the gas is to capture it and store it. Carbon capture and storage (CCS) requires technical solutions for cleaning the gas and transporting it through pipes into storage sites. Storage options include saline aquifers and, marginally, exhausted gas fields. Coal-based ironmaking technologies associated with CCS are the most likely candidates for development.

## Technologies of the future

### ULCOS-BF process – top gas recycling in combination with CCS

Blast furnace top gas recycling relies on separation of the top gas so that the useful components can be recycled into the furnace as a reducing agent. The $CO_2$ is captured and stored. This is the most promising process concept in the middle term, with a demonstrator planned to come on stream with full CCS in a few years' time.

### ULCOWIN: Alkaline electrolysis of iron ore

Electrolysis is commonly used to produce metals other than steel and requires large amounts of electricity. The process would depend on a $CO_2$-lean electricity source such as hydro or nuclear power.

### ULCOLYSIS and MOE: Molten oxide electrolysis

Molten oxide electrolysis works by passing an electric current through molten slag fed with iron oxide. The iron oxide breaks down into liquid iron and oxygen gas. No carbon dioxide is produced. Process emissions are further reduced with a $CO_2$-lean electricity source.

### ULCOS Smelting reduction (HIsarna) in combination with CCS

HIsarna, combines a melting cyclone for ore melting and a liquid-bath smelter vessel for final ore reduction and hot metal production. It produces fairly pure $CO_2$, which can be captured allowing for major $CO_2$ reductions. Construction of the HIsarna pilot plant was completed in 2011 and hot commissioning began the same year at IJmuiden in the Netherlands at an 8 tonne/hour scale.

### Hydrogen flash smelting

Iron is reduced from iron ore at high temperatures (above 1,300°C) and with very short reaction times. No $CO_2$ is emitted but producing hydrogen requires large amounts of $CO_2$-lean electricity. This process can also be operated on low $CO_2$ fuels like natural gas.

# Prioritising safety, investing in our people

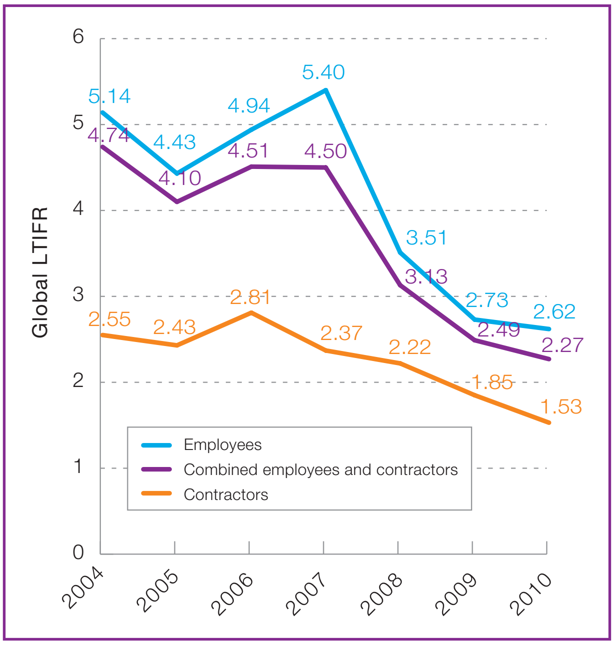
## Employee safety and health

A safe and healthy working environment for all employees is the number one priority for every worldsteel member. worldsteel's policy is to help all our members achieve an accident-free workplace.

This is supported through:

- use of industry safety and health principles
- sharing experience and good practice – through seminars, workshops and development of an alert network to share serious incidents
- annual reporting on safety performance – up to 87 member organisations in 2010 from 46 in 2005
- safety and health excellence recognition programme – showcasing member initiatives and projects.

Figure 9: Lost time injury frequency rate[36]




There is no area, process or type of work that cannot be accident-free. worldsteel member companies are committed to eliminating accidents and injuries from the industry and significant improvements have been achieved over recent years, as shown in Figure 9.

Some businesses have gone without any lost time injuries or fatalities for many years. These companies know that such performance requires excellence in all aspects of their operations. This excellence also produces superior business performance. The most successful steel companies are also the safest.

## worldsteel safety and health principles

worldsteel published guidelines to help companies implement six principles for improved safety performance. Adopting these principles at the highest level, member companies demonstrate their commitment to an injury-free and healthy workplace.

The six fundamental principles are:

- All injuries and work-related illnesses can and must be prevented.
- Management is responsible and accountable for safety and health performance.
- Employee engagement and training is essential.
- Working safely is a condition of employment.
- Excellence in safety and health supports excellent business results.
- Safety and health must be integrated into all business management processes.

## Sharing experience and good practice

In 1999, worldsteel developed Accident-Free Steel, a programme that brought together safety specialists and line managers from worldsteel member companies. This initiative continues today. Senior safety and health managers regularly meet to discuss ways to improve safety and health performance.

# INDUSTRY FOCUS: SAFETY, TRAINING AND COMMUNITY

## Employee development and training

An interesting outcome of worldsteel's project on yield improvement was that good yields are obtained with good people, much more than with good equipment. This emphasises the importance of employee development, training, communication and knowledge management.

To succeed in a technologically-driven environment, the steel industry must continue to offer opportunities to develop the knowledge and skills of its people. New methods of training, such as self-directed learning and online courses, show that the industry considers training a priority.

Some companies have set up close associations with academic institutions to provide specialised training to employees. Others run their own centres. For example, TenarisUniversity and ArcelorMittal University are corporate universities that offer training to thousands of their employees, customers and suppliers.

## Promoting industry knowledge

Steel companies around the world face a shortage of talent in metallurgy, materials science, physics, chemistry, engineering and mathematics.

Recognising this trend, the industry has introduced many initiatives to attract, develop and retain talented people as well as improve the industry's image. One such initiative is steeluniversity.org.

steeluniversity.org is a free online initiative developed by worldsteel. With financial and technical support from worldsteel member companies, it provides interactive e-learning resources on steel technologies. The resources are intended for use by undergraduate students, their teachers, lecturers and professors and also by employees and their trainers in steel companies. Students from over 400 universities worldwide train their skills using steeluniversity.org and many universities have included the simulations into their course work. More than 100 steel companies use steeluniversity.org and 50 of them have made it part of their training programmes.

### The steeluniversity Challenge

Every year worldsteel runs a virtual steelmaking challenge. Participants compete against other teams and individuals in a 24-hour worldwide competition. The steeluniversity Challenge is a unique competition for metallurgists from universities and steelmakers from around the world.

In 2012, a team from Shougang Qiangang in China won in the category for young steel industry employees. A team from Universidade Federal do Ceara in Brazil won in the student category.

# Building mutual respect between our industry and our communities

## Contributing to communities worldwide

Steel companies around the world seek to foster mutual respect between themselves and their local communities. They bring value to the local economy by providing jobs and taxes, but also through numerous social initiatives. These vary from one region to another, and depend on the local culture. They include:

- investing in community education, culture and the arts
- company sponsorship and employee participation in volunteer programmes
- providing housing and healthcare services
- engaging in dialogue to better understand and respond to community concerns and priorities.

### Case study
### Part of local communities

Every ArcelorMittal operation across the world is part of its local community. ArcelorMittal engages with communities to contribute to their social and economic development.

ArcelorMittal contributes to economic development by providing jobs, building local infrastructure and creating opportunities for local businesses to supply their operations. For example, in Liberia, the company's mining project is one of the biggest foreign investments since the civil war.

ArcelorMittal's contribution is not limited to economic development. The company also works with regional communities on local health and education projects. In Liberia, the ArcelorMittal Foundation has renovated two hospitals. These facilities are open to employees, their families and the wider community.

In 2011, around 12,000 people received care in these hospitals.

## Case study
### Developing talent and empowering rural women

A secure source of income through employment helps improve rural women's social and economic status, standards of living, self-confidence and courage to face their many challenges.

The IT industry in India has taken the lead in providing value added services to its customers. Business process outsourcing (BPO) has rapidly evolved. However, these opportunities it provides have largely been for youth in the cities and not available to rural areas, due to infrastructural limitations.

JSW Steel recognised the potential of the BPO sector for various applications and the vast opportunities that it can provide for empowering women in the villages surrounding its operations.

A training centre was set up to train rural women who had completed their higher secondary education. The women were also provided with transport and a stipend for six months. J-Soft, a software subsidiary of JSW Steel set up the necessary communication facilities for the BPO business in Vidyanagar, next to the steel plant. J-Soft identifies projects and supervises the BPO operations.

As a result, more than 1,000 women have been trained. Currently, 150 women are involved as business associates. With their experience, many have subsequently found jobs in JSW steel and other companies in the area. Also, providing skills-based employment opportunities reduces migration to other areas. This helps to provide skilled human resources to the new industries coming up in the Vijayanagar industrial complex.

# Buildings and infrastructure

Society's need for housing is great and growing. According to the UN, 1.6 billion people live in inadequate housing around the world today and an estimated 100 million are homeless: 20 to 40 million in urban areas and about 60 million in rural areas.[37]

The global population is set to grow by another 2 billion people by 2050, accompanied by rapid urbanisation. Especially in BRIC countries, the need for non-residential buildings (schools, offices, shops and manufacturing facilities) and related infrastructure will also continue to grow.

As the need for buildings and infrastructure continues to grow worldwide, reducing structures' consumption of natural resources, and associated emissions, is crucial for future sustainability. While buildings currently account for about 20% of global greenhouse gas emissions, they also present many opportunities for reducing emissions and mitigating climate change.[38, 39]

## Steel enables construction and provides sustainable building solutions

Steel enables construction by providing equipment such as cranes, drills and bulldozers, scaffolding, reusable and portable shelters at construction sites.

Steel is also an ideal material to help meet society's growing needs for buildings and infrastructure in a sustainable way. Not only is it affordable and readily available, its intrinsic properties, such as its strength, versatility, durability and 100% recyclability allow for improved environmental performance across the entire life cycle of buildings.

Steelmakers around the world are increasingly offering intelligent steel construction solutions that enable energy-efficient and low-carbon-neutral buildings. These solutions are highly material efficient and recyclable. They reduce the environmental impacts over the structures' life cycle and help to extend their life span through design for disassembly and reuse.

These steel solutions not only improve the environmental performance of buildings, they also provide other benefits such as affordability and faster, safer and less noisy construction.

From construction to use, reuse and eventual decommissioning at end-of-life – benefits associated with steel building solutions are described by life cycle phase below.

## Construction

### Freedom of design, dematerialisation and material efficiency

Its stiffness allows steel to span greater distances and provides more design freedom than other materials. Steel's superior strength-to-weight ratio makes it possible for the structure to bear high loads using less material. Therefore, less material is needed to make a quality structure, and smaller foundations are required. Steel is also lightweight compared to many other building materials used for the same purpose, which can result in dematerialisation. For example, 1 kg of steel is sufficient to clad almost nine times the area of 1 kg of roof tiles.[40] This also means that more flat steel can be transported in each load than many other materials used for the same purpose. Less material use and less transportation can also lower overall building costs.

As steel building components can be cut to precise specifications or prefabricated off-site, on-site waste is minimised. Any waste can be directly recycled in the steelmaking process.

## How steel is used in buildings and infrastructure

More than half of the steel produced worldwide goes into steel buildings and infrastructure. The possibilities for using steel in buildings and infrastructure are limitless. The most common applications are listed below.[42]

For buildings

- Structural sections: these provide a strong, stiff frame for the building and make up 25% of the steel use in buildings.
- Reinforcing bars: these add tensile strength and stiffness to concrete and make up 44% of steel use in buildings. Steel is used because it binds well to concrete, has a similar thermal expansion coefficient and is strong and relatively cost-effective. Reinforced concrete is also used to provide deep foundations and basements and is currently the world's primary building material.
- Sheet products: 31% is in sheet products such as roofing, purlins, internal walls, ceilings, cladding, and insulating panels for exterior walls.
- Non-structural steel: steel is also found in many non-structural applications in buildings, such as heating and cooling equipment and interior ducting. Internal fixtures and fittings such as rails, shelving and stairs are also made of steel.

For infrastructure

- Transport networks: steel is required for bridges, tunnels, rail track and in constructing buildings such as fueling stations, train stations, ports and airports. About 60% of steel use in this application is as rebar and the rest is sections, plates and rail track.
- Utilities (fuel, water, power): over 50% of the steel used for this application is in underground pipelines to distribute water to and from housing, and to distribute gas. The rest is mainly rebar for power stations and pumping houses.

### Safer, faster and affordable construction

Industry surveys consistently demonstrate that steel is the safest construction material.[41] Components are prefabricated offsite in a safe, controlled factory environment. From here they are delivered to site and erected by a small number of skilled personnel. There is minimal requirement for on-site cutting or adjustment, and no need for the time-consuming and potentially hazardous shuttering and handling operations associated with other construction materials.

Steel construction speeds up the development process and reduces overall construction costs. Shorter construction periods also reduce disruption and result in less disturbance to the local community around the site. Steel is relatively clean and quiet to erect, and requires few site deliveries.

## Use, maintenance and reuse

### Resource efficient, passive buildings and low-carbon or carbon-neutral technologies

In the use phase of a building, steel products can help improve energy efficiency and thermal comfort, and reduce energy and water demand. Steel products also offer solutions and technologies that make passive, low-carbon and carbon-neutral structures possible.

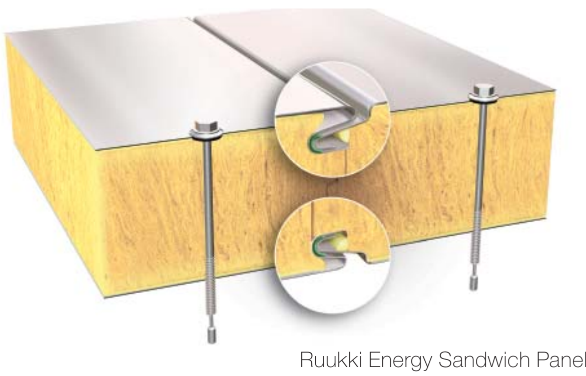
Large internal volumes made possible with steel structures allow for 'one-room-thick' designs. These are buildings that have windows and/or doors on both sides of the room, which allows for good cross-ventilation and can help maintain thermal comfort and indoor air quality with less need for mechanical air-conditioning. If oriented correctly, such buildings can also be effective designs for maximising passive solar heating: large areas of glass allow the sun to warm the building during colder months. Good light penetration also reduces the need for artificial lighting, which further reduces energy consumption. However, windows must be shaded from the sun during summer months to avoid increasing the need for air-conditioning.[40]

In warmer climates, light coloured steel roofs and walls can be used to reflect energy away from buildings, thereby reducing energy demand for internal cooling. In cool climates, where there is minimal need for summertime cooling, dark roofs and walls can be used to absorb solar energy, thereby reducing annual energy demand for heating.[40]

Steel insulating exterior wall panels (such as Ruukki's, pictured below) can also improve use-phase energy efficiency of buildings.[43] Because the panels provide excellent air-tightness, they help to minimise energy use and related costs during the use phase of the building and thereby contribute to savings of up to 30% in maintenance costs. These wall panels are fully reusable and recyclable.

Steel products require minimal maintenance, which results in less resource use compared to alternative materials that require more frequent replacement.

Rainwater can be harvested from roofs and stored in tanks, which helps to reduce the consumption of mains supply water for irrigation, toilet flushing and so on. This also helps control stormwater flow rates. There are steel water tanks, coated with food-grade polymer, that are designed for rainwater harvesting.[40]



Ruukki Energy Sandwich Panel

### Safer, more durable buildings

Steel offers the highest strength-to-weight ratio of any building material. Because of its strength and durability, steel structures can be designed to withstand natural disasters. Steel is also impervious to attacks from termites or fungi, does not rot or split and is highly fire resistant.

With appropriate surface treatment when necessary, it can be weatherproof, corrosion resistant and immune to the harmful effects of UV rays, ensuring a very long service life without degradation.[44]

### Long product life cycles and adaptability for reuse of buildings

Steel's strength and durability allow for long product life cycles. For example, buildings made with steel last 40 to 100 years, or longer with proper maintenance.

Steel-framed buildings are easily adaptable if the configuration of the building needs to change. The ability of steel to bridge long spans means that steel buildings contain large open-plan spaces which are easily reconfigured with partition walls. The steel frame itself can be adapted, with parts added or taken away, and its light weight means that extra floors can often be added without overloading existing foundations.[41]

**Steel also facilitates the conversion of obsolete buildings, such as warehouses or train stations into modern living or working spaces, extending their useful life, saving resources and costs. $CO_2$ emissions savings from building reuse are estimated at 1 to 1.5 kg $CO_2$/kg steel.[5]**

Steel-framed structures can be taken apart and rebuilt without noisy and dusty demolition. This is better for the environment and for the local community.

## End-of-life

### Component reuse and 100% recyclability

Steel products have long lifespans and can be used to create adaptable spaces or to add volume to extend the life of existing buildings. Eventually, however, most buildings will be decommissioned. Reusing or recycling building components is key to the sustainability of a structure's end-of-life, as it is the most economical and ecological solution.

Steel roofing, cladding, purlins, walling and structural beams are increasingly designed for disassembly and reuse (see case studies). Although reinforcing steel is currently recycled rather than reused, there is potential for reuse by assembling buildings from modular reinforced concrete elements, such as standard floor slabs.[5]

Steel is also 100% recyclable, without loss of quality. Therefore, if recovered at the end of each use phase, the life cycle of steel is endless. It can also be easily recovered with magnets.

At 85%, global recovery rates for steel construction applications are relatively high (see p. 14). However, there is potential for improvement. For example, current recovery rates from demolition sites in the UK are 99% for structural steelwork and 94% for all steel construction products – figures that far exceed those for any other construction material.[41] With continued and improved design for disassembly, reuse and recovery rates will continue to increase.

### Did you know?

New **high-strength lightweight steel** is dramatically changing the market. In 1937, **83,000 tonnes of steel** was used to build the **Golden Gate Bridge** in San Francisco. Today, only **half** of that would be needed.[45]

## Case studies

### Energy-efficient designs for disassembly, reuse and recycling

BlueScope Steel makes products that can be used in designs for disassembly and reuse. These are components of a building, or entire buildings, that are designed with the intention of reuse rather than demolition. For example, the MacArthur Centre for Sustainable Living in Australia was designed for disassembly using reusable and renewable materials.[46]

The design incorporates whole sheets of steel for the roofing and much of the walling to maximise opportunities for those sheets to be used again in future. When the steel is no longer needed, it can be recycled.

### Dematerialisation

BlueScope Steel has successfully developed high-strength steel products, so that the same function is achieved using fewer raw materials. This is known as dematerialisation. For example, roofing that was once manufactured at 0.55 mm thick, is today made from high-strength Colorbond steel 0.42 mm think – a reduction of 24%.

Steel framing is another example of design innovation that maintains functionality with less material use. Some house framing that used to be 1.20 mm thick is only 0.6 mm thick today – a saving of 50%.

# Transport

Mobility is essential to our modern way of life. The efficient transport of goods has become key to our ever more globalised economy. Freight has almost doubled over the past 30 years.[39]

Energy use in the transport sector almost doubled between 1970 and 2000 and is still growing strongly at just under 2% a year. The sector accounts for 20% of total global primary energy use and contributes 13% of greenhouse gas emissions.[39] There are, however, many opportunities for improvement. These include a shift of transport modes, more intense use of current transport modes, improved efficiency, and change of drive trains.

## Steel provides strong, safe and sustainable transport solutions

Steel facilitates our mobility and the transport of goods. Whether in the form of bicycles, motorcycles, cars, buses, trains, ships or planes – or in the transport networks that support them – steel is essential to every mode of transport.

Steel is well-suited to transport applications because it is durable, strong (providing safety in the case of collision), lightweight, UV-resistant, affordable, and 100% recyclable. Innovations in design and the development of new high-strength steels have also played a key role in improving the efficiency of many of these transport modes, especially automobiles – with the potential to reduce their life cycle greenhouse gas emissions by nearly 70% (see case study).

Steel provides a vital security margin in case of collision because of its remarkable ability to deform and harden simultaneously. At higher impact velocities, the strength of steel increases without the risk of breakage often associated with other materials.

Steel's strength and durability enables long product life spans and the reuse or remanufacture of components such as rail track, engines, automotive parts, shipping containers and rail cars (see p. 14).

And because steel is 100% recyclable without loss of quality, and easily separated from other materials with magnets, the steel used in transport modes and infrastructure networks can be easily recovered and recycled at end-of-life. For example, vehicles have a recovery rate of about 85% globally (see p. 14), and nearly 100% of the steel in the vehicle can be recycled due to ease of magnetic separation.

FutureSteelVehicle

## Case study
### FutureSteelVehicle

FutureSteelVehicle (FSV) is a programme of WorldAutoSteel, the automotive group of the World Steel Association. It is part of a body of research that represents nearly US$80 million in steel industry investment.

The FSV:

1. Achieves 35% body structure mass savings compared to an average vehicle.

2. Uses 97% high-strength (HSS) and Advanced High-Strength Steel (AHSS). The FSV programme brings more advanced steel and steel technologies to its portfolio, including more than 20 new AHSS grades, representing materials expected to be commercially available by 2020.

3. Reduces total life cycle greenhouse gas emissions by nearly 70%. Evaluating vehicle performance during the use phase only does not properly assess vehicle emissions impact. The total life cycle must be taken into account. AHSS is the only material to achieve reductions in all life cycle phases. AHSS combined with an electrified powertrain reduces total life cycle greenhouse gas emissions by 56% to 70% compared to an average vehicle.

4. FSV enables five-star safety ratings.

5. Dramatic mass and emissions reductions are achieved at no cost penalty over current steel body structures. The FSV with a battery electric powertrain can be manufactured and assembled for an estimated US$1,115.

## How steel is used in transport

Nearly 17% of steel produced worldwide is used to meet society's transport needs. It is also essential to the related infrastructure: roads, bridges, ports, stations and airports. Some major applications today include:[42]

- For cars and light trucks
  An average car contains 960 kg of steel and iron. 34% is in the body structure, panels, doors and trunk closures for high-strength and energy absorption in case of a crash. 23% is in the drive train, consisting of cast iron for the engine block and machinable carbon steel for the wear resistant gears. 12% is in the suspension, using rolled high-strength steel strip. The remainder is found in the wheels, tyres, fuel tank, steering and breaking systems.

- For ships and shipping containers
  Steel for the ship hull is rolled mild steel. These are strong and dimensionally consistent plates that are welded together. Shipping containers are also made of steel.

- For trains and rail cars
  Steel makes up 20-25% by mass of high speed trains.[48] The main steel components of these trains are bogies (structure underneath the trains including wheels, axels, bearings and motors). Freight or goods wagons are made almost entirely of steel.

- For aeroplanes
  Steel is required for the landing gear.

- For infrastructure
  Transport networks: steel is used in bridges, tunnels, rail track, and in constructing buildings such as fueling stations, train stations, ports and airports. About 60% of steel use in infrastructure is rebar. The rest is sections and rail track.

# Energy

Energy is essential for development. About 1.6 billion people have no access to electricity and about 2.4 billion rely on traditional fuels (wood, agricultural waste, cow dung) for cooking and heating.[39]

Giving everyone access will require strong growth in energy supply. Improving the well-being of people in developing countries, the expected economic growth in industrialised countries, and projected population growth, will likely lead to a 50% increase in world energy demand by 2030.[49]

## Steel is essential to energy production and distribution

Steel is critical for supplying the world with energy. Whether based on fossil fuels, nuclear technology or renewables, steel is indispensable in producing and distributing this energy. Steel also has an important role to play in improving the efficiency of these energy sources and many steel applications – such as cars (see p. 30) and buildings (see p. 26).

## Innovative steel solutions contribute to improved efficiency

Below are a few examples of how steel is being used to improve the efficiency of energy production.

Transformers: Transformers step down the voltage from power stations to household voltage. The magnetic core of transformers is made of steel. As a result of continual development and increased application of new electrical steel grades, the energy loss in modern transformers can be reduced by 35% compared to conventional ones.[50]

Wind towers: Steel provides the strength for taller, more efficient wind turbines.[51]

Fossil fuel power plants:[50]

- High temperature-resistant steels have made efficiency in steam power plants possible and have the potential to be developed and employed even further.
- Combined heat and power (CHP) allows waste heat in power plants to be used for power generation as heat energy, increasing the overall efficiency of fossil fuel power plants. The waste heat is transported exclusively in steel pipes.

### Case study
### A fully-integrated solar panel façade

Ruukki has developed a photovoltaic system that is fully integrated into a building's façade. The solar power system does not depend on the sun's warmth, only its radiation. The power generated is used to meet the building's own needs and can be fed into the electricity grid.

In the façade of an average-sized office building in Finland, Ruukki's solar panel façade can produce 18,000 kWh of electricity a year. This is enough to meet the annual needs of a medium-sized, electrically heated family home. Output and capacity can easily be increased.

The system is based on modular solar power or PV panels, which have been made from glazed PV modules, and Ruukki's steel rainscreen panel system. The PV modules are based on copper indium gallium diselenide (CIGS) thin-film technology, a commonly used technology in solar cells. Installation is quick and easy.

## Steel's role in energy production and distribution

Steel is indispensable for energy production and distribution.

Nuclear and fossil fuel based energy:

- mining equipment
- offshore oil platforms
- equipment for oil and gas extraction and production
- natural gas and oil pipelines and storage tanks
- power plants.

For the production and distribution of electricity:

- transformers (magnetic steel core)
- generators and electric motors
- power distribution pylons and steel-reinforced cables.

For energy transport and distribution:

- ships, trucks and trains used to transport fuel
- transport networks: steel is required for bridges, tunnels, rail track, and in constructing buildings such as fueling stations, train stations, ports and airports.

Steel is also used in all areas of renewable energy.

- Biomass: steel is used extensively in agriculture (see p. 35).
- Solar: steel plays a key role in converting solar energy into electricity or hot water. It is used as a base for solar thermal-panels and in pumps, tanks and heat exchangers.[52]
- Wave and tidal: a steel pile is the main component of a tidal turbine in tidal energy systems. Steel is also used to fabricate wave energy devices. The steel used is formulated to withstand the challenges of the marine environment.
- Hydroelectric: steel is needed to reinforce concrete dams.
- Wind: steel is the main material used in onshore and off-shore wind turbines. Almost every component of a wind turbine is made of steel, from the foundation, to the tower, gears and casings (see p. 11).

## Did you know?

No generator, transformer or electric motor could be operated without **electrical steels** needed to transform electrical power into usable energy. Electrical steels are iron-silicon alloys tailored to produce **specific magnetic properties.**

**Wherever electrical energy is generated, electrical steels are needed.** This core material is used throughout the **entire energy value chain**: from power generation (generators), transmission and distribution (transformers) to the consumption (electric motors and appliances) of electrical energy in the electrical components industry.

# Food and water

Global demand for food, feed and fibre are expected to double by 2050 as the world's population grows to around 9 billion.[53] Population growth, coupled with further industrialisation and urbanisation, will result in increased demand for water.

Freshwater withdrawals have tripled over the last 50 years and the demand continues to increase by 64 billion cubic meters a year.[54] Current needs are also still going unmet, with more than one out of six people lacking access to safe drinking water, or 1.1 billion people.[55] There is great potential to improve supply through better management of our water resources.

## Steel is integral to food and water supply

Steel is needed for growing, storing and delivering our food. It is also needed in water collection, storage, purification and distribution.

Steel also provides solutions that help to improve water management and reduce losses. For example, in many cities more than 40% of the total water supply is lost during distribution. Tokyo has adopted corrugated stainless steel pipes for 90% of its extensive network of underground potable water pipes, eliminated leakages and lowering costs.[56]

## Steel cans – preserving food safely and sustainably

Almost 200 billion cans of food are produced each year. Compared to other food preservation methods, steel cans save energy because refrigeration and freezing is not needed. They are also tamper-resistant and protect food and drink from moisture, oxygen and light – helping to preserve the nutritional value of its contents without the need for additives.

Steel cans are 100% recyclable and have an average global recycling rate of 68%.[57] There is also potential to make steel cans reusable and lighter by altering designs and canning processes.[5]

### Did you know?

Globally, about **7.2 million tonnes of steel** packaging is recycled each year. This saves **11 million tonnes of $CO_2$ equivalents** which would have come from new steel production. This saving is equivalent to taking approximately **280,000 cars** off the road. **Each can recycled saves about twice its weight in $CO_2$.**[57]

## Steel's role in food and water supply

For food

- agriculture: farming tools and equipment, silos, equipment to feed and shelter livestock, pipes and irrigation systems, water tanks
- distribution: ships and shipping containers, rail, trucks, planes and related infrastructure such as bridges, tunnels, rail track, fueling stations, train stations, ports and airports
- preservation and storage: food cans, refrigerators
- preparation: appliances such as stoves, ovens and microwaves, and utensils.

For water

- collection: pumps, pipes, well-drilling equipment (see p. 27 – Utilities)
- storage and distribution: pumps, pipes, tanks, buckets (see p. 27 – Utilities)
- purification and recycling: equipment and tanks for waste water treatment plants and desalination plants (see case study).

## Case study
### Making freshwater more readily available

Outokumpu develops solutions for desalination with duplex stainless steel, making the process more affordable and freshwater more readily available.

Water infrastructure represents a large share of public spending, especially in areas where freshwater is in short supply. Desalination – turning seawater into consumable and drinkable water – is the preferred solution for supplying water for many arid regions. Stainless steel provides solutions for the desalination industry, ensuring long-lasting, maintenance-free equipment.

Owing to its high strength, duplex stainless steel allows for dematerialisation of desalination systems through reductions in plate thickness and, consequently, in weight. Reduced weight also reduces plant investment costs and results in raw material and energy savings related to production, transport, and welding. Duplex desalination technology is used worldwide.

# WHAT GOVERNMENTS AND POLICYMAKERS CAN DO TO HELP

## Improve the life cycle performance of steel and steel products

Cooperation with other stakeholders, especially government and legislators, is of key importance in enabling the steel industry to improve. Below is an outline of some ways in which governments and policymakers can facilitate improvements in steel's life cycle performance that will help our industry to fulfill its vision and sustainable development commitments,[58] and benefit society as a whole.

## Climate change

Governments that are signatories to the UN Framework Convention on Climate Change are negotiating commitments to GHG emissions after 2012.

worldsteel's key message to governments is that all steel-producing countries need to be involved in setting commitments and timetables for future actions.

The responsibility lies with governments to set a framework and policies for positive action on climate change that has an equal impact on steel and other industries. Equally, an approach that has similar impact in different countries and regions is vital. The right approach will avoid cost differences in different countries. Cost differences increase the serious problem of carbon leakage and will not reduce global GHG emissions.

Policies to add a tax or a price on carbon emissions, assist technology transfer, Clean Development Mechanism projects or other financial incentives should not distort fair competition in the industry.

Governments must support research and development of breakthrough technologies. The major expenditure required cannot come from industry alone. Government funding needs to be available in terms of primary research and in the more significant sums for pilot plants, to prove the technical and economic feasibility of new technologies. Already, major governmental support for breakthrough technologies on carbon reduction is in place in the EU and Japan.

## Incorporate life cycle thinking into legislation

It is critical that life cycle thinking is incorporated into legislation. For example, vehicle emissions regulations need to shift from a tailpipe emissions basis to a full life cycle basis. Life cycle assesssment (LCA) considers emissions from all aspects of a vehicle's life, from material production to end-of-life-recycling, as well as the actual use phase, and should play an important role in current regulations in discussion around the world.

When vehicle emissions assessment is focused solely on emissions produced during the driving phase (tailpipe), this encourages the use of lighter weight alternative materials that are often more energy intensive or greenhouse gas-intensive to produce. However, this may have the unintended consequence of increasing greenhouse gas emissions during the vehicle's total life cycle.

Legislation that focuses only on one part of a product's life cycle may have the unintended consequence of shifting environmental problems from one part of the product's life cycle to another.

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worldsteel represents approximately 170 steel producers (including 17 of the world's 20 largest steel companies), national and regional steel industry associations, and steel research institutes. worldsteel members represent around 85% of world steel production. worldsteel acts as the focal point for the steel industry, providing global leadership on all major strategic issues affecting the industry, particularly focusing on economic, environmental and social sustainability.

wordsteel members are committed to a vision where steel is valued as a major foundation of a sustainable world. This is achieved by a financially sound industry that takes leadership in environmental, social and economic sustainability.

In 2002, the global steel industry worked together to establish a policy on sustainable development. This built on a set of principles established in 1972 and a statement of principles issued in 1992. Our Sustainable Development Charter, based on this policy, was signed by 66 member companies in 2012.

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# Appendix 7


PROJECT IRON BOOMERANG
east west line parks limited

# Calibre Operations Pty Ltd

# East West Line Parks Limited

# Additional Simulations and Capacity Assessment – Supplementary Report

## CARP11069-REP-Z-005

MASTER COPY

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# CONTENTS

## 1.0 BACKGROUND

Calibre has previously developed a report to assist with demonstrating to stakeholders, including the QLD Government, the efficiency merits of the East West Line Parks Ltd (EWLP) solution for the Galilee Basin. EWLP has subsequently engaged Calibre to undertake a further analysis of an altered (Eastern) alignment, including above rail parameters such as fuel burn across 26.5 tonne axle load (tal), 32.5tal and 40tal, and the below rail characteristics of the proposed network at 240mtpa and 120mtpa.

Calibre has also been asked to undertake an assessment of an alternative standard gauge (SG) 32.5tal alignment and an alternative 26.5tal proposed alignment and connection to the QR National (QRN) network to compare with the EWLP corridor.

Calibre understands the information is required to inform an efficiency study and report (to be prepared by others) in order to demonstrate a superior logistics solution to stakeholders.

## 2.0 EXECUTIVE SUMMARY

This report builds on work previously completed in the EWLP Additional Simulations and Capacity Assessment CARP11069-REP-Z-002. During the initial study, Calibre settled on an efficiency measure that consolidates track distance, tonnages hauled, and fuel consumption into a single understandable measure to compare systems.

The EWLP alignment routes the haulage task along a further distance than either of the two alternative alignments, and in order to offset the additional distance penalty, uses 40tal limits rather than 26.5tal and 32.5tal. To demonstrate the fuel efficiency of the 40tal wagons, the EWLP alignment was simulated with 26.5tal, 32.5tal, and then 40tal wagons.

Initial simulations used a 30 Tonne Tare mass wagon for the 40tal trains, and the simulation runs reflected a higher fuel burn in the empty direction due to the heavier wagons. Calibre then ran additional simulations at 26 Tonne Tare following discussions with EWLP and Everything Infrastructure, and applied a shorter (270 wagon) reference train to more closely match locomotive power to trailing load over the alignment.

The resulting fuel burns compare quite favourably with all the simulation runs at 32.5tal, 26.5tal, and 30t tare 40tal wagons. When coupled with aerodynamic wagon covers, and a shorter reference train (270 wagons) which requires fewer locomotives, the EWLP solution burns 25,440,000 less litres of fuel over a 12 month period at 240mtpa than for the equivalent tonnages over the alternative SG 32.5tal corridor.

The results suggest pursuit of a light tare 40tal coal wagon is a goal worth striving for, with a number of alternative concepts beyond conventional design possible. A shorter, squatter wagon with a suitably low centre of gravity may produce significant efficiencies and set new benchmarks for rail innovation.

The results confirmed that a 270 wagon reference train using 3 locomotives is a more efficient solution than the 300 wagons train using 4 locomotives. The shorter trains need a total of 14 fewer locomotives in the fleet, and 90 fewer wagons. An advantage that 270 wagon train offers, is it is easily divisible by 3 – the optimum wagon set. 3-wagon sets need only 1 ECP control unit to control the brakes on the 3 wagons. Maintenance rake sizes drive the maintenance facility workflow, and are easily established by factors of 3 – 30, 45, 60, 75, or 90.

Results for a lighter tare 40tal wagon are favourable when compared to the 32.5tal due to the payload and empty journey mass advantages.

The fitting of wagon covers is estimated to offer 9% fuel efficiency over a non-covered wagon. The benefits of covers extend to significant reductions in fugitive coal dust emissions. Coal dust contaminated ballast and substructures, weakening track support and can lead to higher maintenance costs, track degrading and derailments.

Table 1 shows the full comparison of fuel usage across the EWLP Eastern Alignment utilising various axle loads and incorporating the use of covered wagons and the proposed reference trains of the alternative alignments.

**Table 1: Fuel Usage Comparison**

| | Train Type | Total Fuel Litres | Litre per Tonne | Fuel consumption per '000 GTK |
|---|---|---|---|---|
| **EWLP Eastern Alignment** | Uncovered Train 270 (26t Tare) | 41,229 | 1.17 | 1.43 |
| | Covered Train 270 (26t Tare) | 37,518 | 1.06 | 1.30 |
| | Uncovered Train 300 (26t Tare) | 49,470 | 1.26 | 1.54 |
| | Covered Train 300 (26t Tare) | 45,018 | 1.15 | 1.40 |
| | Uncovered Train 300 (30t Tare) | 50,868 | 1.34 | 1.55 |
| | Covered Train 300 (30t Tare) | 46,290 | 1.22 | 1.41 |
| | Uncovered 300 Wagons 26.5tal | 35,927 | 1.42 | 1.59 |
| | Uncovered 300 Wagons 32.5tal | 39,359 | 1.23 | 1.49 |
| **Alternative Standard Gauge 32.5 TAL** | Uncovered Train 240 Wagons 32.5tal | 29,787 | 1.16 | 1.61 |
| **Alternative Narrow Gauge 26.5 TAL** | Uncovered Train 120 wagons 26.5tal | 16,805 | 1.66 | 2.49 |

## 3.0 PROJECT SCOPE

The scope of this project encompasses a multi-faceted approach to assess the capabilities and outputs of the EWLP Eastern Alignment primarily. The scope also includes an assessment of an alternative 32.5tal SG alignment and an alternative 26.5tal narrow gauge alignment connecting into the QR National Network.

### 3.1 Phase 1

1: Simulations to provide EWLP with a comparison for 26.5tal and 32.5tal variations for the HA199VA01 (Western GIC Alignment) and Eastern GIC Alignment using 300 wagon reference train.

- Speed Graphs for 26.5tal and 32.5 tal empty and loaded
- Transit times for 26.5tal and 32.5tal empty and loaded
- Fuel Burn for 26.5tal and 32.5tal empty and loaded
- Comparison of 26.5tal and 32.5tal to original 40tal using the fuel per '000 GTK measure.

2: Compare simulations runs for reference train using 9%[1] reduction in fuel consumption over the total cycle with reference to the EcoFab NASA aerodynamic paper in relation to covered wagons.

3: Assess infrastructure requirements Eastern GIC Alignment for a 240mtpa (reducing to 220 mtpa from QRN connection point) and a 120 mtpa scenario.

### 3.2 Phase 2

Provide a high level assessment of a proposed narrow gauge 26.5tal alternative alignment with connection to the QRN Network through to Abbot Point. This is to include the metrics of:

- Above rail requirements
- Below rail requirements
- Cycle times
- Fuel consumption.

Assumption for assessment:

- Newlands trunk capacity of 110mtpa
- 60mtpa from Carmichael mine area
- 40mtpa to Abbot Point
- 20mtpa to Dudgeon Point (not included in this assessment beyond QRN connection point)
- 30mtpa from Mac Mines.

[1] Fuel reduction factor and supporting report supplied by EWLP

### 3.3 Phase 3

Provide a high level assessment of a proposed standard gauge 32.5tal alignment to Abbot Point. This is to include the metrics of:

- Above rail requirements
- Below rail requirements
- Cycle times
- Fuel consumption.

Assumption for assessment:

- Trunk capacity of 150 mtpa
- Mine connection points, alignment geography for simulations, and relevant tonnages to be supplied by EWLP.

### 3.4 Phase 4

Collate and submit all information as a supplementary report to CARP11069-REP-Z-002: Additional Simulation and Capacity Assessment

## 4.0 ASSUMPTIONS

Table 2 outlines the rollingstock assumptions for this assessment.

**Table 2: Rollingstock Assumptions**

| Vehicle | Tare (t) | Length (m) | Axle Load | Pay Load (t) | Gross Weight (t) |
|---|---|---|---|---|---|
| ES44Ac Locomotive | 196 | 22 | 32.5 t | N/A | N/A |
| GT42Ac Locomotive | 120 | 22 | 20 t | N/A | N/A |
| Coal Wagon (26.5 tal) | 22 | 15.7 | 26.5 t | 84 | 106 |
| Coal Wagon (32.5 tal) | 22 | 16.2 | 32.5 t | 106 | 130 |
| Coal Wagon (40 tal) | 30 | 19.3 | 40 t | 126 | 160 |
| Coal Wagon (40 tal) | 26 | 19.3 | 40 t | 130 | 160 |

Calibre has used a maximum payload accuracy estimate of 97% of theoretical capacity for each wagon. This figure represents the assumed level of target accuracy in order to ensure at a minimum, certainty of tonnage system throughput with the capital applied to the task, and enables the Operators to ensure that there is sufficient buffer to protect from overload condition.

For fuel consumption and to measure transit time, this simulation study applied a “start to finish” analysis of the train as it travelled the alignment. Excluded in the fuel consumption figures for the comparison between networks, was fuel used during loading, unloading and other non-productive dwell times.

Calibre uses OpenTrack simulation tool to measure the energy expended in overcoming resistance to train movement, expressed in Mega Joules (MJ). The formula for converting MJ to litres is as follows;

Formula; $litres = \frac{MJ * 222}{3600 * 0.843}$

Where;

*MJ* = Output of OpenTrack (is the energy calculated by OpenTrack to move the train over the alignment)

*g/kWh* = the assumed locomotive efficiency (222g/kWh)

Density of Diesel Fuel (*0.843*t/$m^3$)

No of seconds in an hour = *3600*

## 5.0 EWLP WESTERN GIC TRAIN COMPARISON – 26.5TAL, 32.5TAL AND 40TAL

### 5.1 Assessment parameters

Trains across all three axle loads in the simulations were initially based on a 300 wagon reference train, with an appropriate number of locomotives to haul the trailing load. A loaded and unloaded train simulation was completed to provide the transit time and energy expended in Mega Joules (MJ) during the simulated trip. This data has been used to calculate the estimated fuel consumption in litres of diesel per train trip for an empty and loaded train on the GIC (western) alignment.

The following initial train configurations were used in the different simulations to produce the required data for a comparison between the different alignment options.

Train composition:

- 26.5tal - 4 x GT42Ac[2] Locos and 300 26.5tal wagons (22t tare)
- 32.5tal - 3 x ES44Ac Locos and 300 32.5tal wagons (22t tare)
- 40.0tal - 4 x ES44Ac Locos and 300 40.0tal wagons (30t tare).

### 5.2 Results of the comparison

Table 3 provides the consolidated results for each of the nominated axle loads. To allow for comparison between the options, two calculations have been utilised in the assessment. These are litres of fuel per tonne and fuel consumption per ‘000 GTK’s. Both of these measures are referenced in Section 2.2.4 of CARP11069-REP-Z-002 Additional Simulations and Capacity Assessment. This comparison was carried out on the Western Alignment.

The results demonstrated that the potential for the 40tal train lies in utilising the locomotive power to its maximum potential, making some allowance for contingency, and striving for as lighter tare as possible. The heavier payload advantages that 40tal offers, along with the potential to make better use of the tractive efforts available with modern locomotives, demonstrates that a 40tal solution is an economically superior solution than 32.5tal.

[2] GT42Ac equivalent to 4100 class QR narrow-gauge locomotive

The approach of using a 300 wagon reference train across each axle load scenario found that it is difficult to identify the economic 'sweet spot' in terms of above rail asset utilisation. Using the tractive effort potential of the locomotives to determine the reference train by axle load was found to be a more effective way to find the efficiency advantages.

**Table 3: Fuel Consumption – Western GIC Alignment**

| Train Type | Pay Load (Tonnes) | Total Transit Time (Hrs:Mins) | Total Fuel Litres | Litre per Tonne | Fuel consumption per '000 GTK |
|---|---|---|---|---|---|
| 26.5 tal | 25,200 | 21:46 | 41,239 | 1.63 | 1.67 |
| 32.5 tal | 31,800 | 21:35 | 45,247 | 1.42 | 1.57 |
| 40.0 tal | 37,800 | 20:54 | 58,003 | 1.53 | 1.62 |

## 5.3 Reduction of Fuel for Covered Wagons

EWLP have identified an opportunity to improve on the efficiency of their proposed 40tal coal railway. Fitting the wagons with an aerodynamic wagon cover will eliminate the contamination of adjoining properties during the journey, ensure consistent designed moisture level and product quality, and prevent coal dust from contaminating the track substructure. Coal dust degrades the effectiveness of ballast, and can lead to track substructure failure and subsequent derailment and maintenance costs.

A more tangible economic benefit of wagon covers is the decrease in air resistance and drag experienced with empty train trips. Ecofab, a global manufacturer of wagon covers commissioned a study by Monash University, and a NASA test using wind tunnels, which demonstrated a potential for fuel consumption savings, particularly for empty trips.

Ecofab's results demonstrate an average saving of 9% in total trip fuel consumption using covered wagons. Wagons designed to offer additional aerodynamic benefits may offer additional savings when coupled with wagon covers.

Calibre undertook a fuel consumption analysis by using the base data provided by OpenTrack™ of the GIC 40tal (30t tare) 300 wagon reference train and reduced the total fuel consumption by 9%.

A reduction of 5,221 litres of fuel from the original estimated fuel consumption was identified using a 9% efficiency gain equating to a reduction of 0.14 litres per tonne.

The results have been displayed in Table 4.

**Table 4: Fuel Consumption with Covered Wagons – Western Alignment**

| Train Type | Total Fuel Litres | Litre per Tonne | Fuel consumption per '000 GTK |
|---|---|---|---|
| Uncovered Train | 58,003 | 1.53 | 1.62 |
| Covered Train | 52,782 | 1.39 | 1.47 |

When further analysed across the EWLP Eastern alignment (see section 6), and using 26t Tare wagons with covers, when compared to the alternative 32.5tal SG solution uncovered wagon fuel burn results, the covers and 40tal efficiencies together represent a 25,440,000 litres of fuel burn saving over 12 months of operation @ 240mtpa. When compared with the 26.5tal wagon of the Narrow Gauge/QRN alignment results, the benefits of covered, light tare, aerodynamic wagons hauling greater payloads are significant.

### 5.4 Infrastructure Requirements for 240 mtpa

Calibre has conducted an assessment of the infrastructure requirements for the Western GIC Alignment with trunk capacity at 240mtpa and 120mtpa.

Calibre has identified that the 240mtpa profile will require duplication of the main trunk from the 431km location (Mac Mines Connection) to the 0 km point at the maintenance yard. Separation of loaded trains in one direction (known as headway) will need to be 55 minutes to provide the required capacity. 11 crossover locations are required to facilitate this tonnage throughput and provide operational flexibility and surety. Crossover locations have been selected to accommodate the 55 minute headway and will need assessment against engineering requirements to ensure placement suitability.

**Table 5: Crossover Locations 240mtpa – Western Alignment**

| Crossover Number | Location on Network |
|---|---|
| 1 | 431.0 km |
| 2 | 399.0 km |
| 3 | 333.3 km |
| 4 | 290.2 km |
| 5 | 259.1 km |
| 6 | 224.8 km |
| 7 | 199.7 km |
| 8 | 163.6 km |
| 9 | 109.4 km |
| 10 | 61.4 km |
| 11 | 17.1 km |

The remaining 196 kilometres of network can be single line section, with 8 passing sidings to provide sufficient capacity for the crossing and staging of trains onto the network.

Calibre has nominated the crossing locations in accordance with operational sensibilities to facilitate the throughput task. Where possible, the crossing locations are matched to the mine junction locations. Further assessment should be undertaken to provide confidence that these locations satisfy both operational and engineering needs for the design of the network.

Table 6 outlines the crossing locations for the 240mtpa network. The sections shown in red in the table are duplicated sections.

**Table 6: Crossing Locations 240mtpa – Western Alignment**

| Station From | Station To | Location Point | Required Tonnes |
|---|---|---|---|
| China Coal | Alpha Coal GVK | 626.5km | 30,000,000 |
| Alpha Coal GVK | Kevin's Corner GVK | 606.0km | 75,000,000 |
| Kevin's Corner GVK | Alpha North | 601.0km | 105,000,000 |
| Alpha North | Degulla | 577.5km | 135,000,000 |
| Degulla | Siding 1 | 542.0km | 150,000,000 |
| Siding 1 | Carmichael Coal | 508.5km | 150,000,000 |
| Carmichael Coal | Siding 2 | 475.0km | 210,000,000 |
| Siding 2 | Mac South | 453.0km | 210,000,000 |
| **Mac South** | **Bowen** | **431.0km** | **240,000,000** |
| **Bowen** | **Maintenance Yard** | **219.3km** | **220,000,000** |

## 5.5 Infrastructure requirements for120mtpa

Calibres assessment of the network against the 120mtpa scenario, demonstrates that a single line section network with 13 passing sidings will be sufficient. Table 7 outlines the crossing locations that have been identified to meet the operational requirements of the network. As with previous iterations, these sidings will need further investigation to ensure that design requirements balance with operational needs.

**Table 7: Crossing Locations 120mtpa – Western Alignment**

| Station From | Station To | Location Point | Required Tonnes |
|---|---|---|---|
| China Coal | Alpha North | 626.5km | 30,000,000 |
| Alpha North | Degulla | 577.5km | 70,000,000 |
| Degulla | Siding 1 | 542.0km | 90,000,000 |
| Siding 1 | Mac South | 508.5km | 90,000,000 |
| Mac South | Siding 2 | 431.0km | 120,000,000 |
| Siding 2 | Siding 3 | 383.1km | 120,000,000 |
| Siding 3 | Siding 4 | 335.2km | 120,000,000 |
| Siding 4 | Siding 5 | 287.3km | 120,000,000 |
| Siding 5 | Siding 6 | 239.4km | 120,000,000 |
| Siding 6 | Siding 7 | 191.6km | 120,000,000 |
| Siding 7 | Siding 8 | 143.7km | 120,000,000 |
| Siding 8 | Siding 9 | 95.8km | 120,000,000 |

| Station From | Station To | Location Point | Required Tonnes |
|---|---|---|---|
| Siding 9 | Maintenance Yard | 47.9km | 120,000,000 |

## 5.6 Rollingstock Requirements

The rollingstock requirements for 240mtpa are listed in Table 8.

**Table 8: Rollingstock Requirements**

| Mine | Trains | Train Sets | Locomotives | Wagons |
|---|---|---|---|---|
| Mac Mines Project South | 2.89 | 3 | 12 | 900 |
| Carmichael | 6.15 | 6 | 24 | 1,800 |
| Degulla | 1.63 | 2 | 8 | 600 |
| Alpha North | 3.34 | 3 | 12 | 900 |
| Kevin's Corner | 3.47 | 3 | 12 | 900 |
| Alpha West | 1.76 | 2 | 8 | 600 |
| Alpha | 3.5 | 4 | 16 | 1,200 |
| China First | 3.57 | 4 | 16 | 1,200 |
| **Spare** | | | **13** | **320** |
| Total | | 27 | 121 | 8,420 |

It is intended that all train consists will be pooled and dispatched to meet the overall demands of the network. This process would be managed through the use of Master and Daily Train Planning and also through the resource allocation tools.

Included in the above totals, a pool of spares has been estimated to support operations. This may consist of:

- 13 locomotives (1 spare loco for every 2 consists)
- 3 spare swing rakes of 100 wagons each (1 swing rake for every 10 trains) plus 20 spare wagons.

Swing rakes allow for the employment of a bulk maintenance strategy where as one entire block of wagons is removed from service and replaced with a swing rake to allow for scheduled maintenance to occur.

# 6.0 EWLP EASTERN GIC TRAIN COMPARISON VER 2 (26.5TAL, 32.5TAL AND 40TAL)

## 6.1 Assessment parameters

As with the assessment of the Western Alignment, trains in the initial simulations are based on a 300 wagon reference train. A loaded and unloaded train simulation was completed to provide the transit time and energy expended in MJ during the simulated trip. This data has been used to inform the fuel consumption in litres of diesel per train trip on the Eastern GIC alignment.

The following train Metrics were used in this assessment.

Train composition:

- 26.5tal - 4 x GT42Ac Locos and 300 26.5tal wagons (22t tare)
- 32.5tal - 3 x ES44Ac Locos and 300 32.5tal wagons (22t tare)
- 40.0tal - 4 x ES44Ac Locos and 300 40.0tal wagons (30t tare).

The analysis identifies that using 300 wagon reference trains across the three different axle load scenarios, did not provide comparable result for the purposes of efficiency analysis, however it provided a good foundation to determine the approach for further efficiency simulations analysis.

## 6.2 Results of the comparison

Table 9 provides the consolidated results for comparison of each of the trains. The two calculations utilised in the assessment were, litres of fuel per tonne and fuel consumption per ‘000 GTK’s. Both of these measures are referenced in Section 2.2.4 of CARP11069-REP-Z-002 Additional Simulations and Capacity Assessment.

Similar to the western alignment simulations, the analysis shows that the 40tal reference train is overpowered in comparison to the 32.5tal reference train. In addition, the 30 Tonne tare of the 40tal train wagons is contributing to higher return trip fuel consumption.

Although a difference of 0.11 litres of fuel per tonne was recorded in favour of the 32.5tal train when compared to the 40tal train, the analysis also shows a distinct advantage to the 40tal train over the 26.5tal train when both measures are compared.

**Table 9: Fuel Consumption – Eastern GIC Alignment**

| Train Type | Pay Load (tonnes) | Total Transit Time (Hrs:Mins) | Total Fuel Litres | Litre per Tonne | Fuel consumption per ‘000 GTK |
|---|---|---|---|---|---|
| 26.5 tal | 25,200 | 18:21 | 35,927 | 1.42 | 1.59 |
| 32.5 tal | 31,800 | 18:14 | 39,359 | 1.23 | 1.49 |
| 40.0 tal | 37,800 | 17:44 | 50,868 | 1.34 | 1.55 |

## 6.3 Reduction of Fuel for Covered Wagons

Using the data provided by OpenTrack™ a reduction of 4,578 litres of fuel from the original estimated fuel consumption was identified using the 9% reduction with the consumption of fuel reducing by 0.12 litres per tonne.

The fuel consumption per ‘000 GTK was also reduced and a difference of 0.14 was recorded. The results have been displayed in Table 10.

**Table 10: Fuel Comparison – Eastern Alignment**

| Train Type | Total Fuel Litres | Litre per Tonne | Fuel consumption per ‘000 GTK |
|---|---|---|---|
| Uncovered Train | 50,868 | 1.34 | 1.55 |
| Covered Train | 46,290 | 1.22 | 1.41 |

### 6.4 Infrastructure Requirements for 240 mtpa

Duplication is required for the main trunk from the 398 km location (Mac Mines Connection) to the maintenance yard. Separation of loaded trains will be 55 minutes to provide the required capacity on the duplicated sections. Eight crossover locations are required to ensure operational flexibility and surety. These locations are listed in Table 11. The placement of the crossover locations is dictated by the need to have 55 minutes separation between loaded trains. Further analysis is required to ensure the engineering suitability of these locations.

**Table 11: Crossover Locations – Eastern Alignment**

| Crossover Number | Location on Network |
|---|---|
| 1 | 398 km |
| 2 | 336 km |
| 3 | 289 km |
| 4 | 255 km |
| 5 | 220 km |
| 6 | 168 km |
| 7 | 114 km |
| 8 | 60 km |

Beyond the duplication, the remaining 196 kilometres of network will be single line section. Seven passing sidings are required on this portion of the network to provide sufficient capacity. Where possible, Calibre has placed the passing sidings at the junction of mine spur lines.

As with the location of the crossovers in the duplicated section, further studies should be undertaken to provide confidence that the passing siding locations are suitable from an engineering perspective. The sections marked in red in Table 12 are fully duplicated sections, the crossovers for which are listed in Table 11 above.

**Table 12: 240mtpa Network Capacity Assessment**

**(Stations named after nearby mine deposits)**

| Station From | Station To | Location Point | Required Tonnes |
|---|---|---|---|
| China Coal | Alpha | 573 km | 30,000,000 |
| Alpha | Kevin's Corner | 552 km | 60,000,000 |
| Kevin's Corner | Alpha North | 547 km | 90,000,000 |
| Alpha North | Degulla | 530 km | 130,000,000 |
| Degulla | Siding 1 | 497 km | 150,000,000 |
| Siding 1 | Carmichael | 458 km | 150,000,000 |
| Carmichael | Mac South | 420 km | 210,000,000 |

| | | | |
|---|---|---|---|
| **Mac South** | **Bowen** | **398 km** | **240,000,000** |
| **Bowen** | **Maintenance Yard** | **220 km** | **220,000,000** |

## 6.5 Infrastructure requirements for120mtpa

To provide sufficient capacity for 120mtpa scenario, Calibre recommends a single line section network with 12 passing sidings at the following locations. As with previous iterations, the sidings will provide for passing and staging of trains to and from the mainline.

**Table 13: 120mtpa Network Capacity Assessment**

| Station From | Station To | Location Point | Required Tonnes |
|---|---|---|---|
| China Coal | Alpha | 573km | 30,000,000 |
| Alpha | Degulla | 530 km | 70,000,000 |
| Degulla | Siding 1 | 497 km | 90,000,000 |
| Siding 1 | Mac Mines | 447 km | 90,000,000 |
| Mac Mines | Siding 2 | 398 km | 120,000,000 |
| Siding 2 | Siding 3 | 348 km | 120,000,000 |
| Siding 3 | Siding 4 | 298 km | 120,000,000 |
| Siding 4 | Siding 5 | 248 km | 120,000,000 |
| Siding 5 | Siding 6 | 199 km | 120,000,000 |
| Siding 6 | Siding 7 | 149 km | 120,000,000 |
| Siding 7 | Siding 8 | 99 km | 120,000,000 |
| Siding 8 | Maintenance Yard | 49 km | 120,000,000 |

## 6.6 Rollingstock Requirements

The rollingstock requirements for 240mtpa are listed in Table 14.

**Table 14: Rollingstock Requirements (required for each potential customer)**

| Mine | Trains | Train Sets | Locomotives | Wagons |
|---|---|---|---|---|
| Mac Mines South | 1.99 | 2 | 8 | 600 |
| Carmichael | 4.02 | 4 | 16 | 1,200 |
| Degulla | 1.43 | 2 | 8 | 600 |
| Alpha North | 3.08 | 3 | 12 | 900 |
| Kevin's Corner | 2.41 | 3 | 12 | 900 |
| Alpha | 2.81 | 3 | 12 | 900 |
| China First | 3.26 | 4 | 16 | 1,200 |

| | | | | |
|---|---|---|---|---|
| **Spare** | | | **10** | **220** |
| Total | | 21 | 94 | 6,520 |

It is intended that all train consists will be pooled and dispatched to meet the overall demands of the network. This process would be managed through the use of Master and Daily Train Planning and also through the resource allocation tools.

Included in the above totals, a pool of spares has been estimated to support operations. This consists of:

- 10 locomotives (1 spare loco for every 2 consists)
- 2 spare swing rakes of 100 wagons each (1 swing rake for every 10 trains) plus 20 spare wagons.

Swing rakes allow for the employment of a bulk maintenance strategy where as one entire block of wagons is removed from service and replaced with a swing rake to allow for scheduled maintenance to occur.

# 7.0 NARROW GAUGE 26.5TAL ALTERNATIVE ALIGNMENT

## 7.1 Assessment parameters

Calibre has used OpenTrack™ to undertake a simulation of the narrow gauge alternative alignment which is assumed to connect into the QR Network. Calibre has utilised the QR National metrics for this assessment, with trains for the Greenfield also restricted to the known Brownfield metrics:

- Narrow Gauge - 4 x GT42Ac Locos and 120 X 26.5tal wagons.

A loaded and unloaded train simulation was completed to provide the transit time and energy expended in MJ during the simulated trip. This data has been used to calculate the estimated fuel consumption in litres of diesel per train trip for an empty and loaded train on the Narrow Gauge/QR National Alignment.

**Table 15: Fuel Consumption Adani/QR National Alignment**

| Mine | Pay Load (Tonnes) | Total Transit Time (Hrs:Mins) | Total Fuel Litres | Litre per Tonne | Fuel consumption per '000 GTK |
|---|---|---|---|---|---|
| Carmichael | 10,080 | 11:48 | 16,264 | 1.61 | 2.49 |
| Mac Mines South | 10,080 | 12:17 | 17,346 | 1.72 | 2.49 |

## 7.2 Infrastructure Requirements for 110 mtpa

Due to the tonnage profile from Carmichael and Mac Mines, 60mtpa and 30mtpa respectively, duplication is required for the entire network. Separation of trains in the loaded direction is 30 minutes to provide the required capacity. 20 crossover locations are required to provide operational flexibility and surety.

Calibre has used the existing crossing loop locations on the QR National Network as the location for crossovers once the system is duplicated. Crossover locations on the Greenfield component of the narrow gauge network have been selected to accommodate train separation of 30 minutes. Engineering validation will be required to confirm these locations as suitable.

**Table 16: Crossovers**

| Network | Number of Crossovers |
|---|---|
| NG greenfield | 5 |
| QR Network (Newlands) | 15 (Existing Passing Sidings) |

Table 17 outlines the train consist and train pathing requirements for the Alternative Narrow Gauge26.5tal alignment for both Carmichael and Mac Mines.

**Table 17: Rollingstock Requirements**

| Mine | Transit Time (Hrs:Mins) | Cycle Time (Hrs:Mins) | Distance in km | No. of Trains | Train Paths Required |
|---|---|---|---|---|---|
| Carmichael | 12:17 | 20:65 | 413.000 | 8 | 9.8 |
| Mac Mines South | 11:48 | 21.42 | 439.000 | 16 | 18 |

## 8.0 ALTERNATIVE STANDARD GAUGE 32.5TAL ALIGNMENT

### 8.1 Assessment parameters

Calibre has used OpenTrack™ to undertake a simulation of the Alternative Standard Gauge Alignment. A loaded and unloaded train simulation was completed to provide the transit time and energy expended in MJ during the simulated trip. This data has been used to calculate the estimated fuel consumption in litres of diesel per train trip for an empty and loaded train.

The following train configurations were used in the different simulations to offer the required data for the comparison. Data for simulations was provided by EWLP.

Train composition:

- 32.5tal – 3 x ES44Ac Locos and 240 32.5tal wagons.

As Calibre has not been supplied the horizontal and vertical alignments for each mine spur connection to the main line for this study, an average fuel consumption rate of 9.88 litres per km per loco has been utilised for each. This figure is based upon OpenTrack™ outputs on other sections of this network, and is added to the OpenTrack™ outputs for the rest of the loaded and unloaded run.

**Table 18: Fuel Consumption Alternative 32.5tal SG Alignment**

| Mine | Pay Load (Tonnes) | Total Transit Time (Hrs:Mins) | Total Fuel Litres | Litre per Tonne | Fuel consumption per '000 GTK |
|---|---|---|---|---|---|
| Alpha | 25,440 | 14:61 | 30,063 | 1.18 | 1.60 |
| China First | 25,440 | 15:27 | 31,150 | 1.22 | 1.58 |
| Kevin's Corner | 25,440 | 14:28 | 29,727 | 1.16 | 1.61 |
| Alpha North | 25,440 | 14:42 | 29,983 | 1.17 | 1.61 |

| | | | | | |
|---|---|---|---|---|---|
| Degulla | 25,440 | 13:30 | 28,014 | 1.10 | 1.64 |

## 8.2 Infrastructure Requirements for 150 mtpa

Duplication is required across the 487 km of the network, with the remaining 20 km to Alpha Mine being a single line section. Separation of trains in the loaded direction will be 60 minutes to provide the required capacity. Eight crossover locations are required to afford operational flexibility and surety and have been placed in this assessment to support the 60 minute train separation. As the single line section will service Alpha only, passing of trains along the 20 km length will not be required; however the mine balloon loop will be able to accommodate two trains to perform a crossing move if necessary.

As with the previous assessments, further studies should be undertaken to provide confidence that the locations are best suited to the engineering requirements of the alignment, as well as the operational sensibilities.

**Table 19: Infrastructure Siding and Crossovers**

| Passing Sidings | Number of Crossovers |
|---|---|
| 0 | 8 |

Table 20 shows the ramp of tonnages across the alignment, and where the mines are expected to join this proposed network. Mine tie-in data has been supplied by EWLP.

**Table 20: 150 mtpa Mine Tie-in and Capacity Assessment**

| Station From | Station To | Location Point | Required Tonnes |
|---|---|---|---|
| Alpha | China First | 507 km | 30,000,000 |
| China First | Kevin’s Corner | 487 km | 60,000,000 |
| Kevin’s Corner | Alpha North | 480 km | 90,000,000 |
| Alpha North | Degulla | 476 km | 130,000,000 |
| Degulla | Maintenance Yard | 425 km | 150,000,000 |

Table 21 outlines the train consist and train pathing requirements for the Alternative SG 32.5tal alignment for all identified stakeholders.

**Table 21: 150 Mtpa Rollingstock Requirements**

| Mine | Transit Time (Hrs:Mins) | Cycle Time (Hrs:Mins) | Distance in km | No. of Trains | Train Paths Required |
|---|---|---|---|---|---|
| Alpha | 14.61 | 27.07 | 507 | 4 | 3.5 |
| China First | 15.27 | 27.80 | 529 | 4 | 3.5 |
| Kevin’s Corner | 14.28 | 26.71 | 498 | 4 | 3.6 |
| Alpha North | 14.42 | 26.86 | 501 | 5 | 4.7 |
| Degulla | 13.30 | 25.63 | 460 | 3 | 2.8 |

## 9.0 26T TARE 40 TONNE AXLE LOAD 270 WAGON REFERENCE TRAIN SIMULATION (EASTERN ALIGNMENT)

Calibre has undertaken an assessment of the 40tal Eastern Alignment using an assumed 26t tare wagons to identify the efficiencies of the higher payload wagons on fuel consumption. Table 22 outlines the rollingstock metrics that forms the basis of this assessment. The previous 40tal simulations at 30 Tonne tare, showed that for the system to provide the benefits of heavier payloads, the wagon tare is an important metric to control to as low as possible.

**Table 22: Rollingstock Metrics 270 Wagon Train**

| Loco Length (m) | Loco Tare (t) | Wagon Length (m) | Train Length (m) |
|---|---|---|---|
| 22 | 196 | 19.3 | 5,277 |

An opportunity exists for EWLP to work with rollingstock manufacturers to develop an innovative approach to the wagon design. As this proposed railway does not have the inherent legacy issues of existing railways such as structure gauge, shorter and wider wagons may be possible. This style of design may have a positive influence on factors such as 'in-train forces', reducing the long term maintenance on rollingstock. It may allow for faster loading and unloading times, reducing the cycle time and therefore fuel consumption. Savings may also be realised through a reduction in capital expenditure on items such as crossing loops and balloon loop lengths.

This analysis also introduces subsequent simulations of trains more matched to locomotive tractive effort potential. 270 x 40tal wagons is a more efficient match for three GE ES44Ac locomotives than 300 x 40tal. With a closer match of locomotive power to trailing load, a more efficient fuel burn is evident.

Table 23 shows the fuel consumption outputs of the study. This has been displayed in litres per tonne and consumption per '000 GTK and includes the 30t tare wagon as a comparison.

**Table 23: Fuel Usage Comparison**

| Train Type | Pay Load (Tonnes) | Total Transit Time (Hrs:Mins) | Total Fuel Litres | Litre per Tonne | Fuel consumption per '000 GTK |
|---|---|---|---|---|---|
| 270 Wagons 26t Tare | 35,100 | 19:02 | 41,229 | 1.17 | 1.43 |
| 300 Wagons 26t Tare | 39,000 | 17:16 | 49,470 | 1.26 | 1.54 |
| 300 Wagons 30t Tare | 37,800 | 17:44 | 50,868 | 1.34 | 1.55 |

It is evident from the analysis that matching the trailing load to locomotive potential significantly improves the fuel consumption results. Transit times are slower; a result of the heavier trailing load per locomotive, and the locomotives spend more time in higher power settings, however the result is a more efficient use of available power.

Calibre has also provided an assessment of the impact of covered wagons on fuel consumption. This can be seen in Table 24. For reference, the 30t tare wagons have been included in this table. The lighter tare wagons compare favourably with the 30t tare wagons reference train.

**Table 24: Covered/Uncovered Fuel Comparison**

| Train Type | Total Fuel Litres | Litre per Tonne | Fuel consumption per '000 GTK |
|---|---|---|---|
| Uncovered Train 270 (26t Tare) | 41,229 | 1.17 | 1.43 |
| Covered Train 270 (26t Tare) | 37,518 | 1.06 | 1.30 |
| Uncovered Train 300 (26t Tare) | 49,470 | 1.26 | 1.54 |
| Covered Train 300 (26t Tare) | 45,018 | 1.15 | 1.40 |
| Uncovered Train 300 (30t Tare) | 50,868 | 1.34 | 1.55 |
| Covered Train 300 (30t Tare) | 46,290 | 1.22 | 1.41 |

## 9.1 270 Wagon Train Impact on Infrastructure (240mtpa)

With a heavier trailing load per locomotive and lower payload train than the 300 wagon reference train, a review of the infrastructure was required to compare with earlier findings. A slower transit time, and lower payload means that more trains are required in the system. Separation of loaded trains will need to be 50 minutes to provide the required capacity on the duplicated sections. Calibre have identified that 10 Crossovers are required to service this tonnage profile and enable the shorter headways required.

Beyond the duplication, the remaining network will be single line section. Seven passing sidings are required on this portion of the network to provide sufficient capacity. Where possible, Calibre has placed the passing sidings at the junction of mine spur lines.

As with the location of the crossovers in the duplicated section, further studies should be undertaken to provide confidence that the passing siding locations are suitable from an engineering perspective.

**Table 25: Infrastructure Comparison – 26t Tare 270 Wagon Reference Train**

| Ref Train | Passing Loops | Crossovers | Duplication | Train Numbers |
|---|---|---|---|---|
| 270 Wagon 26t Tare | 7 | 10 | 398 km | 23 |
| 300 Wagon 30t Tare | 7 | 8 | 398 km | 21 |

## 9.2 Rollingstock Requirements

The rollingstock requirements for 240mtpa are listed in Table 26.

**Table 26: Rollingstock Requirements**

| Mine | Trains | Train Sets | Locomotives | Wagons |
|---|---|---|---|---|
| Mac Mines Project South | 2.17 | 2 | 6 | 540 |
| Carmichael | 4.37 | 5 | 15 | 1,350 |
| Degulla | 1.56 | 2 | 6 | 540 |
| Alpha North | 3.36 | 4 | 12 | 1,080 |
| Kevin's Corner | 2.64 | 3 | 9 | 810 |
| Alpha | 3.12 | 3 | 9 | 810 |
| China First | 3.66 | 4 | 12 | 1,080 |
| **Spare** | | | **11** | **200** |
| Total | | 23 | 80 | 6,410 |

It is intended that all train consists will be pooled and dispatched to meet the overall demands of the network. This process would be managed through the use of Master and Daily Train Planning and also through the resource allocation tools.

Included in the above totals, a pool of spares has been estimated to support operations. This consists of:

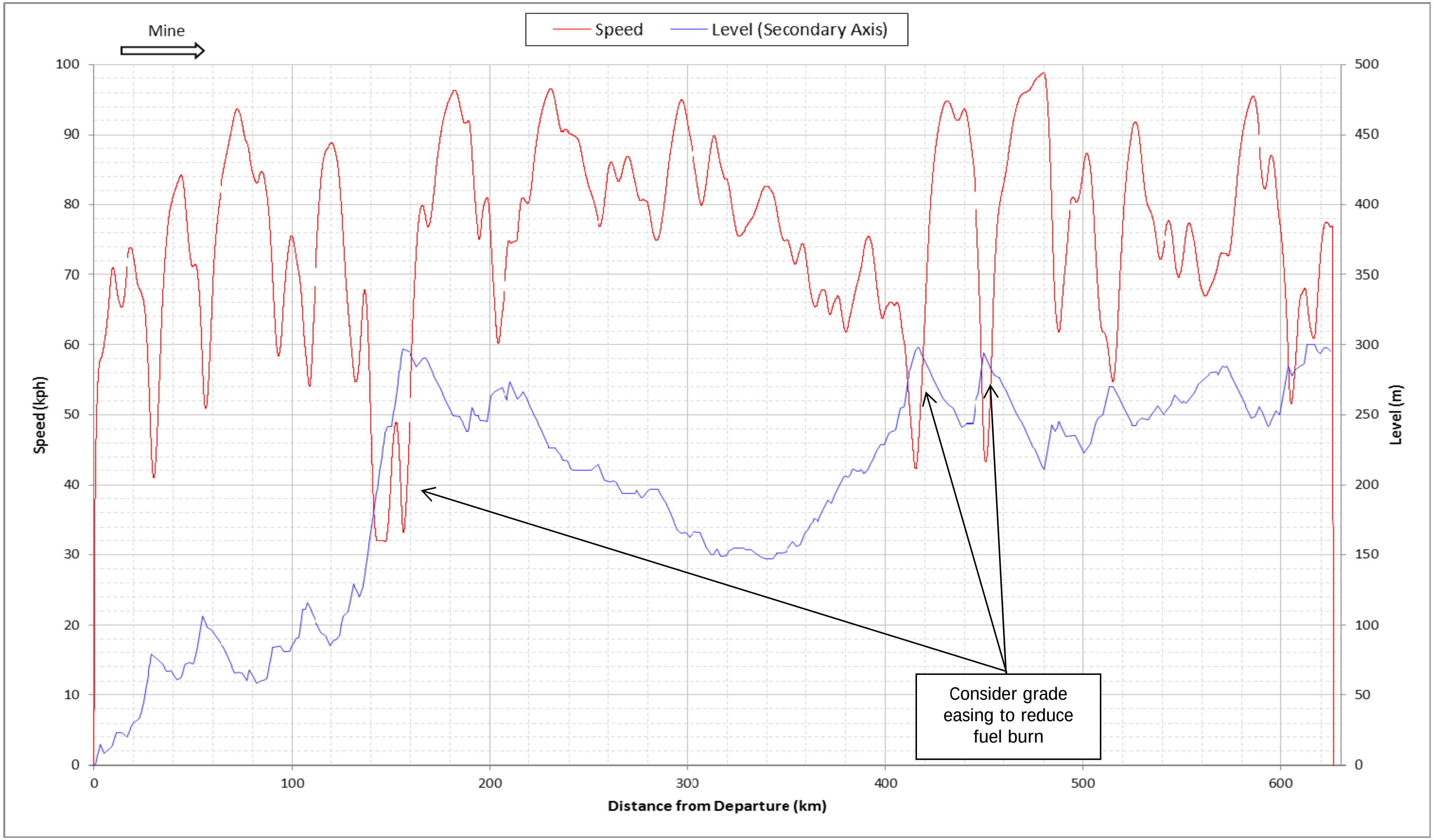
- 11 locomotives (1 spare loco for every 2 consists)
- 2 spare swing rakes of 90 wagons each plus 20 spare wagons.

Swing rakes allow for the employment of a bulk maintenance strategy where as one entire block of wagons is removed from service and replaced with a swing rake to allow for scheduled maintenance to occur.

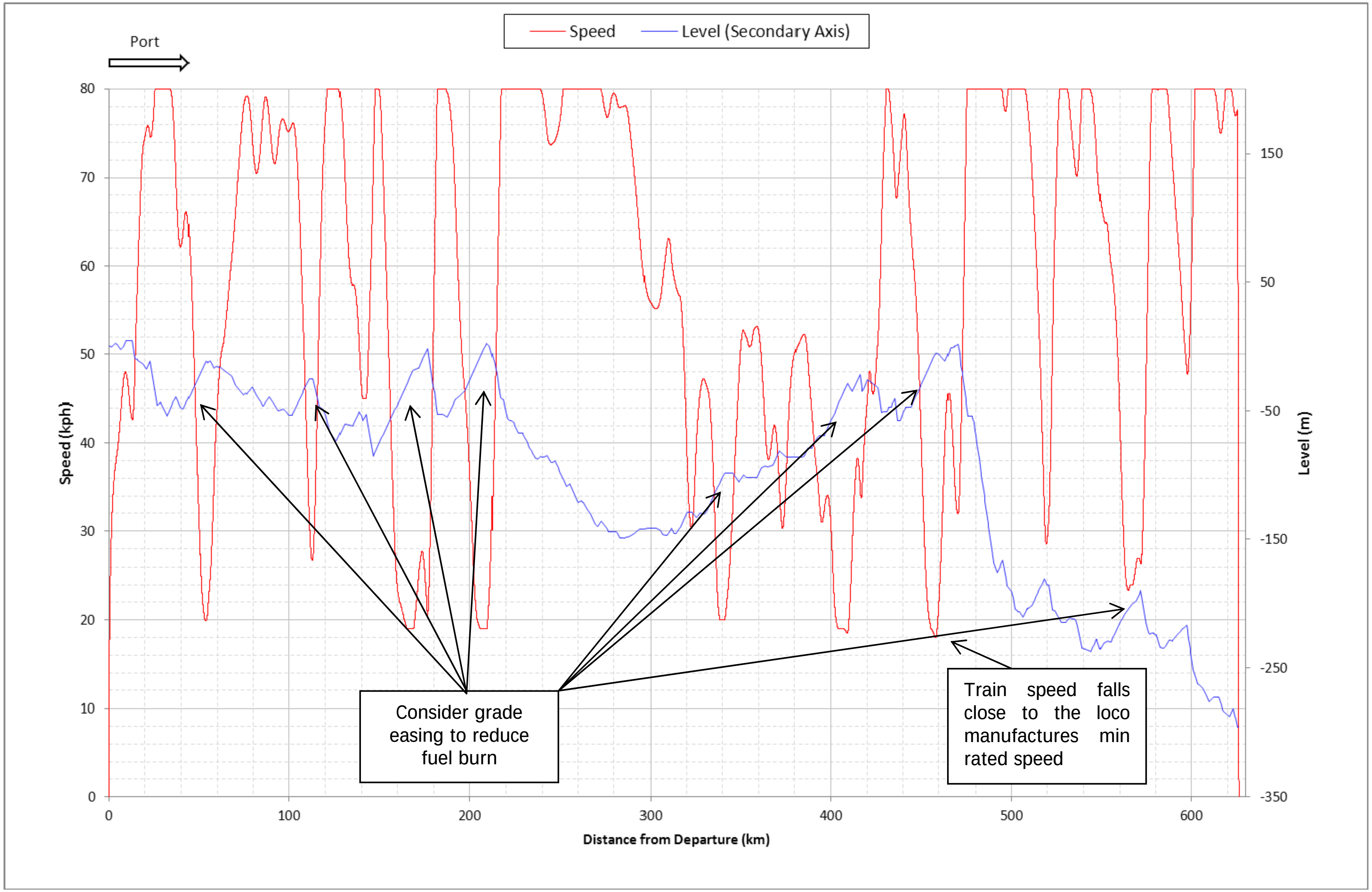
What the 270 wagon analysis demonstrates is despite the slower cycle time, and although a larger number of trains are needed, it results in fewer wagons, and fewer locomotives that the 300 wagon reference train case.

270 wagon train offers an easily managed wagon set maintenance strategy. Easily divisible by 3, 3 – pack wagon sets are multipliable by 5 (15), 6 (18), 9 (27), 10 (30), 15 (45), 18 (54), 20 (60), 30 (90), 40 (120). The resulting rake sizes can be flexibly adapted to a shunt plan and maintenance strategy. Intuitively, 60, 90 or 120 wagon sets are logical for planned maintenance. Calibre has assumed wagon sets of 90 apply for this analysis. Each wagon requires annual inspection, and can be scheduled with an asset management tool that interacts with the activity scheduling for the maintenance and provisioning dwells.

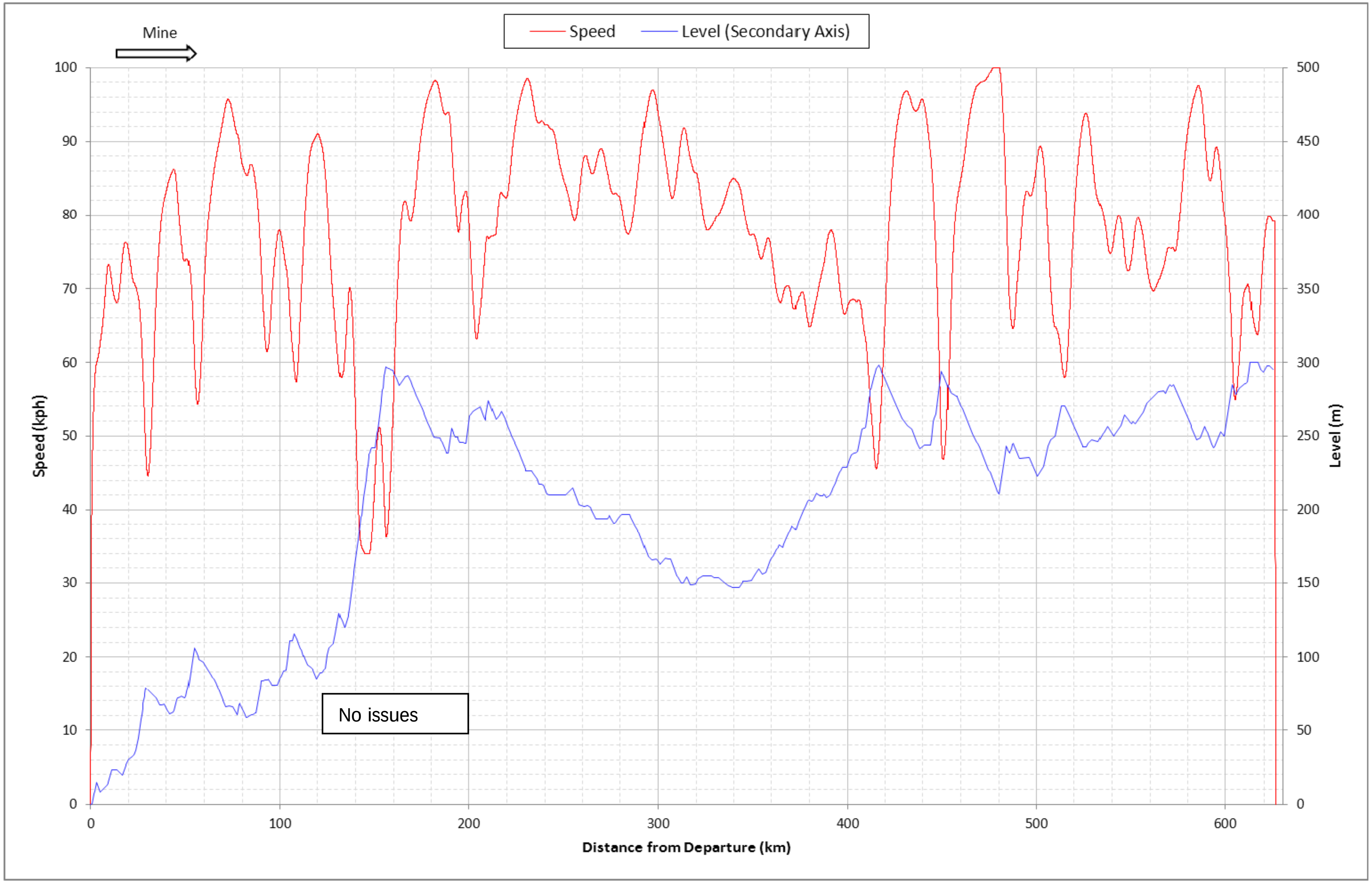
Speed Graph EWLP HA199-VA01 26.5tal Empty Train


Mine
Speed
Level (Secondary Axis)
Speed (kph)
Level (m)
Distance from Departure (km)
Consider grade easing to reduce fuel burn
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400
450
500
0
100
200
300
400
500
600

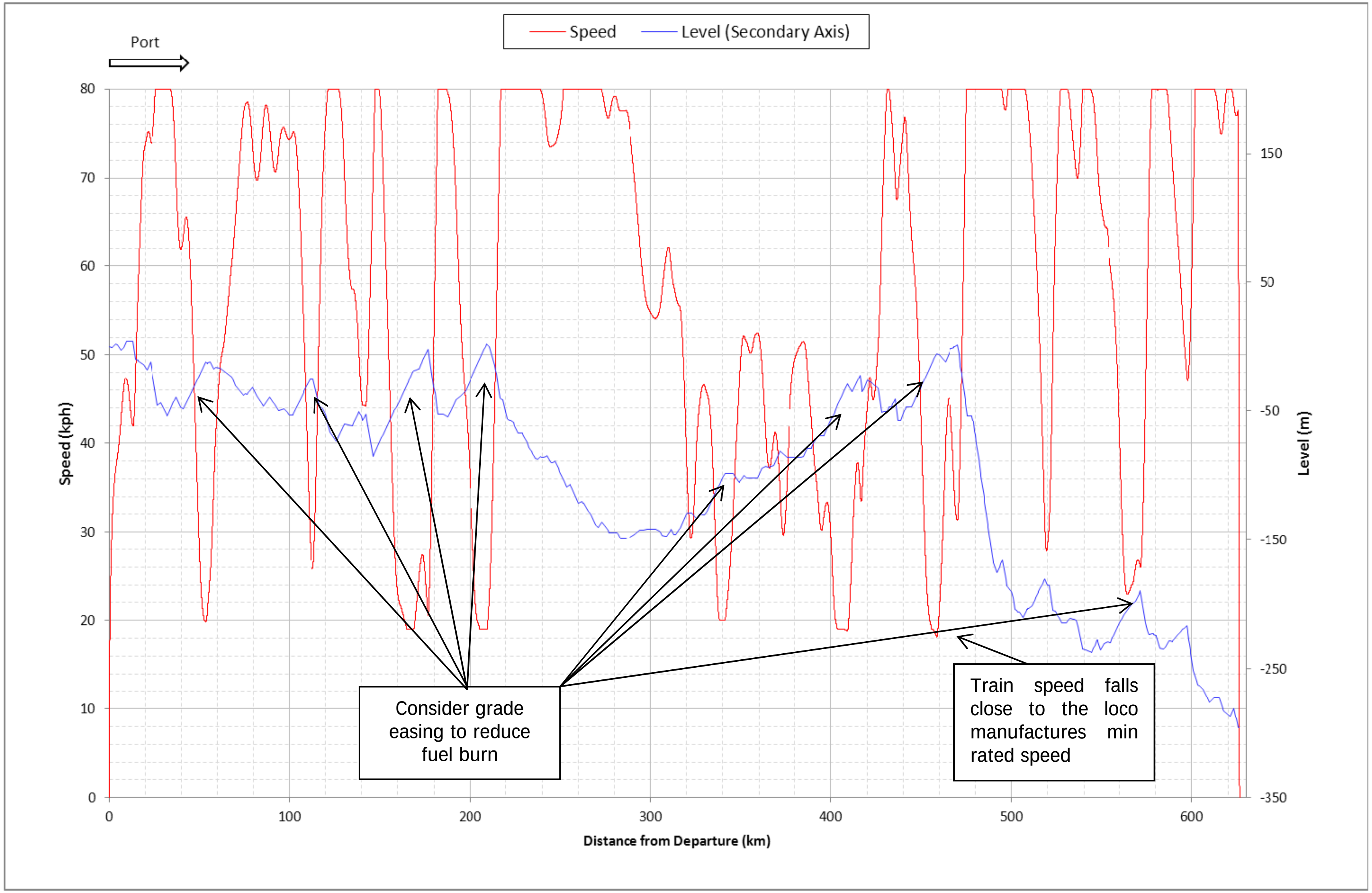
Speed Graph EWLP HA199-VA01 26.5tal Loaded Train



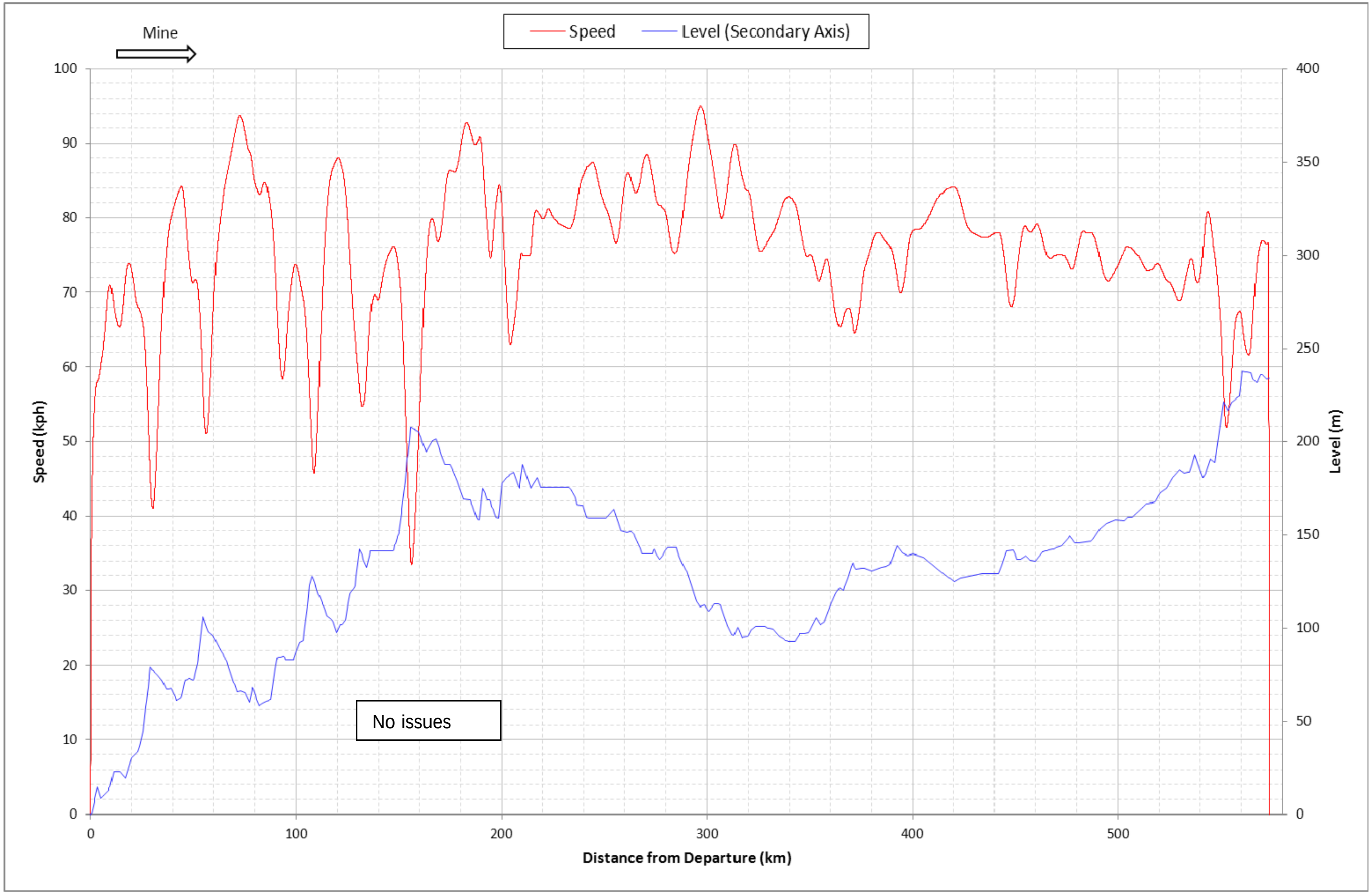

Speed Graph EWLP HA199-VA01 32.5tal Empty Train



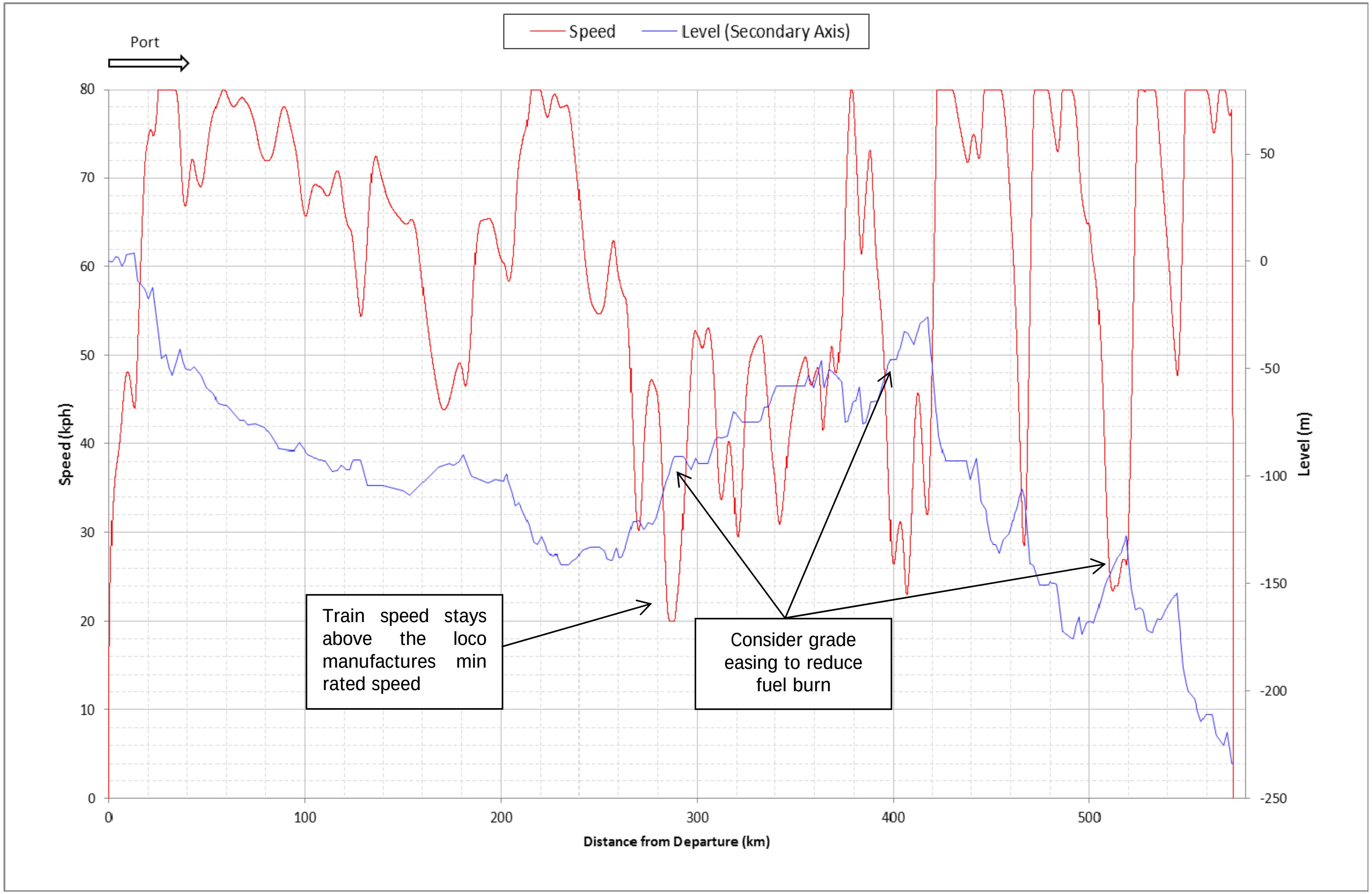

Speed Graph EWLP HA199-VA01 32.5tal Loaded Train


Speed
Level (Secondary Axis)
Port
80
70
60
50
40
30
20
10
0
Speed (kph)
150
50
-50
-150
-250
-350
Level (m)
0
100
200
300
400
500
600
Distance from Departure (km)
Consider grade easing to reduce fuel burn
Train speed falls close to the loco manufactures min rated speed

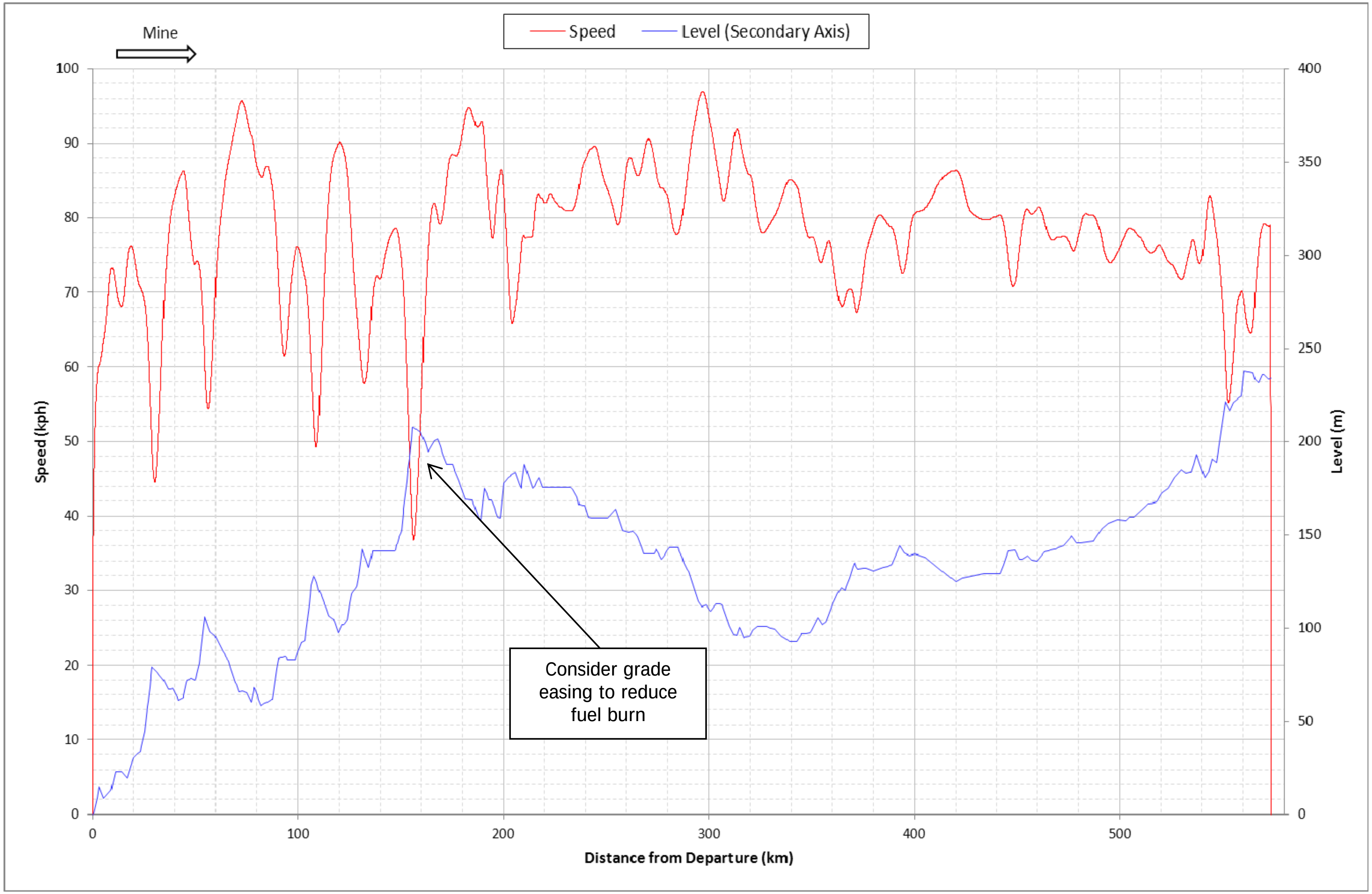
Speed Graph EWLP Eastern GIC 26.5tal Empty Train


Mine
Speed
Level (Secondary Axis)
Speed (kph)
Level (m)
Distance from Departure (km)
No issues
100
90
80
70
60
50
40
30
20
10
0
400
350
300
250
200
150
100
50
0
0
100
200
300
400
500

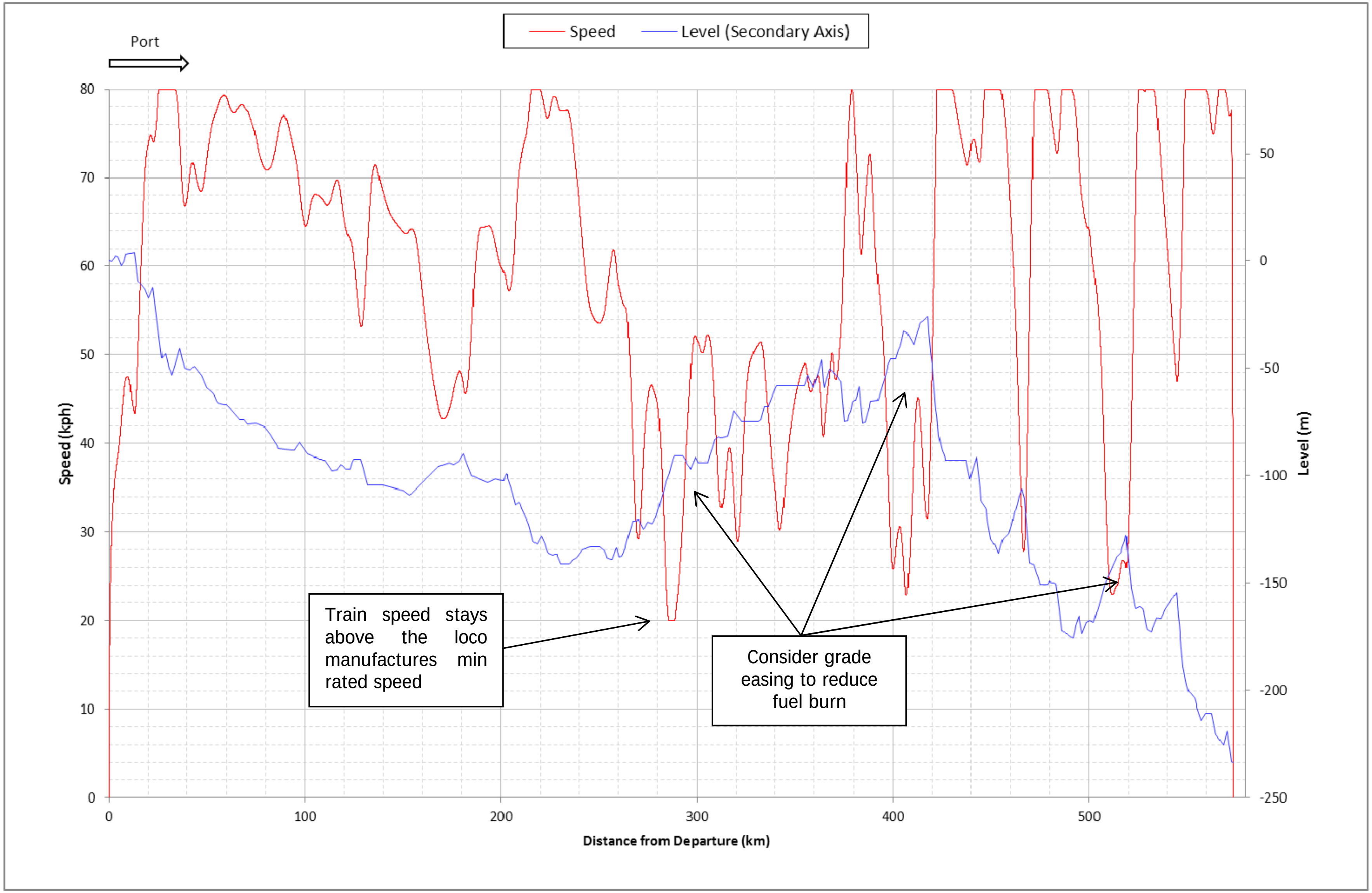
Speed Graph EWLP Eastern GIC 26.5tal Loaded Train


Speed
Level (Secondary Axis)
Port
Speed (kph)
Level (m)
Distance from Departure (km)
0
10
20
30
40
50
60
70
80
0
100
200
300
400
500
-250
-200
-150
-100
-50
0
50
Train speed stays above the loco manufactures min rated speed
Consider grade easing to reduce fuel burn

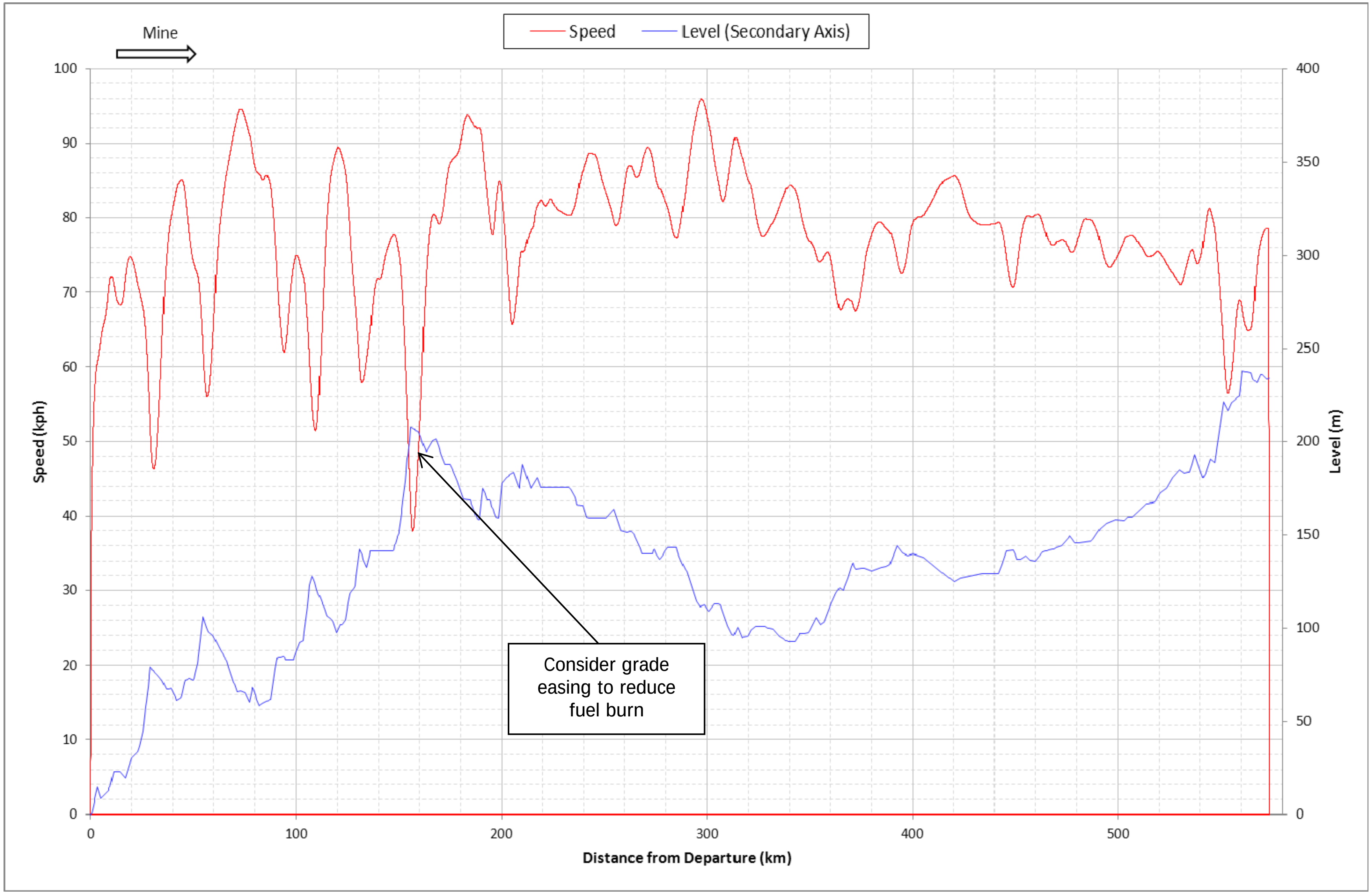
Speed Graph EWLP Eastern GIC 32.5tal Empty Train


Mine
Speed
Level (Secondary Axis)
Speed (kph)
Level (m)
Distance from Departure (km)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400
0
100
200
300
400
500
Consider grade easing to reduce fuel burn

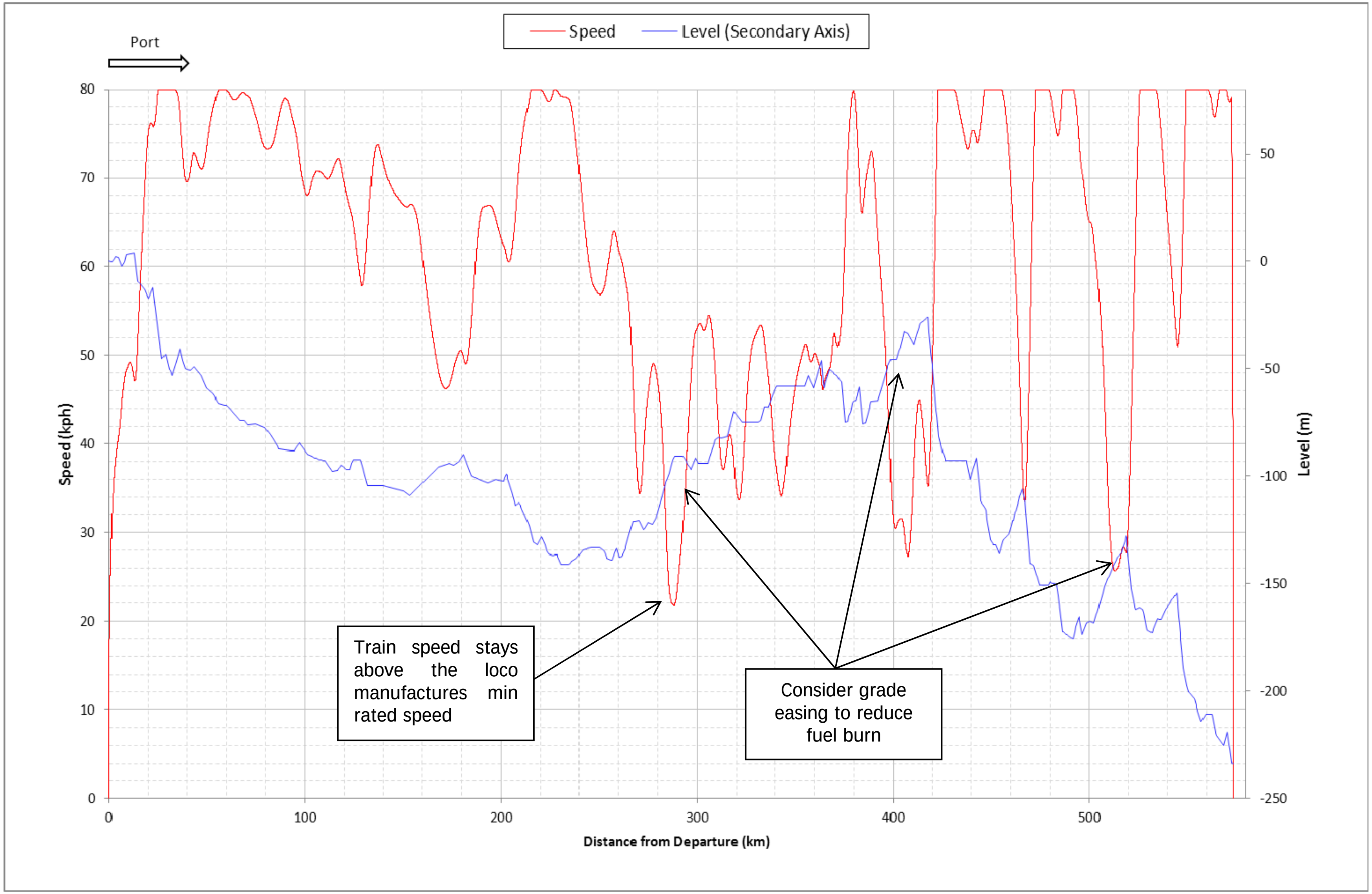
Speed Graph EWLP Eastern GIC 32.5tal Loaded Train


Speed
Level (Secondary Axis)
Port
Speed (kph)
Level (m)
Distance from Departure (km)
80
70
60
50
40
30
20
10
0
50
0
-50
-100
-150
-200
-250
0
100
200
300
400
500
Train speed stays above the loco manufactures min rated speed
Consider grade easing to reduce fuel burn

Speed Graph EWLP Eastern GIC 40.0tal Empty Train


Mine
Speed
Level (Secondary Axis)
Speed (kph)
Level (m)
Distance from Departure (km)
Consider grade easing to reduce fuel burn
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400
0
100
200
300
400
500

Speed Graph EWLP Eastern GIC 40.0tal Loaded Train


Speed
Level (Secondary Axis)
Port
Speed (kph)
Level (m)
Distance from Departure (km)
0
10
20
30
40
50
60
70
80
0
100
200
300
400
500
50
0
-50
-100
-150
-200
-250
Train speed stays above the loco manufactures min rated speed
Consider grade easing to reduce fuel burn

# Appendix 8


PROJECT IRON BOOMERANG
east west line parks limited

# Initial Advice Statement
for
# GALILEE INFRASTRUCTURE CORRIDOR PROJECT


## East West Line Parks Limited

**March 2012**

## Disclaimer

The illustrations appearing in this document are conceptual and are not drawn to scale, and they are not representative of a particular region or location and should not be construed as a facsimile of a conceptual multi user infrastructure corridor.

This document has been prepared by East West Line Parks Limited (EWLP) based upon available information in the public domain and content supplied by specialist consultancies that have subject matter expertise in their knowledge domain.

All statements, other than statements of historical fact, are forward looking and involve risks and uncertainties. There can be no assurances that such statements will prove accurate.

Actual results and events could differ materially from those anticipated in statements.

EWLP does not assume the obligation to update any forward looking statement.

# Table of Contents

# Executive Summary

East West Line Parks Limited (EWLP), in this context referred to as the "Proponent", is a public company incorporated in the State of Queensland, which proposes to develop a Galilee Infrastructure Corridor.

Separately, EWLP is also the proponent of a nation-building Project known as Project Iron Boomerang (PIB), which involves the development of slab steel manufacturing facilities on Australia's east and west coasts strategically connected by a transcontinental rail crossing. The Galilee Infrastructure Corridor proposed in this Initial Advice Statement ("IAS") will potentially form part of the eastern segment of the proposed transcontinental rail crossing.

The Proponent intends to build, own and operate a 650km open access, multi user, multi-purpose infrastructure corridor (the Corridor) from the Port of Abbot Point to the coal mining regions of the Bowen and Galilee Basins.

The Corridor will be complete with rail and telecommunications infrastructure and comprised of the following three elemental sections:

- a 390 kilometre length of corridor from the Abbot Point State Development Area to a junction north of North Goonyella in the Bowen Basin then continuing west to the northern end of the Galilee Basin;
- a 230 kilometre length of corridor extending from the northern Galilee south along the length of the Galilee Basin and terminating near the town of Alpha to transport thermal coal from proposed mines; and
- a 30 kilometre spur line from the junction near North Goonyella south to a narrow gauge transfer hub near Moranbah to service primarily the transport of metallurgical coal.

The Corridor will be used primarily to site a dual track, standard gauge, heavy haul railway system and a carrier grade high availability communications network (for train control and general communications) with the capacity to provide coal and other freight services to current and future mining operations in the two coal mining regions, and other communities adjacent to the Corridor.

The Project will facilitate the Proponent's vision for an open access freight Corridor to Abbot Point, which is justified for the compelling economic and community benefits it will provide, including the following:

1. services the doorstep of all Galilee Basin mining tenements and aggregates their freight volumes via a single multi user, infrastructure Corridor containing a standard gauge, heavy haul rail system that delivers optimum economic efficiency to all users;
2. simultaneously introduces a standard gauge, heavy haul freight solution to Abbot Point from an integrated rail location central to the Bowen Basin coalfields;
3. provides the Abbot Point State Development Area and the proposed new port facilities with a high capacity rail connection incorporating state-of-the-art, carrier grade telecommunications to assist the centralised management of all rail traffic entering;
4. for the entire Corridor incorporates advanced train control signalling on a common shared platform for optimised freight efficiency in a multi user environment;
5. promotes the State's yet unrealised ambition to connect the minerals region around Mt Isa (the North West Minerals Province) to the east coast via a heavy haul rail

corridor of optimum economic efficiency by advancing such an asset nearly half the required distance; and

6. provides for future community utility services to be located within the corridor.

Further, the Corridor is sensitive to the need to preserve valuable cropping land and existing farming and other key established land uses in the parts of regional Queensland that it traverses. From its terminus at Abbot Point the Corridor alignment to the south and west maximises its proximity as far as practical to the existing Bowen Basin rail corridor. Heading west from the junction at North Goonyella to the northern Galilee Basin it follows the foothills of higher land formations at relatively flat longitudinal grade and remains to the north of the major black soil areas and out of flood plains. Its route therefore minimises impacts on valuable agricultural lands to the south of the Corridor. Then adopting a generally north-south alignment along the Galilee Basin back towards its point of origin near the town of Alpha, the Corridor continues to bypass agricultural zones whilst remaining strategically close to all of the mining tenements.

With its planned minimum encroachment on valuable agricultural cropping, cattle grazing lands and black soil floodplains, together with specially designed rolling stock to minimise required trip frequencies and avoid dust emissions, the Corridor therefore minimises environmental and community impact.

Community consultation on the Project concept commenced in 2006 in cooperation with the Mayors of the Whitsunday and Isaac Regional Councils. Regular presentations and information updates have been given at Council meetings, community meetings, with land owners, with farmers, and peak local groups including the Corridor to Coast group and economic development enterprise organisations.

The Project is of strategic significance in that it will:

- contribute to the Government's Infrastructure Policy, the promotion of domestic capital formation, and shape future infrastructure planning and development in Queensland;
- support the National Government's infrastructure priorities as outlined in the 2011 Report by Infrastructure Australia to the Council of Australian Governments including the delivery of Competitive International Gateways, A National Freight Network and a National Broadband Network;
- contribute to the long term employment sustainability in the regions for the existing industry sectors and open up upstream and downstream development opportunities realised by existing and potential industries utilising the Corridor;
- have the capacity to serve multiple sectors including agriculture and pastoral, not only the mining sector;
- function as a trade corridor and provide foundation customers in support of the Multi-Cargo Facility at the Port of Abbot Point;
- enable an efficient use of land and resources within the current Corridors owned by the Coordinator General in the Abbot Point State Development Area and within the Corridor owned by North Qld Bulk Ports;
- eliminate the need for multiple corridors connecting to the Galilee basin and thereby reduce financial costs involved in the development of a multiplicity of rail corridors currently proposed;

- have the capacity to provide for multiple uses into the future including water, energy and information and communication technology infrastructure to support regional development in Queensland;
- contribute to the utilisation of existing Government Owned Corporation (GOC) infrastructure and returns on such investments; and
- open up new potential to service the North West minerals province and developments further afield.

The Project represents a unique opportunity to coordinate the Galilee Basin coal transport requirements within a single corridor by an efficient heavy haul railway system with maximum economic benefits to the Queensland economy, the broader community and the coal miners in the region well into the future.

The Proponent's proposal for a multi user, duplicated 40 tonnes per axle load standard gauge line constructed in good foundations away from floodplains, with optimum rail geometry and served by state-of-the-art heavy haul rolling stock and a carrier grade telecommunications network with advanced train control signalling, will facilitate optimum operational freight efficiency. This will achieve significant savings for the coal mine owners in the Galilee and Bowen Basins by aggregating freight volumes, consolidating supply chains and deploying a combination of high efficiency rail freight design parameters not currently available for coal freight in Queensland. It will enable the mining companies accessing the Corridor to optimise the productive and efficient operation of their mining tenements in the context of the high AUD exchange rate and ever increasing input cost pressures. It offers the most cost competitive solution to the Galilee (and Bowen) mining companies to enable the Mining industry in Queensland to continue to be globally competitive.

Funding for the Project, estimated to require a capital investment in the order of $A 4 billion including rolling stock and communications infrastructure, will be based on investor equity and debt financing. To implement the appropriate financial structure, the Proponent remains in detailed discussions with its financial advisors and potential financiers, including domestic and international financial institutions and investment banks. A number of mining companies have been consulted on the potential for collaboration and appropriate financial structures for multi party collaboration in establishing the corridor are being formulated.

This Initial Advice Statement (IAS) given under section 27(a) of the *State Development and Public Works Organisations Act 1971 (Qld)* provides detailed information for the Queensland Government, interested stakeholders and the general public with initial advice on the proposed Project, the Galilee Infrastructure Corridor for which application is made to declare the Project a project of significance under section 26 (i) of the *State Development Public Works Organisations Act 1971 (Qld)*. In particular, this IAS is provided to:

- assist the Coordinator General to make a decision on a 'significant project' declaration;
- enable stakeholders to determine the nature and level of their interest in the proposal; and
- assist the Coordinator General to prepare draft terms of reference for an environmental impact statement for the proposed Project if declared.

The scope of the IAS is to outline the nature of the Project, its key elements, its social, economic and environmental dimensions including impacts and measures to mitigate adverse impacts, key state and local government policies and planning instruments relevant to the Project, the reasons for the Project being declared a project of significance under the

*State Development and Public Works Organisation Act, 1971 (Qld)* and the processes and approvals required to undertake the Project.

This solution of optimum economic freight efficiency will deliver on the Government's strategic infrastructure needs for the regions at least economic cost and lowest environmental impact. It is submitted that the Corridor as outlined in this IAS provides the 'common sense' shared freight infrastructure solution which is in the State's best interest.

The content of this Initial Advice Statement is strictly confidential and must not be disclosed by the Coordinator General to any person, other than as permitted by law and section 31 of the *State Development and Public Works Organisation Act* 1971. EWLP acknowledges that the Coordinator General may refer parts of the Initial Advice Statement to any entity the Coordinator General considers may be able to give the Coordinator General comments and information that will help in preparing the EIS.

# GALILEE INFRASTRUCTURE CORRIDOR PROJECT

# 1. Introduction

### 1.1 Background

Mining is of major economic significance to the State of Queensland. Its direct expenditure of more than $A25 billion in 2010 - 2011 accounted for almost 10% of Gross State Product and employed over 45,000 people. The State Government has before it multiple proposals for major projects to expand or open new mining operations in the State, particularly for the mining of metallurgical and thermal coal deposits in the Bowen and Galilee Coal Basins. Future growth in coal export tonnage from the Galilee Basin alone is projected to be in excess of 300 Mtpa with an export value in excess of $A20 billion annually.

A key requirement for the successful development of these resources is the provision of infrastructure to transport the coal to coastal ports for export. The planning and establishment of the necessary transport infrastructure and associated services should be co-ordinated such as to optimise the efficiency with which the required freight services can be provided in terms of economic benefits to the State while minimising environmental and social impacts.

The State has also designated the area adjacent to the existing Abbot Point harbour coal terminal for expansion with a multi cargo sea freight facility and a special development zone for heavy industrial use.

The proposal considered in this Initial Advice Statement focuses on delivering on these objectives in a way that can meet the needs of all key stakeholders: mining companies, industrial users, regional communities and government.

### 1.2 The Galilee Infrastructure Corridor

The proposal involves an infrastructure corridor (to be known and referred to herein as the 'Galilee Infrastructure Corridor' (GIC) or the 'Corridor') nominally 150 metres in width from the Abbot Point State Development Area (or adjacent land) to the Bowen and Galilee Coal Basins and the construction and operation within it of rail and communications infrastructure of State significance.

The primary purpose of the Corridor is to provide, for the long term, an efficient multi user, multipurpose, open access rail freight system to transport coal from all of the Galilee and parts of the Bowen coal basins to the Abbot Point State Development Area and Port. The Corridor will be complete with rail and telecommunications infrastructure and comprised of the following three elemental sections:

- a 390 kilometre length of Corridor from the Abbot Point State Development Area to a junction north of North Goonyella in the Bowen Basin then continuing west to the northern end of the Galilee Basin;
- a 230 kilometre length of Corridor extending from the northern Galilee south along the length of the Galilee Basin and terminating near the town of Alpha to transport thermal coal from proposed mines; and
- a 30 kilometre spur line from the junction near North Goonyella south to a narrow gauge transfer hub near Moranbah to service primarily the transport of metallurgical coal.

The Proponent proposes to facilitate and co-ordinate the design and construction of a railway and associated infrastructure, including telecommunications service infrastructure, within the Corridor. The railway will be a high efficiency, heavy haul, dual track standard gauge line capable of carrying 40 tonnes load per axle (40 tal) rolling stock providing freight operations to serve the needs of all proposed and future mines in the Galilee Basin and multiple coal mines in the Bowen Basin. The efficient high capacity railway system proposed will be similar to and, compatible with the state-of-the-art heavy haul Pilbara railway system in Western Australia. The telecommunications infrastructure will provide a high availability carrier grade network, in part consisting of a fibre core and a wireless overlay network, for train control and general communications. Funding for the Project, estimated to require a capital investment in the order of $A4 billion including rolling stock and communications infrastructure, will be based on investor equity and debt financing.

A key priority for the Project is to address the State Government's strategic planning objectives for managing growth in coal exploration and mining in the Bowen and Galilee Basins at the least economic and social cost. This can only be achieved if, in addition to existing infrastructure serving the freight needs of the Bowen Basin, there is a single 'common sense', open access, efficient heavy haul infrastructure Corridor to meet the growth in freight requirements of new or additional coal tonnages from both the Bowen and Galilee Basins as well as providing an option for servicing the minerals province expansion in the Mt Isa region.

Another key priority of the Project is to provide a high capacity state-of-the-art railway connecting heavy industries at the Abbot Point State Development Area to the proposed port facilities at Abbot Point.

### 1.3 Economic Significance

The Corridor is of economic significance to the State and the nation, in that it will:

i. contribute to the Australian Government's Infrastructure Policy;

ii. support the State Government's *Queensland Infrastructure Plan*;

iii. contribute to domestic capital formation; and

iv. shape infrastructure planning and development, and facilitate further economic development in Queensland.

While the Project will not directly generate royalties or export duties to government, it will facilitate major investment and economic returns through the development of mining sector opportunities for upstream industry and downstream processing industries which will in turn contribute royalties as well as revenue by way of taxes and charges for State and Commonwealth Governments; and generate significant national export revenue.

### 1.4 Better Infrastructure Coordination

Significantly, the Galilee Infrastructure Corridor will support the Coordinator General's infrastructure planning and development view that from a planning perspective, in achieving the freight requirements of mining in the Bowen and Galilee Basins, a single Corridor to the Abbot Point sea port, rather than multiple corridors traversing the State, would be in the State's best long term infrastructure interests.

A number of rail corridors are currently proposed for mining projects within the Galilee and Bowen Basin Regions. Associated processes for declaration of a significant project under section 26 of the S*tate Development and Public Works Organisation Act 1971 (Qld)* and preparation of Environmental Impact Statements have been initiated on these projects and are at various stages of progress.

Studies have been undertaken for environmental impact assessment for the various mining projects and the associated rail construction projects to support the proposed mines within the Galilee and Bowen Basin regions.

The Proponent has carried out extensive pre-feasibility studies on its Project and commenced preliminary work on the Environmental Impact Assessment for the Corridor.

### 1.5 Project Finance

The Proponent has engaged global financial and investment institutions to assess funding requirements for the Project and to advise on appropriate components of equity and debt financing for construction and permanent financing. A number of the relevant mining companies have been consulted on the potential for collaboration, and appropriate financial structures for multi party collaboration in establishing the corridor are being formulated.

The Proponent's studies to date have demonstrated that the cost per tonne of coal hauled from the Galilee to Abbot Point will be minimised for each user when a high capacity line with the optimum operational efficiency this Proponent proposes is made available to all mining companies on an equitable basis.

A key factor in project financing is to ensure funding is allocated to construction in a timely manner to align with projected operational timelines of potential users of the infrastructure, namely the various mining companies holding resources in the Galilee Basin. Collaboration in the funding mechanism will aid bankability of both mines and rail freight infrastructure.

### 1.6 Users

The Proponent is consulting with potential users of the railway regarding consortium participation, establishment of a joint Board representing members of the consortium, and the appointment of a respected independent supervising authority to oversee project construction on behalf of the Board.

The Proponent considers that the other railway proposals put forward may serve the individual interests of their proponent mining companies, and other than the Galilee Infrastructure Corridor Proponent's proposal, no other proposal appears (from information the Proponent has assessed) able to equitably or optimally serve the individual interests of all the current proposed mines in the Galilee Basin, namely MacMines, Adani, Vale, Waratah, HCPL, GVK, AMCI. The other Proponents proposals neither gives consideration for the significant potential for new and emergent Miners nor the long term freight transport needs of the entire Galilee Basin. The Proponent believes that its approach secures the improved freight efficiencies only achievable from a multi user single Corridor collectively serving all mines in the Galilee Basin, and is therefore in the best commercial interest of each mine owner. The Proponent will clarify these arrangements with the potential participants, so as to meet their timelines for financial investment decisions.

The potential for the Corridor also to serve new or expanded mines in the Bowen Basin further strengthens the economic efficiency of the Proponent's model and the benefits of operational cost sharing for the Galilee Basin mining operators.

### 1.7 Why is the Galilee Infrastructure Corridor a Project of Significance?

In addition to the matters outlined above, the declaration of the Galilee Infrastructure Corridor as a Project of Significance is justified on the following grounds:

1. The Project will, subject to a declaration as a Project of significance fall within the development application process pursuant to the *Sustainable Planning Act 2009 (Qld)* and would involve separate applications to multiple local governments and a referral to the Commonwealth Government pursuant to the *Environment Protection and Biodiversity Conservation Act 1999 (Cth).*
2. Without timely coordination of the separate applications, agency referrals and decision making processes the Project viability could be threatened if project and commercial timeframes, as required by potential users of and investors in the Corridor, are not met.
3. The Corridor will traverse four local government areas, and will require a multiplicity of approvals from State and Commonwealth Government agencies during the pre construction, construction and post construction operations within the Corridor.
4. The complexity of the coordination and timing of the approvals processes between multiple agencies across multiple levels of Government will need careful, whole of government, coordination of an EIS and approvals process to enable the Project to progress in a timely manner and to meet the operational needs of associated mining operations.
5. The Corridor will facilitate the cost efficient freight of cargo to and from the Abbot Point State Development Area for the benefit and needs of multiple economic sectors, including the mining sector, the agricultural sector and the pastoral sector.
6. The Project is of strategic significance to multiple localities and local government areas of Queensland including the Local Government Areas of Whitsunday, Isaac, Charters Towers and Barcaldine Regional Councils.
7. The Project is consistent with and supports a range of Government strategic policy and planning instruments affecting the relevant regions including support for the Government's Regional Growth Management, Economic Development and Policy frameworks.

8. Approval of a single infrastructure corridor, as opposed to multiple corridors, will contribute to a significant reduction in the long term environmental impact on land, natural fauna and flora and economic and social impacts on the agricultural sector and rural communities generally, not to mention the wasted financial costs involved in the development of a multiplicity of corridors, as currently proposed.

9. The Project will have significant economic benefits and generate substantial regional and local employment in construction and support services. Additionally, the Project will contribute to long term employment sustainability in the regions for existing industry sectors and will open up employment opportunities from upstream and downstream development realised by existing and potential industries utilising the Corridor.

10. In addition to facilitating a core freight corridor for mined ores, the Corridor will support other industry sectors and infrastructure owned and operated by a number of entities which will provide a range of products to many members of the public and industry sectors.

11. The Corridor will function as a trade corridor for foundation customers for the proposed Multi Cargo Facility at the Port of Abbot Point.

12. The strategic significance to the State includes establishing infrastructure which anticipates continued growth in accordance with the Queensland Government's ambition for a strong economy in Queensland. The Proponent intends to build, own and operate the Corridor infrastructure to serve the coal regions of the Bowen and Galilee Basins and potentially the future needs of the minerals region around Mt Isa (the North West Minerals Province) and beyond.

13. In addition to the duplicated rail line and telecommunications infrastructure which forms part of the Project and this IAS, the proposed Corridor provides sufficient space for future potential rail tracks as well as water, energy and enhanced telecommunications infrastructure to support regional development in Queensland and it will therefore contribute to better utilisation of, and returns on investments in, existing infrastructure.

14. The development of future infrastructure (e.g., other utility services and pipelines infrastructure in addition to that required to provide core mining freight services) will require separate consideration and assessment to this Project, however reserving the potential for that infrastructure to underline the Corridor's suitability for Project of Significance status.

### 1.8 Other Potential Designations

Having regard to the multiple users and purposes for which the Corridor may be available to serve, the Government may, at the appropriate time, consider:

a) designating the Corridor as Community Infrastructure under the *Sustainable Planning Act 2009 (Qld),* or

b) declaring the Corridor as a State Development Area under the *State Development and Public Works Organisation Act 1971 (Qld).*

A Community Infrastructure designation, which can be made by the relevant Minister, would identify the Corridor land to facilitate the integration of land use and infrastructure planning, and the cost effective and efficient provision of the infrastructure.

Before designating land for Community Infrastructure, the designating Minister must be satisfied that:

- the proposal satisfied a public benefit test such that the project will contribute to environmental protection or ecological sustainability, or satisfy community expectations for the efficient and timely supply of infrastructure, and
- there has been adequate environmental assessment, including adequate public consultation, and also adequate account of issues raised in the public consultation.

Similarly, the potential for the Corridor to be declared a State Development Area could be given future consideration having regard to the potential uses of the Corridor land for purposes of strategic significance to the State's economic future. Such uses could include:

- communication network facilities;
- railway lines and associated facilities including general freight ;
- water infrastructure or infrastructure for water cycle management;
- energy infrastructure;
- waste management facilities;
- oil and gas pipelines;
- operating works under the *Electricity Act (1994 (Qld)*;
- emergency services facilities; and
- storage and works depots and the like including administrative facilities associated with the provision or maintenance of any of the above infrastructure facilities.

The Proponent will engage with the Government and the community further on this matter in the course of the EIS as the potential of the corridor to meet the relevant criteria becomes clearer.

# 2. The Proponent

The Project Proponent is East West Line Parks Limited (EWLP).

EWLP is a public company incorporated in the State of Queensland. The company was incorporated as a proprietary company on 1st March 2006 and completed conversion to public company registration, to broaden the company's share base, on 9th September 2011.

EWLP proposes the Galilee Infrastructure Corridor as a standalone project. EWLP's ultimate vision is to provide an efficient multi user infrastructure corridor that services the North West minerals province and eventually connects to the north west of Western Australia. The multiple users of the corridor would also benefit from additional corridor use efficiencies should the Proponent's Project Iron Boomerang proceed, and the Corridor thereby also promotes the realisation of Project Iron Boomerang.

The company has appointed an Executive Management Team and a Study Manager to design and develop the Project. A Project Management Team will manage a number of specialist consultants experienced in Queensland, Australia and overseas to undertake necessary design, construction and procurement inputs to the Project.

These inputs include assessment of the potential environmental, social and technical impacts of the proposed Corridor, more detailed design development and construction strategies in relation to corridor location and alignment, co location requirements and safety, earthworks, rail, cargo, information communication and technology infrastructure. Specialist services will be deployed also for impact assessment, and specialist legal consultants in associated planning approvals, common user access policies and protocols, infrastructure agreements and service delivery requirements.

Contact details for the Proponent are provided below.

**Proponent Contact Details**

| | |
|---|---|
| ***East West Line Parks Limited*** | East West Line Parks Limited<br>Level 16, 344 Queen Street<br>Brisbane, QLD 4000<br>(GPO Box 899, Brisbane QLD 4001) |
| ***Managing Director*** | Shane Condon<br>shane.condon@ewlp.com.au |
| ***Project Director*** | Tom James<br>tom.james@ewlp.com.au |
| ***Study Manager*** | Tony Lubicz<br>tony.lubicz@ewlp.com.au |
| ***Phone*** | +61 (0) 7 3221 6966 |
| ***Facsimile*** | +61 (0)7 3221 5545 |
| ***Reception*** | reception@ewlp.com.au |
| ***Website*** | www.ewlp.com.au |

# 3. The Nature of the Proposal

## 3.1 Scope of the Project

The proposal involves the development of a multi user, multipurpose infrastructure corridor (the Corridor) approximately 650km in length and nominally 150 metres wide comprised of the following three elemental sections:

- a 390 kilometre length from the Abbot Point State Development Area to a junction north of North Goonyella in the Bowen Basin then continuing west to the northern end of the Galilee Basin;
- a 230 kilometre length of corridor extending from the northern Galilee south past all mining tenements along the length of the Galilee Basin, terminating near the town of Alpha.

- a 30 kilometre spur length from the junction near North Goonyella south to a narrow gauge transfer hub near Moranbah.

The location and alignment of the Corridor is shown in Figure 1 (see page 13).

The Corridor will comprise a standard gauge, 40 tonnes load per axle heavy haul dual track rail freight system with a nominal gradient of 1:320 together with associated telecommunications infrastructure from the Galilee and Bowen Coal Basins to Abbot Point port. The first stage of construction will deliver a single track freight capacity in excess of 100 million tonnes per annum (Mtpa) and include provision of a service road and the accommodating earthworks formation and drainage made ready to facilitate the rapid and cost efficient duplication of the proposed heavy haul line to a freight capacity in excess of 350 Mtpa. Beyond this there is also provision within the Corridor for additional rail tracks to further increase its freight carrying capacity.

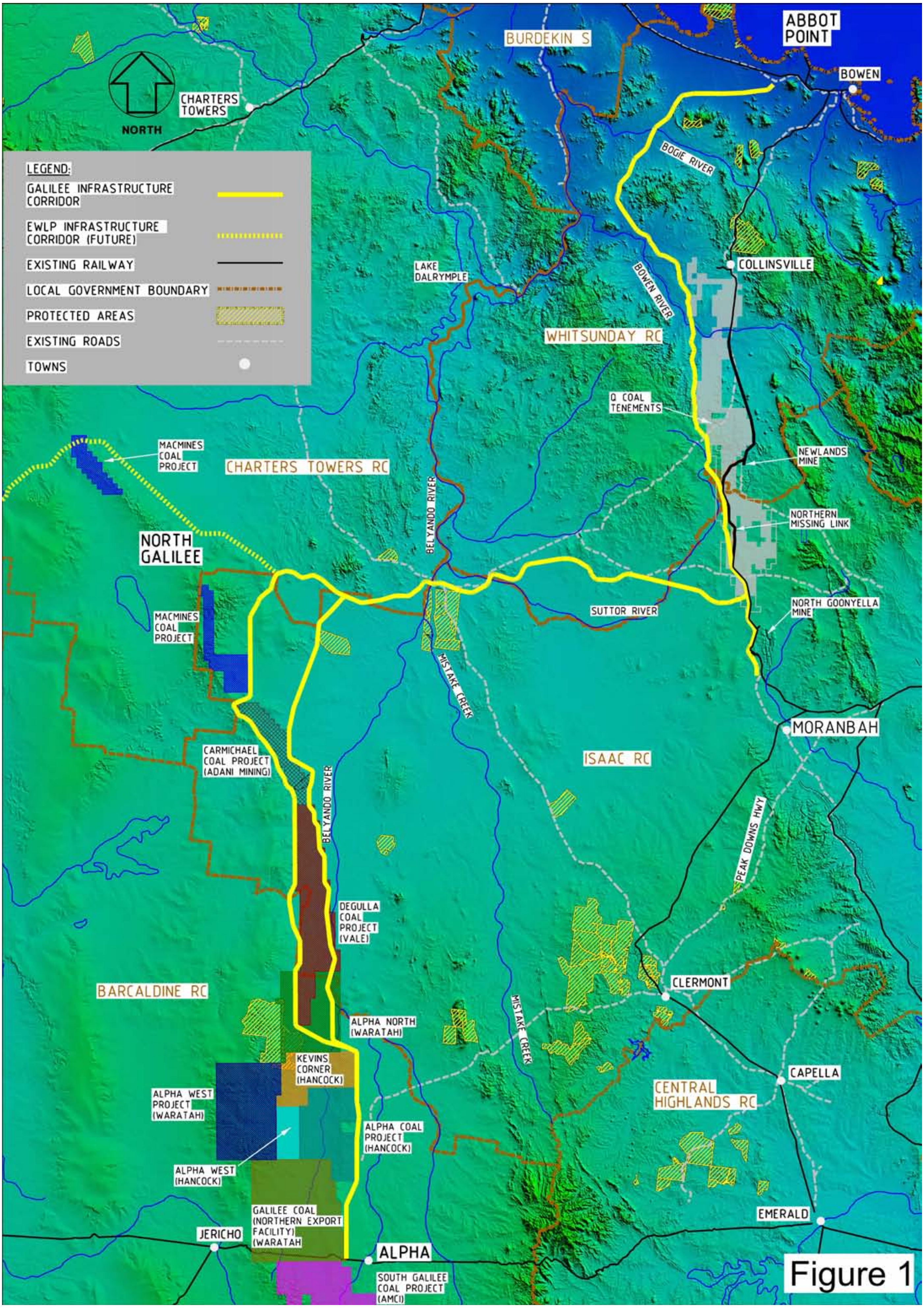
The proposal will include but not be limited to the following key phases of delivery:

- rail alignment and infrastructure design within the Corridor prior to approval;
- Corridor acquisition;
- detailed design, engineering, procurement and construction strategies, capital and operating estimates as part of a Bankable Feasibility Study (BFS) including development of an Environmental Impact Statement (EIS);
- construction management including commissioning of the rail and telecommunications infrastructure; and
- operations.

The Proponent will project manage the acquisition, design and construction of the rail and telecommunication infrastructure within the Corridor and will provide a turnkey site and a tenure required for the proposed infrastructure to be located within the Corridor, commensurate with the needs of the commercial terms for the infrastructure.

The Corridor will promote the long term economic development of the region, the State and the nation. Therefore, although not included in the current Scope, the Corridor is located and aligned to be extended west to service the Mt Isa region and the North West Minerals Province and beyond as well as adapted for future needs including additional rail lines, gas, water and other utilities.

The proposed nominal corridor width referred to above is expected to be sufficient to satisfy these future intentions, which would be the subject of separate detailed proposals.


ABBOT POINT
BOWEN
BURDEKIN S
CHARTERS TOWERS
NORTH
LEGEND:
GALILEE INFRASTRUCTURE CORRIDOR
EWLP INFRASTRUCTURE CORRIDOR (FUTURE)
EXISTING RAILWAY
LOCAL GOVERNMENT BOUNDARY
PROTECTED AREAS
EXISTING ROADS
TOWNS
BOGIE RIVER
COLLINSVILLE
BOWEN RIVER
LAKE DALRYMPLE
WHITSUNDAY RC
Q COAL TENEMENTS
NEWLANDS MINE
NORTHERN MISSING LINK
MACMINES COAL PROJECT
CHARTERS TOWERS RC
BELYANDO RIVER
NORTH GALILEE
SUTTOR RIVER
NORTH GOONYELLA MINE
MACMINES COAL PROJECT
MISTAKE CREEK
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING)
ISAAC RC
BELYANDO RIVER
PEAK DOWNS HWY
DEGULLA COAL PROJECT (VALE)
BARCALDINE RC
CLERMONT
ALPHA NORTH (WARATAH)
MISTAKE CREEK
KEVINS CORNER (HANCOCK)
ALPHA WEST PROJECT (WARATAH)
CAPELLA
CENTRAL HIGHLANDS RC
ALPHA COAL PROJECT (HANCOCK)
ALPHA WEST (HANCOCK)
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
EMERALD
JERICHO
ALPHA
SOUTH GALILEE COAL PROJECT (AMCI)
Figure 1

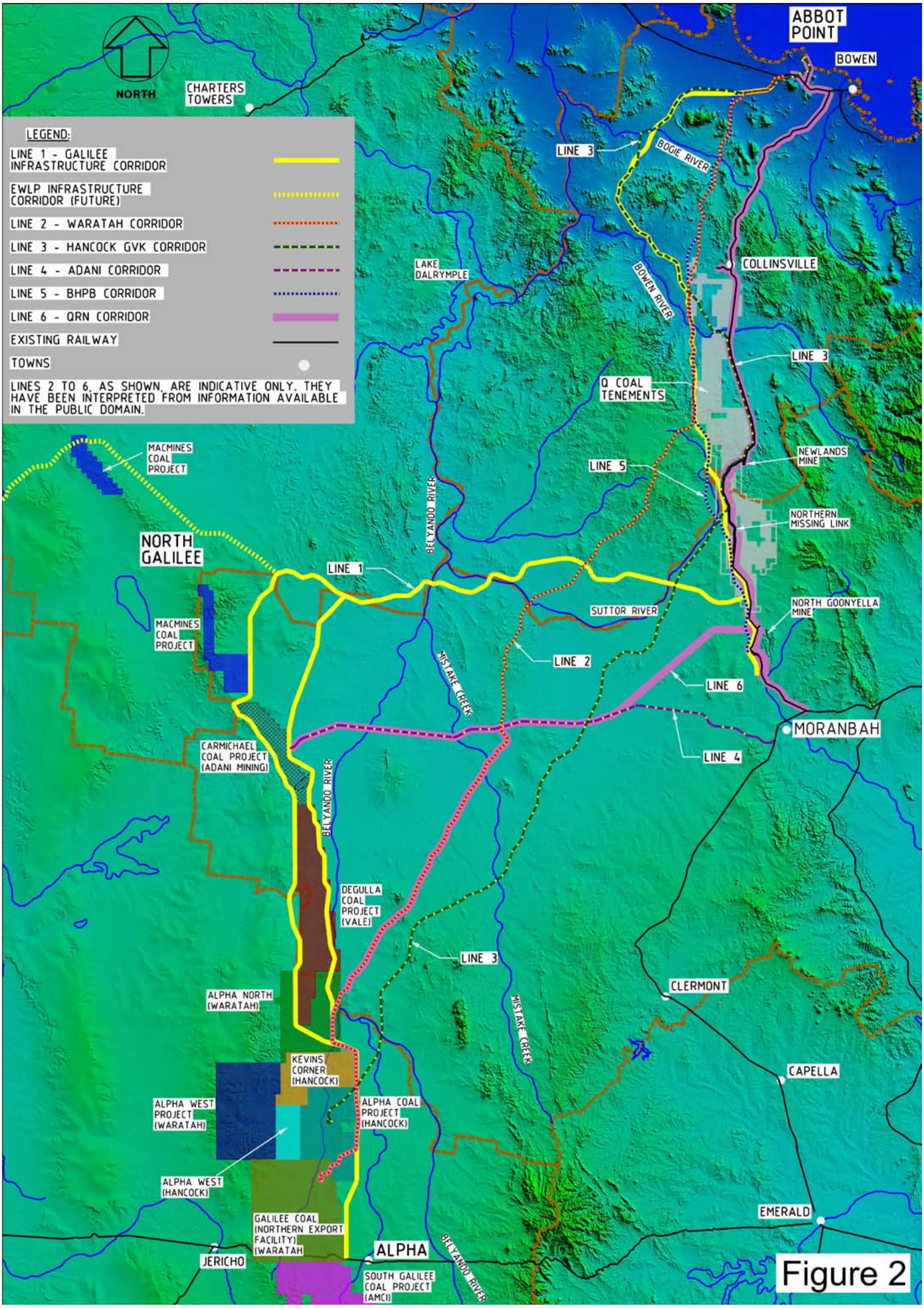

ABBOT POINT
BOWEN
NORTH
CHARTERS TOWERS
LEGEND:
LINE 1 - GALILEE INFRASTRUCTURE CORRIDOR
EWLP INFRASTRUCTURE CORRIDOR (FUTURE)
LINE 2 - WARATAH CORRIDOR
LINE 3 - HANCOCK GVK CORRIDOR
LINE 4 - ADANI CORRIDOR
LINE 5 - BHPB CORRIDOR
LINE 6 - QRN CORRIDOR
EXISTING RAILWAY
TOWNS
LINES 2 TO 6, AS SHOWN, ARE INDICATIVE ONLY. THEY HAVE BEEN INTERPRETED FROM INFORMATION AVAILABLE IN THE PUBLIC DOMAIN.
LINE 3
BOGIE RIVER
LAKE DALRYMPLE
BOWEN RIVER
COLLINSVILLE
LINE 3
Q COAL TENEMENTS
MACMINES COAL PROJECT
LINE 5
NEWLANDS MINE
NORTHERN MISSING LINK
BELYANDO RIVER
NORTH GALILEE
LINE 1
SUTTOR RIVER
NORTH GOONYELLA MINE
MACMINES COAL PROJECT
LINE 2
MISTAKE CREEK
LINE 6
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING)
LINE 4
BELYANDO RIVER
DEGULLA COAL PROJECT (VALE)
LINE 3
CLERMONT
ALPHA NORTH (WARATAH)
MISTAKE CREEK
KEVINS CORNER (HANCOCK)
CAPELLA
ALPHA WEST PROJECT (WARATAH)
ALPHA COAL PROJECT (HANCOCK)
ALPHA WEST (HANCOCK)
EMERALD
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
JERICHO
ALPHA
BELYANDO RIVER
SOUTH GALILEE COAL PROJECT (AMCI)

Figure 2

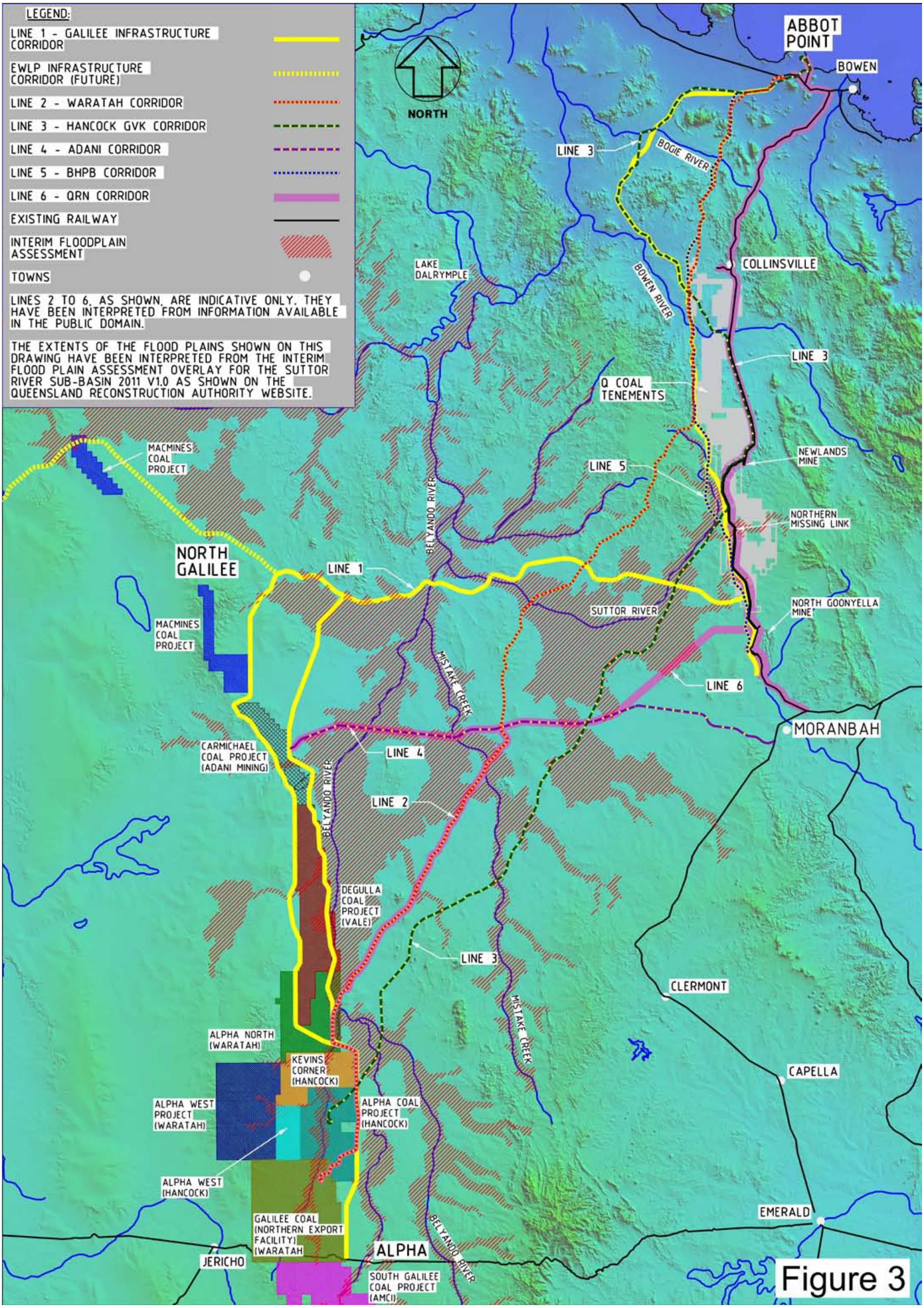

LEGEND:
LINE 1 - GALILEE INFRASTRUCTURE CORRIDOR
EWLP INFRASTRUCTURE CORRIDOR (FUTURE)
LINE 2 - WARATAH CORRIDOR
LINE 3 - HANCOCK GVK CORRIDOR
LINE 4 - ADANI CORRIDOR
LINE 5 - BHPB CORRIDOR
LINE 6 - QRN CORRIDOR
EXISTING RAILWAY
INTERIM FLOODPLAIN ASSESSMENT
TOWNS
LINES 2 TO 6, AS SHOWN, ARE INDICATIVE ONLY. THEY HAVE BEEN INTERPRETED FROM INFORMATION AVAILABLE IN THE PUBLIC DOMAIN.
THE EXTENTS OF THE FLOOD PLAINS SHOWN ON THIS DRAWING HAVE BEEN INTERPRETED FROM THE INTERIM FLOOD PLAIN ASSESSMENT OVERLAY FOR THE SUTTOR RIVER SUB-BASIN 2011 V1.0 AS SHOWN ON THE QUEENSLAND RECONSTRUCTION AUTHORITY WEBSITE.
NORTH
ABBOT POINT
BOWEN
LINE 3
BOGIE RIVER
LAKE DALRYMPLE
COLLINSVILLE
BOWEN RIVER
LINE 3
Q COAL TENEMENTS
MACMINES COAL PROJECT
NEWLANDS MINE
LINE 5
BELYANDO RIVER
NORTHERN MISSING LINK
NORTH GALILEE
LINE 1
SUTTOR RIVER
NORTH GOONYELLA MINE
MACMINES COAL PROJECT
MISTAKE CREEK
LINE 6
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING)
LINE 4
BELYANDO RIVER
LINE 2
DEGULLA COAL PROJECT (VALE)
LINE 3
CLERMONT
MISTAKE CREEK
ALPHA NORTH (WARATAH)
KEVINS CORNER (HANCOCK)
CAPELLA
ALPHA WEST PROJECT (WARATAH)
ALPHA COAL PROJECT (HANCOCK)
ALPHA WEST (HANCOCK)
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
EMERALD
BELYANDO RIVER
JERICHO
ALPHA
SOUTH GALILEE COAL PROJECT (AMCI)

Figure 3

## 3.2 Land Use

### 3.2.1 Existing Land Use

Planning undertaken to date indicates the Corridor will traverse multiple tenures including freehold, rural leaseholds, existing services corridors (such as gas and water pipelines) and various road and other public reserves.

The Corridor traverses predominantly agricultural and grazing land held under Leasehold and Freehold tenure and has avoided Strategic Cropping lands where identified.

Further assessment during the EIS study period will identify whether the Corridor may traverse areas identified on the trigger maps as Strategic Cropping Land. This will be validated during ongoing Government liaison and field assessments to ensure any impact on such lands is minimised or avoided.

There are several operating mines in the Bowen Basin potentially affected by the Corridor as well as other mining tenements under exploration or development. The Corridor has been sited to avoid all operating mines, so as not to adversely affect the current or planned operations of these mines.

Discussions with traditional owners, native title claimants and the owners of land have commenced and will be ongoing through the design, land acquisition and construction phases and beyond to ensure the sensitivities and concerns of each group are appropriately acknowledged.

### 3.2.2 Intended land use

The Corridor will be primarily used for rail transport of product from the Galilee and Bowen Basins to the Port of Abbot Point in the first instance.

Construction of the Corridor will require freehold acquisition, long term leases, easements or rights of way over various lengths of the Corridor, and arrangements to access any existing impacted infrastructures in the Corridor, the nominal width being 150 metres plus localised widening for high embankments and cuttings depending on topography and expansion where practical and relevant. The maximum width of the Corridor at any location will vary depending on cutting height and topography.

The Corridor will provide for a dual track, standard gauge, heavy haul railway system and a carrier grade high availability communications network in part consisting of a fibre core and a wireless overlay network for train control and general communications. There is also future provision within the Corridor for additional rail tracks, water and gas pipelines.

## 3.3 Project Need, Justification and Alternatives Considered

### 3.3.1 Objectives

The primary objective of the Project is to provide an open access, common user infrastructure Corridor of optimum economic efficiency for the long term benefit of all users and stakeholders, especially for the transport of mined coal from the Galilee Basin and Bowen Basin to the Port of Abbot Point. The Corridor alignment and design is specifically intended to avoid the need for multiple railway corridors traversing the State to meet the needs of the proposed mines within the Galilee Basin area.

Once established, the Corridor will meet the significant freight and associated needs for the current and planned coal mining ventures for the respective Bowen and Galilee Basins and further west, as well as provide potential freight services to / from regional towns and communities, for agricultural produce and associated service needs of communities and economic sectors in the regions and to / from Abbot Point multi cargo facility sea port and the Abbot Point special development zone.

Implementation of the Project will provide the basis for the Proponent to promote further industrial development in the Abbot Point State Development Area capitalising on the resources available from the Bowen Basin and provide export avenues for coal mining ventures operating at both the Bowen Basin, Galilee Basin and Abbot Point.

To optimise the operational efficiency of the freight Corridor, the Corridor will incorporate state-of-the-art, carrier grade, high availability communications technology and standard gauge, 40 tonnes load per axle rail at maximum 1:320 vertical gradient.

### 3.3.2 Feasibility Studies

The Proponent has extensively studied the freight model proposed, including freight growth of the relevant regions and beyond to areas such as the North West Minerals Province and Mt Isa region. The Project design incorporates using modern, fuel efficient locomotives and high capacity, environmentally friendly, closed lid coal wagons where compatible with existing infrastructure capable of delivering greater payloads per train and at lower cost per tonne from mine to port.

The emergence of the Galilee Basin coal mine development projects has provided the opportunity for the Proponent to offer the region a solution which greatly improves upon the multiplicity of railway corridors being proposed. This “common sense” solution is achieved by developing a single, multi user, multipurpose Corridor providing an efficient heavy haul standard gauge railway system.

The Proponent has also completed a preliminary Corridor Definition Study in October 2011 which has determined the most suitable route for the Corridor alignment that meets key business objectives whilst maintaining its commitment to minimising land use impacts in the region.

The Proponent is currently undertaking the detailed business case, and reference design and commencing the EIS for the Project.

### 3.3.3 Support for Government Policies and Strategies

The State Government has recently issued a *Queensland Infrastructure Plan 2011 (QIP)* and has plans and policies in support of the Coal Industry and economic development in the North West Minerals Province and Mt Isa Region.

In particular, this Project will support the Government’s key objectives in addressing the following themes in the QIP:

- attraction and retention of staff, particularly in the regions;
- address Mining Boom Impacts;
- strengthen Economic Diversity in support of local communities;
- provide Inter-regional accessibility; and

- enhance Service Provision by providing transport infrastructure to service regional communities with fuel, energy, water, mining equipment, agricultural service inputs and produce freight needs.

The QIP will be specifically supported in meeting the Freight Movement needs of the mining regions referred to in the Plan as summarised below:

*"Other priorities include improving road and rail access between Mackay and the Bowen and Galilee basins, and facilitating rail corridor development that supports industry provision of efficient rail linkages between the Galilee Basin and Abbot Point."* (QIP p. 64):

The Project will also support these policies and plans by providing open transport access to the Abbot Point State Development Area and significantly contribute to trade growth, particularly in the resources sector by meeting the long term trade needs at the Port. The Project offers a multi user, multipurpose infrastructure Corridor from the Galilee Basin to Abbot Point:

*"... to facilitate large scale industrial development while recognising environmental, community and cultural values adjacent to the deepwater Port at Abbot Point.*

*A multi cargo facility is also proposed at the Port of Abbot Point... a sheltered harbour, capable of handling multiple cargos with a number of new berths ... represents a significant industrial development opportunity for the State''* (QIP p.64):

The Project also has potential to support the strategic objectives of the *Northern Economic Triangle Infrastructure Plan 2007-2012*, securing the future prosperity of the North West and North Queensland as a triangle of mineral processing and industrial development. In particular, the proposal will support the strategic objective of:

*"Infrastructure development to establish Bowen as a major new industrial precinct for the large scale industries including chemicals production, mineral refining and metals smelting."* (QIP p. 33);

The Project will also provide an infrastructure foundation for meeting the future strategic needs of the Mt Isa region by addressing the accessibility of the region to supplementary transport infrastructure:

*"Reliability of transport infrastructure is compromised by seasonal factors such as flooding, black soils and the effects of high temperatures on rail track requiring significant maintenance."* (QIP p.17);

The Proponent intends to work with the State Government during the construction phase of the Project to give effect as appropriate to the principles of local industry participation with the objective of giving full, fair and reasonable opportunity for Queensland businesses to participate in the Project.

### 3.3.4 Preferred Option and Alternatives

#### 3.3.4.1 Preferred Option

The proposed Galilee Infrastructure Corridor is the preferred corridor which satisfies the Proponent's overall project objective: namely an open access freight Corridor of optimum economic efficiency for the long term benefit of all users and stakeholders.

The Corridor is the product of a refinement process by which the Proponent has applied multi-criteria risk assessment procedures to analyse numerous potential alignments (totalling approximately 36,000 route kilometres).

The Proponent's analysis acknowledged the following essential freight Corridor attributes as the appropriate 15 point criteria by which a Corridor to Abbot Point should be determined:

1. aggregates freight from all Galilee Basin mine tenements via a single Corridor of minimum length, inclusive of spurs (essential for optimum freight efficiency, and limit land use impact);
2. integrates with the Bowen Basin coalfields (essential for optimum efficiency and service utility);
3. incorporates state-of-the-art standard gauge rail (an essential starting point for Pilbara style freight efficiency);
4. enables 40 tonnes load per axle track and wagon capacity (essential for optimum freight efficiency rail and wagon capacity);
5. maximum 1:320 gradient against the loaded train consist (essential for optimum operational efficiency);
6. enabled for cost efficient duplication to >350 Mtpa capacity (essential for achieving full Galilee Basin capacity in a single Corridor or dual track);
7. incorporates state-of-the-art carrier grade telecommunications and wireless overlay network (essential to enable real time locomotive management and train control signalling for optimum operational efficiency);
8. incorporates advanced train control signalling on a common shared platform for optimal freight efficiency in a multi user environment (essential for an efficient environment to enable mining companies to be masters of their destiny);
9. accommodates future community utility services (essential for maximum shared community benefit);
10. minimum encroachment on valuable agricultural cropping and cattle lands (essential for minimum land use impact);
11. minimises foundations on black soil floodplains and other poor natural materials (essential for minimum capital cost and land use impact and to minimise long term operational risk);
12. minimum earthworks and rock excavation and optimum cut-fill balance (essential for minimum capital cost and land use impact);
13. minimum drainage and flood mitigation measures and the avoidance of floodplains (essential for minimum capital cost and risk of operational disruption due to flooding events);
14. suitably configured for direct heavy haul rail Corridor extension west to the Mt Isa region and the North West minerals province (to catalyse and promote its economic development); and
15. maximises practical alignment proximity to existing rail corridors (in order to reduce land use impact).

The Proponent's preferred Corridor, as shown in Figure 1 (see page 13), adheres to these criteria and has the following particular attributes:

- provides a single, multi user infrastructure Corridor to Abbot Point servicing the doorstep of all mining tenements in the entire Galilee Basin whilst minimising the required length of railway including spurs;

- simultaneously provides a standard gauge heavy haul freight solution to Abbot Point from an integrated rail location central to the Bowen Basin coalfields;
- builds in optimum economic operational efficiency for all users by having standard gauge, heavy haul railway line of 40 tonnes load per axle capacity with maximum up gradient of 1:320, duplicated as demand builds;
- enables the use of the latest generation of American heavy haul locomotives;
- the proposed use of closed lid coal wagons that eliminate in transit dispersion of coal dust as well as being environmentally desirable with increased efficiencies through reduction in aerodynamic drag thereby reducing the usage of locomotive diesel fuel;
- enabled for cost efficient line duplication to 350Mtpa capacity;
- incorporates state-of-the-art, carrier grade, high availability communications technology;
- incorporates a train management strategy enabling optimal multi user freight density and efficiency;
- accommodates other potential future community utility services: e.g. water, gas, power, enhanced telecommunications etc;
- minimises land use impacts and encroachment on valuable agricultural cropping and cattle grazing lands;
- minimal floodplain encroachment (ref. Figure 3 – see page 15), minimising costly drainage requirements with reduced risk of operational disruption due to flooding events;
- minimises areas of poor soil foundations and rugged rocky terrain, thereby minimising construction costs and operational risk;
- facilitates cut/fill balance with minimum earthworks and imported fill by selecting topographically suitable terrain;
- aligns adjacent to existing rail corridors, where practical to do so, to minimise land use impacts;
- aligns for direct heavy haul extension further west to service the development of the Mt Isa region and the North West Minerals Province;
- avoids townships (e.g., Collinsville) and minimises impacts on other recognised settlement areas and significant rural infrastructure (e.g. homesteads, stockyards, stock dams, bores);
- avoids environmentally sensitive areas such as National Parks and known declared nature reserves;
- avoids existing and planned mines and other infrastructure; and
- locates required ancillary infrastructure (e.g. unloading infrastructure and rail loops at Abbot Point) all within close proximity to existing key infrastructure.

With reference to Figure 3 (see page 15), the extents of the flood plains illustrated is the most recent interim floodplain assessment overlay sourced from the Queensland Reconstruction Authority website.

With reference to Figure 1 (see page 13), the following paragraphs describe the preferred Corridor route.

The Corridor from the northern Galilee Basin to the junction at North Goonyella (west to east) follows the foothills of higher land formations at relatively flat longitudinal grade and remains to the north of the major black soil areas and out of flood plains. This route minimises impacts on valuable agricultural lands to the south of the Corridor and can comfortably generate an earthworks cut-to-fill balance on the railway formation, thereby minimising the potential need for imported fill and its impact on land forms and surrounding property.

Adopting a generally north-south alignment along the Galilee Basin, the Corridor bypasses agricultural zones and remains close to all of the Galilee Basin mining tenements. Its route will be selected from two current options during the EIS study and design development period: either along the western flank of the Galilee mining tenements or along the eastern tenement boundaries (both options are shown in Figure 1 - see page 13). Whichever of these options is selected, each of the various emerging and future mines in the Galilee Basin may then be joined to the Corridor by a localised rail loop connection. In this way, the Corridor not only minimises impacts on landholders but also provides all potential Galilee Basin mines with a ready access to a single high capacity Corridor of high flood immunity without the need to build lengthy inefficient spur lines that disrupt the community and the environment.

The Proponent proposes a rail transfer hub near Moranbah to enable new and existing mining operations in the Bowen Basin an option to haul metallurgical coal on an efficient heavy-haul standard gauge railway to Abbot Point. The rail transfer hub will link to the current and emerging Bowen Basin mines via a spur line which will be either narrow gauge or standard gauge or dual gauge. (a combined narrow gauge and standard gauge track) as preferred. Equally, should particular mining companies prefer, the dual gauge line may be extended through to the Galilee Basin.

The Corridor route between North Goonyella and Abbot Point may deviate at two locations from that shown in Figure 1 (see page 13), subject to further detailed analysis and ongoing landowner discussions to be concluded during the EIS study period. From approximately 60 km north of Moranbah the alignment will either be to the west of the Q-Coal tenements (as shown) or on an alignment through those tenements.

From approximately 25 km south of Collinsville, the Corridor to Abbot Point will be selected from one of two routes: the western alignment (as shown), which meets the Proponent’s maximum up-gradient criterion of 1 in 320, or a route through the Clark Ranges which, although being 30 km shorter, exceeds this gradient criteria at localised points. Further train simulations are being undertaken to determine which of these options has the better whole-of-life cost efficiency.

The current Corridor alignment design has attempted to avoid sterilisation of known mining tenements. During the EIS evaluation further design optimisation will be undertaken in consultation with the relevant mining companies to ensure the least impact on or complete avoidance of mining tenements is achieved.

The Proponent’s proposed multiple user, duplicated 40 tonnes load per axle standard gauge line constructed in good foundations away from floodplains, with optimum rail geometry and served by a state-of-the-art latest generation of American heavy haul locomotives together with the efficiencies gained from closed lid coal wagons and a carrier grade telecommunications network with advanced train control signalling, will facilitate optimum operational freight efficiency.

This will achieve significant savings for the coal mine owners in the Galilee and Bowen Basins by aggregating freight volumes, consolidating supply chains and deploying a combination of high efficiency rail freight design parameters not currently available for coal freight in Queensland. This will enable the mining companies to maximise the productive and efficient operation of their tenements in the context of the high AUD exchange rate and ever increasing input cost pressures. It offers the most cost competitive solution to the Galilee Basin (and Bowen Basin) mine operators to enable them and the Mining industry in Queensland to continue to be globally competitive.

The Proponent considers that it is in the State's best interest that all Galilee Basin freight users are served by its proposed open access freight Corridor, enabling all mines to be adequately serviced long term in the most efficient way.

Further, the Proponent's solution promotes the State's yet unrealised ambition to connect the North West Minerals Province to the east coast via an economically efficient heavy haul rail line, by advancing such an asset nearly half the way to Mt Isa.

#### 3.3.4.2 Alternatives

The Proponent has analysed numerous alignment options (totalling more than 36,000 route kilometres), which it assessed against its 15 point selection criteria (ref 3.3.4.1 above). The focus of the criteria is to provide the optimum economic freight efficiency to ensure comparative economic benefit is returned to all parties using the railway alignment / Corridor that provides the least possible cost per tonne hauled.

These studied options had many things in common with other freight corridor proposals from the Galilee and Bowen Basins currently in the public arena for consideration, of which there appear to be at least five in number. These include three proposed corridors from the Galilee which traverse generally from south-west to north-east, an additional corridor mooted as an east-west connection from the central Galilee to Moranbah, a new corridor traversing generally northwards from Moranbah to Abbot Point and a brown fields upgrade of the existing narrow gauge rail line from Moranbah to Abbot Point is also proposed.

These alternative proposals therefore serve as useful comparators.

From publicly available data the Proponent has applied its 15 point multi criteria risk assessment criteria to analyse each of these proposed rail corridor options for the region and to determine the potential suitability of each to meet the Proponent's essential project objective: namely, an open access freight Corridor of optimum economic efficiency for the long term benefit of all users and stakeholders.

With reference to Figure 2 (see page 14), in which the Proponent's preferred Corridor is identified as Line 1, the proposed alternative rail corridors (Lines 2 to 6 inclusive) may be broadly categorised as follows:

**Line 2:** 25 tonnes load per axle coal wagons operating on a 40 tonnes load per axle standard gauge rail track from a tenement in the southern Galilee generally in a north-easterly direction to Abbot Point;

**Line 3:** 32 tonnes load per axle standard gauge rail from a tenement in the southern Galilee Basin, generally in a north-easterly direction to Abbot Point.

**Line 4:** 20 – 25 tonnes load per axle potentially dual gauge line from a tenement in the central Galilee east to Moranbah, with connections to lines 2, 3 or 6;

**Line 5:** 20 – 26 tonnes load per axle narrow gauge rail from the Bowen Basin, near Moranbah, through to Abbot Point proposed as part of a wider open-access corridor.

**Line 6:** 20 – 26 tonnes load per axle set of narrow gauge rail corridors including brown fields upgrade from Abbot Point to North Goonyella with a new connection that joins it to Line 4 and thereafter becomes a twinset of diverging corridors which overlay parts of both Line 4 and Line 2.

The Proponent considers that each of these alternative corridors presents comparative disadvantages, including the following:

- Each of the alternative corridors best serves the single tenement from which it originates, whereas the GIC is designed to service all Galilee Basin tenements equitably;
- the alternative corridors are not suited to the aggregation of all Galilee Basin freight into a coordinated, optimum efficiency solution of required high capacity, whereas the GIC is selected for this purpose;
- each of the alternative corridors requires a network of additional trunk and spur lines of significant length to fully serve the Galilee Basin, whereas the GIC achieves this outcome via a single corridor of minimum length;
- the alternative corridors are not configured for direct heavy haul extension to economically service the future expansion of the North West Minerals Province around Mt Isa, whereas the Galilee Infrastructure Corridor is configured for this;
- the alternative corridor alignments do not suit the Galilee Infrastructure Corridor's proposal for a heavy haul 40 tonnes load per axle track and rolling stock operations, whereas this criteria is essential to achieving optimum economic efficiency on long haul freight; and
- the alternative corridor alignments add significant capital cost and operational and maintenance risk in traversing significant tracts of black soil, floodplains and/or rugged terrain, whereas the Galilee Infrastructure Corridor alignment minimises exposure to unfavourable costly topography.

The Proponent considers each of the options it has reviewed, including the proposed alternative alignments in the public domain, does not suit all of its 15 point risk assessment criteria and therefore does not meet its essential project objective: namely, an open access freight Corridor of optimum economic efficiency for the long term benefit of all users and stakeholders.

A 'do nothing' option, whilst avoiding potential adverse impacts on landholders and the environment in the region, would leave the Galilee Basin coal resources stranded and the Bowen Basin coal reserves under developed and further delay the realisation of the development potential for the North West minerals province. It would also fail to adequately service the new Abbot Point multi cargo facility and adjacent State development Area special zones, which demands a modern high capacity rail service for its economic potential to be reached.

### 3.3.5 Summary of Key Strategic Benefits

The Project represents a unique opportunity to coordinate the Galilee coal transport requirements within a single Corridor by an efficient heavy haul railway system with maximum economic benefits to the Queensland economy, the broader community and the coal mining companies in the region well into the future.

The Project is of strategic significance in that it will:

- contribute to the Government's Infrastructure Policy, the promotion of domestic capital formation, and shape future infrastructure planning and development in Queensland;
- support the National Government's infrastructure priorities as outlined in the *2011 Report* by Infrastructure Australia to the Council of Australian Governments including the delivery of Competitive International Gateways, A National Freight Network and a National Broadband Network;
- contribute to the long term employment sustainability in the regions for the existing industry sectors and open up upstream and downstream development opportunities realised by existing and potential industries utilising the Corridor;
- have the capacity to serve multiple sectors including agriculture and pastoral, not only the mining sector;
- significantly reduce disruption to landholders and to the valuable cropping and grazing lands of the region;
- function as a trade Corridor and provide foundation customers in support of the Multi Cargo Facility at the Port of Abbot Point;
- enable an efficient use of land and resources within the current corridors owned by the Coordinator General in the Abbot Point State Development Area and within the corridor owned by North Qld Bulk Ports;
- eliminate the need for multiple corridors connecting to the Galilee basin and thereby reduce financial costs involved in the development of a multiplicity of rail corridors currently proposed;
- have the capacity to provide for multiple uses into the future including water, energy and information and communication technology infrastructure to support regional development in Queensland;
- contribute to the utilisation of existing Government Owned Corporations (GOC) infrastructure and returns on such investments; and
- open up potential to service the North West minerals province and developments further afield.

## 3.4 Components, Developments, Activities & Infrastructure that Constitute the Project to be declared Significant

Initial assets in the Corridor (Galilee to Abbot Point via Moranbah) will potentially be:

- 650 km of duplicated 40 tonnes load per axle heavy haul, standard gauge railway from Abbot Point to the Bowen and Galilee coal basins;
- passing tracks and sidings;
- several bridge-over-river crossings;

- several road-over-rail crossings particularly west of Moranbah;
- several rail over rail crossings;
- carrier grade communications network to enable rail operators and other parties to utilise a multi service networks from Abbot Point to the Galilee Basin and beyond. The communications network will in part consist of:
  - 1250 km fibre optic cable(s) for control of rail operations and general communications;
  - a carrier grade high availability wireless overlay network for control of rail operations; and
  - advanced rail signalling equipment for safe rail operations.

A preliminary checklist of key components of the planning phase includes:

**Table 1: Key Components of the Planning Phase**

| Item | Status |
|---|---|
| **Rail** | ■ Dual track, heavy-haul, standard gauge railway comprising of 68kg/m rail, prestressed concrete sleepers on ballasted track;<br>■ Storage and passing tracks with interchange capability;<br>■ Signalling and communications facilities;<br>■ Marshalling yards;<br>■ Material Transfer Hub. |
| **Rolling Stock**<br><br>**Structures** | ■ Specially designed 40 tonnes load per axle coal freight wagons; or existing large heavy haul coal wagons, where applicable.<br>■ Heavy Haul Locomotives.<br>■ Rail-over-river bridges;<br>■ Road-over-rail bridges;<br>■ Rail-over-rail bridges;<br>■ Train Control facilities;<br>■ Major Culverts;<br>■ Cattle pass (under and/or over). |
| **Buildings** | ■ Maintenance workshops;<br>■ Administration offices;<br>■ Crew amenities buildings;<br>■ Refuelling and servicing facilities/workshops (ultimately); |
| **Roads** | ■ Service roads for construction and operations (maintenance);<br>■ Upgrading of existing Council and State networks where necessary. |
| **Accommodation** | ■ Accommodation for construction (multiple sites). |

| Table 1: Key Components of the Planning Phase | |
|---|---|
| **Item** | **Status** |
| **Miscellaneous** | ■ Fencing to exclude cattle and wildlife;<br>■ Signage. |
| **Telecommunications Network** | ■ Fibre optic core;<br>■ Transmitter and repeater stations;<br>■ Communications towers. |

The Project will also include a material transfer area to facilitate the transfer of materials from narrow gauge to standard gauge rolling stock and will be located to the north west of the town of Moranbah.

A key component of the Corridor will be a state-of-the-art integrated signalling and communication system based on fibre optic cores with a wireless overlay network that will enable significantly improved coordination of train movements to and from the port, avoiding congestion by optimising scheduling and ensuring efficient use of the rail freight network.

A complete list of components of the Project will be further developed during the engineering and design phase of the Project.

### 3.5 External Infrastructure Requirements

Other assets forming part of this Project, which are outside the Corridor battery limits, will include:

- train refuelling facilities (at or near the Port);
- rolling stock maintenance workshops (possibly in the vicinity of Moranbah or Abbot Point);
- ballast quarries supporting railway construction and future maintenance requirements;
- sleeper Manufacturing Plant; and
- flash butt Welding Depot and rail transfer facility.

There will be additional needs for passing and storage tracks at various points along the Corridor. These will be sited appropriately where landforms are suitable so as to minimise the need for landfill or excavation to extend the Corridor width and, in consultation with landholders, away from housing and homesteads and areas impacting land use.

Additional infrastructure for marshalling, servicing, repairing and transhipment of product will also be required, predominantly on site. Refuelling facilities will be sited at or near the port so as to avoid the need for large storage facilities and associated high fuel transport costs to a major inland facility.

Needs for water supplies and electricity are largely related to the construction phase of the Project and are noted in section 3.7 below.

### 3.6 Time-frames for the Project

The construction delivery time frame for commencement of rail operations from Abbot Point to the Galilee Basin via Moranbah has been planned to suit the coal haulage needs of the emerging mine in the Galilee and Bowen Basins. The preliminary Schedule is outlined in Table 2 below. The projected date for start-up of operations for the North Galilee Basin to Abbot Point Port is early 2016. Note: dates supplied below are in Calender Years (CY):

| Table 2: Proposed Schedule | |
|---|---|
| **Milestones** | **Dates** |
| **Studies and Plans** | |
| Complete Corridor Definition Study | Q4, CY11 |
| Issue IAS to Coordinator-General of Queensland | Q1, CY12 |
| Complete environmental constraints assessment and cultural heritage plan | Q1, CY12 |
| Prepare EIS draft Terms of Reference | Q2, CY12 |
| Submit Environmental Impact Statement (EIS) to Government | Q1, CY13 |
| Complete Detailed Design and Planning Study | Q4, CY13 |
| Coordinator General's Report issued | Q4, CY13 |
| Final State and Commonwealth Govt approvals | Q4, CY13 |
| Order long-lead items (LLIs) | Q4, CY13 |
| **Construction** | |
| Start construction of railroad from Abbot Point to Alpha via Moranbah | Q4, CY13 |
| Complete railroad between Abbot Point and Moranbah | Q3, CY15 |
| Complete railroad between Moranbah and Alpha | Q4, CY15 |
| **Operations** | |
| Commence operations from Abbot Point to Bowen Basin | Q4, CY15 |
| Commence operations from Abbot Point to Galilee Basin | Q1, CY16 |

Note that a staged approach will be adopted for commissioning, enabling operations to commence from the Bowen Basin in Q4 2015. Start-up of operations from the Galilee Basin is anticipated to be in Q1 2016.

### 3.7 Construction and Operational Processes

Construction is scheduled to begin in Q4 2013 and will involve the following activities:

- establish workforce camps, suitable access roads and compounds;
- establish borrow pits and quarries;

- clearing of the rail alignment;
- bulk earthworks and open drainage;
- culvert drainage and other structures including bridges;
- formation, capping and ballast;
- sleepers and rail placement;
- installation of communications and signalling infrastructure;
- locomotive and wagon maintenance facilities;
- provision for electrification; and
- batter treatments and environmental controls.

### 3.7.1 Access Roads, Construction Camps and Compounds

Access roads identified for use during construction will include the existing roads network and any additional access ways negotiated with landowners as required by the constructors for the proper execution of the works.

The Project will attract a significant construction workforce whom it is envisaged will be housed in camp accommodation established along the route. Camp sites will be fully configured to industry standards and established to comply with all relevant Council bylaws and guidelines with respect to accommodation, water and sewage/waste management.

Initial site activities will include small mobile teams that will either be accommodated in townships, caravan parks or fly camps depending on the nature of the activity. The principal workforce engaged in earthworks, bridge and railway construction will be accommodated in the construction camps strategically placed along the Corridor route as to optimise daily travel distance of the workers. Detailed planning on the construction methodology will be refined during the EIS study period dependent on the outcomes of negotiations with Government agencies and landholders. At this stage it is envisaged that there may be 5 construction camps each with in excess of 600 persons capacity, complying with relevant Local and State Government requirements and located approximately 100 to 120 kilometres apart between the Galilee, Moranbah and Abbot Point, with progressive relocation of material stockpiles and storage yards for equipment and machinery.

Power to these camp sites and storage compounds will be accessed from the grid where possible or generated on site. Water supply (potable) will be sourced by bores and Reverse Osmosis (RO) plants established within the camp perimeter or alternatively trucked to site as required in the absence of any available pipelines, town supplies or suitable bores as approved under the Water Act 2001. The location of the construction camps, their power and water requirements and mode of supply will be determined during the EIS study period.

Grey water generated from the camp population will either be treated on site and recycled on garden areas within the camp facilities or removed from site and disposed of in accordance with the Local Council Bylaws within approved disposal areas and as required by State regulations where applicable.

### 3.7.2 Construction

Construction will be undertaken on at least the following three main fronts concurrently: the Abbot Point to Moranbah section; the west to east Corridor from North Galilee through to North Goonyella; along the Galilee Basin mining tenements.

There are likely to be several temporary work sites along each work face that will move as work progresses. The workforce will be taken to site daily along existing roads or via the Corridor itself to minimise impacts on local landholders.

Civil works would include construction of earthworks, road works, maintenance track, drainage culverts, bridges and other structures.

Rail works would include track laying, telecommunications and signalling installation.

Building works would include provision of locomotive and wagon maintenance facilities and the establishment of concrete batch plants and a prestressed concrete sleeper manufacture facility.

Plant and equipment necessary to carry out the construction works will be sourced from local contractors where suitable and brought to the site by road. The following construction equipment is likely to be engaged in the work activities:

Civil works: piling rigs, cranes, compressors, water carts, rollers, scrapers, trucks, loaders, bulldozers, graders, excavators, backhoes and crushing plants for various aggregates including ballast.

Rail works: track layer, ballast wagons, rail welder, tamper, water cart, excavator

Building works: backhoe, truck, delivery vehicles, crane, small tools.

The Corridor route has been selected to avoid floodplains and minimise culvert drainage and to ensure a relatively low volume earthworks with balanced cut and fill outcome may be obtained. The detailed design will ensure such an outcome is realised with minimum haul distances and minimum requirement to establish borrow pits for additional embankment material.

The bulk earthworks majority short haul exercise will be undertaken using scraper fleets with trucks and excavators used for longer haul.

Drainage works will consist of standard culvert installations.

Bridge construction will consist of economical standard elemental construction.

There are no dangerous chemicals utilised at any of the communication sites. All power is generated on site potentially by a combination of wind turbines, photovoltaic cells and fuel cells (that are run from LNG). The stored power is in recombinant gel cell battery banks. Similarly the fibre optic cable is trenched and buried to a depth of 1 to 2 metres in the Corridor.

The artefacts of the ITC installation subject to the outcome of detailed survey are likely to be 30 communication sites interspersed approximately every 25 Km in the Corridor. These sites are approximately 20 metres by 20 metres perimeter security fenced are for digital radio back-haul repeater signalling and fibre optic termination and re amplification for the core IP/MPLS network and the cellular radio overlay network Base Station repeaters. Each site accommodates a tower of varying height and design to house cellular radio antennae radiating elements, digital radio (microwave) back-haul and wind turbines. The equipment is connected by cable housed in hardened conduits that are terminated in the ballistic rated IP enclosures where sensitive electronic equipment is maintained in the appropriate environment. The hardened conduits are designed to minimise or resist the impact of fauna.

### 3.7.3 Construction Materials including Water Supply

Operational water supplies will be required for dust suppression, earthworks construction, haul road maintenance, capping layer construction, concrete batching, weed washing bays and other construction needs. The Proponent will determine the Project's volumetric water requirements and the means of water supply for the Project during the EIS study period.

It is anticipated that water will be obtained from underground water sources, from temporary or permanent dams in the region and from private utilities via existing pipeline. It is envisaged that temporary dams and bores with appropriate storage will be established as water supply for the construction. In addition water will be accessed under licence from rivers and existing water pipelines where possible.

Where earthworks are involved and particularly at river crossings, all site runoff water will be captured in detention basins to treat sediment loads and used for dust suppression. Discharge to land will only be permitted when sediment loads are within acceptable runoff limits. All wastes will be appropriately managed through treatment and disposal by approved methods and sites will be fully restored on completion.

In support of the construction activities, significant quantities of materials including the supply of culvert and bridge elements will be delivered from off-site locations. There may also be temporary manufacturing facilities located along the Corridor route for pre-stressed concrete sleeper manufacture, flash butt welding and rock crushing for capping and ballast material supply. These activities as well as the major construction works will attract an increase in local vehicular movements for the delivery of materials to the various facilities. The Proponent will work with the Local Councils, Main Roads Department and the community at large to ensure the condition of the existing road infrastructure is maintained to a safe standard for all users during construction.

### 3.7.4 Operation and Maintenance

Operation and maintenance of the rail lines in the Corridor will be undertaken under contract on behalf of the Proponent. State-of-the-art locomotive and wagon facilities and other required installations will be established at locations to be determined during the EIS study period. Separate facilities will be required for maintenance of locomotives and rolling stock.

## 3.8 Workforce Requirements during Construction and Operation

The Project will attract a major construction workforce to the region. The Project is expected to engage approximately 3,500 workers during construction period, and it is anticipated that the operating railway and associated infrastructure will generate at least 150 direct permanent employees.

Whilst it would be ideal to house the temporary workforce within townships for the duration of the construction phase of the Project, realistically it is envisaged there may be an accommodation shortage in these areas that will necessitate temporary construction camps allowing for some fly in fly out (FIFO) construction workers.

Accommodation for the operational workforce will be accessed at suitable locations in proximity to the maintenance facilities established and required maintenance tasks, most likely at Moranbah and/or Alpha and/or Bowen townships.

### 3.9 Economic Indicators

Coal exports are one of the largest contributors to Queensland's economy in terms of both employment opportunities and royalties. Coal reserves in the Galilee and Bowen Basins are estimated to account for more than 70% of the known State reserves, with a significant portion of these reserves being accessible to open cut mining.

More than 65% of these reserves are thermal coal with the remainder being metallurgical (coking) coal used for steel-making. A summary of this resource and its value to the State is provided in Table 3.

**Table 3: Summary of the importance of coal in the Queensland economy***

| Parameter | Description |
|---|---|
| Total known reserves – Queensland<br>● Bowen Basin<br>● Galilee Basin | 32 billion tonnes<br>● 21 billion tonnes (coking, thermal) (estimated)<br>● 22 billion tonnes (thermal) (estimated) |
| Annual production (2008-09) | ● 71 million tonnes (thermal)<br>● 106 million tonnes (coking) |
| Total value of coal production | $A38+ billion |
| Contribution to Queensland economy | 56% for Mackay Region economy alone |
| Employment (direct and indirect estimated) | 45,000 approximately |

* Queensland Resources Council data – www.qrc.org.au

The Project represents an opportunity for significant domestic capital formation for Queensland. Functioning as a trade corridor for foundation customers for the proposed Abbot Point State Development Area, where it will also benefit and meet the needs of multiple economic sectors, the Project will underpin an overarching economic development strategy to enable significant downstream value adding to Australian and Queensland-sourced mineral and coal resources, including the longer term potential to establish a substantial steel industry production capacity in Queensland.

### 3.10 Financing Requirements and Implications

The Project is estimated to require a capital investment in the order of $A4 billion for the proposed rail infrastructure, rolling stock and communication technology within the Corridor.

Funding for the Project will be based on investor equity and debt financing, which may include leasing of rolling stock. The Proponent has been in detailed discussions with potential sources of financing for this specific Project for over a year. This includes consultation with domestic and international financial institutions and investment banks. Relevant expertise also exists within the Proponent's senior management team.

The total equity capital requirement is expected to be about $A1 billion. This will be raised from a combination of sources including infrastructure funds and private equity. The Proponent also anticipates offering equity participation to mining companies in the Galilee Basin that enter into long term "take or pay" freight contracts. The Proponent may also consider a future public share issue and listing.

The total debt capital requirement is expected to be in the order of $A3 billion. Debt financing will be supported by 20 year "take or pay" contracts with mining companies and other potential users of the railway. The Proponent is satisfied of the ability of the Project, backed by the take or pay contracts, to raise the debt financing on internationally competitive terms.

Whilst a final decision will be made later in the development of the Project, the Proponent anticipates that rolling stock will be financed through lease arrangements with an international infrastructure investment fund.

Based on recent discussions with financial institutions and current knowledge of project funding, the Proponent is confident of raising the equity and debt funding that the Project will require.

While the Project is not dependant on any source of public funding, the strategic nature of the Project and its potential to provide a range of community infrastructure services into the future may justify future public investment.

# 4. The Location of Key Project Elements

## 4.1 Location

The location of the proposed Corridor in a regional context is shown in Figure 1 (see page 13).

The alignment design has been derived from the Digital Terrain model created from the SRTM (Shuttle Radar Terrain Mapping). This data was imported into the 12D software for the alignment and earthworks calculations. The SRTM data has a stated vertical accuracy of +/- 16m.

The proposed Corridor lies within the local authority areas of Whitsunday, Charters Towers, Isaac and Barcaldine Regional Councils. Road networks in the area are limited and may require some upgrade to sustain construction traffic. Future access improvements may constitute an integral part of the proposed Corridor development.

## 4.2 Tenure

The key existing tenures affected by the Project are freehold and crown leasehold, predominantly for grazing purposes. Reference has already been made in Section 1 to other crown lands that might be affected such as road corridors, watercourses, stock routes and tenures for other existing infrastructure.

The Corridor will be developed according to the most appropriate tenure option after consultation with State and local governments. Options include a combination of freehold, leasehold, sublease, or easements over existing tenures. Subject to further planning of construction requirements, temporary access to areas outside the nominal Corridor width may be necessary.

Relevant local government planning schemes relate to those townships referred to previously and will be further considered in undertaking the EIS. The issues affecting tenure are further discussed in Section 5.4 below.

# 5. Description of the Existing Environment

## 5.1 Natural Environment

This section sets out the key environmental factors relevant to the Project. Section 6 will identify the potential impacts of the Project.

A more detailed description and evaluation of its attributes in terms of potential impacts of the construction and operations of the railway will be provided in the detailed EIS to be prepared.

### 5.1.1 Land

The proposed Corridor for the preferred alignment traverses a variety of land forms and land uses.

The area of northern Galilee basin is in the Desert Uplands bioregion, which is characterised by plateau residuals, ridges and sand plains. Soils are of low fertility and land use is predominantly low intensity grazing of native pastures (approximately 94% of region). It is mainly a beef cattle area though some sheep are raised in the western parts.

Vegetation is mainly eucalypt woodlands with a grassy or spinifex understorey. Acacia spp. woodlands are widespread, especially where clearing has occurred and fire has been a feature. It has a semi-arid climate with seasonally highly variable rainfall (median rainfall of 450 mm approximately) which predominantly falls in the summer months.

The Corridor route crosses the Great Dividing Range and other significant catchment divides including Darkes Range, which confine drainage in the Belyando and associated tributaries, and two significant lake systems – Lake Galilee and Lake Buchanan.

The majority of the route from North Galilee to Moranbah and north to beyond Collinsville, as well as the southern spur line from North Galilee to Alpha, traverses a broad area known as the Brigalow Belt bioregion. This is an area of complex landforms and soils including extensive areas of cracking clays and sodic texture contrast soils with challenging properties for construction.

Landforms consist of undulating to rugged ranges and extensive areas of alluvial plains, the latter subject to widespread flooding in storm events. Vegetation is mainly Acacia harpophylla (Brigalow) and other Acacia spp., eucalypt woodlands and grasslands.

Climate ranges from semi-arid in the south and west to tropical in the northern parts above Collinsville. Median rainfall is about 590 mm and is summer dominant.

The route traverses much of the catchment area of the Burdekin Falls Dam and crosses the Belyando, Isaac and Bowen Rivers and their tributaries.

North-west of Collinsville, the route diverges around and through the Clarke Ranges and enters the coastal draining system of the Bogie River which flows to the ocean north of Abbot Point after skirting the Mt Aberdeen National Park. This area has a sub-tropical to tropical climate with strongly summer dominant rainfall (mean annual rainfall of 1,010 mm) and a moderate chance of cyclonic events. The area is unusual for north Queensland in that it is known as the dry tropics, being in a rain shadow to some degree though with an annual long term range of up to 2,000+ mm.

The route traverses several mountainous areas of the Clarke and Connors Ranges which are characterised by tall eucalypt forests and areas of evergreen rainforest and vine thicket. Modest earthquakes are known to occur in this area and as recent as mid 2011 and the final route alignment will factor in avoidance or mitigation measures through earthquake zones. Coastal wetlands and mangroves within the Abbot Point State Development Area occur beyond the end of the Corridor.

The geology of the route covers a broad range of lithologies and unconsolidated sediments, including:

- large tracts of Quaternary Alluvium (sands, silts and clays);
- carboniferous pyroclastics, flows, quartzose sandstones and fine grained sediments, with some lateritised overlays of Tertiary clayey sandstones;
- devonian sediments and meta-sediments with minor volcanics;
- permian sediments and areas of Tertiary duricrust on the plateau surfaces;
- tertiary basalts;
- permian sediments to the west of the Clarke Range; and
- large areas of Upper Carboniferous to Lower Permian granitic rocks of the Clarke Range before descending to the coastal lowlands.

### 5.1.2 Hydrology

There are several major waterways intercepted along the route. The majority of the route lies within the Burdekin River catchment draining via mainly ephemeral systems including the Belyando, Suttor and Bowen/Broken Rivers.

The Corridor will require six major river crossings and 29 creek and watercourse crossings. The river crossings are at the following rivers and creeks, some of which will be crossed more than once: Elliot, Bogie, Bowen, Suttor, Belyando Carmichael, Splitters, Finley, Sandy, Glen Blazes, Capsize, Herbert, Johnnycake, Table Mountain, Pelican, Twelve Mile, Rosell, Suttor North, Eaglefield, Kennedy, Eaglefield again, Verbena, Serpentine, Black Wattle, Bull, Bully, Sandy, Eight Mile, Laglan Spring and Forrester creeks.

Two ephemeral lakes, namely Lake Galilee and Lake Buchanan, lie towards the western end of the Project area.

Further investigations may be needed into groundwater resources of the route area as the route lies to the east of the Great Artesian Basin (GAB) and overlies the shallower groundwater resources of the Tasman Basin. Bores are predominantly for stock water and domestic use and are of variable depth and salinity.

There are no significant water supplies available along the route other than the Collinsville to Alpha water supply pipeline.

### 5.1.3 Air

The area is dominated by rural land use, with grazing of native pastures being the most extensive form and only smaller areas of cultivation. Cultivation is largely confined to heavy cracking clay soils deeper than 60 cm in the region as these are the only soils with sufficient water holding capacity to sustain rain-fed cropping in about 75% of years. Dust from both these sources is low and generally short-term associated with cultivation and mustering activities.

The existing airshed of the regions along the proposed route is not generally affected by dust from mining or other economic activity. The region is notable for having generally a very low to low incidence of dust storms. Hydrocarbon emissions are associated with mining and cultivation activities but the spatial distribution is such that impacts are relatively small.

Noise impacts in the rural area is low as there is little regular activity associated with heavy machinery, cultivation equipment or other noise generating sources. Noise emissions associated with operating mines are high, but these are well separated from likely areas of noise nuisance.

### 5.1.4 Ecosystems

The relevant regional ecosystems are set out above.

There are a number of relevant matters listed under the E*nvironmental Protection and Biodiversity Conservation Act 1999 (Cth).* Threatened plant and animal species are dealt with in the following section. Other Matters of National Environmental Significance (MNES) identified from a Protected Matters database search are shown in Table 4.

**Table 4: Summary of MNES – EPBC Protected Matters search**

| Item | Number (10 km buffer around proposed corridor) | Description |
|---|---|---|
| World Heritage Properties | 1 | Great Barrier Reef |
| National Heritage Places | 1 | Great Barrier Reef |
| Wetlands of International significance (Ramsar Wetlands) | 1 | Coongie Lakes |
| Great Barrier Reef Marine Park | Relevant | General Use Zone and Habitat protection |
| Commonwealth Marine Areas | Relevant | General provision |
| Commonwealth Lands | None | - |
| Commonwealth Heritage Places | 1 | Great Barrier Reef Region |
| Commonwealth Reserves | None | - |

Additionally, seven nationally important wetlands have been identified, which apart from Lake Buchanan, largely occur in the northern and coastal vicinity of the Corridor.

#### 5.1.5 Flora and Fauna

A preliminary review of public databases has indicated that there are several flora and fauna species likely within the Corridor that are listed under the *Nature Conservation (NC Act) Act 1992 (Qld)* and the EPBC Act. A summary of these, taken from the EPBC Protected Matters search, is shown in Table 5.

**Table 5: Summary of scheduled species – EPBC Protected Matters search**

| Threatened species | Number (10 km buffer around proposed Corridor) |
|---|---|
| Ecological communities | 4 |
| Threatened species | 41 |
| Migratory species | 45 |
| Listed marine species | 88 |
| Whales and other cetaceans | 12 |
| Critical Habitats | None |

It is likely that not all of these species as identified in the database search process will be found and impacted by the corridor. Nevertheless, the EIS will specifically target these identified species to assess the potential impacts and develop appropriate mitigating measures where needed.

### 5.2 Social and Economic Environment

The proposed Corridor traverses parts of Whitsunday, Charters Towers, Barcaldine and Isaac Regional Council local government areas. Significant towns within or near to Corridor include Bowen, Abbot Point, Charters Towers, Collinsville, Moranbah and Alpha. Outside of the towns, rural and agricultural activity dominates the social and economic character of the region.

#### 5.2.1 Economic and Demographic Characterisation

Readily available regional statistics have been obtained from a search of the PIFU database using the Bowen Basin Population Report, 2010 (Office of Economic and Statistical Research, Qld Government, June 2010) and an OESR generated report for Central highlands and Charters Towers regions (www.oesr.qld.gov.au 23 October 2011)

The rural community is largely associated with extensive grazing properties and is broadly distributed while Moranbah and Bowen/Abbot Point are predominantly urban communities. A summary of key population statistics is provided in Table 6.

| Table 6: FTE populations for the Bowen Basin, June 2010 (after OESR Bowen Basin Population report, 2010) | | | | |
|---|---|---|---|---|
| **Statistical Local Area (SLA)*** | **Resident population estimated** | **Total non-resident workers** | **FTE population estimate** | **Percentage of non-resident workers** |
| Belyando | 12,091 | 3,278 | 15,369 | 21 |
| Nebo | 2,989 | 3,714 | 6,703 | 55 |
| Bowen | 14,442 | 479 | 14,921 | 3 |
| **Total** | 29,522 | 7,471 | 36,993 | 26 |

***** These three SLAs represent the full route coverage

Belyando SLA covers the North Galilee to Moranbah area, while Nebo and Bowen SLAs cover the northern section through Collinsville to Abbot Point.

### 5.2.2 Accommodation and Housing

It is clear that a significant component of the SLAs that represent the mining provinces depend on non-resident workforce to the extent of 21% and 55% respectively, while Bowen (including Collinsville) is sufficiently close to the coast to attract a full time resident population. This highlights the importance of fly-in-fly-out (FIFO) and drive-in-drive-out (DIDO) populations to the mining industry. The lack of well distributed urban centres along the route highlights the critical need to establish attractive employment opportunities to encourage regional growth and development.

There is limited availability of commercial accommodation (houses, motels, boarding houses etc.) in the region with the great proportion of non-residents being housed in mine-supplied single person quarters (SPQs). A brief summary of accommodation options for the Bowen Basin or relevance to this proposal is provided in Table 7.

| Table 7: Non-resident workers – accommodation sources for the Bowen Basin, June 2010 (after OESR Bowen Basin Population report, 2010) | | | | |
|---|---|---|---|---|
| **Statistical Local Area (SLA)*** | **Number of non-resident workers** | **Hotels/motels** | **Caravan parks/other** | **Total** |
| Belyando | 2,711 | 210 | 357 | 3,278 |
| Nebo | 3,607 | 62 | 45 | 3,714 |
| Bowen | 243 | 23 | 213 | 479 |
| **Total** | 6,561 | 295 | 615 | 7,471 |

*****These three SLAs represent the full route coverage

The major source of accommodation is dependent on the provision of SPQs, which service both FIFO/DIDO and semi-permanent workforces. This restricts the ability of families to relocate to the region and to establish viable communities. EWLP recognises that the Queensland Government is seeking to limit the impact of FIFO/DIDO workforces and will investigate ways in which this may be achieved.

#### 5.2.3 Social and Recreational Services

There are limited social and recreational facilities available in Collinsville and Moranbah to meet the needs of a largely temporary workforce while servicing the needs of the resident population. EWLP recognises the potential for large itinerant workforces to involve some adverse impacts on local communities.

#### 5.2.4 Cultural Heritage (Indigenous and non-indigenous)

A number of Native Title claims are likely to be active over the route of the Corridor. The Jangga and Birri peoples have active claims in the region affected. Contact will be made with representatives of the local Traditional Owner groups to seek cultural heritage clearance for the route investigation and eventual construction process.

Consultation will include the nature and form of Indigenous Land Use Agreements (ILUA) where appropriate and the development of a Cultural Heritage Management Plan (as set out in Section 7.4 below of this IAS) as part of the construction process. It will be necessary to initiate discussions with the claimants at the appropriate time.

Landholders and local historical groups will be approached also to determine the European heritage values of the area. Given its interesting history of settlement and the long-standing of several homesteads, it will be desirable to ensure that these values are protected to the maximum extent possible. Detailed assessment will be initiated and appropriate consultation undertaken with representative bodies in the course of undertaking the EIS.

### 5.3 Built Environment

Townships near the route are Bowen, Collinsville, Moranbah and Alpha. The route does not go directly through these townships but passes close by some of the communities. The Corridor terminates at the Abbot Point State Development Area, which has been dedicated by the Queensland Government as an industrial and port complex and nearby and to the north west of the township of Alpha.

The principle infrastructure along the route consists of grazing and mining operations, roads, bridges and existing railways. Substantial mining operations already exist in the Bowen Basin and drilling is well underway within mining tenements of the Galilee Basin.

#### 5.3.1 Infrastructure

The Corridor route traverses largely undeveloped country; however there is some infrastructure in the region that will be potentially impacted.

There are Council and State controlled roads in the region, and the Corridor is intended to approximately parallel the existing QR National corridor north of Moranbah. The Corridor will require measures to address crossings involving:

- Eight State Controlled Roads
- Sixteen unsealed Local Government Roads, and
- Nineteen Stock Routes

Ergon and Powerlink hold rights of way for power lines in the area of the Bruce Highway near Abbot Point State Development Area and transmission lines on several properties will cross the Corridor. Powerlink, in particular, has transmission lines which would cross the Corridor within the following properties: CeSalis, Strathalbyn (north west of Collinsville), Havilah, and Eastern Creek (south of Collinsville)

Numerous other crossings occur where there are low voltage power lines for local distribution of power.

A Sunwater Pipeline runs through the region. The Corridor is closely aligned beside the pipeline in several locations and crosses it once near the North Goonyella mine.

The North Queensland Gas Pipeline runs through the region. The Corridor runs close beside it in several locations and also crosses it once near the North Goonyella mine.

### 5.3.2 Traffic and Transport

The preferred Corridor will intersect the Bruce Highway and the Gregory, Suttor, Cerito and Bowen Development Roads, as well as numerous smaller shire roads.

Unsealed local government controlled roads potentially affected include: Glenore, Strathalbyn, Herbert Creek, Johnny Cake, Strathmore, Myuna North, Myuna South, Collinsville Elphinstone, Broadmeadow, Kilcummin-Diamond Downs, Stratford, Moray-Bulliwallah, Moray-Carmichael, Laglan Lou Lou Park, Jerico-Degulla, Degulla roads.

Detailed investigations will be undertaken for the preferred route during the EIS phase. It is likely that many internal property access tracks will also be impacted by the Corridor.

The remoteness of most of the route is unlikely to generate traffic management issues relevant to the Project.

### 5.3.3 Community Amenities

There are limited social and recreational facilities available in Collinsville and Moranbah to meet the needs of a largely temporary workforce while servicing the needs of the resident population. There are no key social amenities and services affected by the Project. Investment by the Proponent in social amenities for workers during the construction and operational phases will be addressed more fully in the EIS.

## 5.4 Land Use and Tenures

The dominant land use is beef cattle on leasehold lands and coal mining by open cut methods. Significant areas of rain-fed cropping land occur with smaller areas of irrigated cropping along the Bowen-Broken Rivers near Collinsville.

North-west of Collinsville, the route diverges around and through the Clarke Ranges and enters the coastal draining system of the Bogie River which flows to the ocean north of Abbot Point after skirting the Mt Aberdeen National Park. The predominant land use is cattle grazing and agricultural.

### 5.4.1 Key Local and Regional Land Uses

Key land uses, local government areas, protected areas and mining development areas have been addressed above. These include agricultural, mining, urban township, crown and environmental reserves and transport and utility infrastructure.

### 5.4.2 Key Local and Regional Land Tenures

Existing tenures in the region to be traversed by the Corridor include:

- Freehold;
- Crown land;
- Pastoral leases;
- Easements, covenants and rights of way; and
- Native title.

The regions west of Moranbah consist of lands predominantly used for beef cattle production. Current assessment indicates the following properties will be potentially affected by the Corridor.

- Eighteen grazing properties between Abbot Point and Moranbah
- Eleven grazing properties between Moranbah and North Galilee
- Nineteen grazing properties between Galilee North and Alpha

The Corridor terminates at Abbot Point State Development Area and associated coastal management zone. The port at Abbot Point will potentially affect the Great Barrier Reef World Heritage Area, however, the port development *per se* is not part of the Corridor within the scope of this Project. Four local government areas are affected and the Abbot Point State Development area will be subject to a development control plan.

The Proponent intends to acquire all land needed for the Corridor under either Freehold title or long term leases or by way of easement rights so as to provide security of tenure to users of the Corridor to meet their commercial requirements under long term contracts. Freehold title will also facilitate access to capital for development costs.

Where freehold title is not feasible, the Proponent proposes to discuss with government the availability of alternative tenure arrangements that will still ensure long term security for the Corridor, whether through alternative designations of Project land or under arrangements analogous to those provided for in the *Transport Infrastructure Act 1994 (Qld)* in relation to rail corridor land and acquisition of land for use as part of a rail transport corridor.

### 5.4.3 Native Title

The *Native Title (NT) Act 1993* recognises the rights and interests of indigenous peoples with respect to their traditional laws and customs where they can demonstrate a continuing involvement with the land.

Claims have been registered over various parts of the overall route by the Birri People, Wiri People (core country claim) and the Jangga People (as per the Federal Court National Native Title Tribunal - 30 September 2011). Determinations of Native Title over these areas are pending.

## 5.5 Planning Instruments, Government Policies

There are a series of approvals required for significant project declaration and which are part of the Environment Impact Statement (EIS) process. The Coordinator-General has powers under the *State Development and Public Works Organisation Act 1971 (Qld)* (SDPWO Act) to direct that an EIS be undertaken for significant projects and these may involve referral to the Commonwealth Government for determination under the EPBC Act.

When an EIS is being conducted under the SDPWO Act, the Integrated Development Assessment System (IDAS) approvals under the *Sustainable Planning Act 2009 (Qld)* (SPA) as well as other approvals processes of other relevant Acts are suspended. This suspension remains in place until the Coordinator General's evaluation report is completed and sent to the IDAS assessment manager and other approval managers for their consideration.

Other legislation that may have relevance to the Project is set out below.

- *Native Title (Queensland) Act 1993 (Qld);*
- *Aboriginal Cultural Heritage Act 2003 (Qld);*
- *Environmental Protection Act 1994 (Qld);*
- *Vegetation Management Act 1999 (Qld);*
- *Nature Conservation Act 1992 (Qld);*
- *Water Act 2000 (Qld);*
- *Dangerous Goods Safety Management Act 2001 (Qld);*
- *Petroleum and Gas (Production and Safety) Act 2004 (Qld);*
- *Transport Infrastructure Act 1994 (Qld); and*
- *Mineral Resources Act 1989;*

There are also several Policies and Guidelines that must be complied with such as air, noise, water, waste and riverine protection permitting. The Project will be subject to several Environmentally Relevant Activities (ERA) requiring approvals by Department of Environment and Resource Management (DERM).

Reference has been made to other Government policies in Section 1.

# 6. Potential Impacts of the Project

## 6.1 Natural Environment

Construction of the Corridor and rail lines will have potential impact on land and water resources. Regional vegetation communities affected include the Desert Uplands and Brigalow communities.

During clearing and earthworks operations required for the construction of the rail formation and site access roads and during excavation activities for culvert installations there are likely to be impacts associated with runoff from bare surfaces leading to sedimentation in streams. Similar impacts will arise from quarrying activities established within relative proximity external to the Corridor for the supply of suitable track formation and rail ballast materials and in relation to the establishment and operation of concrete batch plants.

Properly understanding the flow characteristics of streams in catchments upstream and downstream of the Corridor will be important to the design of Corridor infrastructure (rail, road, bridge, pipes and culverts) to minimise impacts on the catchments and downstream floodplains.

Coal dust contamination of areas adjacent to the Corridor will be averted by virtue of the need for only one rail transport Corridor and the proposal in this Project to use specially designed closed-lid coal freight wagons. This will protect nearby grazing pastures from contamination and also minimises the risk of fire outbreaks.

The on-site haulage of materials and the use of the site access roads to bring construction equipment and permanent materials including reinforcing steel and concrete materials to site are likely to have ongoing sediment runoff impacts. The road transport of construction materials from off-site locations to site may also have impacts on the integrity of the local road network.

Selection criteria for the Corridor route alignment included:

- avoiding known sensitive environmental areas, homesteads, townships and minimising the impact to other infrastructure;
- avoiding National Parks, existing mines and urban concentrations;
- reducing the risk within flood prone areas, major watercourses and difficult topography by locating the alignment in higher ground, positioning major watercourse crossings as upstream as conceivably possible whilst avoiding flood plains and avoiding mountainous terrain;
- grade separation of major road, rail and existing infrastructure crossings;
- a desktop geotechnical investigation of the proposed Corridor route identifying high risk areas such as poor foundation materials (black soil), sources of suitable borrow materials for embankment construction and rock areas for crushing for ballast supplies;
- optimising the Corridor route and width to accommodate a minimum of two railway lines to potentially service the greatest number of mines within a single Corridor and thereby minimise the land footprint;
- impose less social, biological and ecological impact than the multiple alternative corridors under consideration by minimising the amount of grazing and agricultural land sterilised for the transport of coal; and
- allow within the Corridor for expansion to four rail lines and extension to Mt Isa, the North West Minerals Province and beyond.

Such an innovative approach to infrastructure and resource management has the following advantages:

- minimises impacts on identified Strategic Cropping Land areas and other good quality agricultural land;
- minimises exposure to flood-prone areas risk of operational impairment of the railway during wet seasons;
- minimises impacts within black soil areas considered as high risk potential of substandard foundation conditions and instability;
- provides grade separated crossings to major arterial roads and railways removing risk of vehicular/train collisions and traffic delays to the public;
- minimises environmental impacts, including greenhouse gas emissions, by introducing heavy haul freight capacity rolling stock carrying significantly greater tonnages per travel event thereby requiring significantly fewer travel events for any given amount of product moved to port, compared to existing practices in Queensland ;

- provides covered/enclosed coal wagons, thus significantly reducing environmental impacts of dust loss on local communities adjacent to the Corridor; and
- allows mine operators to share costs and retain valuable capital funds to underwrite further development by avoiding a high level of investment in individual separate rail infrastructure.

Operation of the facility is likely to involve minimal impact on land resources however care will be needed to address impacts on overland water flows.

There are environmentally sensitive areas in the region and these will be subject to more detailed assessment as part of the EIS process. Final route selection will however avoid, for example, Blackwood and Mt Aberdeen National Parks and remnant forests associated with the Leichhardt Range and uncleared areas within the Burdekin Dam catchment.

Potential impacts on fauna and flora are likely to be confined to loss of habitat along the Corridor and indirect impacts where the Corridor may bisect faunal corridors or affect adjacent habitat/communities. Where vegetation is partially cleared, this may lead to edge effects and potential impacts on the sustainability of the smaller remnant plant community. During construction, there are also likely to be impacts from frequent vehicular movements between properties in regard to the potential spread of flora pest species.

### 6.2 Amenity – Including Noise, Air Quality, Vibration, Lighting, Urban Design and Visual Aesthetics

Construction and operation of the railway within the Corridor will involve some dust emissions associated with earthmoving machinery and other vehicular activity.

Though most of the Corridor is in remote or sparsely populated rural locations, rail operation will generate potential noise and vibration impacts which, will need to be managed, in particular where the route approaches or is adjacent to homesteads and townships.

A significant benefit of this proposed open access, heavy haul 40 tonnes load per axle railway compared to proposals to construct multiple less efficient lines and corridors is that significantly less train movements will be required resulting in correspondingly less noise and amenity impacts for the same tonnage of coal hauled.

Visual amenity is unlikely to be significantly affected by the Project however this will be assessed in more detail, in particular in relation to township development.

### 6.3 Social Environment – Beneficial and Adverse Potential Impacts

The social environment is characterised largely by rural communities and towns. The key issues in relation to social impact are potential impacts on social amenity, noise and vibration, construction impacts, employment, housing and accommodation and cultural heritage.

The issues relating to the construction workforce are discussed elsewhere in this document. Housing and accommodation will need to be addressed in the context of construction and ongoing operation of the Project.

Indigenous culture may be affected and this will need to be assessed and managed as part of the EIS.

### 6.4 Economic Effects

The Project will clearly have beneficial impacts on employment and attraction of a workforce to the area. This will in turn provide an injection of private expenditure into local economic activity which could and may assist in the revival or growth of regional townships.

The Corridor will also potentially enhance access to freight services for township and rural production outputs and provide a Corridor for delivery of fuel and other services to the regions through which the Corridor passes. As a multipurpose Corridor, the potential for upgraded communications and other utility services will be presented also.

### 6.5 Built Environment

The Project will involve the construction of several rail-over-river and road-over rail bridges to meet the needs of the Project and avoid impacts on the travelling public. Power, water and telecommunications will be provided as components of the construction, including state-of-the-art wireless communications and signalling technology.

The Proponent is already a licensed carrier under the Commonwealth Telecommunications Act, and as well as the digital wireless overlay system, plans to offer a best of breed Train Control System (TCS) to other operators so that all train command and control operations are on a single shared platform to facilitate maximum efficiency. The installation of this infrastructure will have minimal impacts due to its modest footprint.

The Corridor will intersect the Gregory, Suttor and Bowen Development Roads as well as several shire roads. A detailed inventory will be developed during the EIS of all likely impacts on established roads and farm tracks. This will include traffic studies to identify impacts on significant roads. Nevertheless, the Proponent intends to ensure there will be no impact on the general travelling public and will construct road-over-rail (or rail-over-road where landform enables it) to provide for continuity of operation and maximum public safety.

### 6.6 Matters of National Environment Significance

There are matters, including threatened species, listed under the *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)*. Other Matters of National Environmental Significance (MNES) identified from a Protected Matters database search are shown in Table 5 above. Several wetlands of national importance, largely in the northern and coastal vicinity of the Corridor, while not directly affected by the Corridor, will need to be assessed in the context of the EIS.

## 7. Environmental Management - Mitigation Measures

This proposed single, multi user infrastructure Corridor has many environmental benefits compared to alternative options which would require multiple corridors and its carefully selected route aims to eliminate their potentially divisive social impacts.

Having the capacity to handle all coal freight from the Galilee Basin and significant quantities from the expanding Bowen Basin coalfields, it will obviate the need to construct any of the other multiple haulage routes proposed, which traverse in different directions from separate points along the Galilee Basin to Moranbah and/or Abbot Point.

It will also enable the development of all future mines in the Galilee coal basin by the addition of only short spur lines within the mining tenement areas, which other proposed multiple routes cannot facilitate due to their cross-country remoteness.

The proposed Corridor alignment substantially avoids floodplains and farm cropping lands thereby minimising the requirement for significant flood mitigation structures. In addition, by selecting a topographically suitable route, it generates reduced earthworks quantities thus minimising the requirement for imported fill.

For optimum economic freight efficiency the proposed Corridor adopts a maximum 1:320 loaded gradient and utilises 40 tonnes load per axle closed lid coal wagons rolling stock. This economic efficiency is gained hand in hand with fewer train movements with consequent reduction in environmental impact e.g. noise, coal dust and diesel exhaust emissions.

The Proponent proposes to produce an environmental management system for the construction and operational phases of the Corridor that is consistent with the principles of ISO14001 and is amenable to independent third party audit against accepted standards of performance.

### 7.1 Natural Environment

In the Environmental Management Plan for the Project, key measures to avoid or minimise environmental impact on the land, water and vegetation resources of the affected route will be addressed.

Impacts from clearing of vegetation will be minimised due to the largely open nature of the selected route. No burning of vegetative waste will be allowed and all material will be mulched and used for batter stabilisation.

Potential impacts with fauna and flora are likely to be confined to loss of habitat along the Corridor and indirect impacts where the Corridor may bisect faunal corridors or affect adjacent habitat/communities. Where appropriate, consideration will be given to providing underpass or overpass structures to aid Fauna and flora habitat connectivity. Where plant communities are partially cleared, this may lead to edge effects and potential risks to fauna reliant on the smaller community remnant. In such cases, appropriate offsets will be proposed and implemented. Detailed investigation of the Regional Ecosystems listed for the proposed route will validate existing mapping and be used to develop effective management approaches to impacts.

The construction EMP will establish procedures to avoid sedimentation of streams and impacts on ecosystems along the route. All areas disturbed by construction will be rehabilitated progressively on completion of activities in that section. Water will mainly be required for the construction period only and appropriate measures will be taken to acquire appropriate supplies with no impact on local demand for stock and domestic supplies.

The Project when operational will have minimal to no impact on surface and groundwater as flooding risk will be managed through design intervention and the covered wagons will prevent fugitive coal dust entering the surface water environment.

Thorough investigation will be undertaken of all MNES during preparation of the EIS. The database search results are indicative and not definitive for the Corridor and will be tested for validity. The Corridor has been selected to avoid all presently known environmentally sensitive areas and will be refined as detailed information comes to hand. Appropriate management or recovery plans will be developed as and if necessary. As the development does not drain to the Cooper Basin, there will be no impacts on the Ramsar Wetlands in the Coongie Lakes area.

### 7.2 Built Environment

A detailed inventory will be developed during the EIS of all likely impacts on established roads, stock routes and landholder access roads and tracks. This will include a traffic study to identify impacts on significant roads. Nevertheless, the Proponent has already determined that there should be no impact on the general travelling public and will construct road-over-rail (or rail-over-road where landform enables it) to provide for continuity of operation and maximum public safety.

In developing solutions on properties where internal tracks (and also traditional cattle movement to watering points or during mustering cycles) are disrupted, the Proponent will involve landholders in the process to ensure that property management is not impacted. Alternative thoroughfares either under or over the railway will be considered.

The Proponent proposes to provide social and recreational facilities at the construction accommodation villages, where appropriate, to ensure that the temporary workforce does not cause disruption to existing established communities. These amenities may be available to communities on completion of the construction project for their continued use.

### 7.3 Social Impact Management Plan

This proposal offers the reduction of multiple haulage routes to a single, carefully selected Corridor which will minimise the impact on land, the grazing industry and landholders. This will also greatly reduce the fragmentation of rural properties and disruption of normal daily farm management activities.

Air and noise emissions limits will be subject to the Construction EMP to be developed for the Project. Strategies to minimise long term emissions will include real time locomotive management via the wireless overlay network, and regular maintenance of locomotives to ensure the most efficient consumption of diesel fuel. Additionally, the use of covered coal wagons will avoid the release of coal dust to the atmosphere. The capacity to move larger volumes with fewer trains will help limit both air quality issues and noise emissions.

A social impact management plan addressing all the key issues outlined will be prepared as part of the EIS.

### 7.4 Cultural Heritage Management Plan (Indigenous)

The development of a Plan to address indigenous cultural heritage will be undertaken through discussions with the traditional owners and the outcomes of the current native title claims. Appropriate investigations will be undertaken in line with the EIS. A Cultural Heritage Management Plan (CHMP) and Indigenous Land Use Agreement (ILUA) as required will be entered into with the relevant Traditional Owners (TO) following negotiations.

Where significant artefacts, places and other areas of interest are identified these will be dealt with having regard to the desires of Traditional Owners.

### 7.5 Non-Indigenous Cultural Heritage Management

This will be addressed as part of the EIS although there do not appear to be any places registered on the Inventory of Heritage Places that will be affected by the

Corridor. Landholders and local historical groups will be approached to determine the European heritage values of the area. European heritage will be preserved or relocated where required in situations where it cannot be avoided. Given its interesting history of settlement and the long-standing of several homesteads, it will be important that these values are protected to the maximum extent possible.

### 7.6 Greenhouse Gas Management Plan

Construction and operation of the Corridor will result in some greenhouse gas emissions. The Corridor design and operational configuration of the freight services using it are intended to optimise the efficiency of operation and minimise emissions substantially compared to all other currently proposed alternatives.

The EIS will estimate the quantum of emissions GHGe likely to be produced per year in line with standard estimating procedures using the Queensland Government's Guidelines for Preparing a Climate change Impact Statement (CCIS) (EPA 2008). Although a CCIS is normally only required for a proposal submitted to Cabinet, these guidelines provide a basis for assessing specific expectations regarding assessment of potential climate change impacts.

Emissions will be quantified as far as is practicable. Inputs such as embodied energy associated with steel manufacture for the rail lines and other materials to be used in construction will not be considered for the construction phase EIS.

The use of a much greater haulage capacity with the 40 tonnes load per axle wagons has potential to significantly reduce the volume of GHGe per unit of coal transported, making the Project more efficient in this respect. It is in the economic interest of the Project that the efficiencies, especially in energy use, will be optimised and an Energy Management Plan will be developed for the operational phase of the Project.

### 7.7 Waste Management

The construction phase of the Project will be likely to generate waste materials which require management. This will be coordinated as part of the Environmental Management System for the Project to ensure waste is minimised and where feasible recycled, given that most materials will need to be transported in to the construction site/s. Clear procedures to address these issues will be established as part of the Construction EMP.

As the route hugs the foothills of the ranges and avoids the clay plains, there will be sources of rock and spoil that can be used for rail embankment construction. Additionally, as there are significant outcrops of basalt and granitic rocks, it is likely that this material can be used for aggregate in concrete and ballast for the rail tracks, avoiding waste and the necessity for long haulage costs from existing sources.

Where earthworks are involved and particularly at river crossings, all site runoff water will be captured in detention basins to treat sediment loads and used for dust suppression. Discharge to land will only be permitted when sediment loads are within normal runoff limits. All wastes will be appropriately managed through treatment and disposal by approved methods and sites will be fully restored on completion.

Grey water generated from the camp population will either be treated on site and recycled on garden areas within the camp facilities or removed from site and disposed of in accordance with the Local Council Bylaws within approved disposal areas.

### 7.8 Hazard and Risk, and Health and Safety

Hazards and risks with the potential to adversely affect people, property or the environment will be fully assessed as part of the EIS for the Project. Key hazards relate to the construction phase of the Project, particularly in respect of workplace safety. Operational phase safety issues will be similar to that required of existing rail operations so far as potential operating workforce and third party impacts are concerned. Appropriate risk management strategies and tools will be developed as part of the EIS and the Workplace Health and Safety Plan for the Project.

### 7.9 Environmental Management

A series of sub-plans will constitute The EMS for the Project as follows:

- ***Construction Environmental Management Plan (CEMP)***

  During the EIS phase a Draft CEMP will be prepared identifying the environmental elements that will need to be addressed during construction. Once a head contractor has been appointed and a construction methodology is confirmed, this Draft CEMP will be expanded to accurately reflect specific aspects of the proposed delivery mechanisms. Detailed risk assessment will be undertaken by the project team to ensure that all likely impacts are identified and mitigated as far as possible. The CEMP will then target residual risks.

  Key components of the CEMP will include for each element:

  - likely impacts;
  - responsible person/authority;
  - corrective measures;
  - reporting requirements;
  - monitoring and review procedures;
  - communications with personnel for updates; and
  - continuous improvement strategy.

  The Contractor will appoint staff responsible for the implementation of the CEMP and ensure that compliance with all procedures is achieved in line with conditions imposed by the regulating authorities.

- ***Operational Environmental Management Plan (OEMP)***

  A similar format will be adopted for the operational phase of the Project.

- ***Workplace Health and Safety Plan (WHSP)***

  A WHSP will be developed in conjunction with the CEMP and a responsible officer appointed to be charged with ensuring that all activities comply with State and Federal guidelines and standards. Safety of the workforce in a remote location is of critical importance where access to medical support faces significant time delays.

  Regular toolbox talks and provision of adequate water, PPE, shade and sun protection cream will be key attributes of the WHSP. Officers will be trained in such measures as snake bite treatment given the rural and isolated nature of much of the construction route.

- ***Decommissioning Plan***

  As the Corridor is seen to have much wider potential than just the Corridor from the Galilee to Abbot Point, it is not critical at this juncture to plan for a decommissioning plan. It is understood that the expected life of several mines in the Galilee Basin alone is more than 150 years, though much of this depends on the world's future global patterns of continued use of fossil fuels for both thermal and manufacturing purposes.

# 8. Approvals Required for the Project

The following approvals and triggers are a preliminary assessment having regard to the desktop work and preliminary surveys. It is expected that a complete list of approvals will be included in the draft Environmental Impact Statement.

Approvals required for all stages of the Project will include development approvals from local governments or other applicable assessing authorities, building and safety approvals relating to permanent and temporary structures, international standards, licences and permits for heavy lifts and loads, materials stored on site/transported to the site, emissions from construction machinery, operational works, disposal of waste, and all other impacts involved in the construction of a Corridor.

The legislation, policies and information on the likely approvals required for the Project, including ISOs, has been sourced from the Agency websites and from the State and Commonwealth Administrative Arrangements Orders.

**Table 8: Approvals Required For The Project**

| Activity/Approval Trigger | Legislation, Policy, Standard, Permit, Licence | Administering Authority | Activity |
|---|---|---|---|
| **Australian Government** | | | |
| Fauna and Flora of National Significance | Environment Protection and Biodiversity Conservation Act 1999 (Cth) | Department of Sustainability, Environment, Water, Population & Communities | Desktop survey work has been undertaken, survey work has been undertaken for other mining and corridor projects within the Study Area. It appears likely that ground truthing and survey work will reveal fauna and flora of national significance will be present within the survey area |
| Protection of Critical Infrastructure | Critical Infrastructure Protection National Strategy,<br>Critical Infrastructure Emergency Risk Management & Assurance Handbook,<br>National Counter-Terrorism Plan, | Coordinator General in consultation with relevant Security Agency | |
| | AS/NZS 4360:2004 Risk Management,<br>HB 167:2006 Security Risk Management,<br>HB 221:2004 Business | | |

| Table 8: Approvals Required For The Project | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |
| | Continuity Management, HB 292-2006 & HB 293-2006 Business Continuity Management. | | |
| *Native Title Act 1993 (Qld)* | Approvals, agreements | Attorney General's Department | Negotiations and agreements with Traditional Owners and claimants regarding access to their land |
| Importation of machinery and equipment through the Port of Abbot Point | *Maritime Transport and Offshore Facilities Security Act 2003 (Cth)* | Department of Infrastructure and Transport, NQBP Limited. | |
| | ACN 2007/03 Customs Approach to Managing Cargo Reporting Compliance, | | |
| | Australian Customs Cargo Advice. | | |
| Use of Port Authority Land & Shipping Channels | Project Specific Environmental Management Plan, Port of Abbot Point Land Use Strategy, North Qld Bulk Ports Environment Policy, Port of Abbot Point Environmental Management Plan 2010, Environmental Management System. | North Qld Bulk Ports Limited, Department of Transport & Main Roads. | |
| Frequency Allocation for Rail Communications and Signalling | *Telecommunications Act 1997 (Cth)* subsection 56 (1) | Australian Communications and Media Authority Attorney Generals Department | Frequency Allocations and Interception Capability Plans |
| **Local Government** | | | |
| Development approval | Whitsunday Regional Council Planning Scheme | Whitsunday Regional Council | |
| Development approval | Isaac Regional Council Planning Scheme | Isaac Regional Council | |
| Development approval | Charters Towers Regional Council Planning Scheme | Charters Towers Regional Council | |
| Development approval | Barcaldine Regional Council Planning Scheme | Barcaldine Regional Council | |
| Development approval | *Sustainable Planning Act (Qld) 2009* | Department of Local Government & Planning | |
| Building approvals | *Building Act 1975 (Qld)* Building Act Regulations Building Code of | Department of Local Government & Planning | |

| Table 8: Approvals Required For The Project | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |
| | Australia | | |
| Blackwater & grey water on-site sewage systems for construction crews | *Plumbing & Drainage Act 2002 (Qld)* Standard Plumbing & Drainage Regulation Plumbing & Wastewater Code | Department of Local Government & Planning | |
| Potable water supply for construction crews | Water Allocation Register | Department of Environment & Resource Management | Approval may or not be required under the *Water Act 2000 (Qld)* |
| Water supply for wash down areas and for site construction watering needs | Water Allocation Register Local Government | Department of Environment & Resource Management | Approval may be required to use grey water for wash down and site construction watering needs |
| Food handling, waste control for temporary site facilities | Local Govt approval for Environmentally Relevant Activities | Separate approvals from each Council | |
| **Queensland Government** | | | |
| Abbot Point State Development Area | *State Development & Public Works Organisation Act 1971 (Qld)* | Office of the Coordinator General | Not required for the construction of this Infrastructure Corridor, however, approval will be sought should set down areas be required for the machinery and equipment required to construct the Infrastructure Corridor |
| Security Response to Incidents | Queensland Counter-Terrorism Strategy Queensland Infrastructure Protection and Resilience Framework Queensland Government Information Security Classification Framework | Office of the Coordinator General | |
| Approval to clear vegetation | *Vegetation Management Act 1999 (Qld)* | Dept Environment & Resource Management | |
| Water permit to take water from a watercourse, lake or spring or groundwater if required for construction purposes | *Water Act 2000 (Qld)* Water Act Regulations | Dept Environment & Resource Management | |
| Watercourse Crossings | *Water Act 2000 (Qld)* Water Act Regulations | Dept. Environment & Resource Management | |
| Removal of vegetation from a watercourse – Riverine Protection Permit | *Water Act 2000 (Qld)* Water Act Regulations | Dept. Environment & Resource Management | |
| Road and infrastructure crossings | *Transport Infrastructure Act 1994* | Dept. Transport & Main Roads | |

| Table 8: Approvals Required For The Project | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |
| | *(Qld)* | | |
| | SunWater | SunWater | |
| | Powerlink | Powerlink | |
| | *Petroleum and Gas (Production & Safety) Act 2004 (Qld)* | Dept. Employment, Economic Development and Innovation | |
| Use of State Controlled Roads | *Transport Infrastructure Act 1994 (Qld)* | Dept. Transport & Main Roads | |
| Use of Local Government Roads | *Local Government Act 2009 (Qld)* | All Councils | |
| Accreditation for Operator | *Transport (Rail Safety) Act 2010 (Qld)* | Dept. Transport & Main Roads | |
| Protection of fauna and flora | *Nature Conservation Act 1992* | Dept. Environment & Resource Management | |
| Environmentally Relevant Activities | *Environment Protection Act 1994 (Qld)* | Dept. Environment & Resource Management | |
| | Schedule 2 Environment Protection Regulation | Dept. Environment & Resource Management | |
| Air Quality | Environment Protection (Air) Policy 2008 (Qld) | Dept. Environment & Resource Management | |
| Noise Emissions | Environment Protection (Noise) Policy 2008 (Qld) | Dept. Environment & Resource Management | |
| Water Quality | Environment Protection (Water) Policy 2009 (Qld) | Dept. Environment & Resource Management | |
| Waste Management | Environment Protection (Waste Management) Regulation 2000 (Qld) | Dept. Environment & Resource Management | |
| Waste Management | Environment Protection (Waste Management) Policy 2000 (Qld) | Dept. Environment & Resource Management | |
| Cultural Heritage, Cultural Heritage Management Plans | *Aboriginal Cultural Heritage Act 2003 (Qld)* | Dept. Environment & Resource Management | |
| Cultural Heritage | *Queensland Heritage Act 1992 (Qld)* | Qld Heritage Council | |
| Workers' health and safety | *Workplace Health & Safety Act 1995 (Qld)* | Dept. Justice & Attorney General | |
| Movements and storage of goods | *Dangerous Goods Safety Management Act 2001 (Qld)* & Regulation | Dept. Justice & Attorney General | |
| Purchase of land, right of way over land for location of Corridor | Negotiated agreements with land owner, change to title deed | *Property Law Act 1974 (Qld)*<br>*Land Title Practice Manual*<br>*Land Act 1994 (Qld)* for State land | |

# 9. Costs and Benefits Summary

## 9.1 Local, State and National Economies

The core component of the Corridor will consist of an investment in rail infrastructure estimated as having a capital construction cost of $A4 billion, including rolling stock and communications infrastructure.

The Proponent, as a licensed carrier, is planning a carrier grade high availability communications infrastructure to support the freight operation and potentially provide new or improved communications links through the regions traversed by the Corridor at an estimated cost of $A360 million.

The Corridor will have the potential to support the development of mines in the Galilee and Bowen coal basins to transport an estimated capacity in excess of 300 million tonnes per annum.

As elaborated upon in Section 3 above, the proposed rail operation in the Corridor, by adopting a standard gauge 40 tonnes load per axle freight wagon at max 1:320 gradient, meets all of the criteria essential for optimum economic freight efficiency. Uniquely among the possible Corridor route options it will ensure the comparative economic benefit is returned to all parties using the railway via the least possible cost per tonne hauled.

The Project will support the development of mining projects worth $A40 billion in the Galilee and Bowen coal basins with employment potential to reach 2,000 permanent jobs.

The mining industry resources unlocked will, on current estimates of up to 300 Mtpa, generate potential export revenue totalling $A45 billion per annum.

The Corridor opens up access to regional and rural communities to new freight capacity at marginal cost to users for such items as agricultural product to port, water and fuel to farm and supplies to regional towns and communities.

The Corridor will be capable of future extension to Mt Isa and the North West Minerals Province to enable improved access to and transportation of copper, zinc and other minerals to a sea port at Abbot Point.

## 9.2 Natural and Social Environments

The construction of a single infrastructure Corridor serving the Bowen and Galilee coal basins and associated regional communities will achieve the least impact on the natural environment of all current options being proposed for transporting goods by rail between the Galilee Basin and Abbot Point.

The Corridor and railway in its construction phase will generate 3,500 full time employment positions and maintain at least 150 jobs in its operational phase.

The Corridor is to be constructed along a route of overall least economic cost along the foothills of ridges to avoid the high cost of construction on the floodplains and poor soil foundations (black soil) where the Corridor would otherwise have higher impacts on the best available agricultural and grazing lands.

The Proponent proposes a unique operational configuration that ensures freight is carried in covered or ‘closed in’ rail wagons which will avoid dust loss and its associated impacts on land, infrastructure and people adjacent to the Corridor.

# 10. Community and Stakeholder Consultation

## 10.1 Stakeholder Engagement

The Proponent commenced its broad stakeholder communication and engagement Strategy in 2010.

Discussions were held with the Mayors of Whitsunday, Isaac, Cloncurry and Barcaldine Regional Councils to determine how the peak groups and individuals in their communities preferred to be briefed on the Project.

Upon their advice and information given by officers from the Office of the Coordinator General the following briefings were given. All issues raised at these briefings were documented with a view to ensuring that the issues are addressed as part of the environmental impact assessment process.

**Table 9: Table of Stakeholder Engagement**

| Person/Group | Type of Briefing | Place & Date | Issues Raised |
|---|---|---|---|
| Mayor Mike Brunker, Bowen Shire Council<br>Deanne Kelly, Local Member<br>Mark Gaudry, Councillor<br>David Nebauer, Bowen's Economic Development Manager<br>Les Cox, Burdekin Electorate's Media Liaison Officer.<br>Matthew Magin, NQBP<br>Dr Paul Joice, Queensland Nationals candidate for Whitsunday | Introduction & Briefing on Project | 05 Jul 06 | Industrial park at Abbott Point<br>Environmental Policy |
| Indigenous representatives<br>Joe Henaway<br>James Gaston, Chairman, Gudjuda Reference Group Aboriginal Corporation | Introduction & Briefing on Project | 06 Jul 06 | Sustainable benefits<br>Job Training and<br>Subsequent jobs<br>Community development |
| Strategic Advisory Committee, Townsville Enterprise Ltd<br>Representatives, Chamber of Commerce | Briefing on Project | 11 Aug 08 | Emission Trading Scheme (ETS)<br>Feasibility Study(FS)<br>Concerns over land acquisition processes |
| Mayor Lyn Mclaughlin, Burdekin Shire Council<br>Ayr and Home Hill Chamber of Commerce | Briefing on Project | 11 Aug 08 | Federal & States govt approach<br>Rail Link from Moranbah to Abbot |

| Table 9: Table of Stakeholder Engagement | | | |
|---|---|---|---|
| **Person/Group** | **Type of Briefing** | **Place & Date** | **Issues Raised** |
| | | | Point |
| Mayor Brunker and Whitsunday Council | Briefing on Project | 11 Aug 08 | |
| Mackay Area Industry Network (MAIN)<br>Chamber of Commerce | Briefing on Project | 11 Aug 08 | |
| Matthew Magin, NQBP | Briefing on current Project status | 22 Jun 11 | Interest by Meijin Energy<br>EOI T4-T7 timing<br>Coal wagon efficiencies |
| Keith Davies (CoG) Public Forum at Clermont | Community consultation and EWLP briefing of single Corridor | 29 Jun 11 | Concerns of multiplicity of rail corridors planned<br>Concerns over land acquisition processes |
| Kate Weir/Peter Hughes, CoG APSDA Planning Group | Presentation on the Project proposal and impacts within APSDA | 01 Jul 11 | Impact of rail loops on APSDA<br>Land parcels and location – planning perspective<br>QR duplication of T1 NG rail entry,<br>Rail entry into APSDA and stockpile areas T4-T7<br>Lack of rail access to multi-cargo berths |
| Bradley Chandler, Department of Transport | Briefing on Project status and land acquisition issues, corridor sharing with QRN | 19 Jul 11 | Current lease arrangements on QRN corridor,<br>New corridor arrangement procedures |
| Mayor Marshall and Isaac Council | Updated briefing on the Project including outline of proposed route for our single Corridor open access multi user solution | 20 Jul 11 | |
| Mayor Brunker and | Updated briefing on the Project including outline of proposed route for | 02 Aug 11 | Timing of Development |

| Table 9: Table of Stakeholder Engagement | | | |
|---|---|---|---|
| **Person/Group** | **Type of Briefing** | **Place & Date** | **Issues Raised** |
| Whitsunday Council | our single Corridor open access multi user solution | | Application and EIS submission |
| Business Council, Bowen | Updated briefing on the Project including outline of proposed route for our single Corridor open access multi user solution | 02 Aug 11 | |
| Meeting with Mining companies | Overview of the Project including outline of proposed route for our single Corridor open access multi user solution | Qtr 4<br>CY 2011 | Timing for coal delivery<br>Proposal for Collaboration<br>CoG on corridor<br>Miners consortium |
| David Stolz, Office of Coordinator General | Overview of the Project including outline of proposed route for our single Corridor open access multi user solution | 05 Sep 11 | |
| NQBP Brad Fish | General Cargo Wharf discussion<br>Timelines for port development | 21 Sep 11 | |
| Bill Schoch - Waratah | Infrastructure financing – EWLP – ATrade<br>Use of EWLP MUIC | 18 Nov 11 | Time frames |
| Yogendra Sharma - Adani | Use of EWLP MUIC | 15 Nov 11 | Time frames<br>Black soil |
| Keith Davies/Phil Dash, CoG office | Project update and Project Financing Strategies | 15 Nov 11 | Single Corridor<br>Project Financing<br>Customers |
| Bowen Business Information Forum | Overview of EWLP and the Project including outline of proposed route for our single Corridor open access multi user solution | 16 & 17 Nov 11 | |

### 10.2 Intentions for Advisory Agency Briefings

After declaration of the Project, it is intended to provide briefings to State and Local Government Agencies in Brisbane and in the Regions.

The purpose of the briefings is to explain the Project and clarify any questions the Agency representatives may have.

### 10.3 Intentions for Indigenous Community Consultation

The representative Land Councils will be contacted to determine the most appropriate practices and procedures to consult with traditional owners and native title claimants are followed.

### 10.4 Intentions for Community Consultation

The Proponent has worked with State and Local Government Agencies to identify the peak local, industry, environmental groups and other stakeholders who will be central to an effective Consultation Strategy. The Consultation Strategy and program will be in accordance with the Social Impact Assessment Guidelines issued by the Office of the Coordinator General.

See: http://www.deedi.qld.gov.au/cg/resources/guideline/simp-guideline.pdf

and http://www.qld.gov.au/web/community-engagement/guides-factsheets/

## 11. References and Data Sources


Communicating the Imperative for Action: A report to the Council of Australian Governments. June 2011

http://www.infrastructureaustralia.gov.au/2011_coag/

Queensland Government, Community Engagement Guidelines

http://www.qld.gov.au/web/community-engagement/guides-factsheets/

Commonwealth Government, Administrative Arrangement Order

http://www.dpmc.gov.au/parliamentary/index.cfm

Environmental Protection Agency, 2008, Guidelines for Preparing a Climate change Impact Statement (CCIS)

Queensland Government, Guidelines for the Preparation of an Initial Advice Statement

http://www.deedi.qld.gov.au/cg/resources/guideline/guideline-initial-advice-statement.pdf

Queensland Government, Guidelines for the Preparation of Terms of Reference

http://www.deedi.qld.gov.au/cg/terms-of-reference-eis.html

Queensland Government, Guidelines for the Preparation of Social Impact Assessments

http://www.deedi.qld.gov.au/cg/resources/guideline/simp-guideline.pdf

Queensland Resources Council, Mineral and Energy Resources Sector in Queensland: Economic Impact Study

http://www.queenslandeconomy.com.au/economic-report

East West Line Parks Pty Ltd, Pre-Feasibility Study Report, October 2008

Queensland Government Administrative Arrangement Order

http://www.premiers.qld.gov.au/publications/categories/policies-and-codes/admin-arrange-order.aspx

Toward Q2: Tomorrow's Queensland

http://www.towardq2.qld.gov.au/tomorrow/strong-economy.aspx

# 12. Glossary, Acronyms and Abbreviations

| | |
|---|---|
| BFS | Bankable Feasibility Study |
| CCIS | Climate Change Impact Statement |
| CEMP | Construction Environment Management Plan |
| CHMP | Cultural Heritage Management Plan |
| DERM | Department of Environment and Resource Management |
| DIDO | Drive in – Drive out |
| EIS | Environmental Impact Study |
| EMP | Environmental Management Plan |
| EMS | Environmental Management System |
| EP Act | Environmental Protection Act 1994 (Qld) |
| EPBC Act | Environmental Protection Biodiversity Act 1999 (C’th) |
| ERA | Environmentally Relevant Activity |
| EWLP | East West Line Parks Limited |
| FID | Final Investment Decision |
| FIFO | Fly in – Fly out |
| GAB | Great Artesian Basin |
| GHGe | Greenhouse Gas equivalents |
| GIC | Galilee Infrastructure Corridor |
| IAS | Initial Advice Statement |
| IDAS | Integrated Development Assessment System |
| ILUA | Indigenous Land Use Agreement |
| MNES | Matters of National Environmental Significance |
| NC Act | Nature Conservation Act 1992 (Qld) |
| PIFU | Planning Information and Forecasting Unit, OESR |
| OEMP | Operational Environmental Management Plan |
| OESR | Office of Economic and Statistical Research |
| QIP | Queensland Infrastructure Plan 2011 |
| QRN | QR National Limited |
| SDA | State Development Area |
| SDPWO Act | State Development and Public Works Organisation Act 1971 (Qld) |
| SLA | Statistical Local Area |
| SP Act | Sustainable Planning Act 2010 (Qld) |
| SRTM | Shuttle Radar Terrain Mapping |

| | |
|---|---|
| TCS | Train Control System |
| TO | Traditional Owners |
| TOR | Terms of Reference |
| VM Act | Vegetation Management Act 1999 (Qld) |
| WHSP | Workplace Health and Safety Plan |

# Appendix 9


PROJECT IRON BOOMERANG
east west line parks limited

# TATA STEEL CONSULTING

## Provision of Technical Assistance To

## East West Line Parks Pty Ltd

## Brisbane, QLD, Australia

## TSC Project Code – PIB2

## Project Iron Boomerang – Comments on the PIB Cost Model

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February 2012

# CONTENTS



PROJECT IRON BOOMERANG
east west line parks pty ltd

# 1. EXECUTIVE SUMMARY

Tata Steel Consulting (TSC) has been commissioned by EWLP to carry out a pre-feasibility study into the Project Iron Boomerang (PIB) project, in particular developing the estimated breakeven cost of slab for various stages of project development in Queensland, Australia compared to a Base Case plant of the same advanced technology located at a port in Korea. The findings of this study are included in a separate Prefeasibility Study report.

In addition TSC were requested to review the EWLP Slab Cost Model and comment on the declared benefits of the PIB scheme. This paper describes the findings of this review.

## 1.1 CAPEX

The EWLP cost model identifies potential CAPEX savings totalling US$330.7/ tonne of installed capacity. The TSC estimated savings is US$172/tonne of installed capacity. TSC has arrived at this figure using historical data from various sources. It is recommended that basic functional specifications be produced and submitted to steel equipment suppliers to gain updated budget prices to validate further the CAPEX cost.

## 1.2 OPEX

EWLP has identified a number of potential OPEX savings, the following provides a summary of TSC findings against each of these potential savings:

- Utilisation of Beneficiated magnetite. TSC has been unable to validate the EWLP view of US$34/Tonne of slab saving. TSC would recommend that approaches be made to a number of mines that would benefit from the E-W line and explore what cost of ores could be negotiated based on allowing the mines to market via the E-W rail route and the potential for a long term off-take agreement supplying ores and coals to PIB. In parallel with this, TSC could undertake process modelling once information is obtained on ore chemistry etc to arrive at a suitable blend and OPEX cost.
- OPEX savings in terms of supply chain consolidation have been largely eroded since 2007 due to the virtual collapse of the freight shipping price. The current view is that shipping prices will remain low for the foreseeable future, with companies taking orders on a marginal cost basis.
- The scale of the developed case provides the opportunity for the export of substantial quantities of surplus energy to the surrounding economy. There are various options for this considered in section 7 of the prefeasibility report to utilise the estimated 4.6GJ/tonne of slab energy surplus in the form of blast furnace, coke oven and BOS gas.
- Energy consumption of the facility would be at approximately 16GJ/tonne of slab, which is in the order of 15-20% better than typical world practice.
- The scale of the developed case should allow PIB to approach “world’s best” productivity benchmarks for slab production, TSC estimates a productivity figure of 0.25 manhours/tonne of slab produced will be achieved compared to a typical world figure of around 0.5 manhours/tonne.
- There will be substantial savings of green house gas (GHG) emissions mainly due to the supply chain consolidation by only shipping finished slab outside Australia, rather than shipping iron making raw materials (coal and iron ore) as is currently the case. In volume terms this represents a saving of over 50% in the quantities of materials shipped.

- Due to the reduced energy consumption of the developed facility there will be significant reductions in GHG emissions during the iron and steelmaking process compared to world steel average. As yet this has not been evaluated.
- Whilst there are substantial improvements in productivity for the developed scheme, these benefits are largely eroded by the relatively high employment costs in Australia. The Human resource strategy for the Developed scheme will need to address if and how it is possible to reduce this labour cost.

## 2. COMMENTS ON THE PIB COST MODEL

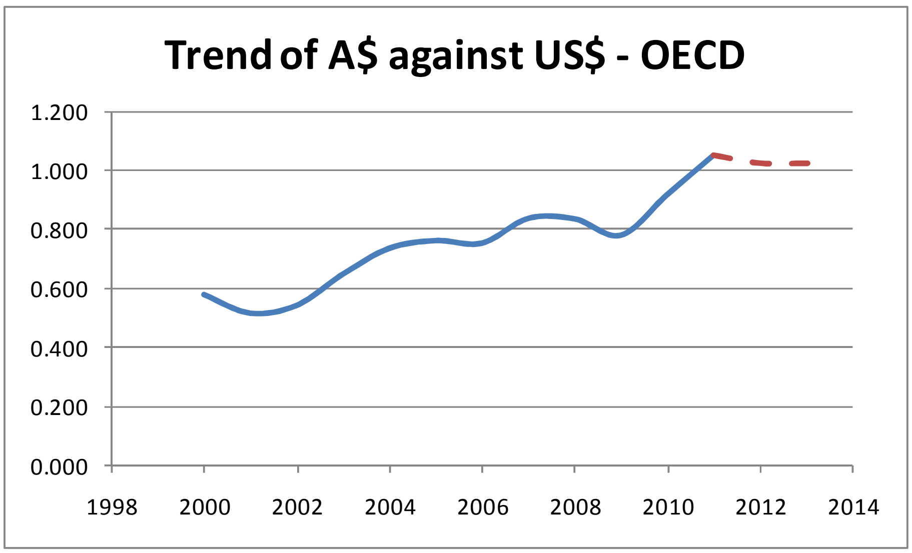
The EWLP slab cost model is a detailed spreadsheet, which calculates the possible savings that could be achieved in the cost of slab production by the PIB concept.

As part of the overall prefeasibility study work undertaken by Tata Steel Consulting, TSC were requested to comment on the model and the assumptions made.

The model was produced over the period 2007/08 and is based on the economic conditions prevailing at that time. The TSC analysis compares these assumptions based on current and likely future trends.

### 2.1 AUSTRALIAN DOLLAR EXCHANGE RATE

The PIB model assumed an Australian dollar exchange rate of A$1=US$0.75. The current rate is A$1=US$1.05. The trend from the OECD in terms of historical exchange rates and expected movements in the next 2 years is shown below.

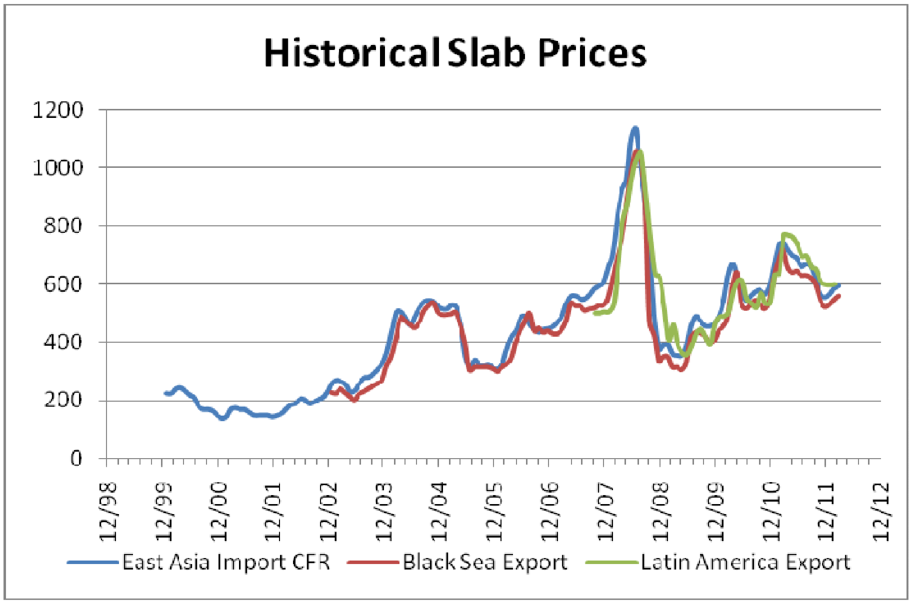



The above shows that for the medium term the A$ is likely to remain at a significantly higher level than that used in the PIB model based on the 2007 rates.

### 2.2 SLAB PRICES

The merchant slab market has been approximately 28MT per annum for the past 5 years with over 60% of the market being sold in Asia.

Analysis of the price of slab yields the following trends.




The above shows that current slab prices are of the order of US$600 per tonne. The original work undertaken by EWLP for PIB was based on 2007 costs. From the above graphs it can be seen that the 2007 figure was around $500/tonne selling price. The PIB model quotes a 2007 "Benchmark" of US$340 per tonne. This is assumed to be broadly the production cash cost of slab at the "works gate" and does not include the capital element.

### 2.3 PIB CAPEX SAVINGS

The PIB model assumes CAPEX savings for the construction of the steel complex from 4 main elements; these are each discussed in turn.

#### 2.3.1 Shared Services (CAPEX)

This element is based on the assumption of having large shared stockyards, sinter plants, coke ovens etc; which according to the PIB estimate would result in a CAPEX saving of US$125 / tonne of installed capacity for PIB when compared with an individual plant unit.

TSC has made the same assumptions in terms of sizing and sharing of facilities in estimating the total CAPEX for a 22MT pa facility at Abbot Point in Queensland. On this basis the TSC estimated savings in CAPEX amounts to US$96 / tonne of installed capacity when compared with a 4.4 MTPA plant in Korea of equivalent technology.

This is based on the assumption that the PIB Steel Producers will share sinter production across 4 large sinter plants and coke production across three large twin battery coke ovens. The assumption is that there would be 5 blast furnaces and 5 steel plants complete with continuous slab casters. Additional savings could be made if the Steel Producers were willing to share steelmaking capacity, however at this stage this has not been evaluated in detail.

#### 2.3.2 Prefabrication of Modular Construction – Built in China

The PIB Model assumes that US$83.3/tonne of installed capacity can be saved from modular construction built in China.

From TSC's experience, modular construction is very much a part of current steel plant erection strategy, with processing units being constructed in large units off line. Therefore, at this stage and without detailed discussion with plant suppliers, TSC cannot validate these potential savings.

In terms of Chinese manufacture, this report has attempted to evaluate the possible savings that could be made from Chinese manufacture; TSC estimates that this could amount to US$76/Te of installed capacity based on the cost of the 22MTPA plant in Queensland.

#### 2.3.3 Standard order of unit construction

The PIB model assumes that US$111.3/tonne of installed capacity can be saved by ordering multiple units of the same design.

TSC has included savings on this item within the Shared services evaluation in 2.3.1 above. This is further detailed within the Prefeasibility report, section 11.

#### 2.3.4 Feasibility Study Cost

The PIB model assumes a saving of US$11.1/tonne of installed capacity in developing a 22MTPA facility as opposed to individual 4.4MTPA facilities.

TSC would agree with this figure having estimated a saving in engineering charges of US$11.6/Te installed compared to the base case plant in Korea . This figure is already built into the overall cost estimates outlined in section 11 of the Prefeasibility report.

#### 2.3.5 Overall summary CAPEX savings

The PIB model assumes the base case CAPEX cost of the steel complex of US$625/Te of installed capacity, which would reduce with the savings above to US$294.3/Te of Installed capacity. This gives an overall saving in CAPEX of US$M7275 based on a 22MTPA plant.

TSC estimate a base case CAPEX cost of the steel complex of US$887 /Te of Installed capacity which would reduce with the savings above to US$715/Te of Installed capacity.

This gives an overall saving in CAPEX of US$M3784, which is 52% of the PIB calculated savings.

This report shows that the cost of capital accounts for some 21-26% of the total cost of slab production. This is obviously an area to explore further in terms of seeking budget prices for the equipment from plant suppliers.

The comparison on CAPEX savings is tabulated below:

| CAPEX Element | EWLP Assumption | TSC Assumption |
|---|---|---|
| Cost of Complex/Te of Installed capacity – Base Case (US$/Te) | 625 | 887 |
| Savings in shared Services (US$/Te) | 125 | 96 |
| Modular construction in China | 83.3 | 76 |
| Standard construction | 111.3 | Included above |
| Feasibility cost saving | 11.1 | 11.6 Included above |
| Overall saving per Te installed capacity | 330.7 | 172 |

| | | |
|---|---|---|
| (US$) | | |
| Revised Cost – Developed case US$/Te installed capacity | 294.3 | 715 |

## 2.4 PIB OPEX SAVINGS

The PIB model assumes OPEX savings for the steel complex from 6 main elements; these are each discussed in turn.

### 2.4.1 Beneficiation of Magnetite 10-20% to Blended Hematite ores 80-90%

The PIB model assumes that a 10% saving in slab cost (based on $340/Tonne of slab) can be achieved through blending a small amount of magnetite with the largely haematite ores, which would give an OPEX saving of US$34 per tonne of slab.

At this stage TSC has been unable to validate this saving, on the basis that it would need to consider the chemical composition of the Magnetite concentrate available and evaluate this blend in the TSC burden models. EWLP have submitted a single Magnetite chemistry to TSC but this ore would be unsuitable due to the high level of alkalis in the composition.

This element of OPEX savings is a major component of the EWLP total OPEX saving as such it requires further investigation.

### 2.4.2 Precinct shared services (OPEX)

The PIB model assumes savings from shared services covering both shift labour and maintenance costs and in terms of Energy consumption.

EWLP have assumed that labour and maintenance costs amount to 23% of the product cost and would aim to save 10% through PIB, which would equate to US$7.8 per tonne of slab (based on $340/Tonne of slab).

In terms of energy costs EWLP have assumed energy accounts for 16% of the production cost and would save 15% of the energy costs through PIB. This would equate to US$8.16 per tonne of slab (based on $340/Tonne of slab).

The TSC study has been based on comparing a new base case slab making facility in Korea of nominal 4.4 MTPA output of slabs with the developed case in Queensland of 22 MTPA. It has been assumed that both facilities would be modern with up to date technology with high levels of automation and energy saving processes. As such whilst there are savings in terms of manpower requirements, it is considered unlikely that there would be significant differences in energy utilisation between the base and developed cases.

The modelling work actually indicates that the labour and maintenance elements of the slab cost are less with a 4.4MTPA plant in Korea than with a 22MTPA plant in QLD on a cost per tonne basis, purely as a function of the relative labour cost differential of Korea compared to Australia.

When comparing current world benchmarks for energy use however and manpower utilisation as already stated in the Prefeasibility report, TSC's view of the PIB facility with this scale and modern efficient technology, the potential savings are:

- Energy requirements for PIB would be the order of 16GJ/Tonne of slab compared with a world average of some 20GJ/ Tonne of slab. Even assuming a 10% improvement of world average levels over the past decade for the best blast furnace route producer's shows that PIB should still be 10-15% more efficient compared to world average.
- Labour requirements for PIB equate to some 0.25 hrs/tonne of slab, which compares with figures for China of 1.21 and average of a number of "Western plants" of 0.59. Actual labour cost savings however would need to take into account the relative employment costs of Australia compared to other nations.

### 2.4.3 FOB Slab-Steel supply chain consolidation

The PIB model for this element looks at the cost of transporting ore and coal by rail across Australia on the E-W line and producing slab at each end, then shipping the slab to Asia as opposed to the conventional method of shipping ores and coals from Australia to a slab plant in Asia.

Based on the 2007/08 rates quoted in the PIB model, EWLP assume that this logistical saving amounts to US$10.6/te saving based on the exchange rate of AS$1=US$=0.75 and producing 21.9MT of slab at each complex.

TSC has reviewed these figures and would not have any comments regarding the rail and handling costs within Australia. The areas where TSC would comment however are on the shipping rates used.

<u>PIB Shipping Rates</u>
PIB have assumed a Capesize shipping rate of coal from Abbot Point to Asia for A$35/Te, which is equivalent to US$26.25/te based on the model exchange rate. Similar figures for iron ore are US$21/te and slab shipping of US$33.75/te.

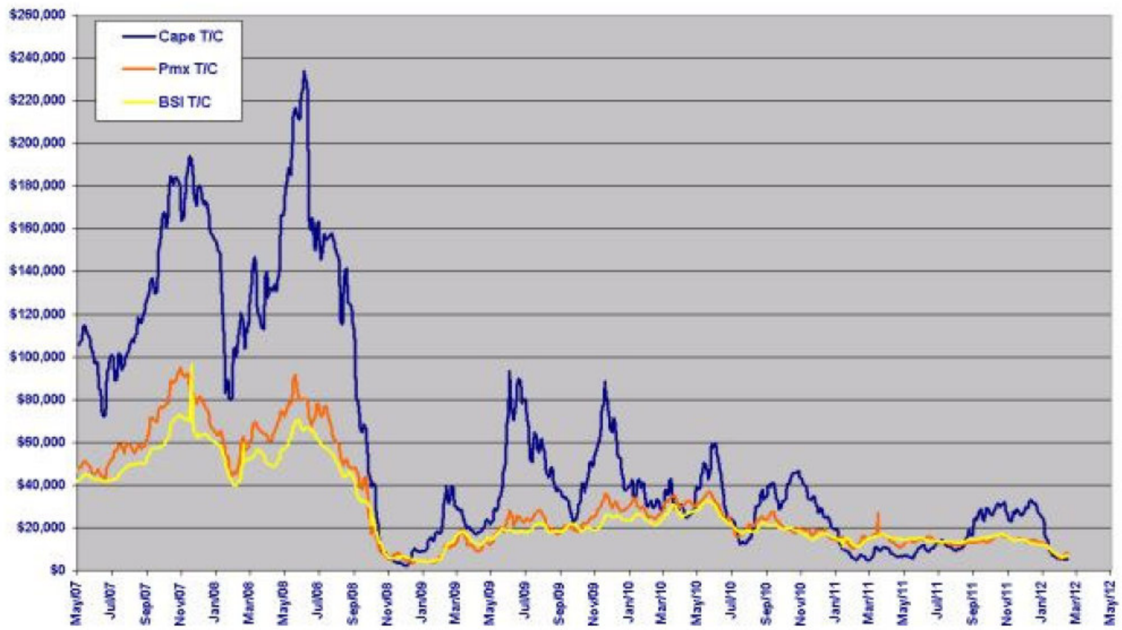
<u>Trends in Shipping Rates</u>
Shipping of ores, coals and steel slabs are driven by supply and demand of shipping. Throughout 2007/08, the cost of shipping was at record highs and subject to large volatility up to the point of the Global Financial Crisis. The inbalance between supply and demand within the shipping industry meant that there was an insufficient cargo space available, prompting high shipping prices.

Over this period a massive construction programme of bulk carriers took place, to the extent that since 2005 the world bulk fleet capacity has nearly doubled in size. The United Nations Conference on Trade and Development Review of Maritime Transport 2011 concluded that:

"The surge in vessel supply is the result of orders placed before the economic crisis. This, combined with lower than-expected demand, has led to a situation where there is an excess supply of shipping capacity. In the dry bulk and container sectors especially, analysts forecast an oversupply of tonnage in coming years. In both sectors, recent and upcoming record-sized new buildings pose a further challenge to owners, who will need to find cargo to fill their ships."

The above is summarised in the relative Daily Charter rate produced by Dryships.com.

As an example, the daily charter rate of a Capesize ship was around US$100,000/day in early 2007 rising to over US$220,000/day in June 2008.




Current charter rates quoted are as follows:

| | Hire Period | Period Rate US$/Day |
|---|---|---|
| Cape Size – Pacific Delivery | 1 year | 17,200 |
| | 3 years | 17,000 |
| | 5 years | 18,500 |
| Panamax – Pacific Delivery | 1 year | 12,200 |
| | 3 years | 13,000 |
| | 5 years | 14,500 |

For the purposes of this study TSC has used corporate 2011 screening values for shipping based on $30,000/day for a capsize ship, a figure significantly higher than the charter rates shown above.

On the basis of the above analysis TSC has reviewed the PIB cost model for this element and produced the following comparison.

| | **EWLP Estimate** | | | **TSC Estimate** | | |
|---|---|---|---|---|---|---|
| | ***Quantity*** | ***Rate*** | ***Annual cost*** | ***Quantity*** | ***Rate*** | ***Annual cost*** |

| | Mtpa | A$/t | A$M | Mtpa | A$/t | A$M |
|---|---|---|---|---|---|---|
| ***COAL*** | | | | | | |
| Rail to port | 39.6 | 6 | 237.6 | 29.146 | 6 | 174.876 |
| Qld Port charge | 39.6 | 3.5 | 138.6 | 29.146 | 3.5 | 102.011 |
| | | **EWLP Estimate** | | | **TSC Estimate** | |
| Demurrage | 39.6 | 3 | 118.8 | 29.146 | 3 | 87.438 |
| Shipping (Cape size) | 39.6 | **35** | 1386 | 29.146 | **14** | 399.16141 |
| Port charge-destination | 39.6 | 3 | 118.8 | 29.146 | 3 | 87.438 |
| Demurrage | 39.6 | 2 | 79.2 | 29.146 | 2 | 58.292 |
| Transport to mill | 39.6 | 3 | 118.8 | 29.146 | 3 | 87.438 |
| | ***Totals*** | **55.5** | **2197.8** | ***Totals*** | **34.2** | **996.65441** |
| ***IRON ORE*** | | | | | | |
| Rail to port | 65.8 | 7.5 | 493.5 | 64.9 | 7.5 | 486.8 |
| WA Port charge | 65.8 | 2 | 131.6 | 64.9 | 2 | 129.8 |
| Demurrage | 65.8 | 2 | 131.6 | 64.9 | 2 | 129.8 |
| Shipping | 65.8 | **28** | 1842.4 | 64.9 | **12** | 764.3 |
| Port charge | 65.8 | 2.5 | 164.5 | 64.9 | 2.5 | 162.3 |
| Demurrage | 65.8 | 2 | 131.6 | 64.9 | 2 | 129.8 |
| Transport to mill | 65.8 | 2 | 131.6 | 64.9 | 2 | 129.8 |
| | ***Totals*** | **46** | **3026.8** | ***Totals*** | **29.8** | **1932.5** |
| **Total** | | | **5224.6** | | | **2929.1** |
| | | | | | | |
| ***ABBOT POINT SMELTER PARK*** | | | | | | |
| | ***Quantity*** | ***Rate*** | ***Annual Cost*** | ***Quantity*** | ***Rate*** | ***Annual Cost*** |
| | ***Mtpa*** | ***A$/t*** | ***A$M*** | ***Mtpa*** | ***A$/t*** | ***A$M*** |
| Rail coal to APSP | 19.8 | 6 | 118.8 | 14.57 | 6 | 87.4 |
| Rail iron ore to APSP | 32.9 | **36.13** | 1188.8 | 32.45 | **36.13** | 1172.5 |
| Steel to ship | 21.9 | **1** | 21.9 | 22 | **1** | 22.0 |
| Demurrage | 21.9 | 0 | 0.0 | 22 | 0 | 0.0 |
| Port charge (AP) | 21.9 | 5 | 109.5 | 22 | 5 | 110.0 |
| Shipping | 21.9 | **45** | 985.5 | 22 | **14** | 297.9 |
| Port charge (East Asia) | 21.9 | 3 | 65.7 | 22 | 3 | 66.0 |
| Demurrage | 21.9 | 0 | 0.0 | 22 | 0 | 0.0 |
| Port to mill | 21.9 | 2 | 43.8 | 22 | 2 | 44.0 |
| | | ***Total*** | **2534.0** | | ***Total*** | **1799.9** |
| ***NEWMAN SMELTER PARK*** | | | | | | |
| Rail iron ore to NSP | 32.9 | **1.44** | 47.4 | 32.45 | **1.44** | 46.7 |
| Rail coal to Moranbah Hub | 19.8 | 3 | 59.4 | 14.57 | 3 | 43.7 |
| Tranship at Hub | 19.8 | **2.5** | 49.5 | 14.57 | **2.5** | 36.4 |
| Rail coal to NSP | 19.8 | **32.12** | 635.9 | 14.57 | **32.12** | 468.0 |
| Steel to NSP stockyard & load | 21.9 | **1** | 21.9 | 22 | **1** | 22.0 |
| Train to Port Hedland | 21.9 | **3.5** | 76.7 | 22 | **3.5** | 77.0 |
| Stockyard & ship load | 21.9 | **4** | 87.6 | 22 | **4** | 88.0 |
| Port charge (Port Hedland) | 21.9 | 0.3 | 6.6 | 22 | 0.3 | 6.6 |
| Demurrage | 21.9 | 0 | 0.0 | 22 | 0 | 0.0 |

| | **EWLP Estimate** | | | **TSC Estimate** | | |
|---|---|---|---|---|---|---|
| | ***Quantity*** | ***Rate*** | ***Annual cost*** | ***Quantity*** | ***Rate*** | ***Annual cost*** |
| | ***Mtpa*** | ***A$/t*** | ***A$M*** | ***Mtpa*** | ***A$/t*** | ***A$M*** |
| Shipping | 21.9 | **45** | 985.5 | 22 | **11** | 243.0 |
| Port charge (East Asia) | 21.9 | 3 | 65.7 | 22 | 3 | 66.0 |
| Demurrage | 21.9 | 0 | 0.0 | 22 | 0 | 0.0 |
| | EWLP Estimate | | | TSC Estimate | | |
| Port to mill | 21.9 | 2 | 43.8 | 22 | 2 | 44.0 |
| | | ***Total*** | **2079.9** | | ***Total*** | **1141.5** |
| **Total** | | | **4613.9** | | | **2941.4** |
| Saving ASM | | | **610.7** | | | **-12.2** |
| Saving US$M | | | **458.0** | | | **-12.8** |
| Saving US$/Te | | | **$10.46** | | | **-$0.29** |

On the basis of the above, the potential savings for supply chain consolidation have been eroded due to the lower cost of shipping which is likely to remain so in the medium term.

### 2.4.4 Sales of Surplus Energy

The PIB model evaluates the benefit of energy sales at some A$M297 which is equivalent to some US$5.16 per tonne of slab produced.

The TSC work estimates that energy sales will amount to some US$10.18 per tonne of slab produced. In addition to this there is a further US$13.51 benefit in terms of sales of By-products.

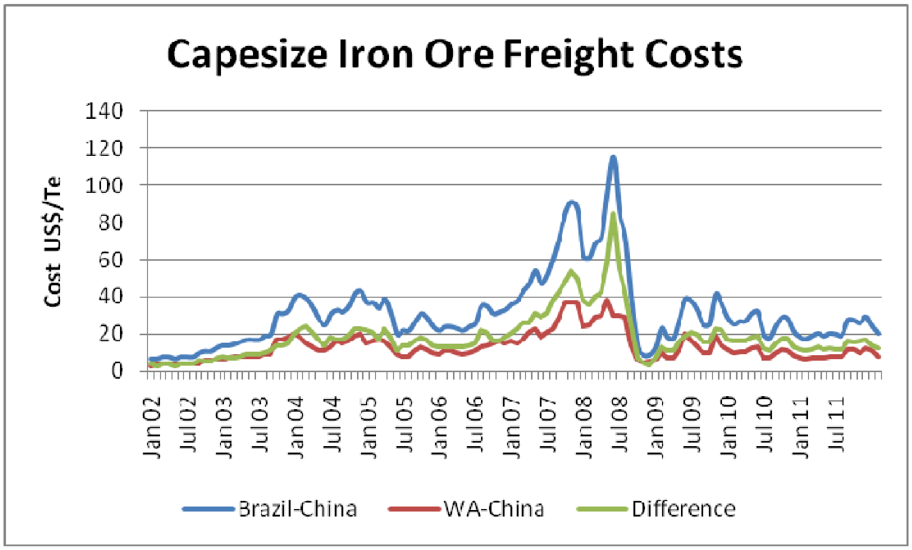
Due to the scale of the proposed steel facilities there are other potential options to generate more surplus energies as stated in section 7.5 of the Prefeasibility report. As yet these have not been evaluated in detail.

### 2.4.5 Brazil versus Port Hedland for Shipping Iron Ore to East Asia

The analysis work in section 2.4.3 above was on the base case assumption that all ores and coals would be shipped from Australia. The PIB model is based on 40% of the iron ores coming through a longer shipping route from Brazil.

The model assumes that supplementing this iron ore supply from Australia would save an additional US$15.2 per tonne of slab on top of the supply chain consolidation.

An analysis of historic shipping rates shows the following from SBB in terms of Capesize ore freight rates on the Brazil – China and Western Australia-China routes.




It can be seen from the above graph that the same volatility is present as per the freight hire cost graph in section 2.4.3. The PIB assumptions made in 2007/8 indicated a difference of some US$38 per tonne of ore in favour of WA. The more likely figure moving forward is in the range $20-22 per tonne of ore, which would equate to a cost saving of US$8-9 per tonne of slab.

### 2.4.6 Environmental $CO_2$ Savings

The PIB model indicates a saving of 8.69 MTPA in $CO_2$ production. This is made up of savings in shipping, reduced energy consumption and selling of surplus energy for local use. The bulk however is due to shipping savings

The financial benefit of this saving has been evaluated on the basis that carbon dioxide emissions will be charged at a rate of US$20 per tonne of $CO_2$ which equates to a slab cost saving of US$4.0 per tonne of slab.

The worldwide development of Emissions Trading is still in its early stages, as yet there is not a "level playing field" with regards to this strategy. The latest view on trading in Australia is a fixed starting price of AU$23/t$CO_2$e (US$24.15) from 1$^{st}$ July 2012 then rising at 5% per year. This is compared with for example the current price of the EU ETS traded price of around US$12/ t$CO_2$e.

TSC would need to study the situation of emissions trading in Australia and the Far East to comment on this element further.

### 2.4.7 Summary of OPEX Savings

The PIB and TSC views on OPEX savings can be summarised as follows comparing the Base and Developed cases:

| Item | EWLP View US$/Tonne Slab | TSC View US$/Tonne Slab |
|---|---|---|
| Beneficiation of Magnetite in the blend | 34 | ? |

| | | |
|---|---|---|
| Precinct Shared Services | 16 | -5.98 |
| FOB Slab steel supply chain consolidation | 10.46 | -0.29 |
| Sales of surplus energy | 5.2 | 0* |
| Brazil vs Port Headland | 15.2 | 8.5 |
| Environmental $CO_2$ saving | 4 | ? |

*There is no difference in terms of energy saving between the base and developed cases, both plants were based on using identical modern technology. The cost of slab however in both cases is offset by $23.69tonne due to sales of excess energy and by-products.

PROJECT IRON BOOMERANG
east west line parks pty ltd

# Appendix 10


PROJECT
IRON BOOMERANG
east west line parks limited

# TATA STEEL CONSULTING

## Provision of Technical Assistance To

## East West Line Parks Pty Ltd

## Brisbane, QLD, Australia

## TSC Project Code – PIB2

## Project Iron Boomerang – Prefeasibility Report

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Newport
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United Kingdom

February 2012

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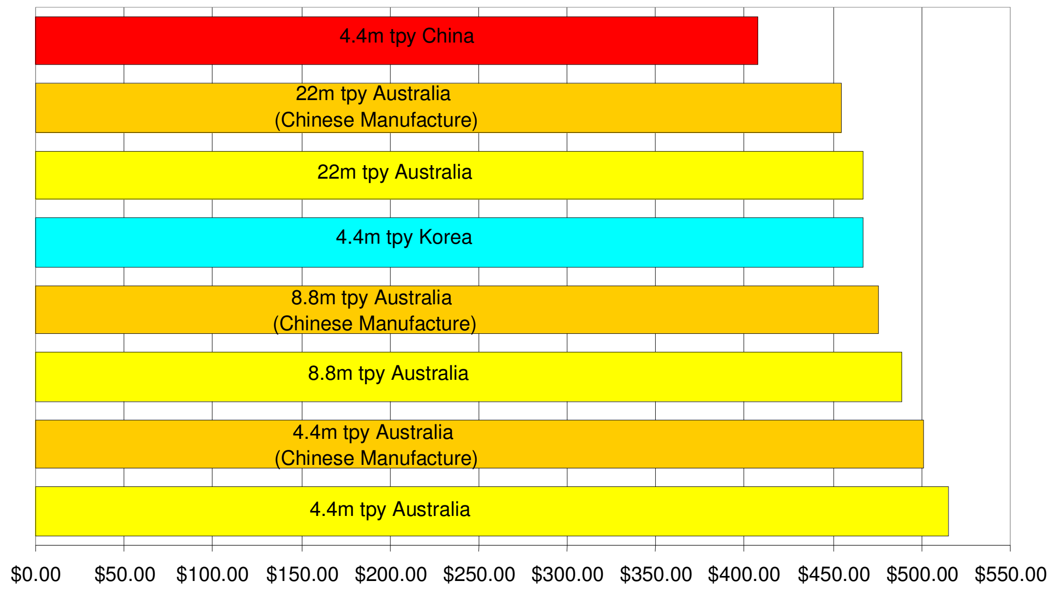
PROJECT IRON BOOMERANG east west line parks pty ltd

## 1. EXECUTIVE SUMMARY

Tata Steel Consulting (TSC) has been commissioned by East West line Parks Limited (EWLP) to carry out a pre-feasibility study into the Project Iron Boomerang (PIB) project in particular developing the estimated breakeven cost of slab for various stages of project development in Queensland, Australia compared to a Base Case plant of the same advanced technology located at a port in Korea. The main findings of this study are as follows.

- Based on the developed case in Australia (22MTPA plant in QLD.) the estimated cost per tonne is some $17.92/tonne of slab cheaper in terms of delivered slab FOB Korea compared with a 4.4MTPA slab plant located in Korea.
- The scale of the fully developed case provides the opportunity for the export of substantial quantities of surplus energy to the surrounding economy. There are various options (considered in section 7 of this report) to utilise the estimated 4.6GJ/tonne surplus of energy in the form of blast furnace, coke oven and BOS gas.
- Energy consumption of the facility is estimated to be approximately 16GJ/tonne of slab, which is the order of 15-20% better than typical world practice.
- A further benefit of the scale of the developed case is that it should allow PIB to approach "world's best" productivity benchmarks for slab production, TSC estimates a productivity figure of 0.25 manhours/tonne of slab produced will be achieved compared to a typical world figure of around 0.5 manhours/tonne.
- There will be substantial savings of green house gas (GHG) emissions mainly due to the supply chain consolidation by only shipping finished slab outside Australia, rather than shipping iron making raw materials (coal and iron ore) as is currently the case. In volume terms this represents a saving of over 50% in the quantities of materials shipped.
- Due to the reduced energy consumption of the developed facility there will be significant savings in GHG emissions during the iron and steelmaking process compared to world steel average. As yet this has not been evaluated.
- On the basis that the proposed Steel Producers will co-operate in terms of process routes, significant savings can be made by standardising on the design of the main iron and steel making processing units, this will generate savings in the following areas:
    - Design costs for repeat designs
    - Economies of scale in ordering & scheduling multiple units through procurement and subsequent erection
    - Savings in spares holding due to the commonality of design
    - Savings in project management and execution
    - Manufacture of equipment in low cost markets such as China
    - Savings associated with the above equate to an estimated US$B3.8 for the developed case as opposed to having 5 stand alone facilities in Korea.
- In evaluating the relative cost of shipping ore and coal from Australia to Korea as opposed to moving the ore and coal within Australia and subsequently shipping the slab to Korea, the original savings identified by EWLP in 2007/8 have been eroded due to the collapse of the bulk freight price.
- Whilst there are substantial savings in productivity levels for the developed scheme compared to the base case and world benchmark levels, due to the relative high level of employment costs in Australia, these benefits are eroded.

The financial summary of the various options considered in this report is presented in the chart below in terms of breakeven slab cost.




At this stage some caution is required with regard the Chinese slab cost for the following reasons:

- Obtaining valid capital cost of equipment on an equivalent scale and to an equivalent specification has been difficult particularly to take account of the latest environmental legislation etc. This has been discussed in section 11 of this report.
- Labour costs in China have been very difficult to obtain and compare on a like for like basis with other economies. This element impacts both on the cost of capital, labour and maintenance in the above analysis.

The recommendations for further work are as follows:

- Explore means to increase the OPEX differential between the PIB case and the base case. This might include raw material costs, labour costs, detailed exploration with suppliers of savings in capital costs as scale increases, cost of rail transportation(for example use of additional freight other than ore and coal on the E-W rail line),etc
- Gain a more detailed appreciation of the iron ore and coal chemistries available to this project and evaluate their impact on the blend and production cost of slab, particularly with regard to the magnetite ores that may be available from mines along the proposed E-W rail line.
- Gain a greater understanding of the proposed Steel Producers product mix to further develop the steel complex operational configuration with particular regard to the steel plant layout and logistics.
- This developed facility will “extend the envelope” in terms of the scale of the main processing units. There are currently very few equipment manufacturers with references producing plants of this size it would therefore be prudent to develop high level facility specifications and approach the technological equipment designers and manufacturers to gain latest budget information on operating and capital cost of equipment taking into

account economies of scale, Chinese manufacture etc. Once this is established review the impact on the cost estimates produced to date.

- Investigate further the logistical flow of material from the steel complex to the port and subsequent loading onto the proposed “roll-on-roll-off” facility and the impact on slab cost.
- Look at further shipping options in terms of long term Charter or buying the necessary cargo vessels. In particular reviewing further the effects of the roll-on roll off slab vessel on shipping costs
- Investigate further the effect of green house gas emissions, not just from a transport viewpoint but to include the potential emission savings from the developed facility due to the much improved energy efficiency of this project compared to world steel average.
- Start to develop equivalent proposals for the Newman steel complex in WA, taking into account the particular differences in logistics with regard to slab transfer to the port.

## 2. OVERVIEW OF PROJECT IRON BOOMERANG

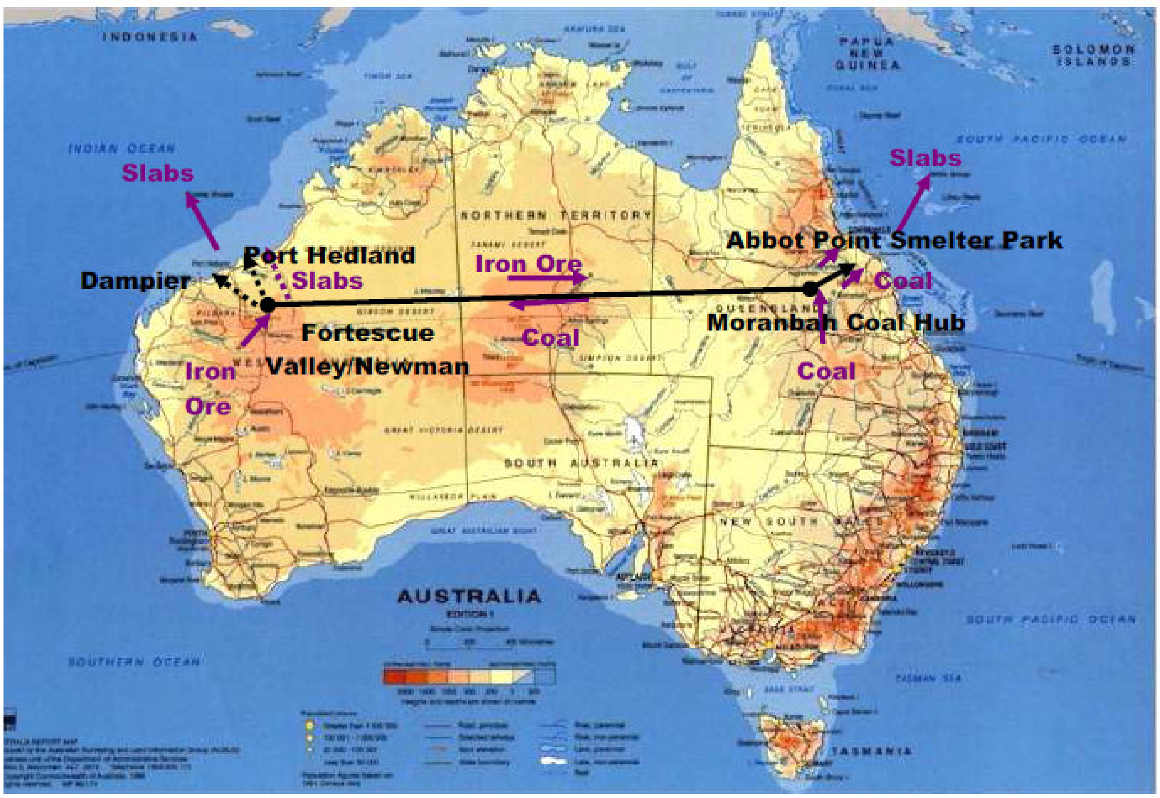
Project Iron Boomerang (PIB) was developed by East West Line Parks Pty Ltd (EWLP) with the aim of establishing semi finished steel production in Australia close to the major sources of raw materials.

This involves the development of an east-west railroad across Australia to link the coal deposits in the Bowen Basin of Queensland with the similarly massive iron ore deposits in the Pilbara Region of Western Australia.

At each end of the railroad, it is proposed to develop semi finished steel production facilities owned by international steelmakers. EWLP would procure, construct and operate a suite of shared services to support the steel making facilities covering such items as power, water, raw materials handling and storage, steel export and site facilities management.

The proposed location of the Pilbara Steel Complex is approximately 55km north of Newman, WA, approximately 400km inland.

The proposed location for the Queensland Steel Complex is a few kilometres from the existing port at Abbot Point.




The steel complexes will be linked by a new heavy gauge inland east - west railway line (40t axle loading) over 3,300 kilometres in length, connected to existing rail line systems. PIB trains will in the majority of cases run inland direct from the mine sites to the steel plants. This will effectively link Australia's vast reserves of iron ore and coal (particularly coking coal), both of which are currently almost exclusively exported, facilitating major steel manufacturing in Australia

## 3. PURPOSE OF THIS REPORT

Tata Steel Consulting (TSC) has been commissioned by EWLP to carry out a pre-feasibility study into the project including analysis at each stage of development. This report sets out the findings of the study.

The first substantive section of the report (section 4) sets out the assumptions (both technical and commercial) made in the study.

Section 5 and 6 consider the manufacturing process options and logistics available to the project and sets out the reasons for the selection of the preferred processes. A high level review of material flows and supporting logistics is provided together with a brief description/specification of the main steel making equipment (e.g. Raw Material handling, Sinter, Coke ovens, blast furnaces, steel plant).

Sections 7 and 8 describe and estimate energy requirements including usage for electricity, gases and water, whilst section 9, assesses manning requirements.

Sections 10, 11 and 12 assess CAPEX and OPEX requirements and consider these in comparison to the construction of facilities in the Far East, which, as far as possible, are intended to reflect possible alternatives to PIB. A cost model has been developed, which considers the CAPEX and OPEX at each phase of the project and the benefits to steel operators and investors of sharing common services and facilities, particularly as scale increases. Total CAPEX is estimated at each phase together with a fully developed Discounted Cash Flow (DCF) of each option.

Specifically, the cost model for the Steel Complex considers the following cases:

- Base Case originally based on a 3.5MTPA steel plant located at a port in SE Asia, subsequently increased to 4.4MTPA.
- Case 1 originally based on a 3.5MTPA steel plant located at proposed PIB site in QLD Australia, subsequently increased to 4.4MTPA.
- Case 2 originally based on a 7MTPA steel plant located at proposed PIB site in QLD Australia, subsequently increased to 8.8MTPA.
- Case 3 a 22MTPA steel plant located at proposed PIB site in QLD Australia.
- CAPEX for the above will be based on Western Supply taking into account economies of scale associated with multiple units. Sensitivity on Chinese supply will also be provided.

Section 13 and 14 contain the main conclusions and the recommendations for further study work.

## 4. LIST OF ASSUMPTIONS

In the production of this Pre-Feasibility study report, TSC has had to make a number of assumptions, which would need to be discussed and verified further if a subsequent full Feasibility Study is undertaken.

### 4.1 TECHNICAL & OPERATIONAL ASSUMPTIONS

#### 4.1.1 Steel Complex Output

It has been assumed that the fully developed project will comprise 22MTPA of steelmaking capacity at each complex as set out in the EWLP Feasibility work.

#### 4.1.2 Indicative Iron Ore Chemistry

In order for TSC to carry out the necessary process modelling work, an assessment of the likely iron ore chemical composition has had to be made. For the purposes of this report the following chemical composition, which is representative of Hematite ores and fines available in Australia, has been assumed

| Chemical | Lump Ore % | Fines % |
|---|---|---|
| Iron | 64.7 | 63.3 |
| Lime | 0.06 | 0.05 |
| Silica | 2.6 | 3.5 |
| Magnesia | 0.1 | 0.07 |
| Alumina | 1.3 | 1.95 |
| Phosphorus | 0.06 | 0.07 |
| Manganese | 0.22 | 0.17 |
| Sulphur | 0.014 | 0.02 |
| $K_2O$ | 0.016 | 0.014 |
| $Na_2O$ | 0.011 | 0.022 |
| FeO | 0.23 | 0.23 |
| $TiO_2$ | 0.047 | 0.08 |
| $V_2O_5$ | 0.003 | 0.005 |
| ZnO | 0.001 | 0.002 |
| PbO | 0.001 | 0.003 |
| Moisture | 2.75 | 7.9 |

#### 4.1.3 Indicative Coal Chemistry

Similarly to the Iron ore requirements above, the following coal blend for Coke production has been assumed for the basis of this report.

| Item | % |
|---|---|
| Volatile matter | 23.1 |
| Ash | 8.82 |
| Phosphorus | 0.033 |
| Sulphur | 0.056 |
| Moisture | 9.7 |

#### 4.1.4 Iron Making Production Philosophy

Iron making production will be based around the blast furnace process. Within this report a discussion on the various alternative iron making processes that could be considered for PIB has been provided. These are described fully in Section 5.1.

The recommendation for a Blast Furnace route has been made on the basis that at the current time the alternative iron making processes are either:

- Not mature or developed technically to compete with the established Blast Furnace Route, or
- Not developed to the same level of scale that can be produced by the Blast Furnace route commensurate to produce 22 million tonnes of semi finished product.

Work to date carried out by EWLP has been based on the assumption that each Blast Furnace will produce nominally 3.6MTPA of hot metal. This is the equivalent of approximately 10000 tonnes of hot metal per day (355 operating days) and would require a furnace with an inner volume of approximately 4000 to 4600 cubic metres. This was typically the norm for large blast furnaces built circa 20 years ago.

In the last 10 years however, a number of furnaces have been either built or rebuilt with increased inner volume in the range 5000 to 6000 cubic metres, giving a capability of output in the range 11000 to 13000 tonnes per day of hot metal. In the case of PIB this would effectively mean that the number of Blast Furnaces required to give the 22 million tonne per year output from a steel complex would be 5, not 6. On the basis of this, it is recommended that each complex be based on 5 blast furnaces.

Carbon for the iron making reduction processes will be provided by a combination of Coke and Injected Coal. For the purposes of this evaluation a coal injection rate of 150kg/THM has been assumed which is a typical industry figure. TSC is aware of higher injection rates up to 180-200kg/THM being achieved and this is an area for further debate with potential Steel Producers and would have a bearing on both CAPEX and OPEX for the project.

Process Modelling has indicated that, assuming coal injection at 150 kg/thm, the Coke requirement in the blast furnace would be around 338kg/ THM giving a total fuel rate of 488kg/THM.

It has been assumed that the Blast Furnace burden will be approximately 85% Sinter and 15% Lump Ore, based on the good quality Iron Ores available.

This again is an area for further discussion. At present, it is assumed that there are sufficient "sintering" ores available to support PIB, however as time progresses, and finer and less high quality ores are processed it is likely that pelletising will become more prevalent. For stable blast furnace operation, the mix should either be predominantly sinter or predominantly pellet. Experience has shown that issues with blast furnace operation can occur with an approximate equal mix of pellet/sinter in the burden.

Iron ore supply from one of the 'Big Suppliers' (sinter feed and lump) will likely be difficult. BHP Billiton and Rio Tinto, who account for almost 90% of iron ore production in Western Australia, are unlikely to have sufficient spare capacity to meet PIB needs from existing sources, however new mines are being developed.

Therefore, better opportunities are likely to exist for iron supply from the new entrants, however almost all of significant new producers are magnetite based which will mean pellet feed or pellets (magnetite / concentrate can be used in the sinter process route but in relatively low quantities circa 10%). The CAPEX and OPEX using either the sinter or pellet route is similar, therefore at this stage For the purposes of this study it has been decided to assume a predominantly sinter route.

Similar issues will likely occur regarding the supply of coal.

Availability of local fluxes (limestone and/or dolomite) require further research. Currently EWLP assumptions are based on importing Limestone from Papua New Guinea by ship to Abbot Point for the Queensland complex and subsequent transfer to the Steel Complex by conveyor. For the proposed Steel Complex in Western Australia, limestone and dolomite will have to be transported from the port by rail due to the much greater distances involved.

Scrap availability is also likely to be an issue in Australia; as such a steelmaking regime low in scrap charge (60kg/TLS) has been assumed, with works generated scrap being supplemented with iron ore as coolant, however additional scrap will still be required to achieve the required 60kg/TLS .

### 4.1.5 Indicative Iron Chemistry

It has been assumed that the hot metal chemistry required by the Steel Producers will be similar. The following basic hot metal chemistry has been assumed:

| Chemical | % |
|---|---|
| Carbon | 4.84 |
| Manganese | 0.3 |
| Silicon | 0.3 |
| Phosphorus | 0.08 |
| Sulphur | 0.035 |

### 4.1.6 Steel Making Philosophy

The precise steel chemistries and grades to be produced will depend upon the semi-finished feedstock and final steel requirements needed to supply the Steel Producers down-stream mills and customer base. This could require quite complex Steelmaking logistics and plant designs. At this stage to simplify the current pre-feasibility work, and in the absence of more detailed information, An assumption has been made that that finished steel output will be slab. The design of Steel plant will be around the Basic Oxygen furnace (BOF) process (see section 5.2. for further discussion on this)

Within the Steel plant scheme, made provision has been made for Ladle metallurgy through ladle furnace and Vacuum Degassing stations between the BOF and the continuous slab casters.

Within the modelling work undertaken for this report, typical industry norms for the following have been used

- yields,
- material recipe compositions,
- consumption rates, and
- generation rates

To arrive at values for inputs and outputs in terms of:

- raw materials,
- services and utilities provision and
- By-product gas generation.

### 4.1.7 Indicative Steel Chemistry

At this stage the finished steel slab chemistry is unknown and will be dependant on the Steel Producers business and marketing plans. Finished steel chemistry has a direct impact on the Steelmaking process route in terms of:

- Layout of plant and equipment
- Secondary steelmaking process requirements
- Alloy additions
- Semi finished product further processing
- Impact of the above on the CAPEX and OPEX of the overall process

For the purposes of this study it has been assumed that the product mix will be predominantly based on typical construction grades of steel, S275 is shown below, values are maximum %:

| C | Si | Mn | P | S | N | Cu | Nb | V | Ti |
|---|---|---|---|---|---|---|---|---|---|
| 0.21 | - | 1.5 | 0.035 | 0.035 | 0.012 | 0.55 | 0.05 | 0.13 | 0.05 |

### 4.1.8 Indicative product Mix

In terms of Slab Product mix, for the purposes of this study, the following slab thickness, width and length summary has been assumed:

| Slab Dimensions | | | Weight/Unit | | Slab Weight at a given Length (tonne) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Length | | | | | | | | |
| Width | x | Thk | | | | | | | | | |
| (mm) | | (mm) | (kg/m) | TPA | 4.5 | 5.5 | 6 | 7 | 8 | 9 | 10.5 |
| 1500 | x | 250 | 2943.75 | 660,000 | 13.25 | 16.19 | 17.66 | 20.61 | 23.55 | 26.49 | 30.91 |
| 1600 | x | 250 | 3140.00 | 660,000 | 14.13 | 17.27 | 18.84 | 21.98 | 25.12 | 28.26 | 32.97 |
| 1700 | x | 250 | 3336.25 | 660,000 | 15.01 | 18.35 | 20.02 | 23.35 | 26.69 | 30.03 | 35.03 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1800 | x | 250 | 3532.50 | 660,000 | 15.90 | 19.43 | 21.20 | 24.73 | 28.26 | 31.79 | 37.09 |
| 1900 | x | 250 | 3728.75 | 660,000 | 16.78 | 20.51 | 22.37 | 26.10 | 29.83 | 33.56 | 39.15 |
| 2000 | x | 250 | 3925.00 | 660,000 | 17.66 | 21.59 | 23.55 | 27.48 | 31.40 | 35.33 | 41.21 |
| 2100 | x | 250 | 4121.25 | 660,000 | 18.55 | 22.67 | 24.73 | 28.85 | 32.97 | 37.09 | 43.27 |
| 2200 | x | 250 | 4317.50 | 660,000 | 19.43 | 23.75 | 25.91 | 30.22 | 34.54 | 38.86 | 45.33 |
| 2300 | x | 250 | 4513.75 | 660,000 | 20.31 | 24.83 | 27.08 | 31.60 | 36.11 | 40.62 | 47.39 |
| 2400 | x | 250 | 4710.00 | 660,000 | 21.20 | 25.91 | 28.26 | 32.97 | 37.68 | 42.39 | 49.46 |
| 1500 | x | 300 | 3532.50 | 770,000 | 15.90 | 19.43 | 21.20 | 24.73 | 28.26 | 31.79 | 37.09 |
| 1600 | x | 300 | 3768.00 | 770,000 | 16.96 | 20.72 | 22.61 | 26.38 | 30.14 | 33.91 | 39.56 |
| 1700 | x | 300 | 4003.50 | 770,000 | 18.02 | 22.02 | 24.02 | 28.02 | 32.03 | 36.03 | 42.04 |
| 1800 | x | 300 | 4239.00 | 770,000 | 19.08 | 23.31 | 25.43 | 29.67 | 33.91 | 38.15 | 44.51 |
| 1900 | x | 300 | 4474.50 | 770,000 | 20.14 | 24.61 | 26.85 | 31.32 | 35.80 | 40.27 | 46.98 |
| 2000 | x | 300 | 4710.00 | 770,000 | 21.20 | 25.91 | 28.26 | 32.97 | 37.68 | 42.39 | 49.46 |
| 2100 | x | 300 | 4945.50 | 770,000 | 22.25 | 27.20 | 29.67 | 34.62 | 39.56 | 44.51 | 51.93 |
| 2200 | x | 300 | 5181.00 | 770,000 | 23.31 | 28.50 | 31.09 | 36.27 | 41.45 | 46.63 | 54.40 |
| 2300 | x | 300 | 5416.50 | 770,000 | 24.37 | 29.79 | 32.50 | 37.92 | 43.33 | 48.75 | 56.87 |
| 2400 | x | 300 | 5652.00 | 770,000 | 25.43 | 31.09 | 33.91 | 39.56 | 45.22 | 50.87 | 59.35 |
| 1500 | x | 350 | 4121.25 | 770,000 | 18.55 | 22.67 | 24.73 | 28.85 | 32.97 | 37.09 | 43.27 |
| 1600 | x | 350 | 4396.00 | 770,000 | 19.78 | 24.18 | 26.38 | 30.77 | 35.17 | 39.56 | 46.16 |
| 1700 | x | 350 | 4670.75 | 770,000 | 21.02 | 25.69 | 28.02 | 32.70 | 37.37 | 42.04 | 49.04 |
| 1800 | x | 350 | 4945.50 | 770,000 | 22.25 | 27.20 | 29.67 | 34.62 | 39.56 | 44.51 | 51.93 |
| 1900 | x | 350 | 5220.25 | 770,000 | 23.49 | 28.71 | 31.32 | 36.54 | 41.76 | 46.98 | 54.81 |
| 2000 | x | 350 | 5495.00 | 770,000 | 24.73 | 30.22 | 32.97 | 38.47 | 43.96 | 49.46 | 57.70 |
| 2100 | x | 350 | 5769.75 | 770,000 | 25.96 | 31.73 | 34.62 | 40.39 | 46.16 | 51.93 | 60.58 |
| 2200 | x | 350 | 6044.50 | 770,000 | 27.20 | 33.24 | 36.27 | 42.31 | 48.36 | 54.40 | 63.47 |
| 2300 | x | 350 | 6319.25 | 770,000 | 28.44 | 34.76 | 37.92 | 44.23 | 50.55 | 56.87 | 66.35 |
| 2400 | x | 350 | 6594.00 | 770,000 | 29.67 | 36.27 | 39.56 | 46.16 | 52.75 | 59.35 | 69.24 |
| | | | | 22,000,000 | | | | | | | |

Average slab length will be nominally 7.5m with an average weight of 33.3 Te. Maximum weight will be 75 Te.

Once the Steel Producer requirements are better understood in terms of finished steel qualities and semi finished product (Slab, Bloom and Billet) this issue should be revisited.

## 4.2 FINANCIAL ASSUMPTIONS

### 4.2.1 Capital Expenditure and Phasing

Capital Costs for major plant items have been estimated based on TSC's own database of capital costs; TSC has then applied its industry judgement to arrive at potential CAPEX cost savings to account for economies of scale and repeat designs. This is discussed further in section 11 of this report.

TSC has assumed that the chosen sites for the steel complex will have no special civil works requirements, which might adversely affect the construction cost. . It is assumed there are no major changes in level and gradient within the site nor are there very soft ground conditions or conversely significant bedrock.

The breakeven cost of slab quoted for each case considered in this study represents the FOB price.

For the purposes of this appraisal, in common with normal steel works practice the Steel Complex is assumed to have an economic life of 25 years.

One of the main benefits of this scheme is the reliance on “return full” trains between 2 steel complexes located at Abbot Point in Queensland and Newman in Western Australia. At this stage this study details the Abbot Point Costs, but is based on the assumption that the Newman complex would be constructed in a similar timeframe.

The Costs between the Abbot Point and Newman complexes should be broadly similar; however some differences will occur due to:

- Potential differences in labour rates between QLD and WA
- Water and Utilities cost differences between QLD and WA
- The Newman plant is some 400KM inland compared to the Abbot Point facility, this will have an effect on
    - Capital cost in terms of delivery of equipment to the site
    - Requirements for slab transportation to the docks
    - Import of other materials, particularly limestone and dolomite

In order to arrive at an estimate for project Phasing, the following basic tabular Gantt chart has been produced.

| Year | -5 | -4 | -3 | -2 | -1 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|
| Phase 1 2 Blast Furnaces | | | | | | | | |
| Phase 2 – Additional 2 Blast Furnaces | | | | | | | | |
| Phase 3 – Final Blast Furnace | | | | | | | | |
| | | | | | | | | |
| % Cumulative CAPEX | 5 | 19 | 39 | 65 | 89 | 100 | 100 | 100 |
| % Production | | | | | | 30 | 90 | 100 |
| Output Tonnes | | | | | | 6.6 | 19.8 | 22.0 |

It has been assumed that for Phase 1 based on 2 Blast Furnaces, plant design and construction will be completed within 60 months starting from issue of a “Notice to Proceed” to the EPC contractor.

Phase 2 for each steel complex would provide additional steel slab production facilities based around a further 2 blast furnaces and would Start approximately 18 months after Phase 1 start and be completed in 4 years.

Phase 3 for each steel complex would provide the additional facilities to increase production to the

22,000,000 tonnes of slab and would start some 3 years after Phase 1 start and be completed some 1 year after phase 1 completion.

Commissioning and working up of phase 1 production would take 2 years, with lessons learned reducing commissioning of phases 2 and 3 so that full output from the complex would be achieved after just over 7 years from commencement of phase 1.

Decommissioning and remediation of the land by the end of the steel mill's life is excluded in the cash flow analysis.

#### 4.2.2 Capital Charges

The discounted cash flow analysis is used to evaluate the breakeven price per tonne of slab produced. A discount rate of 10% has been assumed.

All capital requirements will be available according to the schedules of capital expenditure included for each case considered. The capital infusion could be assumed as cash available for the construction of the steel complex based on a combination of equity and debt, however the level of debt is not considered or accounted for in this study.

The Cost of Capital also uses a discount rate of 10%, which represents the weighted average of capital charges (WACC).

No interest during construction is applied but the timing of capital expenditure is taken into account in the discounted cash flow analysis.

#### 4.2.3 Recurring Major Capital Expenditure

In line with normal practice, it is assumed that the refractory relining of the blast furnaces will need to be replaced every 20 years of continuous operation. The study has assumed a relining will be carried out in the 20th year from start up with steel production assumed to maintain at 100% full capacity during this period (it is understood that this is a relatively simplistic approach and in reality Blast Furnace performance will start to tail off towards the end of it's life however the same assumptions have been made in all cases).

#### 4.2.4 Raw Material Costs

TSC has access to a great deal of commercially available sources of information regarding raw material costs and has used this in estimating both the cost of raw materials and freight costs.

In all cases costs for demurrage have been excluded.

#### 4.2.5 Delivery of Slab

In terms of Delivery of slab, this report assumes that in all cases the finished slab is delivered to a port in South Korea. Slab shipments from Queensland have been assumed to be based on Panamax shipping loads using TSC's latest view on freight shipping costs.

In all cases costs for demurrage have been excluded.

EWLP is currently in discussions with an international Shipping company regarding the design of a roll-on-roll-off vessel for transporting slabs which has the potential to reduce the shipping cost of slab to the final destination. At the stage of righting this report, the potential savings have not been evaluated compared to “standard” Panamax shipping costs.

#### 4.2.6 Inflation

Inflation assumptions were not included. No allowance has been made for escalation of fuel, reductant, raw materials, labour or other costs.

#### 4.2.7 Depreciation

Depreciation is assumed to follow a straight line at 4% rate.

#### 4.2.8 Estimate Accuracy

The estimate accuracy is within the range +/- 25%.

# 5. TRENDS IN IRON AND STEELMAKING TECHNOLOGY

## 5.1 OPTIONS FOR IRONMAKING

There are a number of ironmaking processes, which could be used for PIB and these are discussed below. These comprise:

- Blast Furnace
- Rotary Hearth Furnace
- Rotary Kiln
- HiSmelt
- Corex/Midrex
- Finex
- Natural Gas Based Zero-Reforming HYL Process
- Coal Based HYL Process
- Electric Ironmaking Furnace
- Submerged Arc Furnace (SAF)
- Hisarna
- Ausmelt

In the next sections we will consider the iron making options beginning with the best known of these – the Blast Furnace.

### 5.1.1 Blast Furnace

The Blast Furnace – Basic Oxygen steel furnace process route is the most common production route for crude steel production amounting to just under 70% of World Steel production in 2010 (source Steel Statistical Yearbook 2011).

For the first time in 2010, overall iron production by the blast furnace route topped one billion tonnes.

The blast furnace consists of a tall, vertical shaft furnace, which has the purpose of heating and reducing iron oxides (hematite and magnetite) into hot metal which is basically a carbon-saturated silicon and manganese iron alloy with residual amounts of sulphur and phosphorus.

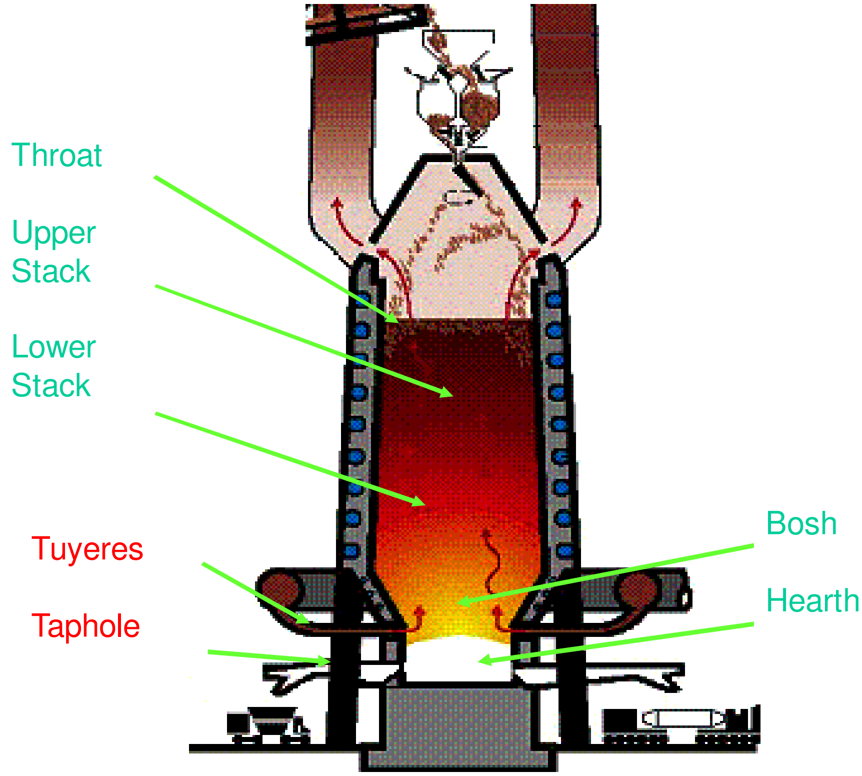
The Blast Furnace can be described as a counter current reactor. Coke, ore and sinter/pellets are charged into the top of the Blast Furnace together with limestone and other fluxes; this charge is known as the Burden. Hot Blast, which is basically preheated air produced by the blast furnace stoves is injected through tuyeres in the base of the furnace fanning the charge and reducing the ore and allowing hot metal to descend into the furnace hearth from where it is tapped.

The Blast Furnace construction is basically a cylindrical steel shell and is divided into 4 main areas.

- Throat – this is at the top of the furnace where the charging equipment is installed and where the blast furnace gas produced during the reduction process is discharged.
- Stack (sometimes called the upper and lower stack) extends from the throat with increased diameter to allow for expansion of solids as their temperature increases.
- Bosh or belly, which is the area between the stack and the hearth. This is where the melting process starts and the burden contracts as liquid iron forms.

- Hearth – This is the area where molten iron (hot metal) and slag accumulate. The tap holes to draw off the iron are located in the hearth. At the top level of the hearth, the tuyeres are located to allow the hot blast to enter the furnaces.

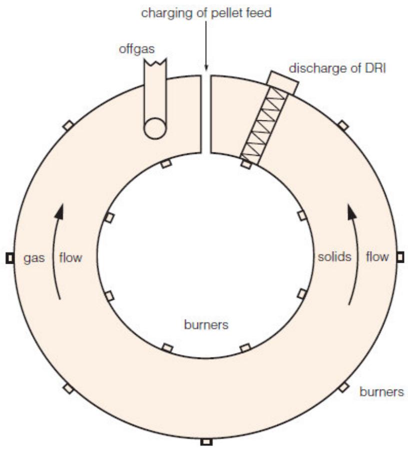
A generic view of a blast furnace is shown below:

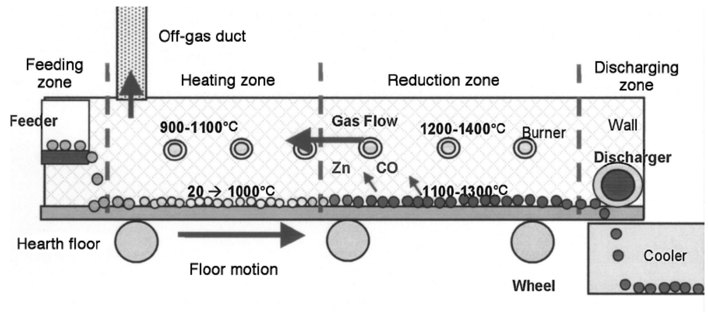



The blast furnace (BF) route is flexible in both operation and output with sizes of BF ranging from 4.5 m hearth diameter (420 $m^3$ volume) up to 15.5 m hearth diameter (5,500 $m^3$ volume) with furnaces under construction of 6000 $m^3$ volume. In terms of daily hot metal output, these range from 700 to 12000 tonnes of hot metal per day.

The raw materials feedstock proposed by PIB will not cause any issues with hot metal production using the Blast Furnace route. In terms of economies of scale, the Blast furnace offers the best method in achieving the required output of 22Mte per annum at each of the proposed steel complexes.

#### 5.1.2 Rotary Hearth Furnace




The rotary hearth furnace (RHF) consists of a flat, refractory-lined hearth rotating inside a high temperature, circular tunnel kiln. The feed typically consists of cold-bonded pellets, made from a mixture of iron ore fines, coal, water and a binder such as bentonite. The pellets are placed evenly on the hearth, usually one to two layers thick to give a fast reaction time. Burners located in the RHF roof and/or sidewalls heat the pellets to the required reduction temperature, typically 1250–1400ºC. The pellets pass first through an oxidising zone and then through the reducing zone.

Heating of the pellet layer is accompanied by drying; and the expulsion and combustion of volatiles from the coal and, when the reduction temperature is reached, the generation of carbon monoxide (CO) from the outer shell towards the pellet centre. Thus, as the iron becomes metallic it is protected both by the CO inside the pellet and by a CO veil surrounding the pellet and the pellet layer as a whole. The maintenance of this CO veil is essential to avoid re-oxidation; particularly in the latter stages of the process when metallisation advances and CO generation weakens. The process is therefore controlled to maintain low oxygen potentials in the local furnace atmosphere.

Additional heat is provided by the injection of excess air to burn the evolved volatiles and carbon monoxide. This combustion provides up to 75% of the total energy to the process. An auxiliary fuel may be burned in the final reduction zone to balance the local energy requirements (Cairns and others, 1998). Thus, the amount of coal used in the pellets depends on its volatile matter (VM) content – more coal is required as the VM increases. However, this decreases the amount of fuel required for the burners, because of the heat supplied by combustion of the volatiles and CO, around 3–5 GJ/t DRI.

The carbon content in the pellet influences the iron metallisation and also the remaining carbon content in the DRI product. The homogeneous mixing of coal with the iron oxide is a key point in reaching the best DRI quality. Like the rotary kiln, the combustion gases from the burners flow counter current to the solids flow. The pellets are fed and discharged continuously and stay on the hearth for only one revolution, typically under 20 minutes, depending on the reactivity of the feed mixture and target product quality. The DRI composition can be varied depending on the RHF operating conditions and the blending ratio of the raw materials. A variable speed hearth drive, for example, controls the retention time of the pellets and hence the desired product quality with regard to metallisation degree and carbon content; longer residence times promote stronger pellets.

The burners are fired with natural gas, fuel oil, waste oil or pulverised coal. Pulverised coal firing increases the capital cost of the plant but provides a more radiant flame than natural gas, however high volatile coals are preferred (>30% VM, >20% ash).

The sensible heat in the off-gas is recovered and used to preheat the RHF burner combustion air and dryer air. The off-gas is then cleaned to remove $SO_2$ and particulates before being vented to the atmosphere. Compared to coal-based smelting reduction processes, RHF processes produce lower volumes of lower energy off-gases, so there is only a small residual capacity for steam generation.

To avoid disintegration of the pellets and to maximise reduction, the furnace atmosphere, gas velocity and gas composition must be accurately controlled in each zone of the RHF to ensure smooth heating and reduction of the pellets, and to avoid re-oxidation in the final furnace zone. It is important to determine the right furnace parameters such as the ratio of the oxidising-to-reducing gases, residence time, temperature profile and gas velocity in order to optimise productivity and DRI quality (Degel and others, 2000). The raw materials specifications and the pellet preparation recipe also need to be optimised according to how the DRI (and HBI) is to be used. Testing in a pilot plant is required.

Although the coal-based direct reduction concept utilising RHFs is a simple one, commercial implementation of the concept has not been easily achieved. Drawbacks associated with RHF processes include:

- **Excessive gangue.** The reduced DRI pellets are made of an iron matrix in which the residues of the coal and binder are trapped. The carbon excess, 60 to 90% of the coal sulphur, all the coal ash and most of the binder thus remain in the product and become part of the feed to the subsequent steelmaking processes (Borlee and others, 1998).
- **Large equipment** is required for a commercial unit. A 500,000 t/y unit would need a 500 $m^2$ RHF with an external diameter close to 50 m. On the other hand, the equipment is relatively simple with most of the furnace constructed from carbon steel, with little expensive alloys, and with normal ironmaking refractory.
- **Operational problems**. The RHF operation by Iron Dynamics in Butler, IN (USA) has shown erratic operation since it started production in 1999. Typical problems related to the strength of cold-bonded pellets (fines creation leading to dust and yield losses) and temperature in-homogeneity across the bed.

Currently, the two main commercially available RHF processes are Fastmet and Inmetco and both are currently used to process steel mill wastes. However, there are other RHF's operation – e.g. at Nippon Steel's Kimitsu Works and others are expected to come on line in the near future. Research is being carried out to increase RHF productivity, DRI quality, and fuel efficiency by, for example, increasing the reaction temperature, the height of the bed, the volatile matter content in the carbonaceous reductant and increasing post combustion.

New RHF concepts are being developed (e.g. ITmk3 by Midrex) that produce iron nuggets rather than DRI pellets by melting down the pellets and thus separating the gangue.

Producing a less reduced DRI reduces the need for burner fuel, which is mostly used in the final and hottest section where oxidising conditions (from post combustion) should be avoided.

The low productivity of RHFs can partly be overcome by producing DRI with lower metallisation (75% to 85%, instead of 95%) and completing the final reduction and melting within an Electric Arc Furnace.

In terms of suitability for PIB, the Nominal Operating capacities of the RHF are very low when compared with the Blast Furnace route. Of the handful of plants known in the world, the largest by far is the Hoyt Lake facility in Minnesota, USA. This is a joint venture of Kobe Steel and Steel Dynamics Inc, commissioned in 2010 using the ITmk3 process with a design capacity of 500 KTPA.

Information produced by Steel Dynamics in their quarterly business updates indicate that the plant is only operating at about 40% of it's design capacity after nearly 2 years of operation.

To adopt this process for large scale operation at PIB would require a minimum of 44 units at each site assuming the current design and operational issues can be overcome.

As described above, the quality of off gas to provide supplementary fuel for generation is also much lower than the conventional Blast Furnace / Coke oven route.

In terms of specific consumption figures, Midrex/Kobe for ITmk3 quote Per Ton of Nuggets:

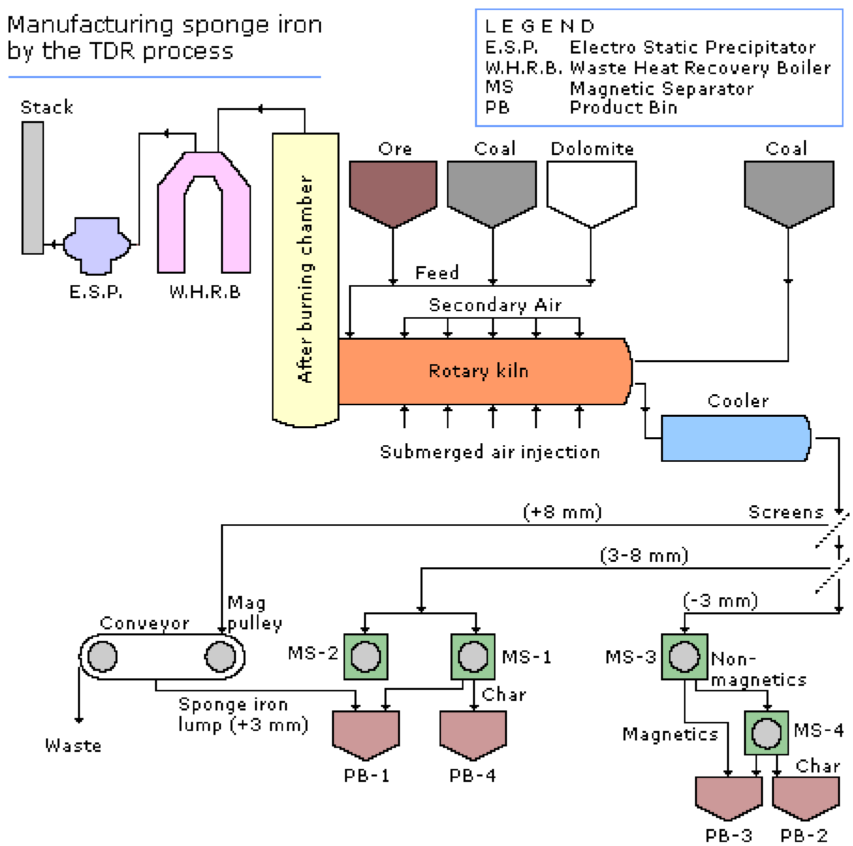
- Iron-bearing Feed (t) 1.5
- Coal (t) 0.5
- Natural Gas Burner Fuel (GJ) 4.6
- Electricity (kWh) 200
- Water (m3) 2.0
- Air (m3) 85
- Nitrogen (m3) 12
- Direct Labour (personnel) 50 total
- Maintenance ($) 5
- Other ($) 15

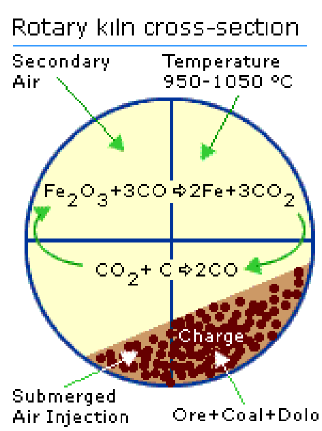
A List of Known RHF plants is shown on the table below from VDEh Plant facts:

| Country | Company | Location/ Works | Plant Status | Manufacturer | Start Up | Process | Type Of Ore | Reduction Medium: | Product: Type | Nominal Capacity |
|---|---|---|---|---|---|---|---|---|---|---|
| Japan | Aichi Steel Corp | Chita, Nagoya | Operating | NSC Const. Div., Jp | 2008 | RHF | EAF Dust | Pulverized Coal | Sponge Iron | 10 |
| Japan | Kobe Steel | Kakogawa, Hyogo | Operating | Kobe Steel, Jp | 2001 | Fastmet® | Mill Scale | Fuel Oil Tailings | Sponge Iron | 16 |
| Japan | Nippon Metal Ind. | Kinuura | Operating | Nippon Steel, Jp | 2008 | RHF | BF/BOF Dust | Coal | Sponge Iron | 200 |
| Japan | Nippon Steel Corp | Hirohata, Hyogo | Operating | Kobe Steel, Jp | 2000 | Fastmet® | BF/BOF Dust | Coal | Sponge Iron | 190 |
| Japan | Nippon Steel Corp | Hirohata, Hyogo | Operating | Kobe Steel, Jp | 2005 | Fastmet® | BF/BOF Dust | Coal | Sponge Iron | 190 |
| Japan | Nippon Steel Corp | Hirohata, Hyogo | Operating | Kobe Steel, Jp | 2008 | Fastmet® | BF/BOF Dust | Coal | Sponge Iron | 190 |
| Japan | Nippon Steel Corp | Hirohata, Hyogo | Under Const. | Kobe Steel, Jp | 2011 | Fastmet® | BF/BOF Dust | Coal | Hbi | 220 |
| Japan | Nippon Steel Corp | Hikari, Yamaguchi | Operating | NSCConst. Div., Jp | 2001 | RHF | BF/BOF Dust | Coal | Sponge Iron | 28 |
| Japan | Nippon Steel Corp | Kimitsu, Chiba | Operating | Nippon Steel, Jp | 2000 | RHF | BF/BOF Dust | Coal | Sponge Iron Pellets | 300 |
| Japan | Nippon Steel Corp | Kimitsu, Chiba | Operating | NSC Const. Div., Jp | 2003 | RHF | BF/BOF Dust | Coal | Sponge Iron Pellets | 135 |
| Japan | Nippon Steel Corp | Kimitsu, Chiba | Operating | Nippon Steel, Jp | 2008 | RHF | BF/BOF Dust | Coal | Sponge Iron | 300 |
| South Korea | Posco | Pohang | Operating | Nippon Steel, Jp | 2009 | RHF | BF/BOF Dust | Coal | Sponge Iron Pellets | 200 |
| South Korea | Posco | Gwangyang | Operating | Nippon Steel, Jp | 2009 | RHF | BF/BOF Dust | Coal | Sponge Iron Pellets | 200 |
| South Korea | Posco | Gwangyang | Operating | Nippon Steel, Jp | 2009 | RHF | BF/BOF Dust | Coal | Sponge Iron Pellets | 200 |
| Pr China | Maanshan I&S Co | Maanshan-I, Anhui | Operating | Nippon Steel, Jp | 2009 | RHF | BF/BOF Dust | Coal | Sponge Iron | 200 |
| Taiwan | China Steel Corp | Kaohsiung | Operating | Nippon Steel, Jp | 2008 | RHF | BF/BOF Dust | Coal | Sponge Iron | 200 |
| United States | Mesabi Nugget Delaware Llc | Hoyt Lakes, Mn | Operating | Tenova It,US & Kobe Steel | 2010 | Itmk3® | Fine Ore, Pellets | Pulverized Coal Or Coal | Iron Nuggets | 500 |

### 5.1.3 Rotary Kiln

A schematic diagram of a rotary kiln process developed by Tata Steel is shown below.




This process and other rotary kiln processes consist of a revolving horizontal cylinder comprising a shell with an internal refractory lining. Seals at each end join the rotating cylinder to the stationary equipment for adding materials and discharging product from the furnace. The furnace is inclined at an angle of 3–4° from the horizontal toward the discharge end so the burden travels through the rotary kiln by rotation and gravity. The overall process requires a duration of approximately 10-12 hours inside the kiln. A metallization of 90-92% should be possible making the product suitable for charging direct to an EAF furnace for steelmaking.

Coal, flux and iron oxide are fed into the high end of the kiln and pass through a heating zone where coal is devolatilized and the charge is heated to the reduction temperature. Iron oxide is reduced in the reduction zone by carbon monoxide.

A portion of the process heat is usually provided by a burner at the solids discharge end of the kiln. The burner operates with a deficiency of air to maintain a reducing atmosphere in the kiln. Additional process heat is supplied by combustion of coal volatiles and the carbon monoxide from the bed. Combustion air is supplied through ports spaced along the length of the kiln. The airflow is controlled to maintain a relatively uniform temperature profile in the reduction zone and a neutral or slightly reducing atmosphere above the bed. The kiln gas flows counter current to the flow of solids.

The iron oxide feed (lump ore or pellets) should fulfil certain requirements regarding chemical composition, size distribution and behaviour under reducing conditions in the kiln. The feed should have high iron content so that costs for further processing in the electric furnace are as low as possible. Sulphur and phosphorus contents should also be low. The minimum size should be controlled at approximately 5 mm. Besides being elutriated from the kiln, fines contribute to accretion build-up (ringing) in the kiln. Reduced fines in the product also re-oxidize more rapidly. Ore reducibility, a measure of the time required to achieve a desired degree of metallization under a standard set of conditions, has a strong influence on the capacity of the kiln. The behaviour of the ore under reducing conditions is important, especially with regard to swelling and subsequent decrepitation.

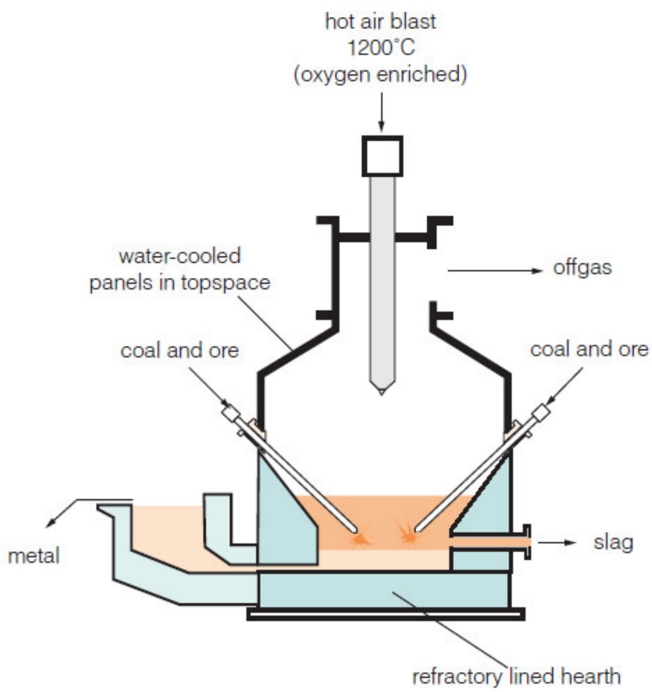
Important factors in the selection of coals are reactivity, volatile matter content, sulphur content, ash content and ash softening temperature. Coal reactivity is indicative of the coal's reduction potential and with increased reactivity; the throughput of the rotary kiln can be expected to increase within certain limits. Consideration should be given to the fact that the volatile content generally increases with reactivity. Because coals with high volatile content generate more gas than can be used in the process for reduction and fuel, the recovery of the sensible and chemical heat contained in the waste gas would have to be considered for overall heat economy. Low-sulphur coals are preferred to minimize sulphur in the DRI product.

The solids discharged from the rotary kiln are cooled, then screened and separated magnetically. DRI fines can be briquetted and used for steelmaking. A carbon char is separated and recycled to the kiln to increase fuel efficiency. The off-gas passes through a gravity separation chamber that can also serve as an afterburner and is then cooled and cleaned before being released to the atmosphere. Dust from the settling chamber is transported to a waste disposal area.

In the SL/RN process the kiln is fed with indurated pellets and/or lump iron ore. Iron sands are used at New Zealand Steel, with design modifications to provide efficient operation. A wide range of fuels and reductants including lignite, char, low temperature coke, coke breeze and anthracite coal have been used satisfactorily. Depending on the fuel used, the proportion of the reductant fed through the inlet of the kiln with the oxide feed and the proportion fired through the burner at the kiln exit will be adjusted. With very low-volatile coal, a supplementary fuel such as natural gas or fuel oil is fed through the central burner or through the air tubes to maintain the proper temperature profile in the kiln. Smooth kiln operation is achieved when operating with a relatively high volatile coal charged together with the iron burden through the kiln feed end.

### 5.1.4 HIsmelt

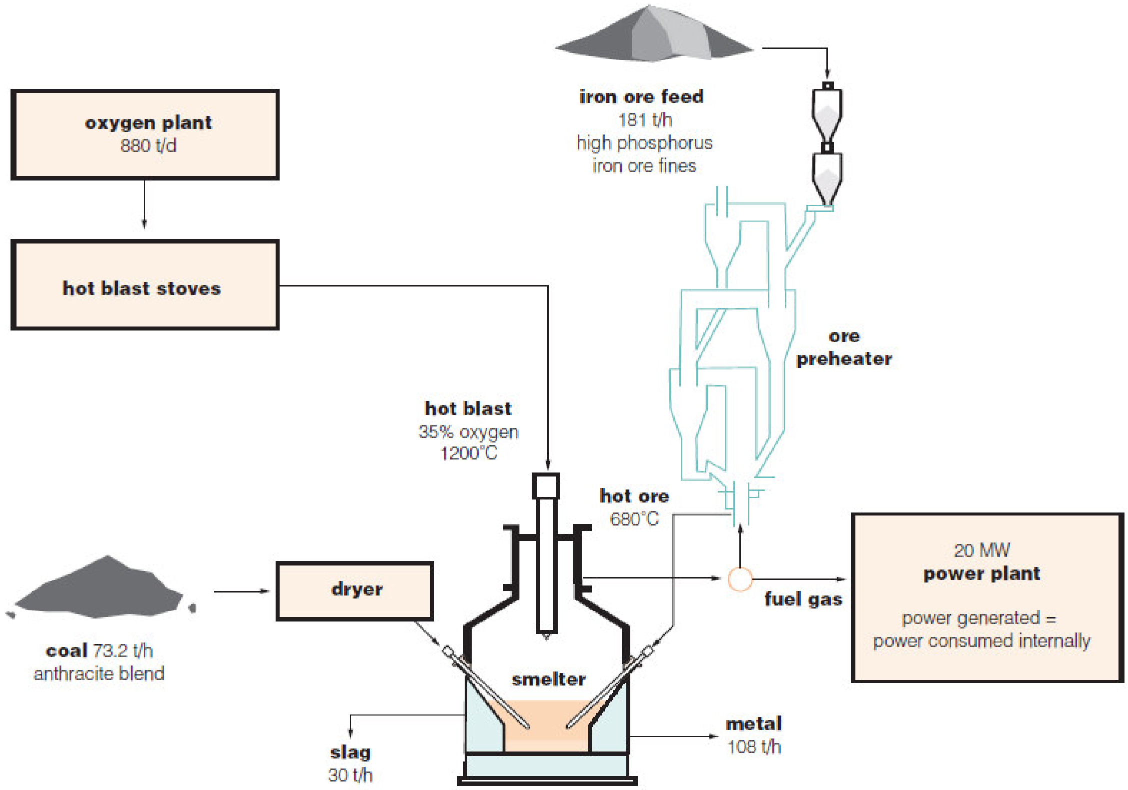
A view of the Hismelt Smelting Reduction Vessel (SRV) (Bates and Muir, 2000) is shown below:




In the HIsmelt process preheated and pre-reduced iron ore fines (typically <6 mm), waste iron oxide materials, ground coal (typically <3 mm) and fine fluxes are injected through side mounted water-cooled lances deep into the metal bath[1]. Rapid dissolution of coal and smelting occurs and the resulting gases (mainly CO and $H_2$), along with the injected nitrogen carrier gas, propel a highly turbulent fountain of metal and slag droplets into the top-space.

Air preheated at 1200ºC, and enriched with oxygen (35%), is injected through a water-cooled lance into the top-space. Post-combustion occurs and the energy produced is transferred to the metal and slag droplets that provide a large surface area for the heat transfer. Post-combustion in the range 50–75% has been achieved (59% is the assumed level in calculations).

The HIsmelt flow sheet and mass streams (Goldsworthy and Gull, 2002) are shown below:




The SRV operates at a moderate pressure of around 1 bar gauge. The hot metal is continuously tapped through a forehearth (siphon) to maintain a nearly constant metal level within the SRV, whilst the slag is periodically tapped via a conventional water-cooled taphole. The hot metal is then desulphurised to produce hot metal with 4% C and low Si.

Production capabilities were assessed across the full range of ferrous feed reduction levels from hematite, hematite goethite, and goethite ores through to DRI. Normal sinter plant feed and typical pellet feed materials (80% finer than 40 µm) can be directly processed. The process can use coals ranging in volatile matter from 9.8% (anthracite) to 38.5% (high volatile bituminous). The fixed carbon, ash, volatile matter, oxygen and sulphur contents do influence productivity. Best results are achieved using a low volatile (10%) anthracite coal. A commercial plant is estimated to have a coal rate of around 650 kg/thm (in combination with an ore preheating system).

The fountain of metal and slag coats the water-cooled panels in the slag and top-space area. It is reported that this results in low refractory wear rates: as low as <1 kg/thm (refractory wear will occur mainly in the highly turbulent bath area). The hot off-gas from the SRV is cooled via a water-cooled hood, cleaned in a scrubber, and used to

a) fire the stoves to create hot air blast
b) preheat and pre-reduce the iron-bearing materials
c) used to generate steam and/or electricity.

**Advantages of the HIsmelt process:**

- can use low value iron ore fines and non-coking coals directly (with actual specific consumption of LV coal expected to be similar to a BF route – once process is fully industrialised)

- can process steel plant waste materials
- can process high phosphorus ore fines (0.12% P) that are unsuitable for processing in blast furnaces or DRI.
- most coals can be used. In general, the use of low and medium volatile coals is preferred, but high volatile coals result in a richer off-gas that can be used for power generation
- flexibility of operation: the process can be started, stopped or idled more easily
- is expected to significantly reduce emissions of $SO_2$, NOx, dioxins and particulates, while some $CO_2$ reduction will be achieved as well.

**Disadvantages of the HIsmelt process:**

- not fully industrialised (see Status)
- expected lower availability (~92%) than the BF and higher refractory wear due to aggressive slag (it typically contains 4% FeO);
- iron yield is slightly lower than for blast furnaces as the FeO content in the slag will be around 4% compared to 2% in blast furnace slag.
- uncertain whether the slag is suitable for direct utilisation in cement production due to its FeO content.

**Status of the HIsmelt development:**

A commercial plant, costing a reported US$208 million, with a capacity of 800 kt/y, based on a 6 m diameter SRV was commissioned in 2005 at Kwinana, Australia. It was a joint venture between Rio Tinto (Australia) 60%, Nucor Corp. (USA) 25%, Mitsubishi Corp. (Japan) 10% and Shougang Corp. (China) 5%. The Kwinana plant was expected to form the platform from which further scale-up (to 8 m hearth diameter) and development of the process and engineering to be made.

The Kwinana plant has been in production for about 4 years. Annual production –

- 2005 - 9,000 tonnes of pig iron.
- 2006 - 89,000 tonnes of pig iron.
- 2007 - 114870 tonnes of pig iron
- 2008 – up to end June 82218 tonnes of pig iron

HIsmelt further optimised the Kwinana Plant operation in the second half of 2008. A major improvement was made by installing two co-injection Giga lances during the July-August shut-down, which contributed to better heat transfer efficiency, lower coal rate, and a record high daily and weekly production rates of 1,834 and 11,000 tonnes respectively. The installation of a full set of Slag Zone Coolers demonstrated that an extended campaign life can be expected under steady operation conditions.

The quality of the metal produced so far has been encouraging with carbon levels consistently around 4.4% ± 0.15. Phosphorus and silicon levels have remained extremely low (0.02% ± 0.01% P, <0.01% Si).

The plant achieved a production rate record of over 80 tonnes hot metal per hour and a sustainable production rate of 75 tonnes hot metal per hour. Numerous other production records have also been broken including highest production in a week, highest production in a month, and lowest coal consumption (810 kg per tonne of hot metal).

However, the reported Hot Blast problems imply that the scaled-up (8m) SRV (~1.5 Mt/y) will be

designed with 4 off-centre lances instead of 1 large centre lance (currently).
In March 2009, HIsmelt advised that the plant had been put on a 12 months "Care and Maintenance" period due to the depressed global market for Pig Iron.

In December 2010 Rio Tinto advised "that the HIsmelt joint venture partners agreed to permanently close the Kwinana site and terminate the joint venture. The majority of closure work is expected to be completed by 2014. The technology business (100 per cent Rio Tinto owned) continues and a number of licensing opportunities are progressing."

In terms of suitability for PIB therefore, HIsmelt technology is not sufficiently mature to suit the large scale production requirements of the project.

#### 5.1.5 Corex/Midrex

The Corex process is the most developed of the smelting reduction technologies using coal and has been in commercial operation since 1989. It combines a melter-gasifier vessel with a reduction shaft to produce a liquid product that is very similar to blast furnace hot metal. Four commercial plants are currently in operation based on the C-2000 module, which has a production capacity of 0.8–1 Mthm/y, namely at Posco's Pohang Works in South Korea, at Saldanha Steel's plant at Saldanha Bay, South Africa,Essar Steel, Hazira, Gujarat steel plant (2 modules) and at Jindal Vijayanagar Steel's steel plant at Torangallu, Karnataka, India (2 modules).

At Saldanha Steel and Essar, the Corex plant has been combined with EAF steelmaking, whilst Jindal and Posco have used the BOF route. Modifications have been introduced as experience with the C-2000 plants is gained. For example, unexpected wear of the refractory lining in the first C-2000 plant at Posco has resulted in changes in the refractory and cooling system design in the melter-gasifier. A C-3000 module with a production capacity of 1.2–1.5 Mthm/y is now available (and used for Finex at Posco). Two C-3000 modules are installed at Shanghai Baosteel Pudong Iron and Steel Co. Ltd. (Baosteel) in Luojing, near Shanghai, China.

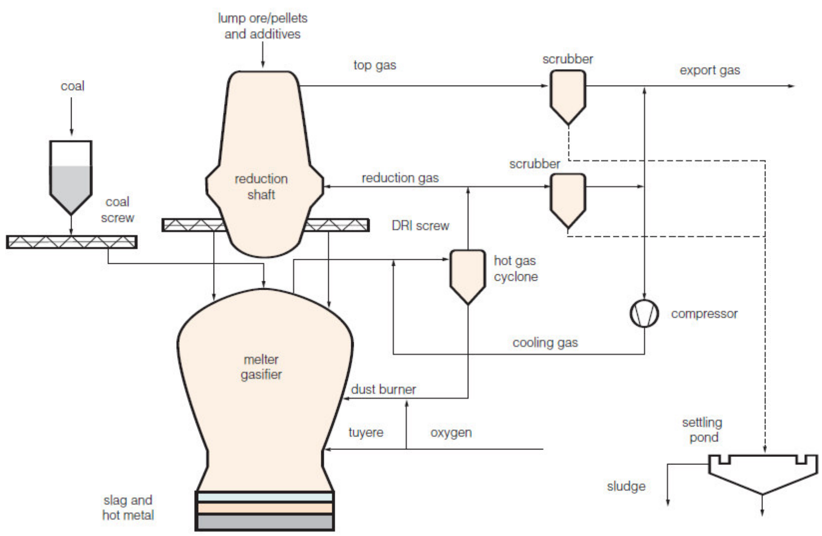



Figure 13 – Corex Schematic

Lump iron ore and/or pellets, and additives (limestone and dolomite) are charged into the top of a reduction shaft. Reducing gas from the melter-gasifier is injected into the lower part to reduce the iron ore to sponge iron (DRI). The additives ensure that adequate slag basicity and sulphur removal from the hot metal in the melter-gasifier is achieved. The hot DRI (metallisation 80–95%) and calcined additives are then transferred into the melter-gasifier by screw conveyors. Lump coal (6–50 mm) is fed in separately through the dome where it falls onto the char bed above the hearth. In the hot, reducing atmosphere (about 1000ºC), the coal is dried and devolatilised to char. The tars and other volatile matter from the coal are cracked and oxidised to mainly carbon monoxide and hydrogen.

Heat for the processes is supplied by the reaction of coal char with the injected oxygen to form carbon monoxide. The DRI passes through the char bed, where it is finally reduced and melted, creating a pool of slag and metal, both are periodically discharged by conventional tapping procedures. The reducing gas, containing about 65% CO and 20% $H_2$ (rest $CO_2$, $H_2O$, $N_2$), exits the melter-gasifier at a temperature of 1000ºC, and is cooled by recycled process gas to 800–850ºC.

After cleaning in a cyclone, the gas is fed into the reduction shaft to reduce the iron ore. The fines captured in the hot cyclone are recycled to the melter-gasifier. The top gas leaving the reduction shaft is cooled and cleaned in a scrubber, when it is now termed the export gas. This gas generally has a net calorific value of about 7,500–8,500 kJ/m3. This corresponds to about half of the energy content of the feed coal. The export gas can be used for a variety of heating, drying, metallurgical, chemical and power generation purposes.

The maximum productivity of Corex plants has been achieved by charging 70% pellets and 30% lump ore to the reduction shaft. Iron ore fines cannot be used without agglomeration in the reduction shaft because of the need to ensure adequate permeability within the bed to permit access and passage of the reductant gas. Instead, the iron ore fines are mixed with the coal and charged directly into the melter-gasifier. Iron ore fines can form up to 15% of the total iron-bearing charge.

Fine steel plant waste products, such as dusts and scales, can also be charged into the melter-gasifier. At the Jindal plant, BOF slag is used as a substitute for limestone, and the Corex sludge is mixed with the pelletising plant feed as a substitute for coal fines. The undersized limestone and dolomite fines (<6.3 mm) that cannot be charged through the reduction shaft can be charged into the melter-gasifier to fine-tune the slag chemistry. At the Saldanha Steel plant, sludge from the wet scrubbers and dust are granulated in a specially designed granulation plant. The granules are sold to a cement producer, but there are plans to recycle some to the melter-gasifier.

The chemical and physical properties of the iron ores and pellets affect the productivity of the plants. The total iron content should be above 60%, and the sum of the $SiO_2$ and $Al_2O_3$ contents should be below 6% to keep the slag volume low. Separation of reducing gas generation from the reduction of iron ore allows a wide variety of coals or their blends to be used, although coal composition does affect its consumption, offgas quality and the amount of excess reducing gas.

A small amount of coke is used in the Jindal plant, before and after shutdowns for process corrective measures. The plant also requires about 10–15% coke, it is primarily required to improve char bed permeability within the melter-gasifier.

The overall economics of Corex depend to a large extent on the economic utilisation of the export gas. Both plants at Jindal and Posco were set up within existing integrated steel units where the prevailing gas deficit is met by the Corex export gas. At Posco the export gas is utilised for power generation, and at Jindal for both power generation and pellet production.

A different option was implemented at Saldanha Steel. The export gas, after removal of the CO2, is utilised in an adjacent Midrex direct reduction plant.

The Midrex process was developed by the Surface Combustion Division of Midland-Ross Corporation in the USA in the mid 1960's. In 1983 Midrex was acquired by Kobe Steel.

The Midrex process produces DRI from pellets using a reducing gas. This DRI is then typically used in EAF steelmaking, as a substitute for metal scrap.

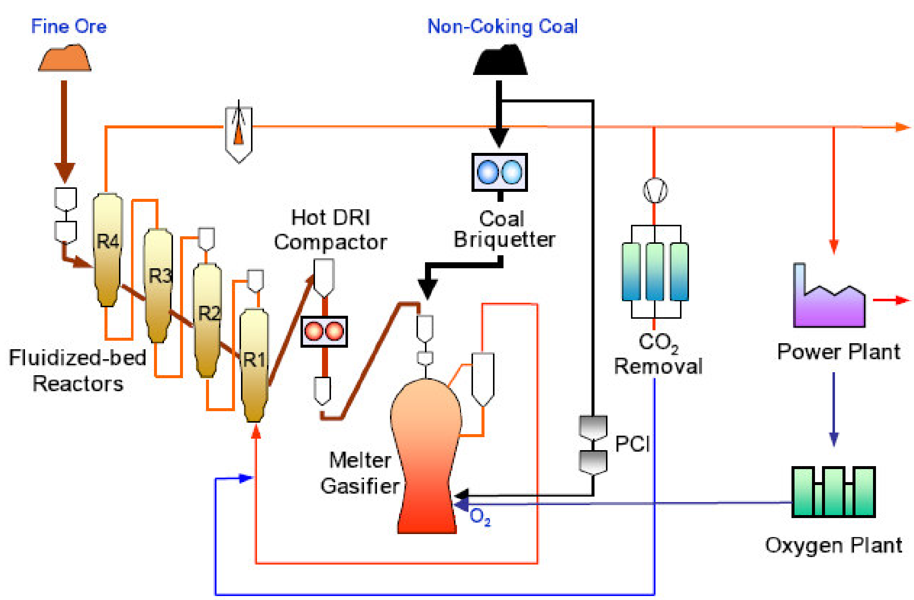
The Midrex process is the most widely used DRI process and typically uses natural gas to produce the reductant gas. When this is not economically available, the required reducing gas can be produced by a coal gasifier (not yet commercially used) or the Corex melter-gasifier. The latter option is operated at Saldahna (SA). This combined Corex-Midrex plant produces around 800,000 t/y of hot metal and 800,000 t/y of DRI.

In terms of the suitability for PIB, the main issue with these processes is again down to scale factor with a typical maximum sized unit producing circa 1,500,000 t/y compared with a Blast furnace producing up to 4,400,000 t/y.

### 5.1.6 Finex

Finex is an innovative Ironmaking process which has been developed by Siemens VAI and Posco.

A Schematic of the process is shown below:




Molten iron is produced directly using iron ore fines and non-coking coal rather than processing through a sinter plant and coke ovens as the traditional blast furnace route.

In the Finex process, iron ore fines are charged into a series of fluidized-bed reactors. The fines pass in a downward direction where they are heated and reduced to direct-reduced iron (DRI) by means of a reduction gas – derived from the gasification of the coal – that flows in the counter-current direction to the ore.

The DRI fines are then hot-compacted to hot-compacted iron, transferred to a charging bin positioned above a melter gasifier and then charged by gravity into the melter gasifier where smelting takes place.

The tapped product, liquid hot metal, is equivalent in quality to the hot metal produced in a blast furnace or Corex plant.

Because the preliminary processing of raw materials is eliminated, the construction of the Finex plant costs less to build than a blast furnace facility of the same scale. Furthermore, a 10-15% reduction in production costs is expected through cheaper raw materials, reduction of facility cost, pollutant exhaustion, maintenance staff and production time.

The excess gas produced from the process can be further utilised for the generation of Electricity.

In addition, it is eco-friendly in that it produces less pollutant such as SOx, NOx, and carbon dioxide than traditional methods.

### *Current Status*

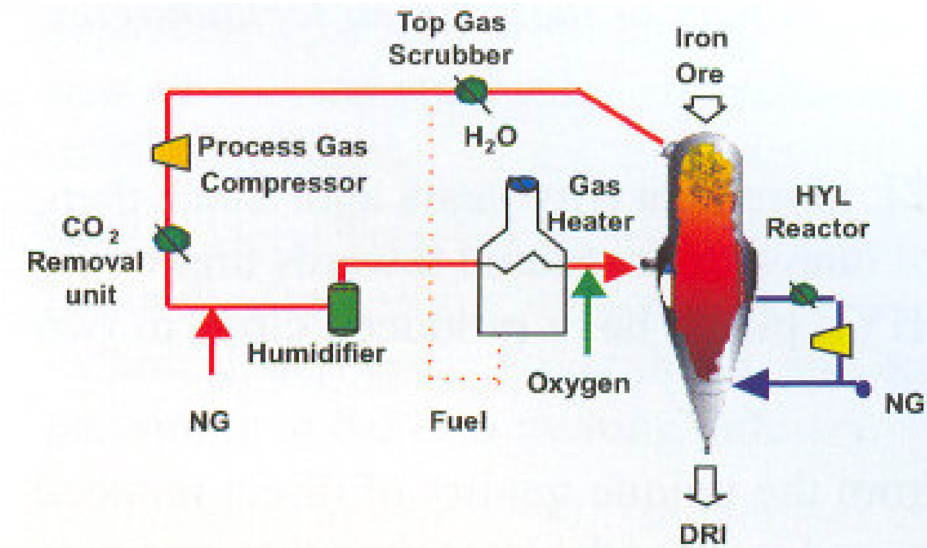
Posco together with Siemens VAI have designed and built the first commercial operational plant in Korea producing 1.5 million tonnes of hot metal per year. Posco are now considering scaling up to 2 million tonnes per annum.

Based on work completed so far, Posco estimate that the Finex equipment costs only 80% of the traditional Blast furnace route costs with operating costs of 85% of the blast furnace route costs.

#### 5.1.7 Natural Gas Based Zero-Reforming HYL Process

The HYL process was developed by Hojalata Y Lamina s.a. (Hylsa) of Monterrey, Mexico with the first commercial unit starting production in 1957.

The Zero Reforming (ZR) HYL process is one of the latest developments by Tenova-HYL. A diagram of the process is shown below:




The HYL furnace is a moving bed shaft type reactor operating at a pressure of approximately 8 bar. Feed material in the form of pellets and/or lump ore is charged through a set of pressurizing and depressurizing bins and sealing valves.

Iron oxide is reduced by a counter current flow of reducing gas which contains mainly $H_2$ produced by self-reforming of natural gas inside the reactor, where fresh reduced iron plays the role of catalyst.

Due to high content of $H_2$, reduction reactions are fast and residence times of 2 – 4 hours are achieved. Natural gas is injected into the reducing gas circuit before the humidifier. Reduced material flows down into a transition zone where most of the carburization of DRI takes place.

Depending on the type of product, the material continues to flow down into either a cooling zone where it is cooled by a counter current flow of cooling gas to produce cold DRI, or is hot discharged into briquetting machines to produce HBI, or discharges hot into a HITEMP® pneumatic transport system to be directly charged into EAF (HDRI).

The product discharges through a set of pressurizing and depressurizing bins and seal valves to keep the reactor high pressure isolated from atmosphere. Spent gas is cooled and cleaned of $CO_2$ and sulphur and re-circulated into a reducing gas circuit. The process has the capability to produce DRI with carbon content in the range between 1.5 to 5 %.

Main Benefits

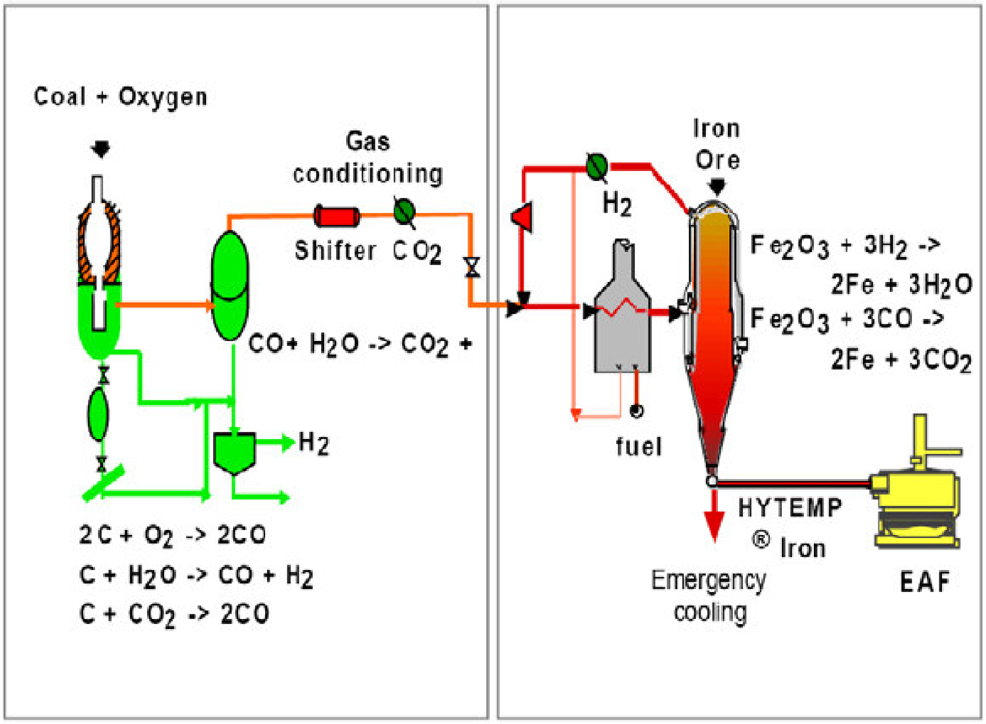
- No need for coking coal and coke
- Lower natural gas consumption compare to reformer based HYL process
- Production of high carbon DRI
- Production of hot DRI that could be charged to an EAF with significant energy savings

Main Disadvantages

- Requires additional electricity and Oxygen over traditional HYL process
- Typically installed capacity is 1MTPA with up to 1.75MTPA under development.

#### 5.1.8 Coal Based HYL Process

The schematic of this process is shown below:




The HYL reactor and its peripheral systems and principles of operation are the same as the gas based HYL process in which oxide material is fed from top and is reduced by a counter current flow of $H_2$ and CO containing gas.

Since natural gas is not available for the carburization of DRI, lower carbon content of product is expected to be approximately 0.4 %. Similar to gas based HYL process, furnace top gas is cooled and cleaned and its $CO_2$ is removed and then recycled into the reducing gas circuit.

Reducing gas is produced in a coal gasifier that can process practically any kind of carbon bearing material. Coal and Oxygen are injected into the gasifier and almost all carbon in the coal is gasified. The gas is dust laden and includes $CO_2$ and $H_2O$ and other impurities. It is cleaned and cooled in a series of cyclones and $H_2O$, $CO_2$ and Sulphur are removed.

Since the reactor is designed to work with high $H_2$ content reducing gas, and the gas from the gasifier contains considerable amounts of CO, a gas shift reactor is required to convert CO into $H_2$ by the reaction $CO + H_2O > CO_2 + H_2$

The shift reactor is installed before the $CO_2$ removal system. The temperature and pressure of the gas is then regulated before injection into the reactor.

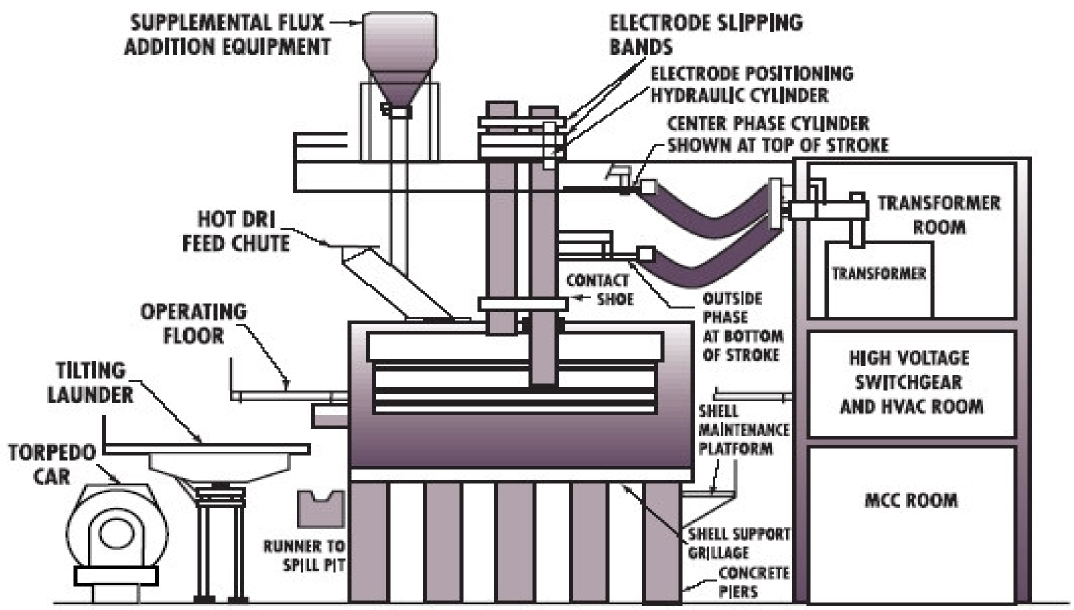
**Main Advantages**

- No need for coking coal and coke
- No need for natural gas
- Usage of low quality coals
- Production of hot DRI that could be charged to an EAF with significant energy savings

The main disadvantages are as per the Natural Gas HYL process described earlier.

### 5.1.9 Electric Iron Furnace (EIF)

The Electric Iron Furnace is a fixed position circular refractory lined airtight vessel that utilises direct arc heating via three electrodes. The technology was first developed by in 1995 by Midrex and Kobe Steel using DRI produced from the RHF pilot plant located at the Kakogawa Steel Works, Japan.




The EIF is stationary, has a fixed roof and tapping is carried out by drilling out a tap hole similar to a blast furnace tapping. DRI is continually gravity fed (either hot or cold) from storage bins located above the furnace.

It is a batch process that utilises pre-baked graphite electrodes (similar to an EAF) and a large hot heel practice to allow for variations in DRI chemistry. As the EIF is sealed and maintained under highly reducing conditions sulphur removal is efficient. Typical hot metal analysis produced by the Midrex pilot plant is as follows:

| %C | %Si | %Mn | %S | %P | Tap Temp. C |
|---|---|---|---|---|---|
| 4.5 | 0.47 | 0.107 | 0.013 | 0.036 | 1455 - 1510 |

### Status of EIF Technology

As previously mentioned Midrex have a 1.5 ton pilot EIF at their research centre in the USA, however the only industrialised application was installed by Paul Wurth at Differdange, Luxembourg, as a part of their Primus Process. This process was designed to treat EAF red dust and oily sludge produced by the various Arbed (now Arrcelor Mittal) steel plants located in Luxembourg.

### EIF Productivity

Limited data is available on EIF productivity, however the Midrex 1.5 tonne pilot plant had production rate of 260 lbs/h with an electrical energy input of 250kVA from a single phase AC transformer.

### EIF Unit Size & Capital Costs

The only industrialised reference plant at Differdange, Luxembourg, is reported to now be producing approximately 125 kt/y. Due to the limited published data of EIF's it is not possible to make any sensible comment on the scaling up of units, however Paul Wurth claim they are comfortable with scaling it to 500 kt/y.

### Capital Costs

Based on a budget estimate from Midrex it is recommended to use a preliminary capital cost estimate of US$160/thm, hence cost per 125 kt/y unit is US$20M.

Please note that given the very limited public availability of capital data on EIF's we strongly recommend to use supplier capital quotes as part of the detailed project report.

### Estimated Consumptions

The unit consumption of the RHF-EIF route was estimated by using the IRMA RHF-EIF model (a steady state heat & mass balance model developed at the Tata RD&T Ironmaking department). Two cases were calculated: DRI with 70% and 85% metallisation.

### Input data and assumptions on the EIF

- 30% of arc power is assumed to be lost to the cooling system (current industrial standard)
- Fe-containing dusts from the EIF are ignored.
- The slag contains 5% FeO and is conditioned to 0.9 B4 basicity. Resulting in the following composition:
  - $Al_2O_3$ 14 wt%,
  - CaO 26 wt%,
  - CaS 2.5 wt%,
  - MgO 9.4 wt%,
  - MnO 0.13 wt%,
  - $SiO_2$ 25 wt%,
  - Rest 18 wt%
- The hot metal consists of 4.5% C and 0.3% Si, 0.3% Mn and 0.05% S.
- Electrode consumption is 1.25 kg/GJ.

### *Calculated unit consumption rates*

Calculation of unit consumption rates of the RHF + EIF combination

| | | 85% metallisation Hot-link | 70% metallisation Hot-link | 85% metallisation Cold-link |
|---|---|---|---|---|
| Ore | kg/thm | 1433 | 1433 | 1433 |
| Coal | kg/thm | 420 | 419 | 418 |
| Bentonite | kg/thm | 18 | 18 | 18 |
| Burnt Lime | kg/thm | 51 | 51 | 51 |
| Natural gas | $Nm^3$/thm | 62 | 68 | 62 |
| EAF electricity | GJ/thm | 1.9 | 2.5 | 3.1 |
| | kWh/thm | 519 | 701 | 875 |
| Electrode | kg/thm | 2.3 | 3.2 | 3.9 |
| Other electricity | kWh/thm | 85 | 85 | 85 |
| | | | | |
| Slag | kg/thm | 205 | 205 | 205 |
| Export energy | GJ/thm | 3.1 | 3.6 | 3.1 |

In terms of suitability for PIB, this process has only currently only one worldwide installation, operating at very low production levels when compared with a conventional blast furnace operation or with Corex/Midrex.

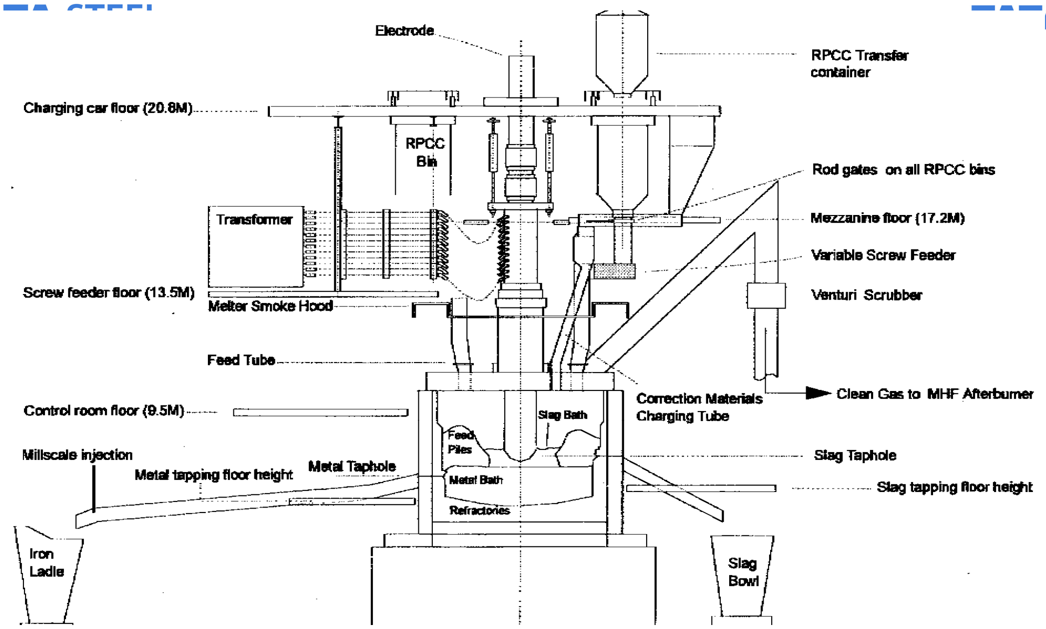
The system relies on a large capacity electricity supply and would require significant power plant input to support this process.

#### 5.1.10 Submerged Arc Furnace (SAF)

The submerged arc furnace consists of either a rectangular or circular refractory lined sealed vessel that utilises resistance heating through a slag layer via a number of electrodes (normally six). The technology has been in use since the early 1900's in a variety of industrial applications including, ferroalloys, pig iron, waste treatment and non-ferrous metals.

DRI is gravity fed (either hot or cold) through the furnace roof from a system of storage bins located above the furnace. Additional fluxing agents i.e. lime or dolomitic lime can also be added in a similar manner, the quantity of which is determined by the analysis of the DRI.

The SAF is stationary and has a fixed roof, refractory sidewalls (MgO Brick) and refractory hearth (carbon block + MgO brick). Campaign lives up to 15 years are achievable with careful furnace operation. The SAF usually has two tap holes, one for slag and one for hot metal, and both are opened up using a dedicated tap hole drill similar to blast furnace tapping.




Off-gas from the SAF, primarily CO, can be recycled to the RHF where it is used as a fuel.

### *Status of SAF Technology*

There are numerous SAF's in production around the world, SMS Demag for example have over 500 reference plants producing over 100 different products, some highlights of which are shown in the table below:

| Customer | Country | Transformer Rating MVA | Product |
|---|---|---|---|
| Eramet-SLN | New Caledonia | 99 | FeNi |
| CVRD | Brazil | 2 x 120 | FeCr |
| SA White Martins | Brazil | 49.5 | CaC |
| Namakawa Resources | South Africa | 1 x 28, 1 x 30 | TiO – slag |
| Kumba Resources | South Africa | 2 x 36 | TiO – slag |
| Xinli | PR China | 30 | TiO – slag |

However reference plants producing hot metal are not as common and research has identified only three furnaces as follows:

| Plant | Country | Transformer Rating MVA | Capacity ktpa |
|---|---|---|---|
| New Zealand Steel | New Zealand | No.1 69<br>No.2 69 | No.1 330<br>No.2 300 |
| Highveld | South Africa | 63 | N/a |
| Iron Dynamics | USA | 38 | N/a |

The Highveld furnace is reported as being mothballed following the acquisition of the company by Arrcelor Mittal, whilst the furnace at Iron Dynamics is reported to have had a problematic history, never achieving nameplate capacity. However the two SAF's in operation at New Zealand Steel (NZS) are successfully smelting a DRI produce via four multiple hearth furnaces and two rotary kilns utilising locally available titaniferous ironsand and high volatiles sub-bituminous B coal. The main design parameters of these SAF's are as follows:

Type - Elkem, rectangular AC furnaces each powered by three 23MVA transformers

Electrodes – Six in-line (three pair) 1.3m dia. Soderberg electrodes

Dimensions – 26m long x 7.6m wide x 4.6m high. 900mmm wall thickness

Hearth – Inverted arch (6.2m wide x 11m radius)

Sidewalls – magnesite brick with combination external steel plate (upper) and water-cooled steel panel (lower) shell supported by vertical buck stay held together at the top and bottom by tie rods to keep the hearth under compression and maintain dimensional control. Penetrative copper coolers at located at the slag level.

Roof – refractory design, either alumina castable or magnesite brick

Charging – continuous feed via variable speed screw feeder from 12 bibs located above the furnace, one either side of each electrode.

Tap holes – Separate tap holes for slag and metal. Two metal tap holes located on one side of the furnace above the lowest point of the hearth and two slag tap holes located on the opposite side 500mm above the metal tap holes.

Launders – slag launders are short with a steep gradient, feeding into a slag pot. Metal launders are longer with a shallow gradient and split at the end to allow feeding into two hot metal ladles.

Off-gas – off-gas production varies between 6,000 and 8,500 Nm3/h at 85% to 90% CO. The off-gas is cleaned in a fixed throat wet venture scrubber before being sent to either the rotary kilns or MHF afterburners for co-generation.

Typical hot metal analysis produced by the SAF's at NZS is:

| %Fe | %C | %Ti | %Si | %Mn | %V | %S | %P |
|---|---|---|---|---|---|---|---|
| 95.0 – 96.0 | 3.0 – 3.3 | .20 - .35 | .15 - .30 | .40 - .50 | .45 - .50 | .025 - .040 | 0.50 - .090 |

## *SAF Productivity*

The role of the SAF is to complete the reduction of and melt the DRI to produce liquid iron of a consistent carbon and sulphur content, hence the productivity of the SAF can be expressed in terms of total output (thm/h).

The two SAF's in operation at NZS have a quoted productivity between 35 to 50 thm/h, dependant upon production rate and inventory.

Discussions with a SAF equipment supplier (SMS Demag) have suggested that a rectangular furnace, approximately 26m long x 10m wide, with a 55MW power input would have a productivity of approximately 80 thm/h, which is comparable to the NZS furnaces who have a power input of 43MW and 39MW respectively.

## *SAF Unit Size & Capital Costs*

**Unit Size**
Given that the SAF is a continuous process an operating time of 8,300 h/y has been assumed and hence a capacity of 660 kt/y has been calculated, which is the maximum unit capacity that SMS Demag have advised.

The SAF's in operation at NZS have quoted capacities of 330 and 300 kt/y, albeit with lower electrical energy inputs.

**Capital Cost**
At a scale of 660 kt/y it is recommended to use a (preliminary) capital cost estimate of 118 USD/thm. This estimate is based on a single source (SMS Demag).

SMS Demag SAF at 660 kt/y = US$ 78M

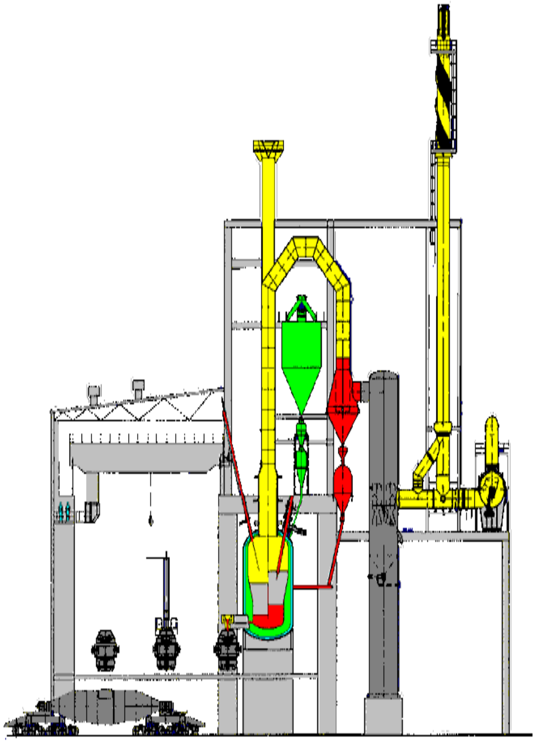
Please note that given the very limited public availability of capital data on SAF's we strongly recommend to use supplier capital quotes as part of the Detailed Project Report.

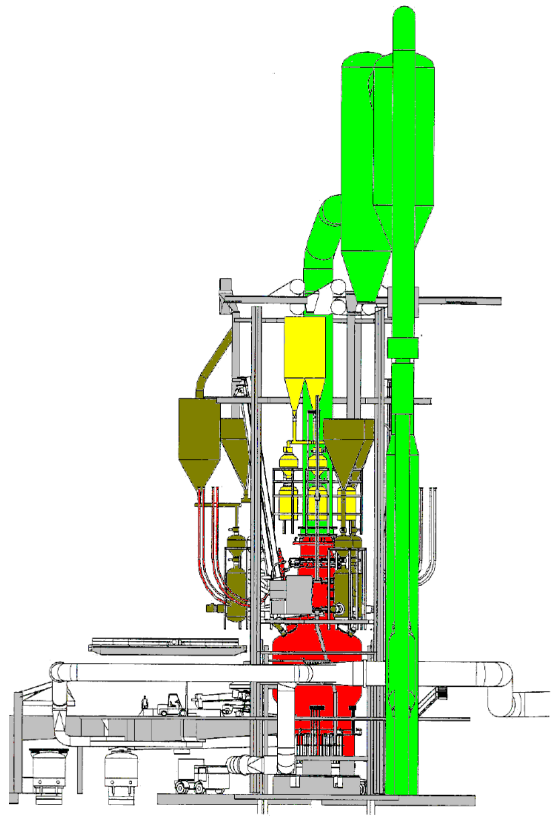
## *Estimated Unit Consumptions*
Unit consumptions quoted by NZS are as follows:

| Item | Unit | Quantity |
|---|---|---|
| DRI | Kg/thm | 1,600 |
| Coal | Kg/thm | 1,145 |
| Limestone | Kg/thm | 70 |
| Electricity | KWh/thm | 900 |
| Electrode | Kg/thm | 2.9 |

SMS Demag quoted electrical power consumption of 700 – 800 kWh/thm and electrode consumption of 2 kg/thm

**5.1.11 HIsarna**





HIsarna is a project jointly funded by the ULCOS partners to develop a €26 million pilot project (including an extended trial period). The basic engineering for a 65 kt/y plant at Tata Steel's IJmuiden plant in the Netherlands has been constructed and undergone some initial trials this year with Project management carried out by Tata Steel's RD&T with HiSmelt as a partner.

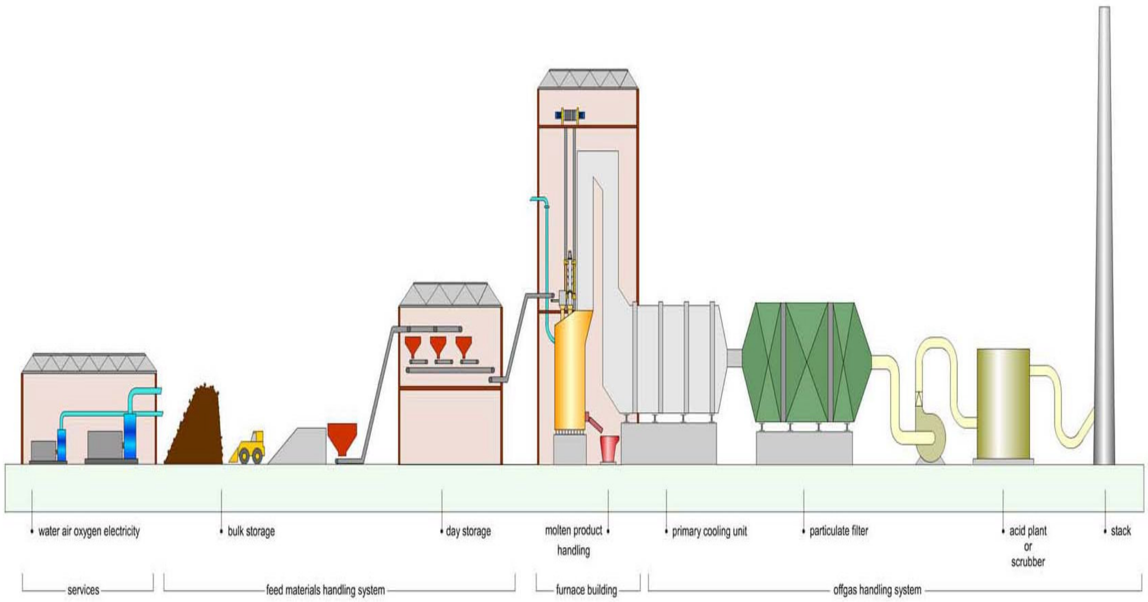
The process is similar, in many ways, to HISmelt but is expected to be more energy efficient and will generate around 20% less $CO_2$. It features an iron ore melting cyclone which is sited above, and feeds into, a bath smelting and reduction vessel.

HIsarna make use of ore fines and can use low cost coals and/or biomass as a fuel.
The process has been designed to handle high phosphorus ores, high zinc ores, and waste oxides.

The plant features 'state of the art ; copper cooling with graphite lining > 2000 kW/$m^2$. A liquid layer of iron ore is frozen on the surface and provides the protection for the inner lining.

Experiments to date have been reasonably successful but a commercial unit is some 7-10 years away. Given this timeline, the HIsarna process is therefore not considered to be a candidate for this project.

#### 5.1.12 Ausmelt




Ausmelt is smelting reduction production using a cold oxygen-enriched air and between 400-900kg/t of coal to produce hot metal and, as such, is not particularly energy efficient, It can be fed with ore or DRI and was established initially to process Cu. Pb. Ti and Zn

The process is simple – taking place in un-pressurised vessels- but is essentially small scale and is unlikely to be scaled beyond 250,000t/y and is rejected for this reason and because it is not yet commercially available.

### 5.2 OPTIONS FOR STEELMAKING

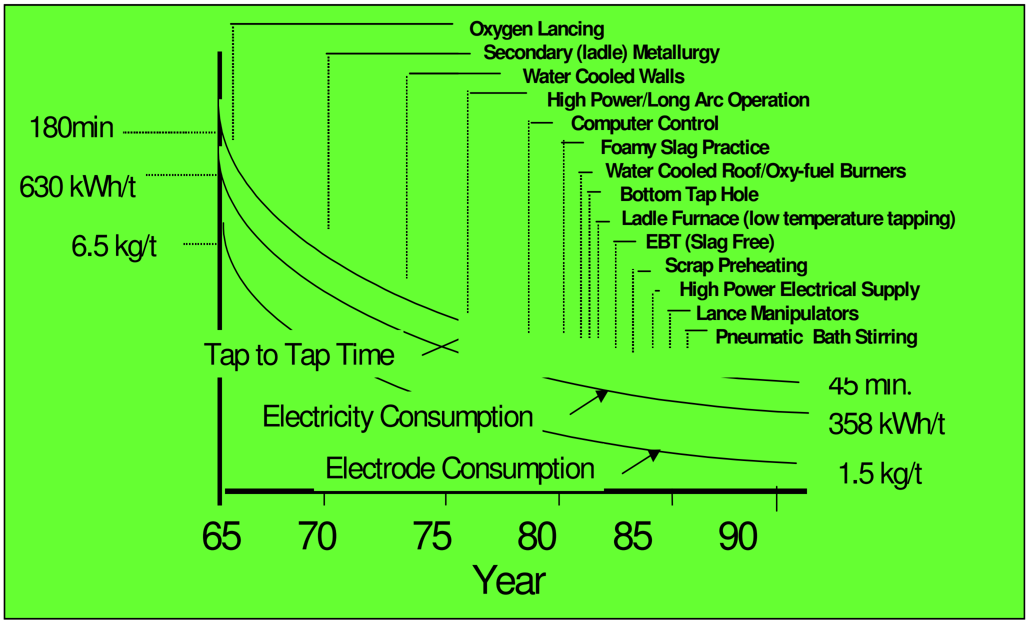
Two steelmaking options have been considered. These are:

- Electric Arc Steelmaking (EAF)
- Basic Oxygen Steelmaking (BOS/BOF)

#### 5.2.1 Electric Arc Furnace

The EAF is a proven technology with the first commercial furnace being commissioned in the late 19$^{th}$ century and now they account for approximately 30% of global crude steel production (circa 410 Mt in 2010).

EAF efficiency has improved significantly over the past 40 years through a series of different innovations:




Modern EAF's have performance data as follows:

| Item | Unit | Performance |
|---|---|---|
| Tap to Tap Time | mins. | 45 |
| Annual Production | ktonnes | 1,500 |
| Scrap Weight | tonnes | 338 (largest) |
| Electrical Power Consumption* | KWh/t | 358 |
| Electrode Consumption* | Kg/t | 1.2 |

*based on 100% scrap charge.

The main advantages of the EAF process route when compared to the more traditional BF / BOS route are as follows:

- Flexibility – can turn on & off by simply operating circuit breaker
- Environmentally Friendly
    - 100% recycled material (scrap)
    - Lower carbon footprint than BF/BOS (if scrap is used)
- Lower capital investment

The main disadvantages of the EAF process are:

- Low productivity (when compared to Basic Oxygen Steelmaking)
- Typical EAF units produce circa 1.5 MTPA with very few references above 2MTPA
- Higher residual content not suitable for many flat product applications (based on 100% scrap input)
- High electricity costs compared to BF/BOS route
- Requires a large stable electricity supply infrastructure
- Requirement for a good source of scrap supply

If the EAF route was to be considered for PIB, the likely scenario would be a mix of DRI and Scrap charge.

### 5.2.2 Basic Oxygen Steelmaking (BOS)

The BOS is the most proven steelmaking technology available with the first Bessemer Convertor being commissioned in the mid 19th century and the basic oxygen convertor being developed in Linz, Austria, by the mid 20th century. The BOS now accounts for approximately 70% of global crude steel production (circa 990 Mt in 2010).

Modern BOS vessels equipped with sub-lances, off-gas analysers, sophisticated process control models and slag splashing are achieving productivity levels in excess of 470 t/h.

The main advantages of the BOS process route when compared to the EAF are:

- High productivity
- No external fuel source
- Suitable for the rapid production of a wide range of steel grades

Whilst the typical scrap to hot metal ratio operated within Europe is typically between 15 – 20%, numerous converters around the world are operated at far lower scrap levels, including Tata Steel operations at Jamshedpur. Tata Steel operates at an average scrap consumption of 7%, however, it has experience of operating BOF converters with no scrap addition at all. It uses iron ore as the coolant in such cases.

| Company | Country | % Hot Metal | % Scrap |
|---|---|---|---|
| Tata Steel, Jamshedpur | India | 93 | 7 |
| Anshan Iron & Steel | China | 92 | 8 |
| JFE, Mirushima | Japan | 95 | 5 |
| Kobe Steel | Japan | 93 | 7 |
| Nisshin Steel | Japan | 96 | 4 |

Hence with the use of works arising scrap, which is assumed to be approximately 3%, and the purchase of a minimal amount of merchant scrap (assumed to be nominally 3%) a proven process route can be adopted to produce quality liquid steel and a competitive conversion cost.

## 6. MATERIAL FLOW / LOGISTICS WITHIN THE STEEL COMPLEX

Based on 22MTPA finished slab output from each steel complex, the following sections give an indication of the main raw material requirements and material flows for the complex. The figures have been derived from a combination of Industry norms and TSC's extensive experience in steel plant layout and operation.

### 6.1 RAW MATERIAL HANDLING

In global terms the raw materials facility will need to handle the following quantities derived from process modelling work:

| | | |
|---|---|---|
| Coking Coal | Te/yr | 11,306,253 |
| Coal Injection Coal | Te/Yr | 3,266,801 |
| Total Coal | Te/Yr | 14,573,054 |
| Lump Ore | Te/Yr | 5,417,383 |
| Fines | Te/Yr | 27,028,388 |
| Total Ore | Te/yr | 32,445,770 |
| Limestone | Te/yr | 8,309,372 |
| Dolomite | Te/yr | 2,475,788 |
| Total Te Conveyed | Te/Yr | 57,803,984 |

In addition to the above significant quantities of other materials will be required, in the main alloy additions to arrive at finished slab chemistry. These could include:

- Olivine
- Quartzite
- Fluorospar
- Aluminium
- Ferrosilicon
- Ferromanganese
- Ferrochrome
- Ferronickel
- Ferromolybdenum
- Ferrovanadium
- Ferrotitanium

#### 6.1.1 Incoming rail materials

From the previous work undertaken by EWLP, each EWL train will consist of 300 wagons pulled by 4 loco units. The payload of each train is as follows:

| | Iron Ore | Coal |
|---|---|---|
| Payload/Wagon(te) | 109 | 65 |
| Payload/Train(te) | 32,700 | 19,500 |

Based on 340 days per year operation an average of 2.92 trains of iron Ore and 2.2 trains of Coal will be required at each steel complex per day.

However on the basis of the 2 steel complexes, one at each end of the E-W line, the net traffic each way ideally should be equal to capitalise on transporting loaded trains in both directions as such will be equal at an average of 2.92 trains per day each way for both Iron Ore and Coal.

This will require each train to be unloaded in approximately 8.2 hrs.

These discharge rates are equivalent to 4000 TPH for Ore and 1800 TPH for Coal.

In terms of wagon discharge there are 2 methods that can be used.

Gondola/Tippler Haulage systems

The Gondola/Tippler system has box carriages (Gondolas) linked with rotary connecting couplings. When the wagon rake arrives laden at the discharge point it is positioned by a hydraulic system and the carriage(s) are clamped and rotated about the rotating coupling, emptying the contents of the Gondola(s) into a discharge hopper from where it can be transported to the stocking areas by a conveyor system.

Emptying of the wagon should pose no problems or issues with material “hanging up” in the wagon

The Gondolas themselves are relatively simple, strong and light boxes with any complexity being in the rotating couplings. Benchmark Gondola systems have carriages of approximately 19t tare weight able to carry 130t across four axles based on the normal 32Te axle load.

Hopper/Bottom unloading system

The carriages of the bottom unloading systems each have pneumatically operated doors on the bottom of each carriage. This involves having additional equipment on each carriage that accounts for between 3 & 4 tonnes of extra tare weight above that of the Gondola system. The hopper itself has to be shaped to allow the material to flow to the exit doors. These are usually angled on both sides and ends. The doors themselves have to be within the axle base thus likely increasing the length of the wagon for a given storage capacity.

Discussion of the merits/issues of each system

Bottom unloading systems are prone to problems in cold climates; however this should not effect operation in tropical Australia, however issues could occur due to increased moisture, largely offset by use of wagon covers (see below)

Bottom unloading systems are generally designed to ensure the product unloads using “mass flow” rather than “funnel flow”. This can be an issue dependant on space limitations and the wagon design.

With bottom unloading, the material, if it is cohesive enough, can form bridges or arches that hold the overburden material in place reducing flow or even preventing unloading. This effect does not happen with Tippler systems.

The bottom unloading design allows the option to cover the wagons. This is a positive aspect for PIB in that over the 3000KM journey, this would:

- Reduce moisture to the product
- Allow for a reduction of drag from the carriage
- Reduce possible material loss due to windage

With the tippler wagon, covered wagons would be very difficult to accommodate requiring additional facilities and manual intervention.

The capital cost of the bottom unloading wagons will be greater than that of the Tippler type. TSC experience suggests circa $k10 per wagon difference based on Indian manufacture. This would need to be offset against the increased Capital cost of the tippler rotating station which would likely be some $5m more than a bottom unloading system (based on Indian prices) and the savings in fuel and windage loss with a more aerodynamic covered wagon.

The EWLP preferred unloading option is to use bottom unloading wagons into a discharge hopper and then feed from the hopper by conveyor to the stocking grounds.

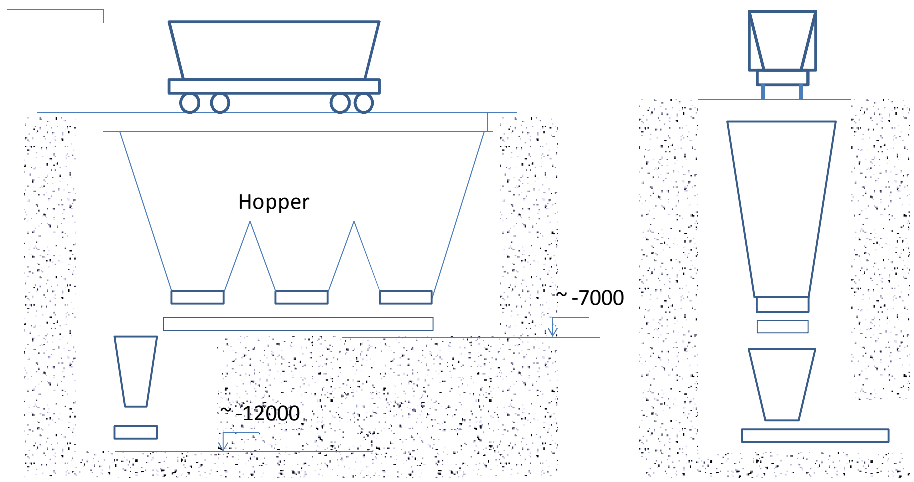
At this stage the design of the wagons is not finalised, however calculations indicate that assuming a wagon bottom opening of 6 doors each 0.7m x 1m in size, unloading times to the hopper once the door is open will be approximately 10 seconds for coal and 5 seconds for ore.

These values are well in excess of the requirements for unloading. In order to provide some comfort in terms of excess capacity, discharge conveyors with throughput rates sufficient to discharge a train in circa 5 hrs, equating to some 6500 TPH for Ore and 3900 TPH for Coal, are suggested.

Based on a wagon length of approximately 20m, the speed of the train during discharge and the time to discharge a train can be estimated.

| Material | Wagon Load Te | Discharge Rate TPH | Train Speed kM/hr |
|---|---|---|---|
| Iron Ore | 109 | 6500 | 1.2 |
| Coal | 65 | 3900 | 1.2 |

In terms of the basic arrangement of the discharge equipment, the sketch below, indicates a view of typical requirements



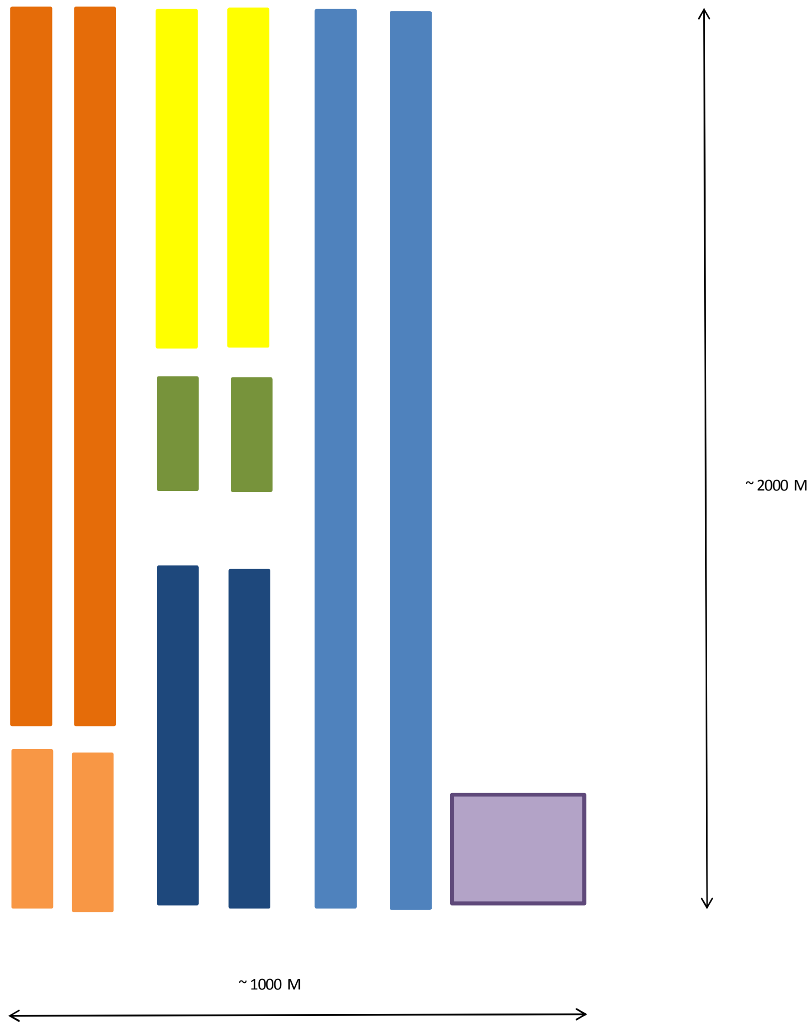

Two (2) wagon unloading stations each for Coal and Ore are proposed.

### 6.1.2 Raw Material Storage Capacity

Although all major raw materials will be imported direct by rail on a regular basis, to take into account possible delays due to adverse weather in this tropical region It has been assumed that space will be required for 6 weeks production.
The table below gives indicative quantities of the material stocks required.

| Material | MTe for 6 wks |
|---|---|
| Coking Coal | 1.3 |
| PCI Coal | 0.4 |
| Lump Ore | 0.6 |
| Fines | 3.1 |
| Limestone | 1.0 |
| Dolomite | 0.3 |
| Misc Fluxes | 0.3 |

A typical layout of the raw materials stocks for this arrangement is shown below




In terms of ground area, this would amount to some 200 Hectares.

It is  proposed that operations of the Coal and Ore stocks would be on the basis of one stockpile being built whilst one is being emptied. As such charge and discharge conveyors and stacker/reclaimers should be sufficient to process coal and ore to match the arrival rates from the wagon unloading stations.

- 6500TPH Ore handling capacity
- 3900TPH Coal handling

The following are proposed:

- 2 off 4000TPH stacker reclaimers for coking coal
- 1 off 1500TPH stacker reclaimers for PCI coal
- 1 off 2000TPH stacker reclaimers for lump ore
- 2 off 6500TPH stacker reclaimers for Fines
- 1 off 1500TPH stacker reclaimers for Limestone/Dolomite

## 6.2 SINTER PLANT OPERATIONAL PARAMETERS

Process Modelling indicates the following typical approximate inputs into the sinter making process in terms of annual tonnes:

| Material | Annual Tonnes |
|---|---|
| Iron ore | 27,000,000 |
| Coke | 1,320,000 |
| Limestone | 3,233,000 |
| Dolomite | 2,350,000 |
| Burnt Lime | 440,000 |
| Quartzite | 352,000 |
| Olivine | 588,000 |

In addition to the above, miscellaneous recycled products from other processes such as:

- Blast furnace dust
- Continuous casting machine scale
- BOS slag and sludge

The output from the sinter making process will be approximately 29.4 million tonnes of sinter per annum.

For the purposes of the proposed Steel Complex, 4 Sinter Plants (in total) would be required to produce the necessary plant outputs, with each plant having to produce approximately 7.5 million tonnes of sinter per annum.

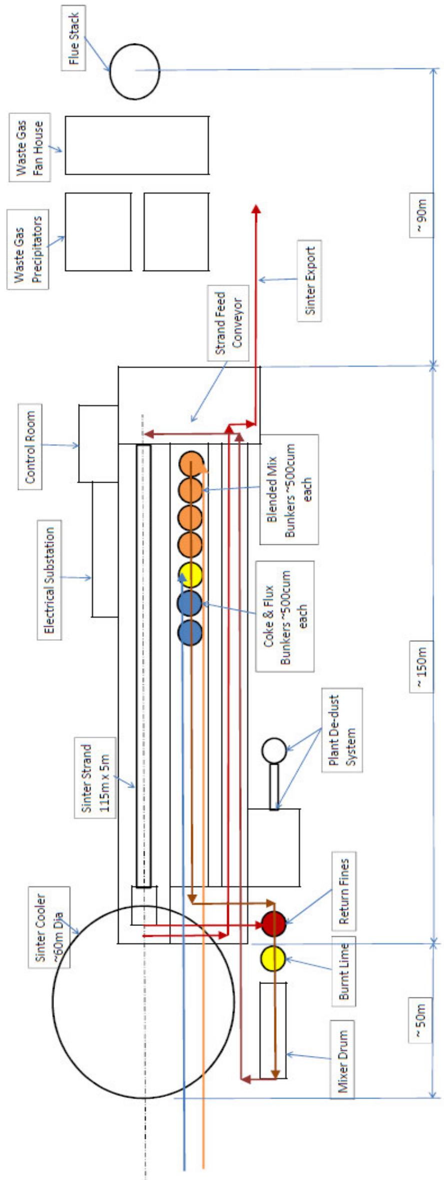
There are currently 9 Sinter plants in the world with quoted outputs greater than 7 million tonnes per annum, these are summarised below:

| Country | Company | Works | Manufacturer | Yr Built or Uprated | Strand Area $m^2$ | Strand w x L | Nom Capacity MTpa |
|---|---|---|---|---|---|---|---|
| Japan | NSC | Oita | Hitachi-Zosen / Lurgi | 1976 | 600 | 5 x 120 | 8.2 |
| Japan | JFE | Fukuyama | Hitachi-Zosen / Lurgi | 1973 / 2003 | 605 | 5 x 121 | 8.0 |
| France | Arcelor Mittal | Dunkerque | Lurgi | 1971 / 1992 | 525 | 5 x 105 | 7.5 |
| South Korea | Posco | Gwangyang | VAI | 2011 | 600 | 5 x 120 | 7.5 |
| Russia | NMLK | Lipetzk | Uralmash | 1964 | 3 x 312 | | 7.3 |
| Russia | NLMK | Lipetzk | Uralmash | 1972 / 2011 | 3 x 312 | | 7.3 |
| Kazakhstan | Arcelor Mittal | Temirtau | Uralmash | 1975 / 1990 | 3 x 312 | | 7.2 |
| Japan | NSC | Kimitsu | Hitachi Zosen | 1971 | 550 | 5.5 x 100 | 7.2 |
| South Korea | Posco | Gwangyang | VAI | 1992 / 2009 | 497 | 4.5 x 110.5 | 7.1 |

It can be seen from the above table that the bulk of the large single strand machines have all been manufactured to a Lurgi design.

A typical sinter plant output is 38 tonnes of sinter per day per $m^2$ of strand area, for the purposes of this study a Plant with a strand area of $575m^2$ based on a strand width of 5m and length of 115m is proposed.

An indicative plant layout of a single sinter plant is shown on the sketch below:

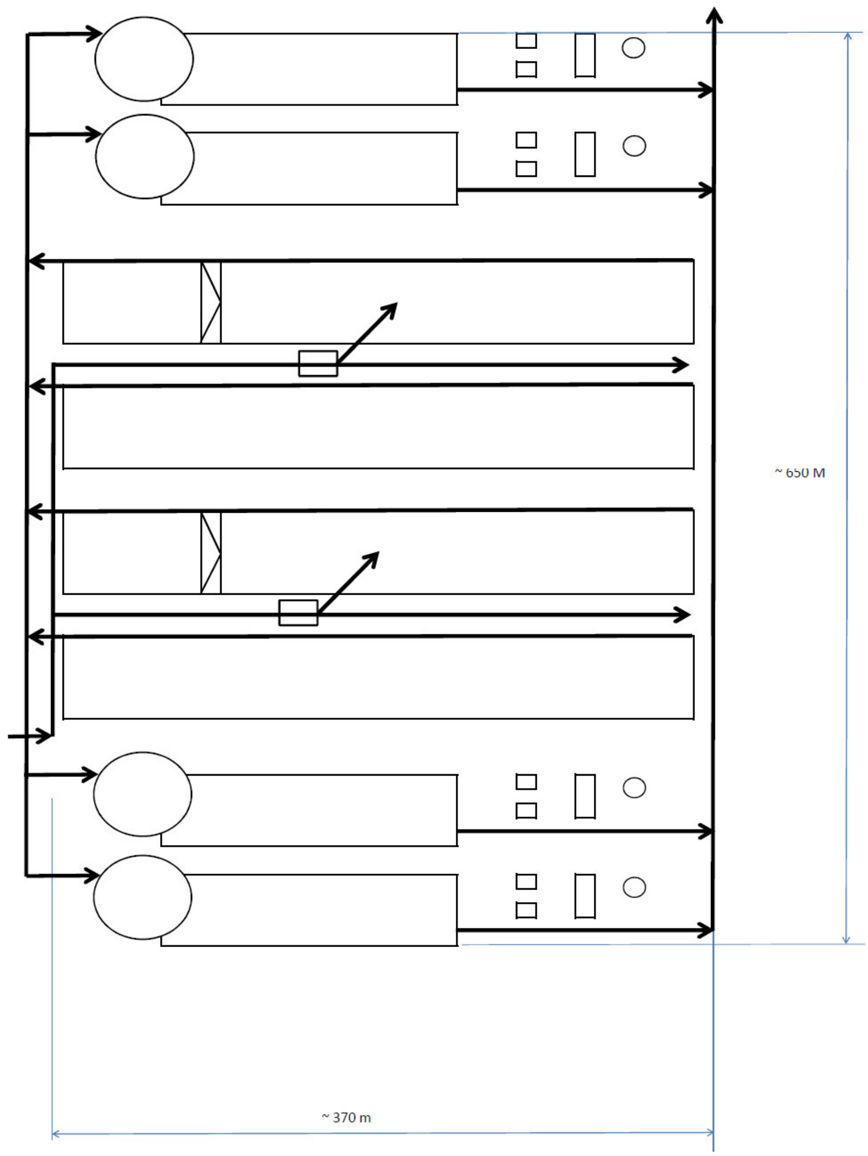



Additional space would be required for sinter feed blending yards; these will need to be capable of handling circa 7000 TPH of material on a continual basis.

Based on typical Barrel Reclaimer capacities of up to 4000 TPH, TSC would suggest 2 off Barrel Reclaimers recovering from 2 stockpiles at any one time with 2 stockpiles being built, i.e. 2 stacker units each feeding 2 stockpiles, capacity circa 4000 TPH each.

To achieve sufficient blending circa 500 passes on each bed will be required by the stacker, Stack dimensions will be 60m wide by 15m high (Cross Sectional Area circa 450m$^2$) Each stack will be approximately 350m long giving a capacity of 1 week bedding and 1 week reclaiming capacity.

The Schematic layout of the sinter complex is shown below:




To account for potential disruptions to the process flow, some sinter buffer storage should be considered to allow sinter to be stockpiled if downstream processing units are not operational. With the proposed 5 blast furnace operation it is unlikely that all furnaces would be shutdown at any one time, so an emergency stockpile of only 1 to 2 days production ~ 120kTe is suggested.

The above solution is seen as an "Optimised" design in terms of equipment and space to achieve the required steel complex output. This solution however is very much dependant on the Steel Producers working together to receive a common sinter blend.

If individual blast furnace blends are required, the sinter plant layout becomes more complex. With this scenario, it is proposed that each sinter plant feeds an individual blast furnace. In this case each plant would need to produce approximately 5.9 MTe of sinter per year, which could be supplied by a hearth area of 460m$^2$, which could be achieved by a reduced hearth length of approximately 92m.

The sinter blending yards would be more complex, requiring 2 beds per sinter plant (one being built / one being reclaimed at any one time). Each bed would be approximately 280m long and be serviced by a shared boom stacker of circa 2500TPH capacity and a barrel reclaimer of 2500TPH capacity across the 2 beds.

## 6.3 COKE OVEN OPERATIONAL PARAMETERS

Process Modelling indicates that to produce the necessary amount of coke feed to the blast furnaces and sinter plants (circa 8.7 MTPA) a total of around 11.3MT of coal will be required.

For the purposes of the proposed Steel Complex, in total 3 coke oven plants of two batteries each with a common By-Products plant are proposed. To produce the necessary plant outputs, each plant will need to produce approximately 2.9 million tonnes of coke per annum.

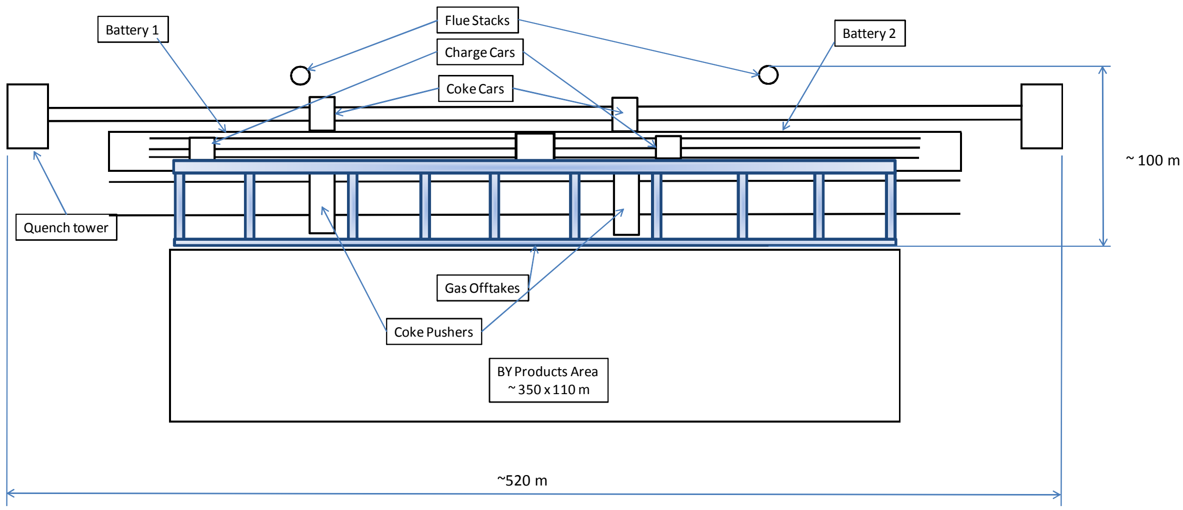
There are currently 6 coke plants in the world with quoted outputs greater than 2 million tonnes per annum from 2 batteries, these are summarised below:

| Country | Company | Works | Manuf. | Year | No. Ovens | H (m) | L (m) | W (m) | Charge Vol (m$^3$) | Cool - ing | Nom Cap KTPA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Germany | TKS | Duisberg | Uhde | 2003 | 140 | 8.3 | 20.8 | .59 | 93 | Wet | 2640 |
| Japan | JFE | Keihin | Still | 1976 | 198 | 7.55 | 17 | .45 | 38 | Dry | 2480 |
| China | Maanshan | Maanshan | Uhde | 2006 | 140 | 7.63 | 18 | .59 | 76 | Wet | 2300 |
| China | Wuhan | Hubei | Uhde | 2008 | 140 | 7.63 | 18 | .59 | 76 | Dry | 2200 |
| China | Shagang | Zhang Jiagang | Chinese | 2009 | 220 | 6 | - | .45 | - | Dry | 2200 |
| China | Shadong | Jining City | Uhde | 2006 | 120 | 7.63 | 18 | .61 | 76 | Dry | 2000 |

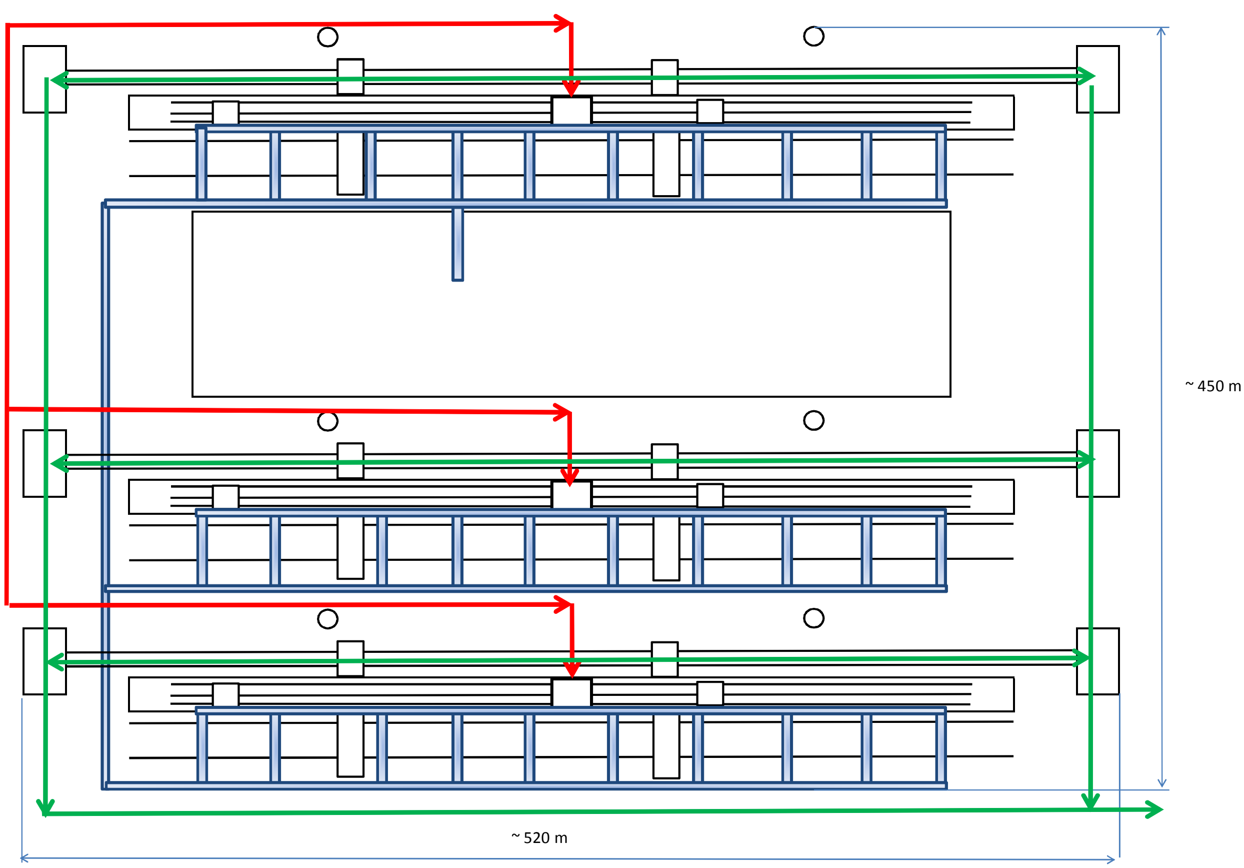
It can be seen from the above table that the bulk of the large twin battery coke plants have all been manufactured to an Uhde design. The trend in all these units has been to go for a large oven of around 80m$^3$ coal charge volume or more.

For PIB, a unit based around similar lines to the Duisberg-Schwelgern design is recommended. To give the required output of 2.9MTPA additional 10-15 ovens would be required, taking the total to say 154 made up of 2 batteries of 77 ovens each.

The single ovens layout is shown below:




The basic schematic of the 3 oven units making up the full coke plant is shown below with the proposed material flows:




To account for potential disruptions to the process flow, some coke buffer storage should be considered to allow sinter to be stockpiled if downstream processing units are not operational, with the proposed 5 blast furnace operation it is unlikely that all furnaces would be shutdown at any one time, so an emergency stockpile of 1 to 2 days production ~ 30kTe is suggested.

## 6.4 LIME PLANT OPERATIONAL PARAMETERS

Process Modelling indicates that to produce the necessary amount of burnt lime to feed the sinter plants and steel plants, a facility producing approximately 8000 tonnes per day will be required.

One of the world leaders in Lime producing equipment is Maerz who manufacture a wide variety of kilns of up to 800 tonnes per day.

For the purposes of the proposed Steel Complex, a total of 10 of the largest Maerz type lime kilns is proposed

## 6.5 AIR SEPARATION PLANT OPERATIONAL PARAMETERS

Process modelling indicates the following requirements for Oxygen, Argon and Nitrogen.

Oxygen
Blast Furnace blast enrichment - 57.6 $NM^3$/ THM = $1.26 \times 10^9$ $NM^3$ / annum
Hot Metal treatment – 15 $NM^3$/ THM = $3.21 \times 10^8$ $NM^3$ / annum
BOF Steelmaking - 58 $NM^3$/ TLS = $1.26 \times 10^9$ $NM^3$ / annum
Continuous Casting - 4 $NM^3$/ Tonne cast slab = $9.0 \times 10^7$ $NM^3$ / annum
Slab Processing - 16.8 $NM^3$/ Tonne finished slab = $3.69 \times 10^8$ $NM^3$ / annum

Total Oxygen requirement is therefore $3.3 \times 10^9$ $NM^3$ / annum which is equivalent to 12928 tonnes per day based on a 365 day per year operation.

Argon
BOF Steelmaking - 0.8 $NM^3$/ TLS = $2.8 \times 10^7$ $NM^3$ / annum
Continuous Casting - 1 $NM^3$/ TLS = $2.3 \times 10^7$ $NM^3$ / annum

Total Argon requirement is therefore $5.1 \times 10^7$ $NM^3$ / annum which is equivalent to 247 tonnes per day based on a 365 day per year operation.

Nitrogen
Coke Dry Quench - 50 $NM^3$/ Tonne of Coke = $4.3 \times 10^8$ $NM^3$ / annum
Blast Furnace - 43 $NM^3$/ THM = $9.4 \times 10^8$ $NM^3$ / annum
Hot Metal treatment – 30 $NM^3$/ THM = $6.4 \times 10^8$ $NM^3$ / annum
BOF Steelmaking - 15 $NM^3$/ TLS = $3.45 \times 10^8$ $NM^3$ / annum
Continuous Casting - 0.16 $NM^3$/ Tonne cast slab = $3.6 \times 10^6$ $NM^3$ / annum

Total Nitrogen requirement is therefore $2.37 \times 10^9$ $NM^3$ / annum which is equivalent to 8120 tonnes per day based on a 365 day per year operation.

Based on the above requirements, the total quantity of air requiring separation is based on the Oxygen requirements and will be equivalent to 55840 TPD of Air, which will provide a surplus of 468 tonnes of Argon per day and 34100 tonnes of Nitrogen.

### 6.6 BLAST FURNACE OPERATIONAL PARAMETERS

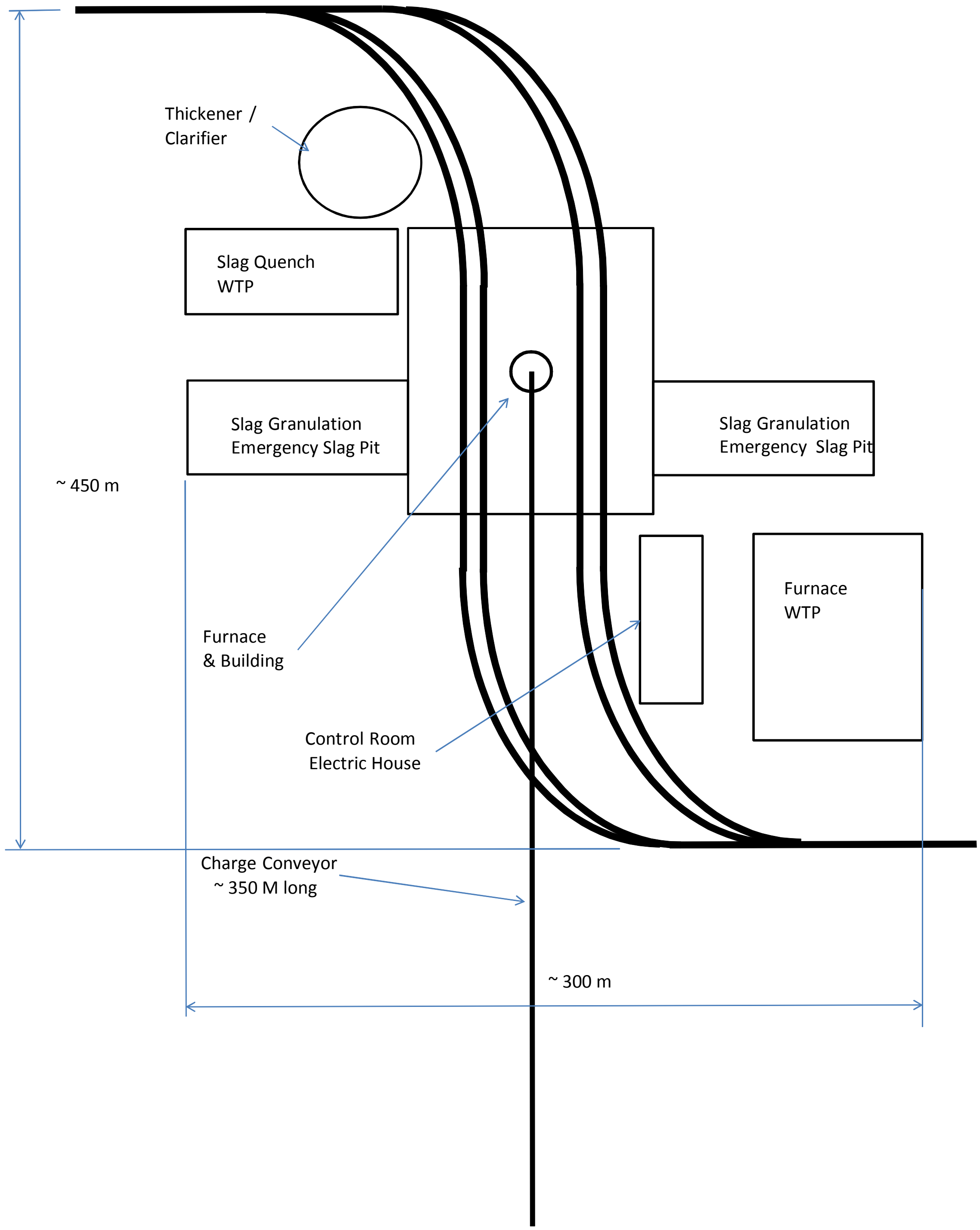
As described in section 4 of this report, Iron production has been based around 5 large blast furnace units, each producing circa 4.4 million tonnes of hot metal per annum.

The table below indicates all current and known planned blast furnaces with annual outputs greater than 4 MTPA, a total of 24 Units.

| COUNTRY | COMPANY | LOCATION/WORKS | MANUF. | YEAR OF START UP / Reline | INNER VOLUME | HEARTH DIAMETER | INJECTION | TOP DESIGN | TRT | TRT RATED POWER | DAILY HOT METAL PROD'N | NOM CAP'y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $M^3$ | M | | | | MW | T/DAY | KT/YEAR |
| SOUTH KOREA | POSCO | POHANG | IHI, Nippon Steel JP | 1981 / 2010 | 5600 | 15,6 | PULV. COAL, ARMCO | BELL-LESS-TOP®, P.WURTH | YES | 28,6 | 14600 | 5310 |
| CHINA | JIANGSU SHAGANG GROUP | ZHANGJIAGANG II, JIANGSU | MCC, CN | 2009 | 5800 | 15,7 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | | 14000 | 5000 |
| SOUTH KOREA | POSCO | GWANGYANG | DAVY-MCKEE, UK: Korea Heavy Ind. | 1992 / 2009 | 5500 | 15,6 | PULV. COAL, ARMCO | BELL-LESS-TOP®, P.WURTH | YES | 14,3 | 14000 | 5000 |
| JAPAN | NIPPON STEEL CORP | OITA, KYUSHU | NIPPON STEEL, JP | 1972 / 2009 | 5775 | 15,6 | PULV. COAL | DOUBLE BELL NSC | YES | 24,96 | 13500 | 4800 |
| JAPAN | NIPPON STEEL CORP | OITA, KYUSHU | NIPPON STEEL, JP | 1976 / 2004 | 5775 | 15,6 | PULV. COAL | DOUBLE BELL NSC | YES | 27,9 | 13500 | 4800 |
| CHINA | BAOSTEEL ZHANJIANG I&S | ZHANJIANG CITY, GUANGDONG | | 2014 | 5700 | 15,6 | PULV. COAL | BELL-LESS | YES | | 13000 | 4600 |
| CHINA | BAOSTEEL ZHANJIANG I&S | ZHANJIANG CITY, GUANGDONG | | 2014 | 5700 | 15,6 | PULV. COAL | BELL-LESS | YES | | 13000 | 4600 |
| JAPAN | NIPPON STEEL CORP | KIMITSU, CHIBA | NIPPON STEEL, JP | 1975 | 5555 | 15,5 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | | 12770 | 4530 |
| CHINA | SHOUGANG JINGTANG UNITED I&S | CAOFEIDIAN ISLAND, HEBEI | CHINA-MANUFACTURER | 2009 | 5500 | 15,5 | PULV. COAL | BELL-LESS | YES | | | 4490 |
| CHINA | SHOUGANG JINGTANG UNITED I&S | CAOFEIDIAN ISLAND, HEBEI | CHINA-MANUFACTURER | 2010 | 5500 | 15,5 | PULV. COAL | BELL-LESS | YES | | | 4490 |
| GERMANY | THYSSENKRUPP STEEL EUROPE AG | DUISBURG-SCHWELGERN | MAN GHH, DE: Ansaldo, IT | 1993 | 5513 | 14,9 | PULV. COAL, KÜTTNER | BELL-LESS-TOP®, P.WURTH | YES | 18 | 12000 | 4300 |
| JAPAN | NIPPON STEEL CORP | NAGOYA, AICHI | NIPPON STEEL, JP | 1979 / 2007 | 5443 | 15,2 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | | 12000 | 4250 |
| CHINA | WUHAN I&S CO | FANGCHENGGANG, GUANGXI | | 2014 | 5200 | 14,8 | PULV. COAL | BELL-LESS | YES | | | 4200 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHINA | WUHAN I&S CO | FANGCHENGGANG, GUANGXI | | 2014 | 5200 | 14,8 | PULV. COAL | BELL-LESS | YES | | | 4200 |
| JAPAN | JFE STEEL | WEST WORKS (FUKUYAMA) | NKK, JP | 1973 / 2005 | 5500 | 15,6 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | 23 | 11800 | 4180 |
| CHINA | BAOSHAN I&S CO LTD | BAOSHAN, SHANGHAI | CISDI, CN: Paul Wurth, Lu. | 2005 | 4747 | 14,5 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | | 11700 | 4100 |
| JAPAN | JFE STEEL | EAST WORKS (CHIBA) | KAWASAKI H. IND., JP | 1977 / 1998 | 5153 | 15 | PULV. COAL, KAWASAKI-SUMITOMO | BELL-LESS-TOP®, P.WURTH | YES | 24 | 11500 | 4070 |
| JAPAN | JFE STEEL | EAST WORKS (KEIHIN) | NKK, JP | 1979 / 2004 | 5000 | 14,8 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | | 11500 | 4050 |
| JAPAN | SUMITOMO METAL IND. | KASHIMA | IHI, JP | 2004 | 5370 | 15 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | 19 | 11000 | 4000 |
| JAPAN | SUMITOMO METAL IND. | KASHIMA | | 1976 / 2007 | 5370 | 15 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | 19 | 11000 | 4000 |
| SOUTH KOREA | HYUNDAI STEEL | DANGJIN B | PAUL WURTH, LU | 2010 | 5250 | 14,8 | PULV. COAL, P.WURTH | BELL-LESS-TOP®, P.WURTH | YES | | 11650 | 4000 |
| SOUTH KOREA | HYUNDAI STEEL | DANGJIN B | PAUL WURTH, LU | 2010 | 5250 | 14,8 | PULV. COAL, P.WURTH | BELL-LESS-TOP®, P.WURTH | YES | | 11650 | 4000 |
| SOUTH KOREA | HYUNDAI STEEL | DANGJIN B | PAUL WURTH, LU | 2013 | 5250 | 14,8 | PULV. COAL, P.WURTH | BELL-LESS-TOP®, P.WURTH | YES | | 11650 | 4000 |
| CHINA | BAOSHAN I&S CO LTD | BAOSHAN, SHANGHAI | NIPPON STEEL, JP | 1985 / 2008 | 4966 | 14,6 | PULV. COAL | BELL-LESS-TOP®, P.WURTH | YES | | 11500 | 4000 |

A typical indicative single blast furnace layout of this size is shown on the sketch below:




The above sketch shows the approximate ground area covered by the main Blast Furnace components, together with the rail tracks feeding the torpedoes under the tap-hole runners. The proposed 5 furnaces can be stacked on approximately 350m centres to provide the full output of 22 MTPA.

Each Blast furnace will consist of 4 tap-holes; typical production philosophy will be by utilising the "Continuous Tapping" method to try to achieve a consistent liquid level in the hearth. This is explained schematically below with the shaded areas representing the tapping time per tap-hole.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Taphole 1 | | | | | | | | | | | | |
| Taphole 2 | | | | | | | | | | | | |
| Taphole 3 | | | | | | | | | | | | |
| Taphole 4 | | | | | | | | | | | | |
| Time Hrs | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |

Based on this philosophy approximately 1188 tonnes of hot metal and 326 tonnes of slag will be cast for each tap-hole sequence.

## 6.7 HOT METAL TRANSFER TO THE STEEL PLANT

From the analysis above, based on 1188 tonnes of hot metal being cast per tap-hole sequence, it has been assumed that the iron will be tapped into 4 torpedo ladles each of a nominal 300 tonne iron capacity. The torpedo ladles will be arranged in 2 groups of 2 being fed by a "rocking spout" arrangement. Based on typical information for these units, the tare weight of each torpedo ladle will be the order of 280 tonnes split across 16 axles giving an axle weight of just over 36 tonnes.

Minimum rail radius of a unit of this size is 75m and all up weight based on 2 torpedoes per train will be approximately 1150 tonnes.

Modelling work indicates that a typical cycle time for a train of 2 torpedoes, tapping at the Blast furnace, transfer to the Steel plant, Hot metal treatment at the steel plant to reduce Sulphur, Silicon and Phosphorus, pour into transfer ladles and return to the blast furnace will take from between 175 and 190 minutes per group. This gives a processing capability of each group of around 4400 tonnes per day. To meet the requirement for PIB of 22MTPA finished steel, 2.6 trains from each furnace will be required giving 14 in total (56 torpedoes) not including spares or allowance for torpedoes being wrecked and relined. It is assumed that this would constitute circa 15% of the fleet giving a requirement of say 64 torpedo ladles.

## 6.8 STEEL PLANT OPERATIONAL PARAMETERS

Steel plant liquid steel production requirements will be approximately 23MTPA. It has been assumed that this requirement will be met by 3 BOF shops each with 3 BOF vessels, each shop producing just over 7.5MTPA of liquid steel.

There are a total of 12 BOF shops based on this configuration with the capability of producing more than 7MTPA, the table below give details:

| Country | Company | Plant | Manufacturer | Date Built / Enhanced | Tap Weight Te | Nominal Output MTPA |
|---|---|---|---|---|---|---|
| Russia | Magnitogorsk | Magnitogorsk | USSR | 1990 / 2012 | 370 | 10.5 |
| China | Shougang | Caofeidian Island | SVAI | 2009 | 300 | 9.7 |
| Russia | Severstal | Cherepovets | USSR | 1980 / 1999 | 350 | 9.5 |
| Japan | NSC | Oita | | 1972 / 1976 | 397 | 9.4 |
| Korea | Posco | Pohang | | 1978 / 1981 | 300 | 9.1 |
| Russia | Novolipetsk | Lipetzk | USSR / SVAI | 1974 / 2011 | 330 | 9 |
| Korea | Hyundai | Dangjin B | JP Plantech | 2010 | 300 | 8.4 |
| Brazil | AM Tubarao | Vitoria | Italipianti | 1985 / 1991 | 300 | 7.6 |
| China | Baoshan | Shanghai | NSC | 1985 / 1991 | 300 | 7.5 |
| China | Wuhan | Wuhan | MDH / VAI | 1996 / 2005 | 300 | 7.3 |
| Netherlands | Tata Steel | Ijmuiden | MDH | 1968 / 1976 | 330 | 7.2 |
| Korea | Posco | Gwangyang | VAI / Hyundai | 1987 | 265 | 7.1 |

A nominal steel tap weight of 275 tonnes has been assumed, which is a typical value for a 3 vessel basic oxygen furnace (BOF) shop. The BOF cycle time will be typically 40 minutes made up as follows:

| Activity | Time (mins) |
|---|---|
| Waiting for scrap charge | 1 |
| Charge Scrap | 3 |
| Charge Hot Metal | 3 |
| Oxygen Blow | 16 |
| Reblow 10% of time | 1.6 |
| Sample | 5 |
| Tap Steel | 6 |
| Slag Splash | 4 |
| Slag tapping | 3 |
| Total Tap/Tap | 42.6 |

Allowing for a vessel life of 6000 heats with 15 days to reline a vessel and with 4% for refractory maintenance, 5% engineering downtime and 5 days annual shutdown, this facility should be capable of up to 8.0 MTPA per BOF shop.

Material flows within the steel plant are very complex and dependant on the final product mix that is agreed for the finished slab, this is to take into account the requirements for

- Secondary steel making such as ladle furnace and vacuum degassing.
- Slab thickness, width and length range.
- Slab cooling requirements such as percentage air cooled and quantity that requires slow cooling for product quality purposes.
- Slab surface dressing and rectification requirements to suit the demanded quality requirements
- Slab further cutting to length and slitting requirements to suit the customer requirements

All these factors have a significant impact on the time taken to process product through the plant. Many of the activities are sequential in nature and dependant on the customer requirements and throughput will have a significant effect on CAPEX both in terms of the technological equipment and the handling equipment such as cranage, transfer cars etc.

As such based on 3 vessel operation some 94 taps per day will be required from each shop. This is at the top end of the production capability for BOF.

Steel will be cast into steel ladles and transferred through the steel plant by a combination of steel transfer car and ladle overhead crane. With a tap weight of 275 Te, the ladle handling facilities will have to be capable of handling an all up ladle weight of some 400 – 420 tonnes.

Ladle furnaces will be required to allow for:

- Additional desulphurisation to suit final steel chemistry requirements
- Adjustment to the steel chemistry by ladle alloy additions
- Steel reheating to cater for extended refining times
- Final adjustment of steel temperature prior to delivery to the caster
- Typical cycle times in the ladle furnace – dependant on chemistry and temperature is 45 – 60 minutes per ladle.

Vacuum Degassing will be required on some grades to:

- Carry out further desulphurisation,
- Hydrogen and nitrogen gas removal.
- Final analysis trim, calcium treatment, flotation rinse (micro stir).
- Temperature checks are then made prior to despatching the ladle to the CCM.
- Typical cycle times in Vacuum degassing – dependant on chemistry and temperature is 30 – 50 minutes per ladle.

At the Continuous casting machine, the teeming ladle is placed by an overhead crane onto a ladle turret, which rotates the ladle into the casting position. The ladle slide gate is then opened and liquid steel flows into a tundish, which serves as an intermediate container / distributor between the ladle and the mould.

The CCM moulds are mounted on oscillating frames and the mould copper plates are cooled by closed primary cooling water system. Due to the cooling in the mould a solidified strand shell is formed and is subsequently supported by the mould foot rollers and segmented support on broad face. Air-mist sprays cool the hot strand as it is slowly withdrawn through the roller segments. At the end of the roller segments pinch roll straightening units are arranged to straighten and withdraw the hot strand. Soft reduction is applied in the straightener withdrawal unit to minimise centreline segregation to ensure slab internal quality. These units serve also for inserting and withdrawal of the dummy bar chain.

A chain type dummy bar is used to seal the mould at the start of casting and to withdraw the hot strand to the withdrawal / straightening units. After separation of the dummy bar from the hot strand the dummy bar is parked in a storage position to stand-by for the next start to cast.

The hot strand is cut into slabs of the desired length by in-line oxy-gas torches, which clamp onto the moving strand. The slabs are transported on run-out roller tables to de-burring and identification stations, and weighing units and then to the final stop. From here the slabs are transported to stacks for air-cooling or to slow cooling pens (for API / NACE grades) using an overhead crane equipped with a tong arrangement.

In terms of subsequent slab handling within the steel plant, the following indicative processes would be required dependant on the slab quality.

API / NACE Grades

- Slow cool for hydrogen removal, dependant on quality and thickness (5 days)
- Sulphur print and / or hot etch
- Potential sub-dividing (aim for >300 $^{o}$C)
- Visual inspection + hand de-seaming as required (> 60 $^{o}$C)
- Potential 4-face scarfing (aim for 60 $^{o}$C – 150 $^{o}$C)
- Re-identify individual slabs
- Weigh + dimension check
- Despatch

Merchant Slab Grades

- Stack to cooling area in close proximity to CCM run-out table
- Can be loaded out for despatch after approximately 48 hours, may need longer for material greater than 300mm thick to allow for hydrogen diffusion and product cooling
- Sulphur print as required (1 sample per ladle minimum)
- Subdividing as required
- Visual inspection + hand de-seam as required
- Weight + dimensional checks as required (rely on on-line weighing as an option)
- Despatch

In practice the above regimes will have a direct effect on space requirements to allow products to air cool and slow cool.

Cooling of API / NACE Grades

These materials will need to be cooled in slow cooling pens, a typical pen plan view dimensions will be circa 12m x 12m. Each pen would be able to hold approximately 44 slabs based on average slab size. For the average slab size, production will be some 2060 slabs per day. Slow cooling of slabs will take approximately 5 days, which means that there will need to be sufficient slow cooling capacity to store some 10300 slabs. This is equivalent to 234 cooling pens. If the slab export bays are arranged such that 3 pits can be located along the width of the bay (Bay width circa 40M to allow for this plus hook approach and rail tracks), the cooling bay total length will need to be some 1100m long allowing circa 2m between each row of pens.

Allowance for Scarfing facilities etc would increase this length by approximately 600m assuming a scarfing facility in each of the 3 steel plants. If we assume this storage area is provided by 2 bays, each bay will need to be approximately 460m long to accommodate the above storage plus allowance for crane hospital bays, clear areas for slab discharge tables and inter bay transfer equipment. This would equate to some 36000m$^2$ of storage area per steel plant.

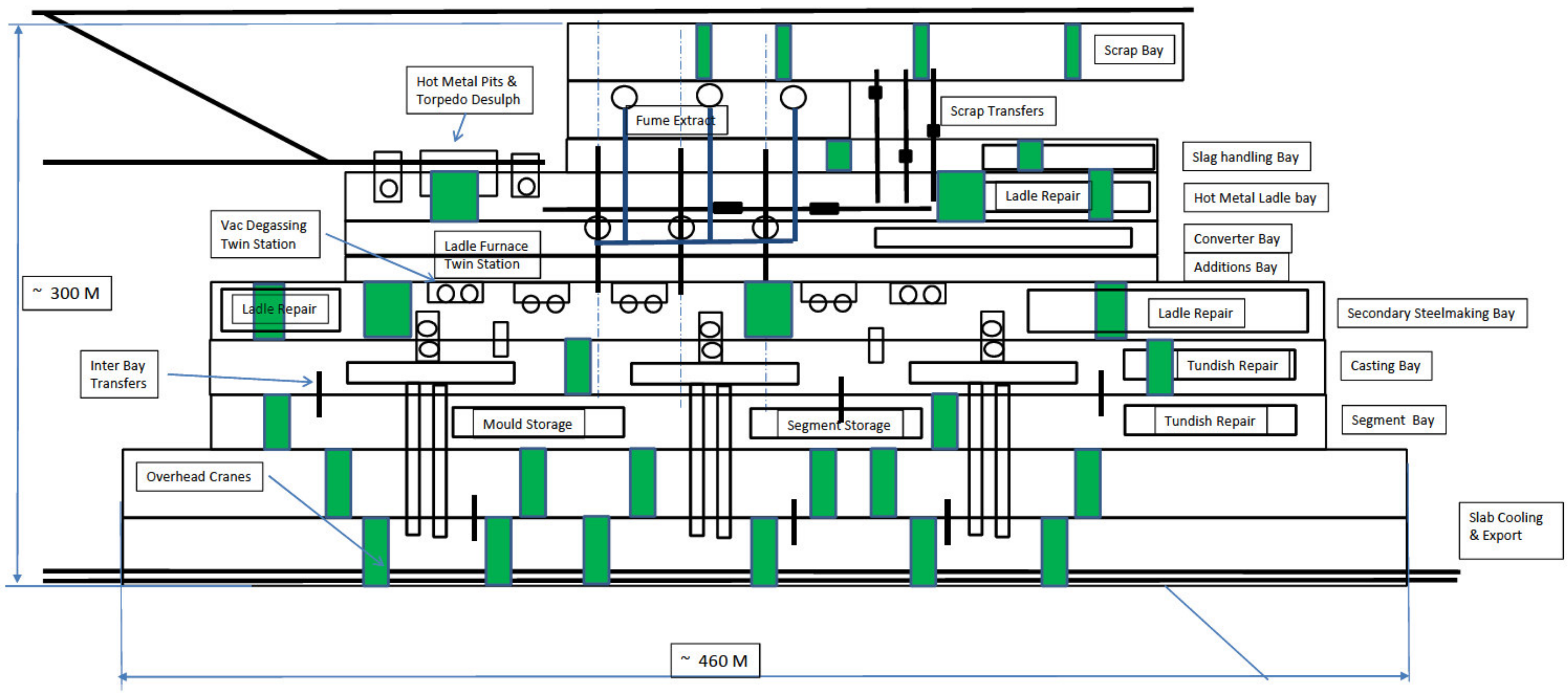
Cooling of Merchant Slab Grades

These materials can be air cooled and can be despatched after about 2 days cooling, assuming these slabs are stacked up to 11 slabs high, a stack would take up approximately 38m$^2$. A storage capacity of some 4200 slabs would be required (circa 2 days production). As before assuming 3 stacks stored across the bay, the bay length would need to be approximately 500m in length. Scarfing would unlikely be required and only a small area for inspection (allow say 50m for each plant) this gives a length of approximately 400m per steel plant, 1 bay only required(16000m$^2$ per steel plant).

This then gives the 2 extremes in terms of the product mix.

An indicative view of the steel plant layout is shown below for the high proportion of NACE/API Option.
For the merchant slab option one of the export bays would not be required together with the slab handling cranes in that bay and the number of Ladle furnace stations and Vacuum degassing stations could be reviewed. Merchant grades can often be cast faster than the more difficult grades so there is also a possible potential to reduce the number of slab casters from 9 to 8.

TSC conservatively estimates a difference of approximately $M60-70 per steel plant or some $M380-410 per steel complex if the cost saving of a slab caster is also taken into account.



Scrap Bay
Hot Metal Pits & Torpedo Desulph
Fume Extract
Scrap Transfers
Slag handling Bay
Ladle Repair
Hot Metal Ladle bay
Vac Degassing Twin Station
Ladle Furnace Twin Station
Converter Bay
Additions Bay
~ 300 M
Ladle Repair
Ladle Repair
Secondary Steelmaking Bay
Inter Bay Transfers
Tundish Repair
Casting Bay
Mould Storage
Segment Storage
Tundish Repair
Segment Bay
Overhead Cranes
Slab Cooling & Export
~ 460 M

In the above case it has been assumed that there would be significant co-operation between the Steel Producers to allow an efficient steel plant design to be completed. As with the case of the Sinter plant, it may be that the Steel Producers would want to keep their options open, particularly with regard to sensitive steel chemistries and process confidentiality. As such up to 5 steel plants may be required each producing nominally 4.4MTPA.

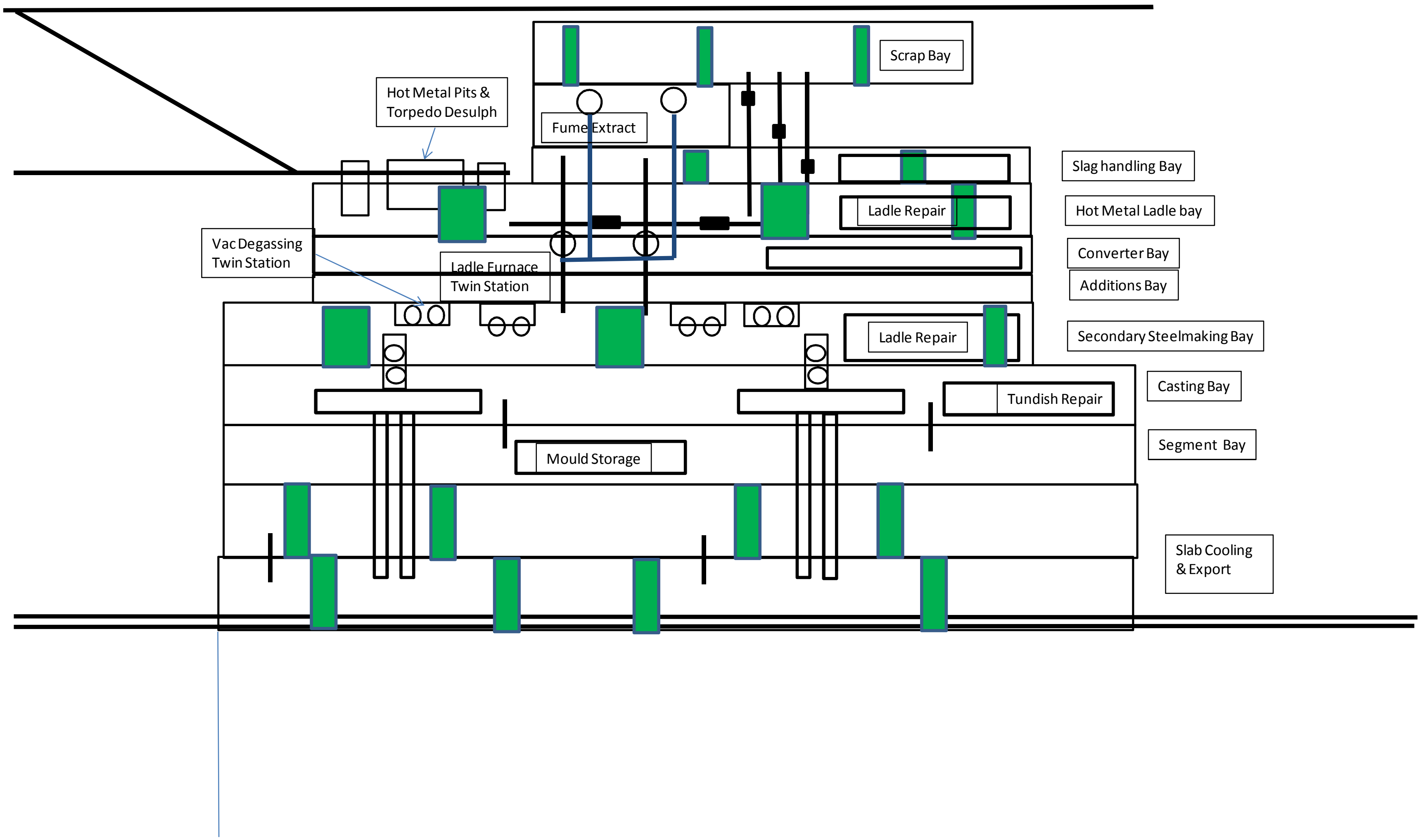
To suit this possible scenario, the layout has been revisited.

BOS capacity could be achieved by 2 vessels per steel shop and output of slabs by 2 twin strand slab casters. 2 Process routes through the plant are envisaged from BOS vessel, through secondary steel making through to the casters and despatch. The cooling/despatch bay length could be reduced for each steel plant.

Based on these assumptions the indicative layout is shown below.

TATA STEEL

TATA



## 6.9 SLAB EXPORT TO THE PORT

In terms of slab export requirements, for initial calculations the following in terms of slab output has been assumed.

- Maximum slab weight 75 tonnes
- Slab width range 1500 – 2400 mm
- Slab thicknesses
  - 250 mm thick 30% of the mix
  - 300 mm thick 35% of the mix
  - 350 mm thick 35% of the mix
- Slab length 4.5 m to 10.5 m giving an average of 7.5 m
- Average slab weight is 33.3 tonnes
- Estimated number of slabs to be shipped is 660,000 slabs per annum

EWLP are proposing a novel "roll-on roll-off" ship design to allow wagons to be transported onto the ship and offloaded using overhead cranes built into the ship's structure.

The length of wagon rake within the ship will be limited to approximately 150m and will be pulled onto the ship by a purpose designed haulage mechanism. As such the rake from the steel plant will need decoupling from the shunting engine prior to loading on the ship.

To minimise wagon cycle time, it is assumed that the rake of wagons to the port will be about 300m to allow the rake to be split into 2 and hauled onto the ship. On this basis the export bay in each of the steel plants will be capable of holding 2 rakes of wagons to be loaded at any one time.

In terms of loading operations at the steel plant, this will be undertaken by Overhead crane using tong lifters, crane safe working load on the tongs will be nominally 75T. TSC have assumed2 cranes loading a rake of 22 wagons (car length will be ~ 13.5m so 22 cars ~300m), each lift will take approximately 3.4 minutes, based on a lift /lower speed of 8m/min, long travel speed of 80m/min and a lift height of circa 6m with an average travel distance of ~60m. The cycle time per slab will be circa 1.7 minutes.

In terms of transport of the rake to the port, if we assume 13KM distance to the port with the train averaging 32km/hr and the facilities are sufficient to empty slabs at the rate of 1.6 per minute we can arrive at the following requirements/capabilities.

| Axle Load Te | Max Car Wt Te | Tare Wt Est T | Cargo Wt | No. Slabs /rake of 11 | Te/ Train | Train Cycle (round trip) Mins | Te Per Day/ Train | Te Per year per train Million Te | Trains required | Trains/ Day |
|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 120 | 22 | 98 | 44 | 1,467 | 219 | 9,658 | 3.53 | 7 | 41.1 |
| 35 | 140 | 25 | 115 | 66 | 2,201 | 278 | 11,389 | 4.16 | 6 | 27.4 |
| 40 | 160 | 28 | 132 | 66 | 2,201 | 278 | 11,389 | 4.16 | 6 | 27.4 |
| 42 | 168 | 28.5 | 139.5 | 88 | 2,935 | 338 | 12,509 | 4.56 | 5 | 20.5 |

The above shows the sensitivity on Axle load based on the average slab size.

The Train Corridor will need to include 2 tracks - 1 to and 1 return from the port, based on the 42 Te axle loads a train will need to be dealt with every 70 minutes.

# 7. HIGH LEVEL ENERGY BALANCE

## 7.1 ELECTRICAL ENERGY

In terms of electrical energy the following table outlines the estimated usage by process group

| Process Area | Estimated Usage MWH/Annum |
|---|---|
| Raw Material handling | 179,192 |
| Coke Plant | 369,627 |
| Sinter Plant | 852,509 |
| Lime Plant | 86,287 |
| Blast Furnace | 2,173,511 |
| Hot Metal Treatment | 65,336 |
| Oxygen Plant | 1,652,176 |
| Steel Plant | 1,630,888 |
| Continuous Casting | 435,487 |
| Slab Processing | 39,600 |
| Miscellaneous Buildings, Workshops, etc | 48,400 |
| Total Usage | 7,533,013 |

Within the process, there will be secondary generation of electricity on both the Blast Furnaces and the Coke Plants by the use of Blast Furnace top pressure recovery turbines (TRT) and Coke Dry Quenching (CDQ).

The Blast Furnace TRT systems will recover approximately 672,961 MWH per annum and the CDQ system assuming all surplus steam is converted to power at 40% efficiency, approximately 1,449,520 MWH

The Net requirement of Electrical Power is therefore 5,410,532 MWH per annum which is equivalent to annualised loading of 617.6 MW.

## 7.2 COKE OVEN GAS

In terms of Coke Oven Gas (COG) produced during the coke making process, various other processing units will have some requirement for this gas; the table below outlines the distribution:

| Process Area | Estimated Production / Usage GJ/Annum |
|---|---|
| Coke plant COG Production | 65,576,267 |
| Coke Plant Underfiring | 30,526,883 |
| Sinter Plant | 2,792,701 |
| Lime Plant | 10,623,596 |
| Blast Furnace | 8,275,896 |
| Steel Plant | 4,823,754 |
| Continuous Casting | 1,782,564 |
| Total Usage | 58,825,394 |

| | |
|---|---|
| Nett Surplus | 6,750,873 |

### 7.3 BLAST FURNACE GAS

In terms of Blast Furnace Gas (BFG) the only process user is the Blast furnace stoves together with COG for stoves heating.

| Process Area | Estimated Production / Usage GJ/Annum |
|---|---|
| BF plant BFG Production | 111,286,179 |
| BF Stoves Heating | 33,103,585 |
| Nett Surplus | 78,182,594 |

### 7.4 BOS GAS

In terms of Basic Oxygen Steelmaking (BOSG), all this is available for use; the production in terms of gas calorific value is 16,777,475 GJ/Annum.

### 7.5 TOTAL ENERGY BALANCE

From the above we can produce a total energy balance for the process, this is summarised in the table below and equated into GJ per tonne of slab produced:

| Process Area | Electrical GJ/Tonne Slab | COG Used GJ/Tonne Slab | BFG Used GJ/Tonne Slab | Coal Energy GJ/Tonne Slab | Coke Energy GJ/Tonne Slab | Gases Made GJ/Tonne Slab | Coke By Products GJ/Tonne Slab | Electricity Generated GJ/Tonne Slab | Nett Energy GJ/Tonne Slab |
|---|---|---|---|---|---|---|---|---|---|
| Raw Material handling | -0.029 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.029 |
| Coke Plant | -0.060 | -1.388 | 0.000 | -15.932 | 11.781 | 2.981 | 0.777 | 0.237 | -1.604 |
| Sinter Plant | -0.140 | -0.127 | 0.000 | 0.000 | -1.792 | 0.000 | 0.000 | 0.000 | -2.058 |
| Lime Plant | -0.014 | -0.483 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.497 |
| Blast Furnace | -0.356 | -0.376 | -1.505 | -4.603 | -9.989 | 5.058 | 0.000 | 0.110 | -11.66 |
| Hot Metal Treatment | -0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.011 |
| Oxygen Plant | -0.270 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.270 |
| Steel Plant | -0.267 | -0.219 | 0.000 | 0.000 | 0.000 | 0.763 | 0.000 | 0.000 | 0.276 |
| Continuous Casting | -0.071 | -0.081 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.152 |
| Slab Processing | -0.006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.006 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Miscellaneous Buildings, Workshops, etc | -0.008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.008 |
| Total Usage | -1.233 | -2.674 | -1.505 | -20.535 | 0.000 | 8.802 | 0.777 | 0.347 | -16.02 |

The above figure of just over 16GJ/tonne of slab produced should be compared in context with estimated average world figures for steel production of about 24GJ/tonne of liquid steel in 1990 (De Beer, Worrell & Blok 1998).

Since that date there have been steady increases in efficiency. Worldsteel estimates an improvement of a further 17% reduction in energy use since 1990 which would give an average value to slab production of around 20GJ/Te of slab.

## 7.5 POTENTIAL SURPLUS GAS USAGE

From the above table a total of some 101,710,942 GJ of fuel is available surplus to the steelmaking requirements.

In a conventional integrated steel works, a large proportion of this (approximately 66%) would have been used to heat slabs in reheating furnaces for subsequent rolling into finished products. This is a particular advantage of an integrated plant over a slab plant as the heating efficiency is typically 60-70% coupled with the potential to have slabs hot charged into the reheat furnaces for greater efficiency.

The PIB project however does not have the downstream mills local to the plant so benefits from hot charging and use of gases for efficient heating will not be available as such an alternative use for the excess gas is required.

### 7.5.1 Generate Electricity

One option would be to use all the surplus gas to generate electricity in a purpose built Power station. If we assume a typical thermal efficiency of 40% for the station some 1290 MW would be generated giving a surplus to export to the grid of some 670MW.

### 7.5.2 Supply to a Blast Furnace Slag Cement Plant

A further option would be to feed Gas and Electricity to a BF slag cement plant located adjacent to the Steel Complex. In the developed PIB case some 6MTPA of blast furnace slag is produced which is a sufficient quantity to make approximately 10MTPA of cement (typical quantities of the finished cement are 60% BF slag, 5% gypsum, 35% clinker), quoted energy requirements for this process are of the order of 85kWH/Tonne electricity and 1.45GJ/Tonne of fuel. (Source - World Best Practice Energy Intensity Values for Selected Industrial Sectors, by Berkeley National Laboratory, Feb 2008)

On this basis capacity of some 100 MW would be required together with 14,500,000 GJ of fuel per annum.

In terms of efficiency, the electricity would be generated at 40%, the fuel would provide heating at some 65-70% efficiency.

With this option approximately 87,211,000 GJ would still be left to generate electricity in a plant of some 1100 MW leaving some 380 MW surplus power after feeding the steel plant and the Cement plant.

### 7.5.3 Install additional Cokemaking Capacity

A further option could be to install an additional 2 batteries of coke ovens to produce additional Coke for sale which would have the added benefit of producing more surplus coke oven gas and steam for electrical generation.

It is estimated that if the additional; batteries were identical to those already proposed in this report the benefits would be as follows:

- Additional coke sales of circa 2.9 million tonnes per year.
- Production of 11,683,130GJ of surplus coke oven gas, which could be converted to 1,298,125MWH of electricity.
- Generation of 483,173MWH of electricity through coke dry quench.
- Offset of 123,209MWH additional electricity required to run the additional coke batteries.
- Offset of circa 11,300MWH for the additional raw material handling
- Offset in terms of increased nitrogen consumption, circa 1.45 x $10^8 m^3$.
- Offset in terms of Water consumption, circa 2.6 million $m^3$ of industrial water and approximately 660,000$m^3$ of potable water.
- Offset in terms of additional manpower to operate the ovens.
- Net electricity benefit would be 1,646,789MWH, which is equivalent to 188MW on a 365 day basis.

### 7.5.4 Other Potential Energy Saving Areas

Other areas that should be considered for a steel complex on this scale is as follows:

- High efficiency electric motors – this technology is commercially available, the motors tend to be more expensive than conventional motors in terms of initial capital spend but do offer a payback in terms of energy savings.
- Use of variable frequency inverter drives – this technology is commercially available and offers significant energy savings over other motor control methods particularly on fans and pumps. A further benefit is much reduced shock loading of drive trains.
- Extensive Automation to balance demand through the process, this also minimises manpower requirements.
- Coke Oven Gas Heat Recovery – A number of companies are looking to implement technology to recover heat from the very large quantities of energy present within the hot coke oven gas produced in the ovens. The waste heat is removed using heat exchangers to generate steam which can be used for subsequent electrical generation.
- Blast Furnace Slag heat recovery – Again this is an area under development by a number of companies to use the high heat capacity of the blast furnace slag produced from the blast furnace to raise steam and then generate electricity.
- BOS Gas steam generation – This system is commercially available and similar to the above processes produces steam and then generates electricity from the hot gas offtake in the basic oxygen steelmaking process.
- Continuous casting slab heat recovery – This is a further area where vast amounts of heat generated by the production process currently go to waste.

## 8. WATER USAGE

Estimated water usage (both Industrial and potable qualities for the various processing units and based on typical consumption figures) is summarised below.

| | Industrial $M^3$/Annum | Potable $M^3$/Annum |
|---|---|---|
| Raw material handling | 132,949 | 809,256 |
| Coke Plant | 7,914,377 | 1,978,594 |
| Sinter Plant | 2,792,701 | 264,572 |
| Lime Plant | | |
| Blast Furnace | 10,889,337 | 544,467 |
| HM Treatment | 5,444,669 | |
| Oxygen Plant | 41,805,986 | |
| Steel Plant | 5,283,159 | 5,283,159 |
| Misc | 2,200,000 | 1,100,000 |
| Total | 76,463,178 | 9,980,048 |
| | | |
| $M^3$/Tonne Slab | 3.48 | 0.45 |
| Exclude O2 Prod | 1.58 | 0.45 |

At this stage it has not been possible to validate water consumptions for the oxygen plant or the lime plant. Net water consumption per tonne of slab is estimated at $2M^3$ excluding these 2 items.

Based on the above estimates, it is estimated that in order to provide **2 days** water supply on site, a raw water reservoir of some $480{,}000m^3$ capacity will be required, this would be provided by a reservoir constructed nominally from ground level by embankments and would be 310m x 310m x 5m deep.

## 9. STEEL COMPLEX WORKFORCE LABOUR REQUIREMENTS

An assessment of the workforce labour requirements to operate and maintain the plant has been undertaken.

The final numbers of personnel required is very much dependant on a number of factors that will need to be discussed and agreed between the various Steel Producers within the PIB project and will include:

- Level of co-operation between the relevant Steel Producers covering:
    - Ability to centralise operational work crews across the various departments such as Sinter, Coke, Iron, Steel and slab production
    - Ability to centralise day and shift maintenance crews across the various departments such as Sinter, Coke, Iron, Steel and slab production
- How will central functions be handled such as:
    - Central Engineering Workshops
    - Site contracts
    - Purchasing
    - Stores
    - Slag & Waste handling
    - Design and Project Engineering
    - Power and Energy
    - Order Entry and Capacity planning and Scheduling
    - Transport and Shipping
    - Finance
    - Human Resources
- Some of the options already described in this report will have a direct bearing on the workforce requirements such as:
    - Sinter plant configuration – will the project be based on 4 large units to give the necessary output or 5 smaller units each one feeding a single blast furnace?
    - Steel Plant configuration – will the project be based on 3 large 3 vessel shops or 5 smaller 2 vessel shops?
- Actual workforce requirements will also depend on a number of external factors such as:
    - Local, and Government legislation;
    - Existing or "new" Company culture;
    - Local "Culture";
    - Existing labour agreements;
    - Cost of labour.
- The numbers quoted below for Operational and Craft grades is based on a modern, automated plant and would include "fully integrated" duties carried out by "teams". This would reduce the overall manning and includes such things as:
    - Flexibility between jobs;
    - Basic engineering skills for production operators;
    - Low level engineering maintenance duties carried out by operatives;
    - Inspections.

In terms of Current operating units, the table below shows typical workforce requirements directly involved in slab production and productivity figures in terms of hrs worked per tonne of slab for a range of facilities. The information was supplied by CRU and is from 2006.

| Plant | Country | Slabs Mte pa | Work Force | Hrs /Year/ person | Hrs/Te Slab |
|---|---|---|---|---|---|
| Anshan | China | 13 | 4000 | 2023 | 0.62 |
| Baoshan | China | 10.28 | 7330 | 2023 | 1.44 |
| Wuhan | China | 9.4 | 7330 | 2023 | 1.58 |
| Oita | Japan | 8.5 | 1421 | 1768 | 0.30 |
| Kwangyang | Korea | 13.33 | 3282 | 2006 | 0.49 |
| Pohang | Korea | 9 | 2772 | 2006 | 0.62 |
| Taranto | Italy | 9 | 3311 | 1669 | 0.61 |
| Burns Harbor | USA | 4.31 | 1700 | 1890 | 0.75 |
| Port Talbot | UK | 4.64 | 1388 | 1733 | 0.52 |
| Teesside | UK | 3.2 | 1250 | 1733 | 0.68 |
| Port Kembla | Australia | 5.1 | 1984 | 1860 | 0.72 |

To give an indication of the extremes of workforce requirements, the manpower requirements based on a single 4.4MTPA slab plant have been estimated. The plant is modern with high levels of automation and flexible working practices are in place between crews. The workforce summary is tabulated below and amounts to just under 1700 staff.

| | Director | Works M'ger | Dep't M'ger | Profess Technical | First line superv./clerical | Oper / Craft | Trainee | Subgroup Total |
|---|---|---|---|---|---|---|---|---|
| Slab production Unit | 1 | 2 | | | | | | 3 |
| Safety, Health & Environm | | | 1 | | | | | 1 |
| SHE Health & Safety | | | | 4 | | | | 4 |
| SHE Environment | | | | 6 | | | | 6 |
| Technical & Continuous Impr | | | | 4 | | | | 4 |
| Sub Total SHE | 0 | 0 | 1 | 14 | 0 | 0 | 0 | 15 |
| Ironmaking | | 1 | | | | | | 1 |
| BF (Dept.) | | | 1 | 13 | 1 | 66 | | 81 |
| Coke Ovens (Dept.) | | | 1 | 12 | | 124 | | 137 |
| Raw materials (Dept.) | | | 1 | 8 | 3 | 60 | | 72 |
| Sinter | | | | 6 | 2 | 22 | | 30 |
| Subtotal Manufacture | 0 | 1 | 3 | 39 | 6 | 272 | 0 | 321 |
| Ironmaking Engineering | | | | | | | | 0 |
| Maintenance Engineering (Dept. | | 1 | | 4 | 13 | 35 | | 53 |
| Eng Coke (Dept.) | | | 1 | 6 | 10 | 25 | | 42 |
| Eng Raw materials(Dept.) | | | 1 | 9 | 7 | 18 | | 35 |
| Eng Sinter | | | | 4 | 7 | 16 | | 27 |
| Eng BF (Dept.) | | | 1 | 9 | 8 | 20 | | 38 |
| Subtotal Engineering | 0 | 1 | 3 | 32 | 45 | 114 | 0 | 195 |
| Technical | | | 1 | 6 | | 10 | | 17 |
| Total Ironmaking | 0 | 2 | 7 | 77 | 51 | 396 | 0 | 533 |
| Quarry & Lime production (Dept.) | | | 1 | 5 | 7 | 19 | | 32 |
| Steelmaking | | 1 | | | | | | 1 |
| Steelmaking Manufacturing | | | | 6 | | | | 6 |
| S/Manf BOS (Dept.) | | | 1 | 11 | 2 | 218 | | 232 |
| S/Manf Concast (Dept.) | | | 1 | 18 | 2 | 244 | | 265 |
| Subtotal Manufacture | 0 | 1 | 2 | 35 | 4 | 462 | 0 | 504 |
| Steelmaking Engineering | | 1 | | | | | | 1 |
| Maintenance Engineering (Dept. | | | | | | 28 | | 28 |
| S/Eng BOS (Dept.) | | | 1 | 8 | 4 | 15 | | 28 |
| S/Eng Concast (Dept.) | | | 1 | 7 | 5 | 17 | | 30 |
| Subtotal Engineering | 0 | 1 | 2 | 15 | 9 | 60 | 0 | 87 |
| Technical (Dept.) | | | 1 | 12 | | 15 | | 28 |
| Subtotal Steelmaking | 0 | 2 | 5 | 62 | 13 | 537 | 0 | 619 |
| Central Engineering | | 1 | | | | | | 1 |
| Shops & Services (Dept.) | | | 1 | 35 | 12 | 200 | | 248 |
| Legislation (Dept.) | | | | 4 | | | | 4 |
| Site Contracts, Systems, purchasing, stores | | | 1 | 12 | 30 | 25 | | 68 |
| Design / Project Eng | | | 1 | 10 | 5 | | | 16 |
| Central Engineering Total | 0 | 1 | 3 | 61 | 47 | 225 | 0 | 337 |
| Power, Energy & Services | | | 1 | 20 | 9 | 55 | | 85 |
| Ord.Ent Capacity Plnng & Sch | | | 1 | 8 | | | | 9 |
| Transport & Shipping | | | 1 | 10 | 15 | | | 26 |
| Finance (Dept.) | | 1 | 3 | 10 | 4 | | | 18 |
| Human Resources (Dept.) | | 1 | 2 | 2 | 3 | | 6 | 14 |
| Overall totals | 1 | 9 | 25 | 269 | 149 | 1232 | 6 | 1691 |

On a like for like basis compared with the productivity of the other steel plants listed, 1152 people would be directly involved in the production of slab which would give a typical hour/Te production of 0.48 based on Australian working hours per annum of 1860 which would be near the top of the productivity league.

With limited sharing across the steel complex, based on the production requirements for a 4.4MTPA unit, the potential manpower requirements for PIB could be as high as 8500 staff.

With optimum sharing across the complex including a rationalisation of the sinter and steel production coupled with centralised shared services, the following requirement for a 22MTPA plant has been estimated.

| | Director | Works M'ger | Dep't M'ger | Profess Technical | First line superv./clerical | Oper / Craft | Graduates | Subgroup Total |
|---|---|---|---|---|---|---|---|---|
| Slab production Unit | 1 | 2 | | | | | | 3 |
| Safety, Health & Environm | | | 1 | | | | | 1 |
| SHE Health & Safety | | | | 10 | | | | 10 |
| SHE Environment | | | | 15 | | | | 15 |
| Technical & Continuous Impr | | | | 10 | | | | 10 |
| Sub Total SHE | 0 | 0 | 1 | 35 | 0 | 0 | 0 | 36 |
| Ironmaking | | 1 | | | | | | 1 |
| BF (Dept.) | | | 5 | 52 | 4 | 264 | | 325 |
| Coke Ovens (Dept.) | | | 3 | 29 | | 298 | | 330 |
| Raw materials & Sinter (Dept.) | | | 4 | 26 | 10 | 192 | | 232 |
| Subtotal Manufacture | 0 | 1 | 12 | 107 | 14 | 754 | 0 | 888 |
| Ironmaking Engineering | | | | | | | | 0 |
| Maintenance Engineering (Dept. | | 1 | | 10 | 33 | 88 | | 132 |
| I/Eng Coke (Dept.) | | | 1 | 15 | 24 | 60 | | 100 |
| I/Eng Raw materials & Sinter(Dept.) | | | 1 | 29 | 23 | 58 | | 111 |
| I/Eng BF (Dept.) | | | 1 | 36 | 32 | 80 | | 149 |
| Subtotal Engineering | 0 | 1 | 3 | 90 | 112 | 286 | 0 | 492 |
| Technical | | | 3 | 15 | | 25 | | 43 |
| Total Ironmaking | 0 | 2 | 18 | 212 | 126 | 1065 | 0 | 1423 |
| Quarry & Lime production (Dept.) | | | 5 | 20 | 28 | 76 | | 129 |
| Steelmaking | | 1 | | | | | | 1 |
| Steelmaking Manufacturing | | | | 15 | | | | 15 |
| S/Manf BOS (Dept.) | | | 3 | 27 | 5 | 524 | | 559 |
| S/Manf Concast (Dept.) | | | 3 | 44 | 5 | 586 | | 638 |
| Subtotal Manufacture | 0 | 1 | 6 | 86 | 10 | 1110 | 0 | 1213 |
| Steelmaking Engineering | | 1 | | | | | | 1 |
| Maintenance Engineering (Dept. | | | | | | 68 | | 68 |
| S/Eng BOS (Dept.) | | | 1 | 20 | 10 | 36 | | 67 |
| S/Eng Concast (Dept.) | | | 1 | 17 | 12 | 41 | | 71 |
| Subtotal Engineering | 0 | 1 | 2 | 37 | 22 | 145 | 0 | 207 |
| Technical (Dept.) | | | 3 | 29 | | 36 | | 68 |
| Subtotal Steelmaking | 0 | 2 | 11 | 152 | 32 | 1291 | 0 | 1488 |
| Central Engineering | | 1 | | | | | | 1 |
| Shops & Services (Dept.) | | | 1 | 88 | 30 | 500 | | 619 |
| Legislation (Dept.) | | | | 10 | | | | 10 |
| Site Contracts, Systems, purchasing, stores | | | 1 | 30 | 75 | 63 | | 169 |
| Design / Project Eng | | | 1 | 25 | 13 | | | 39 |
| Central Engineering Total | 0 | 1 | 3 | 153 | 118 | 563 | 0 | 838 |
| Power, Energy & Services | | | 1 | 20 | 9 | 55 | | 85 |
| Ord.Ent Capacity Plnng & S | | | 3 | 20 | | | | 23 |
| Transport & Shipping | | | 1 | 25 | 38 | | | 64 |
| Finance (Dept.) | | 1 | 8 | 25 | 4 | | | 38 |
| Human Resources (Dept.) | | 1 | 5 | 5 | 8 | | 15 | 34 |
| Overall totals | 1 | 9 | 56 | 667 | 363 | 3050 | 15 | 4161 |

From the table above it can be seen that potential efficiencies of over 50% in terms of manning numbers can be achieved with maximum sharing and cooperation. The number of employees involved in actual production would be 2911 people giving a productivity value of 0.25 hours per tonne of slab which, in TSC opinion, would be best in world.

Actual manpower productivity is not the only measure when estimating the labour cost element of the slab cost, the other being the actual labour rate. Labour rates have been investigated in some detail during this study using information from the US Bureau of Labour Statistics, the National statistics offices of Korea and China, steel company published accounts. On this basis the following annual labour costs have been assumed.

| Country | Annual Labour Cost US$ | Relative labour Cost |
|---|---|---|
| China | 6,890 | 1 |
| Korea | 37,000 | 5.37 |
| Australia | 97,000 | 14.1 |

From the above it can be seen that even with the much improved productivity of the developed case, labour costs per tonne of slab are likely to be significantly higher in Australia than in the base case.

At this stage TSC gives some element of caution in that it has been difficult to establish exact "like for like" comparisons for particularly the Chinese labour rate ensuring the cost includes all the employment cost elements. This is an area for further investigation.

## 10. OUTLINE DESCRIPTION OF COST MODEL

The cost model developed by Tata Steel Consulting is shown schematically in the figure below illustrating the evaluation methodology for the direct cost of the slab production.


The model is robust, dynamic and flexible that suits the evaluation of the cost of producing steel from a steel complex that would require considerations for multi-processes interacting with each other, using several raw materials (externally and locally sourced), and producing several by-products, intermediate products and main products.

This cost model can be developed to include for the cost of the direct $CO_2$ emissions from the various processes within the defined boundary limit of the steel complex.

The key features of the model are as follows:

The main product only considered in the current version of the cost model used by this study is steel merchant slab. However, it should be noted that cost model could be modified to provide multi products options. If multi-products are evaluated, then it would be essential that some constraint (i.e. limitation to define the level of degree of freedom) should be established to determine the break even cost of these multi-products.

For this study – the basic assumptions for the current cost model are:

1. Intermediate Products of a plant or process within the boundary limit would become a

"Local" raw material to other plants/processes. These are expressed as specific cost per tonne of intermediate product. The users of the intermediate product/s are sold by using the direct cost of its producer(s) – this represents the "internal price".

2. All the by-products produced by any plants / processes are sold at a fixed price set in the assumptions and revenues are internally credited to the producer(s).
3. This model is based on a cascading cost model for each plants /major processes leading to the direct cost of producing the steel slab.
4. The break even cost of producing the slab was determined from the cash flow analysis over the economic life of the plant considering the capital cost and indirect cost of the whole steel complex defined by the boundary limit., and the direct cost specifically to the Continuous Casting (plant that produce the Slab) only.
5. The direct costs of each plants / processes are evaluated based on the consumption of the externally sourced or "imported" raw materials, "local" raw materials, fuel and energy (imported, local or both), consumables, direct labour cost, maintenance, and other OPEX and work's expenses specific to the plant.
6. By-products that go out of the boundary limit are sold at a fixed price over the economic life of the plant. The revenue of this by-product is then credited to the plants / processes that produced it.
7. The users of "by-product" energy in the form of off-gases or steam that are produced from certain plant(s) or process(es) are also sold at a fixed price over the economic life; and credit was also given to the producer(s) of the by-product energy.

# 11. CAPEX ASSUMPTIONS

The basis of estimating the total investment cost for each of the cases considered takes into account the following:

- Total installed cost for plant and equipment
- Site Development and Construction
- Recurring Capital Expenditure

## 11.1 PLANT AND EQUIPMENT – MAJOR PROCESSES

The capital cost of the major plant and equipment considered for each case have been estimated and subdivided according to the following main production units:

- Coke Production
- Sinter Production
- Blast Furnace
- Steelmaking
- Continuous Casting

The total installed cost for each plant or process accounts for (but is not limited to):

- Direct material – including plant, equipment and bulk materials
- Plant Construction
    - Installation cost includes the mechanical erection, piping installation, etc...;
    - Instrumentation, process control automation and electrical installation;
    - Civil works, and where necessary other site preparation.
- EPC Services – including contractor's home office and construction supervision.
- Other Costs - including temporary buildings, training and plant start up (excl. First fill).

The equipment cost was estimated from TSC's database of Capital costs, adjusted to 2011 prices. All capital cost estimates should be within ±25% accuracy.

For some of the main production items, the database contains costs for equipment installed in both Western economies and China. As part of this evaluation, TSC has attempted to estimate the relative installed capital cost of equipment for a number of scenarios covering:

- Korea for the base case (Western Supply)
- China – sensitivity on the base case (Chinese Supply)
- Australia – all other cases (Western supply)
- Australia – sensitivity on Western design and key component supply, Chinese manufacture for balance, local supply for construction and materials.

As a further data check, TSC has access to a detailed cost breakdown for an Integrated Iron works facility in SE Asia from both a Western plus local standpoint and Chinese plus local standpoint.

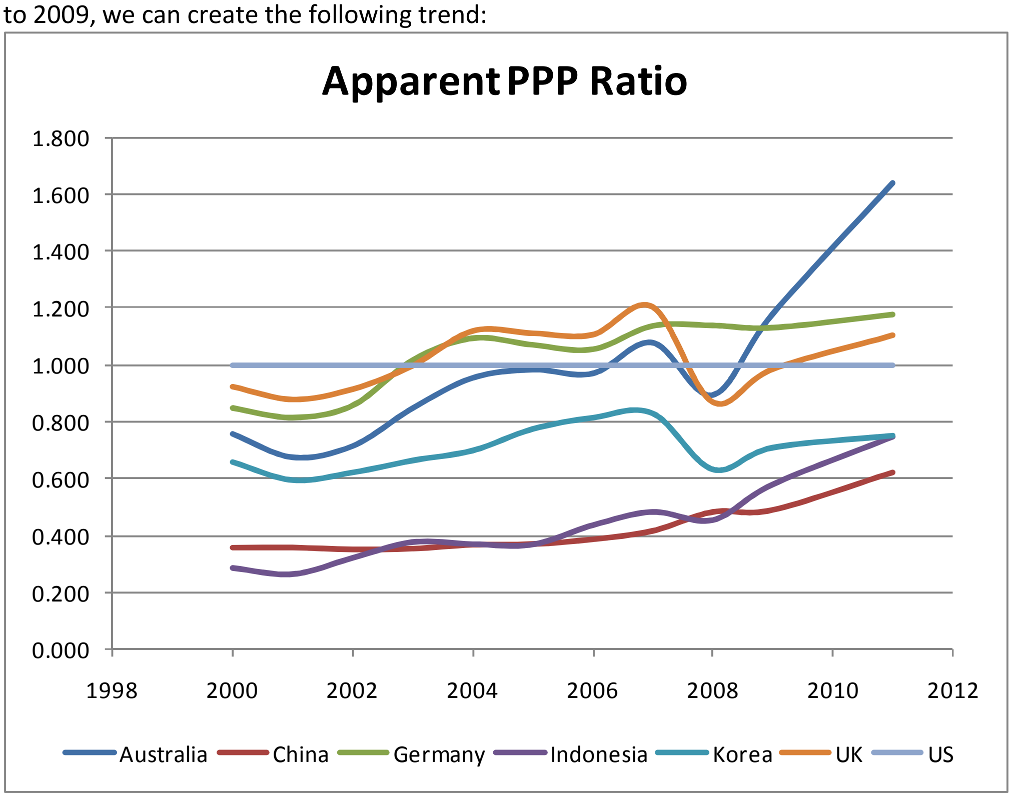
In order to estimate relative costs of labour and construction services across international boundaries, TSC has developed a number of Indices to cover relative productivity for the various countries and the relative purchasing power parity (PPP) indices.

Taking Figures for 2011 and equating to US$ at prevailing 2011 exchange rates the following table Indicates the process adopted using a range of sources including the USA Bureau of Labour Statistics, the National Bureau of Statistics of China and The National Statistical Office of Korea.

| Item / Country | Australia | China | Germany | Indonesia | Korea | UK | USA |
|---|---|---|---|---|---|---|---|
| GDP/Capita (US$)@ PPP | 40100 | 8400 | 37900 | 4700 | 31700 | 35900 | 48100 |
| Employment Cost (Manuf) | 85000 | 5800 | 73400 | 2700 | 37000 | 59800 | 68000 |
| Productivity Ratio Cost/Prod | 2.1 | 0.69 | 1.94 | 0.57 | 1.17 | 1.66 | 1.41 |
| Productivity relative to Indonesia* | 3.68 | 1.21 | 3.4 | 1 | 2.05 | 2.91 | 2.47 |
| PPP Ratio** | 1.6 | 0.62 | 1.18 | 0.75 | 0.75 | 1.1 | 1 |

*Interpretation of Productivity relative to Indonesia means that to carry out an amount of work that costs $1 in Indonesia will cost $3.68 for the same amount of work in Australia.
**Interpretation of the PPP Ratio relative to the US means that a schedule of goods costing $1 in the US will cost the equivalent of US$1.6 in Australia.

If we incorporate this data with Published data collated by "Penn World tables" for the period 2000 to 2009, we can create the following trend:




What the above graph shows is the relative cost in US dollars in a particular country for $1 worth of goods in the US. The graph shows a rapid rise for Australia since 2008 which coincides with the significant strengthening of the AUD$ against the US$. A similar effect is shown for China over the same period.

As a further indicative comparator, to estimate the relative cost of manufacture of Steel plant components, TSC has used information in terms of material and labour cost splits for manufacturing facilities in the UK producing steel plant equipment in terms of machining, fabrication, assembly and electrical fit out, the comparison using the relative productivity and PPP ratios compared to the UK are as follows.

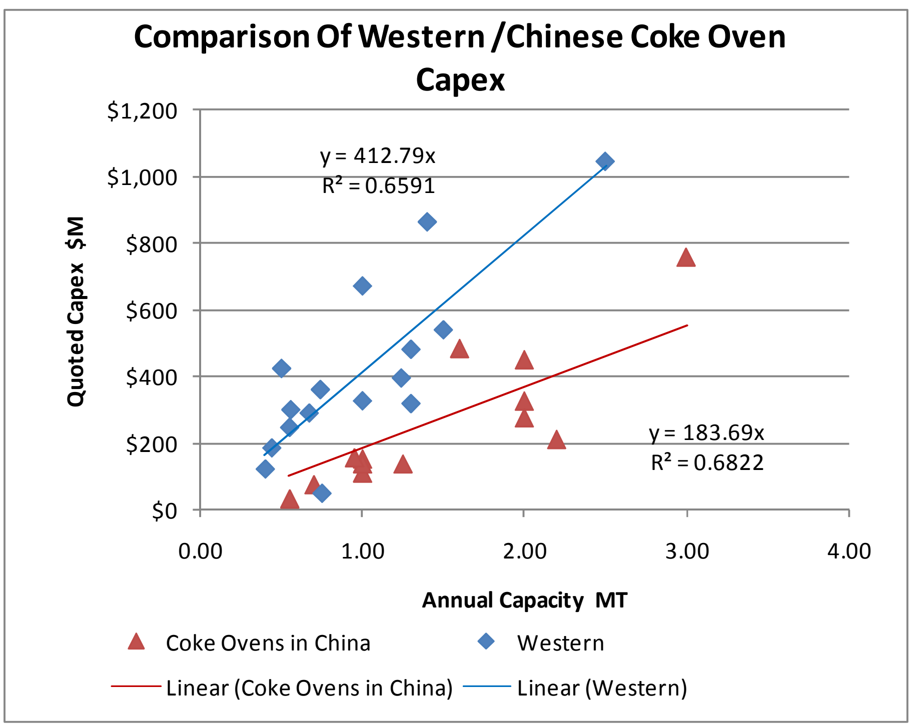
| Item / Country | Australia | China | Germany | Indonesia | Korea | UK | USA |
|---|---|---|---|---|---|---|---|
| Labour Cost % | 63.2 | 20.8 | 58.4 | 17.2 | 35.2 | 50 | 42.4 |
| Material Cost % | 75.8 | 27.4 | 54 | 34.0 | 34.2 | 50 | 45.5 |
| Total compared to UK | 1.39 | 0.482 | 1.12 | 0.51 | 0.694 | 1.0 | 0.88 |

Discussion on each of the main Production areas is considered below.

### 11.1.1 Coke Production

In arriving at Capital costs for coke production, a total of 31 installations that have been constructed or planned from 2003 onwards have been considered. Of these 13 had been constructed in China to Chinese design and some 16 had been "Western" supply.

From the published data, converted to US$ at the time of the announcement and escalated by the US CEPCI index to 2011 prices and the Chinese supply equated to 2011 exchange rates, the following comparison can be made in terms of Western/Chinese costs.



The above Graphs show strong correlation in terms of CAPEX by annual capacity for both the Western and Chinese costs. The data covers Investment announcements from 2003 up to 2009 for Chinese supply and 2010 for Western.

It can be seen from the above that the costs of the Chinese Ovens are significantly less than those in the Western economy.

Since around 2007, legislation has changed in China in that new plants need to be installed with modern processes to reduce the environmental impact of the process, such as Dust emissions and heat recovery. There has also been an upward trend in the ovens size to achieve a better coke product. These changes happened in the Western economies circa 5-10 years earlier.

A further development that has been introduced in the last few years to Coke oven units built in China is Coke Dry Quenching technology. This facility to extract heat and therefore power from the hot coke has been used extensively in Coke oven plants in Japan and Korea for about 15 years, with the bulk of the plants in the "Western" price trend including for this.

Most of the "Chinese" trend plants do not have the CDQ technology, the cost of this facility is typically $30M for a 500KTPA coke plant rising to some $M50 for a 1700KTPA plant.

A further development in terms of Chinese supply has been the strengthening of the Chinese Yuan against the US dollar coupled with large increases (circa 10% PA) in employment costs over the past few years

On the basis of the above the trend for the Chinese supply is likely to be underestimated in terms of the most modern equipment. It is recommended that an addition of 20% be made to the Chinese costs from the trend to account for the introduction of new environmental technology from 2007 onwards plus a factor dependant on the coke plant size to include for CDQ. In terms of Inflation cost, an additional 8% is recommended to account for the increased labour cost (a total labour element of approximately 36-38% for a coke oven facility in China is estimated).

To estimate the effects of using the most modern Western technology and Chinese manufacture, there are a number of references where major European Coke oven plant builders have carried out this approach, typically charging approximately $M150 for the basic engineering, procurement of critical parts, supervision of erection and commissioning and leaving detailed engineering, manufacture and construction to local supply. (Hyundai's Dangjin development and Posco's Kwangyang ovens are examples of these).

To estimate the CAPEX requirements for the various PIB cases, a combination of Western and Chinese trends has been used and cognizance taken of the likely split in local and imported elements for the work.

A typical breakdown of local to imported elements for a European Coke oven manufacturer supplying into South East Asia is:

| Eng, PM, Sup of Construction & Commissioning | Imported Elements | Delivery | Local Supply |
|---|---|---|---|
| 7.3% | 59.1% | 1.9% | 31.7% |

The local supply element is split into 80% materials and 20% labour element.

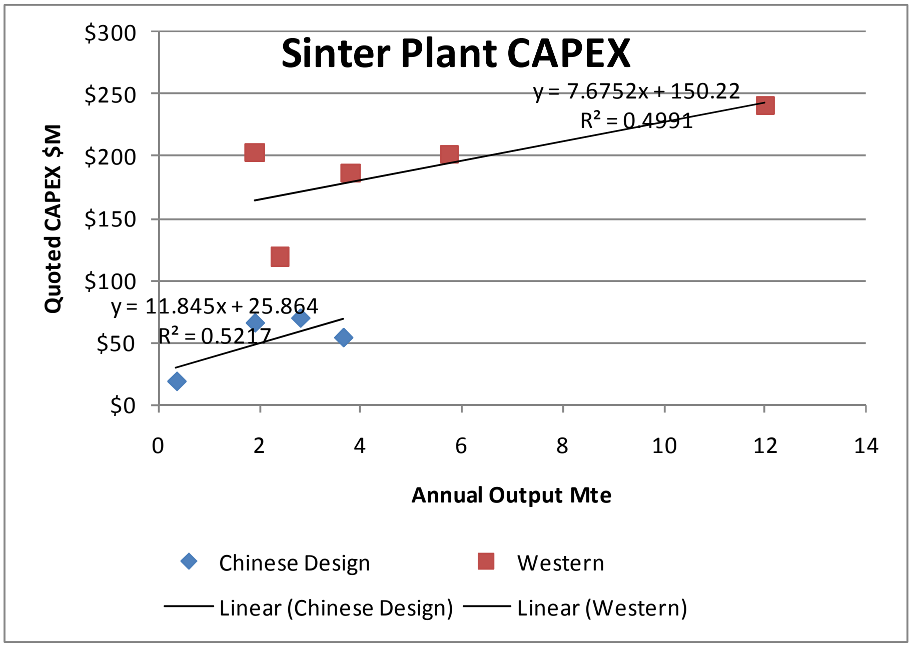
| Case Considered | Steel Output | Coke Required | Estimated CAPEX | | | |
|---|---|---|---|---|---|---|
| | | | Western Design, Korea Local supply, Installation Korea | Western Design, Australia local supply, Installation Australia | Western Design, Chinese Manufacture, Local Supply & installation Australia | Chinese Design Manufacture and Install China |
| | MT | MT | US$M | US$M | US$M | US$M |
| Base Case/Case 1 | 4.5 | 1.8 | 750 | 825* | 725** | 450 |
| Case 2*** | 9.0 | 3.6 | 1390 | 1525 | 1340 | 835 |
| Case3**** | 22.0 | 8.7 | 3235 | 3550 | 3005 | 1920 |

* increased CAPEX for Australia to allow for increased local labour costs compared to Korea .
** assumed that circa $150M worth of engineering and equipment would be supplied from Europe, the balance of the imported items could be made in China with the assumption that Chinese manufacturing costs are 48% of Western for the balance.
***For Case 2, assumed that savings in detail design and procurement will mean that subsequent units will be reduced by the design cost plus an element of the engineering supervision and commissioning plus an element for procurement savings of the original unit cost. On balance 15% on subsequent units has been assumed.
****For Case 3, assumed 3 off units of 2.9MTPA with the second and third sharing the same design as the first, same by-products plant and savings in procurement.

### 11.1.2 Sinter Production

In terms of Sinter plant CAPEX, there is not as much reference information as that for Coke Ovens. However a total of 9 Installations are considered, 5 to Western Design covering years 2007 to 2010and 4 to Chinese design covering years 2008 to 2010. In all Cases of the western design, the units were to be installed in the BRIC economies and are based on the Western Supplier carrying out Basic Engineering and detailed for critical items, procurement of critical items and supervision of erection and commissioning. The remaining activities would be carried out locally. Typical Costs for the western element are the order of $M50.

The trend of CAPEX against Capacity is shown below:




The above Graphs show strong correlation in terms of CAPEX by annual capacity for both the Western and Chinese costs.

It can be seen from the above that the costs of the Chinese Sinter Plants are significantly less than those in the Western economy; however there are no references for Chinese supply greater than 4MTPA output. For PIB in all cases considered, the sinter plant output will need to be at least 6.2MTPA up to 7.5MTPA in the developed case.

The above costs covers only up to early 2010, as such to take into account Chinese wage rises since then. It is suggested that a further 5% be added to account for increases on the manpower element of the cost (estimated at 35-38% of the total).

In a similar vein to the development of the coke ovens costs described above, the Chinese government has been applying changes to legislation in terms of the environmental performance of Sinter plants to bring those more in line with modern Western design. As such to account for this and the lack of references above 4MTPA, it is recommended that an addition 25% be made to account for this.

In terms of Price Breakdown, the following representative split for Western supply to an installation in SE Asia has been assumed. (values as % of total CAPEX).

| Eng, PM, Sup of Construction & Commissioning | Imported Elements | Delivery | Local Supply |
|---|---|---|---|
| 13.5% | 62.8% | 1.5% | 22.2% |

In terms of the local element of work, it has been established that 80% covered the supply of materials and equipment and 20%  covered labour.

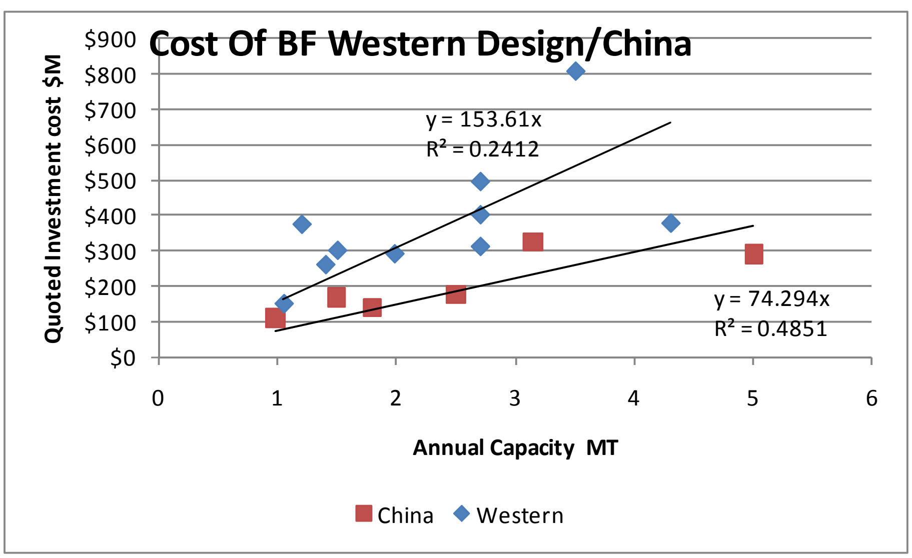
Using similar assumptions as that for the Coke Ovens above:

| Case Considered | Steel Output | Sinter Required | Estimated CAPEX | | | |
|---|---|---|---|---|---|---|
| | | | Western Design, Korea Local supply, Installation Korea | Western Design, Australia local supply, Installation Australia | Western Design, Chinese Manufacture, Local Supply & installation Australia | Chinese Design Manufacture and Install China |
| | MT | MT | US$M | US$M | US$M | US$M |
| Base Case/Case 1 | 4.5 | 6.2 | 200 | 215 | 195 | 130 |
| Case 2 | 9.0 | 12.4 | 365 | 390 | 360 | 245 |
| Case3 | 22.0 | 30.5 | 730 | 785 | 710 | 550 |

For multiple units, because the design and engineering cost is a larger proportion than with Coke ovens,  a 17.5% saving on subsequent units to the same design for Western design and 12% saving for Chinese design has been assumed (Proportion of Engineering Costs are different).

### 11.1.3 Blast Furnace

In terms of Blast Furnace (BF) plant CAPEX, some 16 references have been analysed, with the majority being to Western design but for projects executed in BRIC countries from 2006 to 2010. To estimate the requirements for this the same general philosophy to the Sinter Plants and Coke Ovens has been adopted.



As with the Coke ovens and Sinter plant units, there has been an increased emphasis on improvements to the environmental performance of Blast Furnaces in China, particularly with the addition of furnace top recovery turbines and fume emission control. TSC has some concerns as to whether the cost quoted for the 5MTPA plant in the trend above includes all the costs associated with the blast furnace CAPEX as it is significantly lower than the other Chinese plants in the trend. As such it is recommended that an allowance of 20% be included to account for these items.

The above costs cover only up to early 2010, as such to take into account Chinese wage rises since then, it is suggested that a further 5% be added to account for increases on the manpower element of the cost (estimated at 35-38% of the total)

In terms of Price Breakdown, the following representative split for the Western supply to an installation in SE Asia has been assumed. (values as % of total CAPEX)

| Eng, PM, Sup of Construction & Commissioning | Imported Elements | Delivery | Local Supply |
|---|---|---|---|
| 8% | 56.7% | 2% | 33.3% |

In terms of the local element of work, TSC it has been established that 80% covered the supply of was for materials and equipment and 20% covered for labour.

For the technological equipment supplied from the western sources, it has been assumed that, including the engineering element, this would amount to nominally $M150. Saving on multiple units would be 15% on subsequent units.

| Case Considered | Steel Output | Hot Metal Required | Estimated CAPEX | | | |
|---|---|---|---|---|---|---|
| | | | Western Design, Korea Local supply, Installation Korea | Western Design, Australia local supply, Installation Australia | Western Design, Chinese Manufacture, Local Supply & installation Australia | Chinese Design Manufacture and Install China |
| | MT | MT | US$M | US$M | US$M | US$M |
| Base Case/Case 1 | 4.5 | 4.4 | 675 | 775 | 700 | 410 |
| Case 2 | 9.0 | 8.8 | 1250 | 1435 | 1295 | 760 |
| Case3 | 22.0 | 22.0 | 2970 | 3410 | 3080 | 1805 |

### 11.1.4 Steelmaking

In terms of Basic Oxygen Steelmaking equipment, there are relatively few references and those that exist are based on the cost of the convertor units and associated fume extraction equipment not the total cost of the steel plant.

However there exists plentiful reference cost information for the associated handling equipment that would be required including:

- Ladle repair and handling facilities
- Steel ladles
- Preheating stations
- Ladle furnaces
- Vacuum degassing units
- Overhead cranes
- Ladle transfer cars
- Buildings etc.

From this information it has been possible to estimate the cost of the steel plants required, these are presented below. The building requirements for continuous casting are presented separately, although in reality they would be within the same building structure. It has been assumed that subsequent units would save 17.5% due to economies of scale design commonality etc.

| Case Considered | Steel Output | Estimated CAPEX | | | |
|---|---|---|---|---|---|
| | | Western Design, Korea Local supply, Installation Korea | Western Design, Australia local supply, Installation Australia | Western Design, Chinese Manufacture, Local Supply & installation Australia | Chinese Design Manufacture and Install China |
| | MT | US$M | US$M | US$M | US$M |
| Base Case/Case 1 | 4.5 | 407 | 447 | 414 | 334 |
| Case 2 | 9.0 | 743 | 816 | 756 | 610 |
| Case3 | 22.0 | 1748 | 1920 | 1780 | 1435 |

### 11.1.5 Continuous Casting

References for large slab caster units are more common. A typical cost based on western supply only is ~$M150 for the casting machine capable of producing circa 2.5MTPA of slab. In terms of the requirement for PIB, the following has been estimated on the assumption that the casters are identical with savings in design, procurement; economies of scale subsequent units would save 12.5%.

| Case Considered | Steel Output | Estimated CAPEX | | | |
|---|---|---|---|---|---|
| | | Western Design, Korea Local supply, Installation | Western Design, Australia local supply, Installation | Western Design, Chinese Manufacture, Local Supply & installation | Chinese Design Manufacture and Install China |

| | | Korea | Australia | Australia | |
|---|---|---|---|---|---|
| | MT | US$M | US$M | US$M | US$M |
| Base Case/Case 1 | 4.5 | 415 | 425 | 372 | 241 |
| Case 2 | 9.0 | 778 | 797 | 698 | 452 |
| Case3 | 22.0 | 1867 | 1913 | 1674 | 1085 |

#### 11.1.6 Alternative Steel plant Design

The analysis in the two previous sections on Steelmaking and Continuous casting has assumed that subsequent capacity would be achieved by adding units of 4.4 MTPA in terms of the Steelmaking facilities and additional continuous slab casting machines.

From TSC experience it would be possible for the requirements of Case2, for example, to be met by a single BOS shop of 3 vessels coupled with 3 large slab casters (this would need greater study once the product mix has been established further). If this was the case substantial savings for the Case 2 steel plant could be made.

### 11.2 SUMMARY OF OVERALL CAPEX COST FOR EACH CASE

#### 11.2.1 Base case 4.4MTPA plant location at Port in Korea

The summary of CAPEX for this case is tabulated below:

| | **PROJECT COSTS - CAPEX** | | |
|---|---|---|---|
| | | $ x 1000 | |
| | **FIXED ASSETS** | | |
| 1 | Land | 0 | |
| 2 | Building, construction & civil | 397,883 | 10.2% |
| 3 | Plant & Machinery | 2,894,723 | 74.1% |
| 4 | Water/Utilities Distribution | 40,000 | 1.0% |
| 5 | HV Distribution | 150,000 | 3.8% |
| 5 | Auxiliary Equipment | 306,405 | 7.8% |
| 7 | Contingencies | 0 | 0% |
| 8 | Project Engineering | 115,000 | 2.9% |
| | **TOTAL FIXED ASSETS** | **3,904,011** | 100.0% |

#### 11.2.2 Base case 4.4MTPA plant Sensitivity China

The summary of CAPEX for this case is tabulated below:

| | **PROJECT COSTS - CAPEX** | | |
|---|---|---|---|
| | | $ x 1000 | |
| | **FIXED ASSETS** | | |

| | | | |
|---|---|---|---|
| 1 | Land | 0 | |
| 2 | Building, construction & civil | 306,493 | 11.2% |
| 3 | Plant & Machinery | 1,971,485 | 72.2% |
| 4 | Water/Utilities Distribution | 34,000 | 1.2% |
| 5 | HV Distribution | 112,500 | 4.1% |
| 5 | Auxiliary Equipment | 227,778 | 8.3% |
| 7 | Contingencies | 0 | 0% |
| 8 | Project Engineering | 80,000 | 3.0% |
| | **TOTAL FIXED ASSETS** | **2,732,255** | 100.0% |

### 11.2.3 Case 1 – 4.4MTPA plant QLD Australia

The summary of CAPEX for this case is tabulated below:

| | **PROJECT COSTS - CAPEX** | | |
|---|---|---|---|
| | | $ x 1000 | |
| | **FIXED ASSETS** | | |
| 1 | Land | 0 | |
| 2 | Building, construction & civil | 405,053 | 9.5% |
| 3 | Plant & Machinery | 3,201,023 | 75.3% |
| 4 | Water/Utilities Distribution | 40,000 | 0.9% |
| 5 | HV Distribution | 150,000 | 3.5% |
| 5 | Auxiliary Equipment | 328,548 | 6.1% |
| 7 | Contingencies | 0 | 0% |
| 8 | Project Engineering | 128,000 | 3.0% |
| | **TOTAL FIXED ASSETS** | **4,252,624** | 100.0% |

### 11.2.4 Case 1A – 4.4MTPA plant QLD Australia – Chinese Manufacture

The summary of CAPEX for this case is tabulated below:

| | **PROJECT COSTS - CAPEX** | | |
|---|---|---|---|
| | | $ x 1000 | |
| | **FIXED ASSETS** | | |
| 1 | Land | 0 | |
| 2 | Building, construction & civil | 405,053 | 10.4% |
| 3 | Plant & Machinery | 2,869,503 | 73.7% |
| 4 | Water/Utilities Distribution | 40,000 | 1.0% |
| 5 | HV Distribution | 150,000 | 3.9% |
| 5 | Auxiliary Equipment | 308,657 | 7.9% |
| 7 | Contingencies | 0 | 0% |
| 8 | Project Engineering | 118,000 | 3.0% |
| | **TOTAL FIXED ASSETS** | **3,891,213** | 100.0% |

### 11.2.5 Case 2– 8.8MTPA plant QLD Australia

The summary of CAPEX for this case is tabulated below:

| | PROJECT COSTS - CAPEX | | |
|---|---|---|---|
| | | $ x 1000 | |
| | **FIXED ASSETS** | | |
| 1 | Land | 0 | |
| 2 | Building, construction & civil | 660,852 | 8.7% |
| 3 | Plant & Machinery | 5,937,130 | 78% |
| 4 | Water/Utilities Distribution | 62,000 | 0.8% |
| 5 | HV Distribution | 240,000 | 3.2% |
| 5 | Auxiliary Equipment | 525,515 | 6.9% |
| 7 | Contingencies | 0 | 0% |
| 8 | Project Engineering | 190,000 | 2.5% |
| | **TOTAL FIXED ASSETS** | **7,615,497** | 100.0% |

### 11.2.6 Case 2A– 8.8MTPA plant QLD Australia – Chinese Manufacture

The summary of CAPEX for this case is tabulated below:

| | PROJECT COSTS - CAPEX | | |
|---|---|---|---|
| | | $ x 1000 | |
| | **FIXED ASSETS** | | |
| 1 | Land | 0 | |
| 2 | Building, construction & civil | 660,852 | 9.5% |
| 3 | Plant & Machinery | 5,303,746 | 76.5% |
| 4 | Water/Utilities Distribution | 62,000 | 0.9% |
| 5 | HV Distribution | 240,000 | 3.5% |
| 5 | Auxiliary Equipment | 493,846 | 7.1% |
| 7 | Contingencies | 0 | 0% |
| 8 | Project Engineering | 170,000 | 2.5% |
| | **TOTAL FIXED ASSETS** | **6,930,444** | 100.0% |

### 11.2.7 Case 3– 22MTPA plant QLD Australia

The summary of CAPEX for this case is tabulated below:

| | PROJECT COSTS - CAPEX | | |
|---|---|---|---|
| | | $ x 1000 | |
| | **FIXED ASSETS** | | |
| 1 | Land | 0 | |
| 2 | Building, construction & civil | 1,670,186 | 9.6% |
| 3 | Plant & Machinery | 13,673,555 | 78.6% |
| 4 | Water/Utilities Distribution | 150,000 | 0.9% |
| 5 | HV Distribution | 525,000 | 3.0% |

| | | | |
|---|---|---|---|
| 5 | Auxiliary Equipment | 1,034,504 | 5.9% |
| 7 | Contingencies | 0 | 0% |
| 8 | Project Engineering | 350,000 | 2.0% |
| | **TOTAL FIXED ASSETS** | **17,403,245** | 100.0% |

### 11.2.8 Case 3A– 22MTPA plant QLD Australia – Chinese Manufacture

The summary of CAPEX for this case is tabulated below:

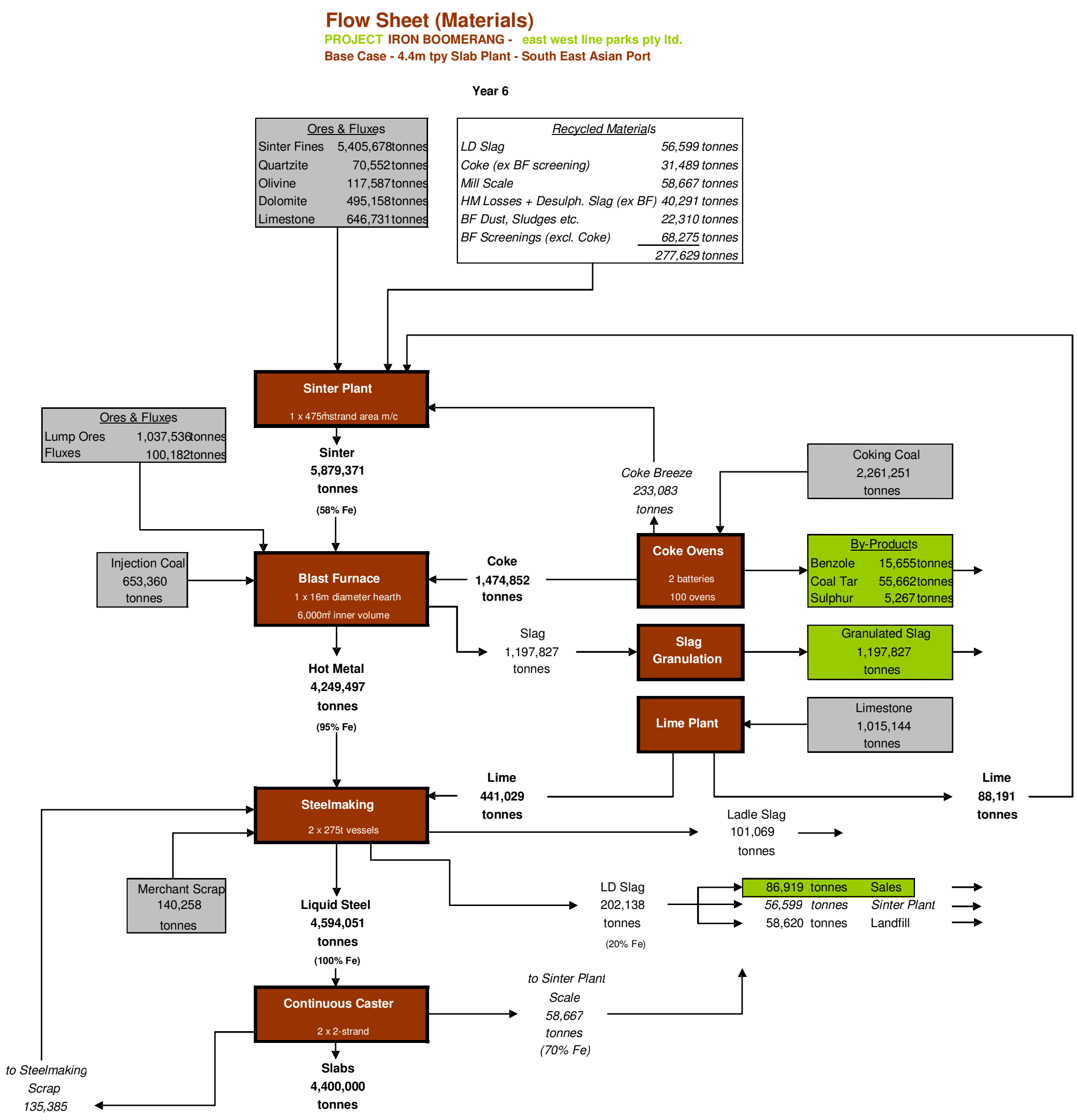
| | **PROJECT COSTS - CAPEX** | | |
|---|---|---|---|
| | | $ x 1000 | |
| | **FIXED ASSETS** | | |
| 1 | Land | 0 | |
| 2 | Building, construction & civil | 1,670,186 | 10.6% |
| 3 | Plant & Machinery | 12,101,144 | 76.9% |
| 4 | Water/Utilities Distribution | 150,000 | 1.0% |
| 5 | HV Distribution | 525,000 | 3.3% |
| 5 | Auxiliary Equipment | 971,607 | 6.2% |
| 7 | Contingencies | 0 | 0% |
| 8 | Project Engineering | 320,000 | 2.0% |
| | **TOTAL FIXED ASSETS** | **15,737,938** | 100.0% |

# 12. SUMMARY OF FINANCIAL EVALUATION

## 12.1 BASE CASE - 4.4 MTPA PLANT PORT LOCATION-KOREA.

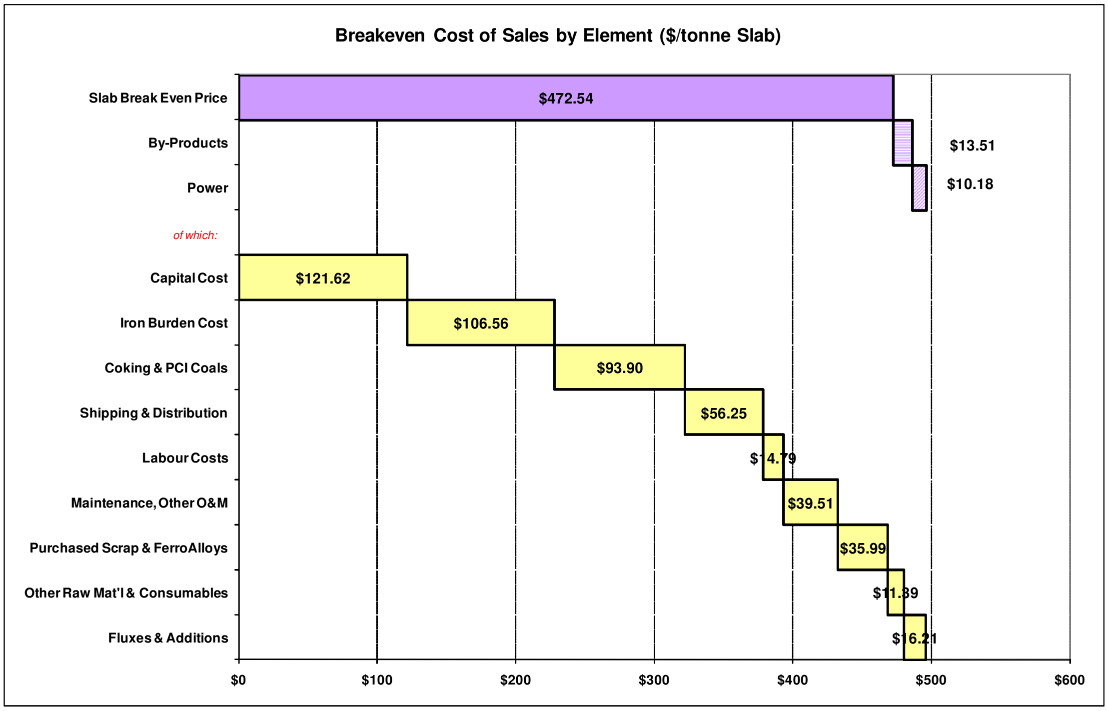
This base case reference plant has been analysed using the TSC developed cost model.

The material Flow Sheet for this case is shown below:



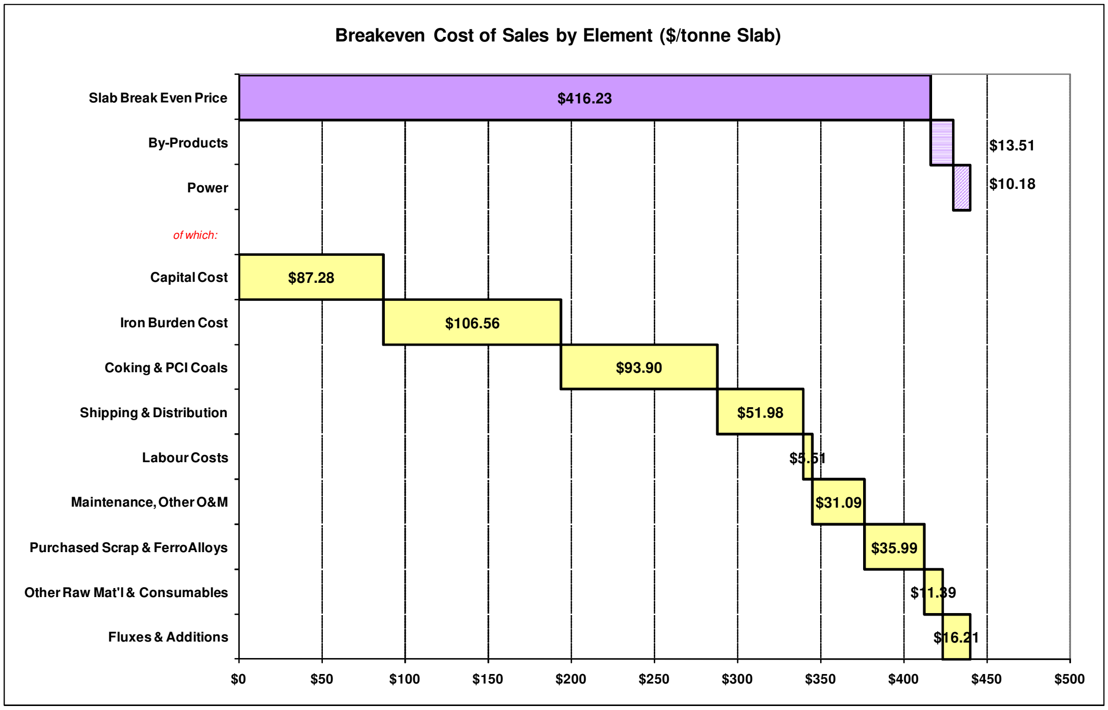

The breakdown of slab cost is shown on the graphic below and indicates a breakeven slab cost of $472.54/Tonne for slab FOB at a Korean port.

It can be seen from the graphic that raw materials, shipping and distribution account for over 64% of the total operating cost with the balance being labour and maintenance.




## 12.2 BASE CASE –SENSITIVITY - 4.4 MTPA PLANT - CHINA

As sensitivity, the expected cost of slab assuming a Chinese location using equipment to Chinese design and manufacture has been assessed. The results are shown below and show that for the Chinese plant, the expected breakeven cost of slab is $416.23 /tonne FOB to South China port, which is some $56.31 per tonne less than the Korean base case.




The main differences over the base case are:

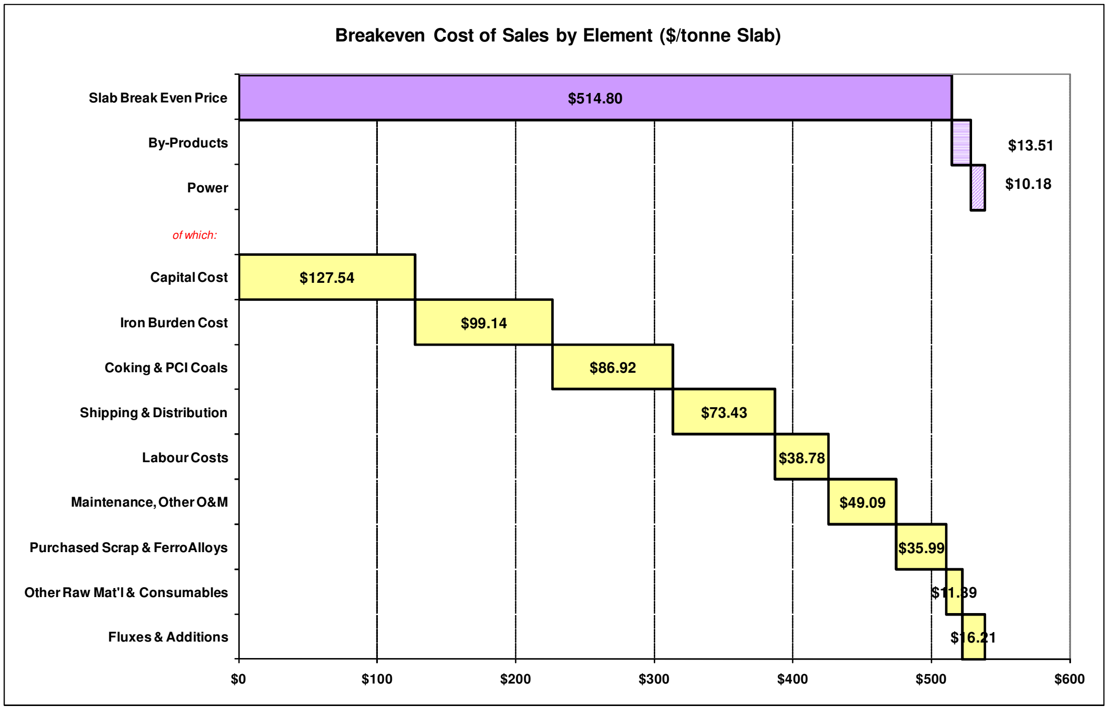
- Capital Cost - $34.34 / Te less
- Shipping and Distribution - $4.27 / Te less
- Labour Costs - $9.28 / Te less
- Maintenance, Other O&M - $8.42/Te less

At this stage TSC would voice some caution in the figures above from the following viewpoint:

- Obtaining valid capital cost of equipment on an equivalent scale and to an equivalent specification in terms of the latest environmental legislation etc. This has been discussed in section 11 of this report.
- Labour costs in China have been very difficult to obtain and compare on a like for like basis with other economies. This element impacts both on the cost of capital, labour and maintenance in the above analysis.

### 12.3 CASE 1 - 4.4 MTPA PLANT -ABBOT POINT, QLD, AUS

For this case the results are shown below:



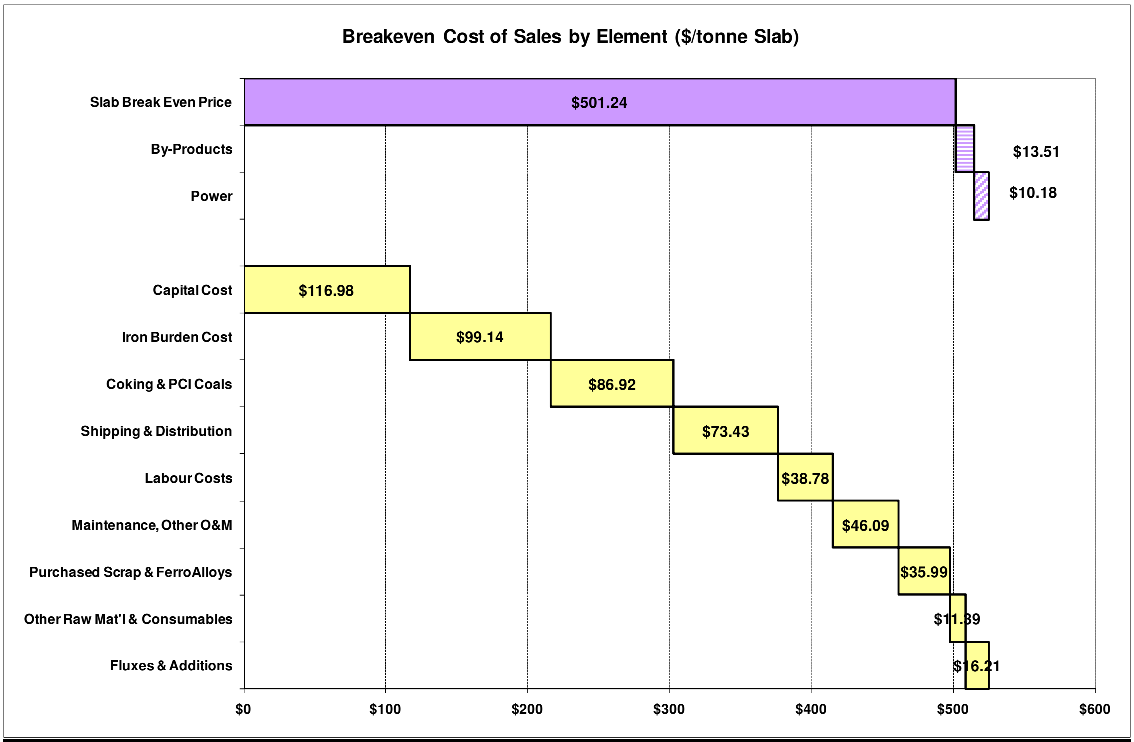

This case was based on Western Supply of equipment with local cost of Installation, civil and buildings. In terms of the transport costs within Australia, the rates provided by EWLP in their 2008 report have been utilised and include an allowance for inflation since then to arrive at 2012 figures. The shipping costs of delivered slab to Korean Port have been estimated based on latest shipping cost information. The Breakeven slab price is some $42.26 /tonne more than the base case.

The increase is due to:

- Higher capital costs
- Higher labour costs
- Increase maintenance costs (labour and materials driven)
- Increased Shipping cost to get slab to a Korean port.

## 12.4 CASE 1A - 4.4 MTPA PLANT -ABBOT POINT- CHINESE MANUFACTURE

For this case the results are shown below:




This case shows a breakeven slab cost of $501.24 /tonne which is significantly less than the previous case by some $13.56 /tonne less due to the reduced Capital cost.

The result however is still significantly higher than the Korean base case by some $28.70/tonne.

## 12.5 CASE 2 - 8.8 MTPA PLANT - ABBOT POINT, QLD, AUS

The material flowsheet for this case is shown below.

TATA STEEL

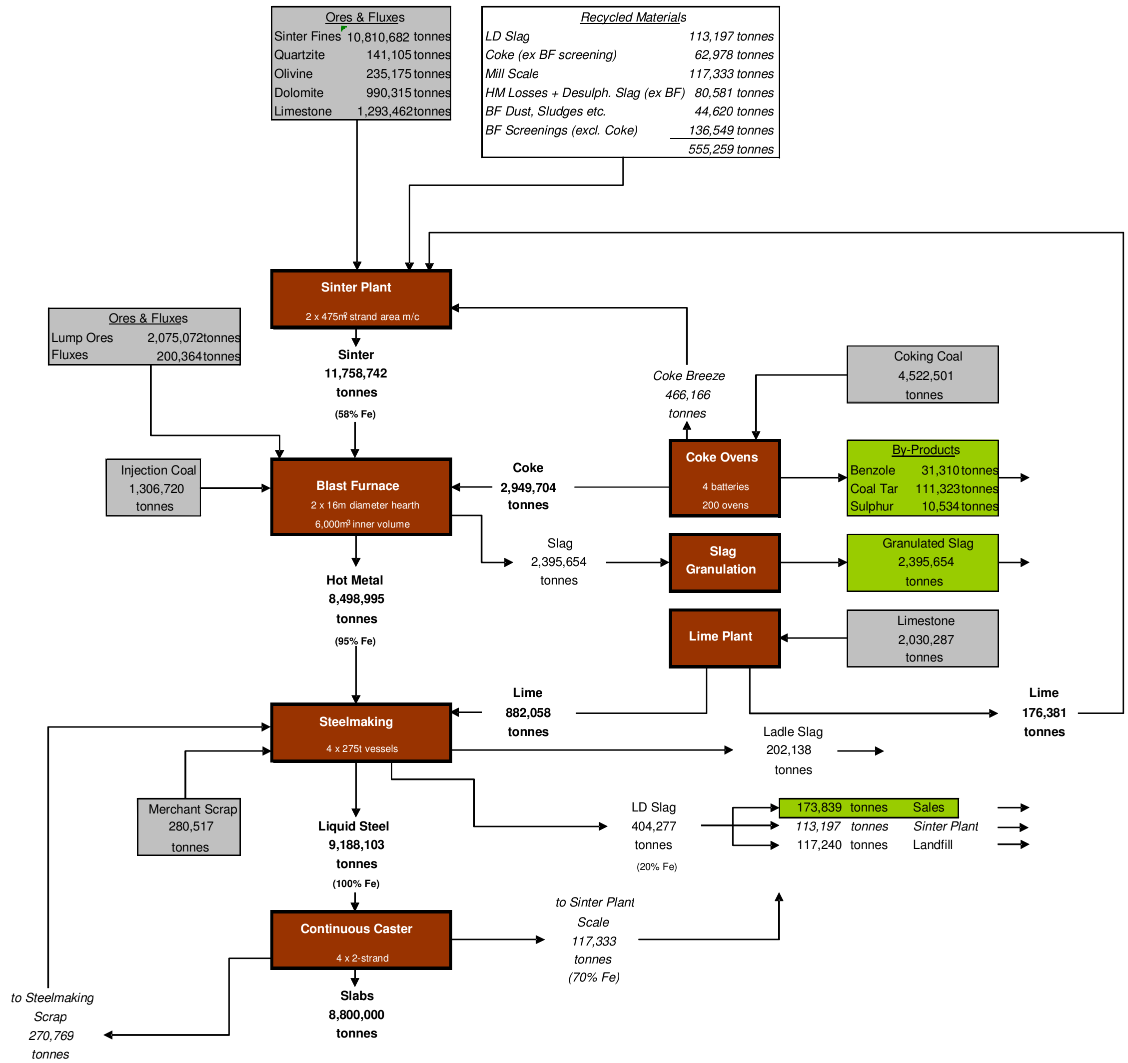
TATA

## Flow Sheet (Materials)

PROJECT IRON BOOMERANG - east west line parks pty ltd.

Case 2 - 8.8m tpy Slab Plant - Abbot Point Smelter Park, QLD

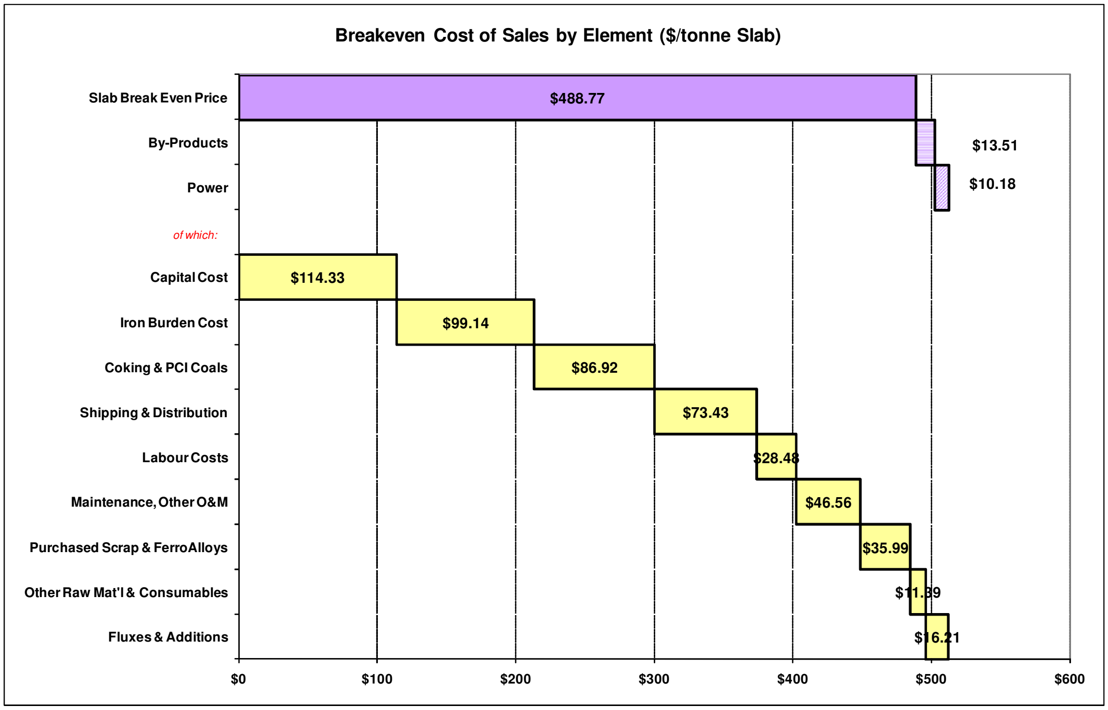
Year 6




For this case which is based on supply of "western" equipment the results are shown below:



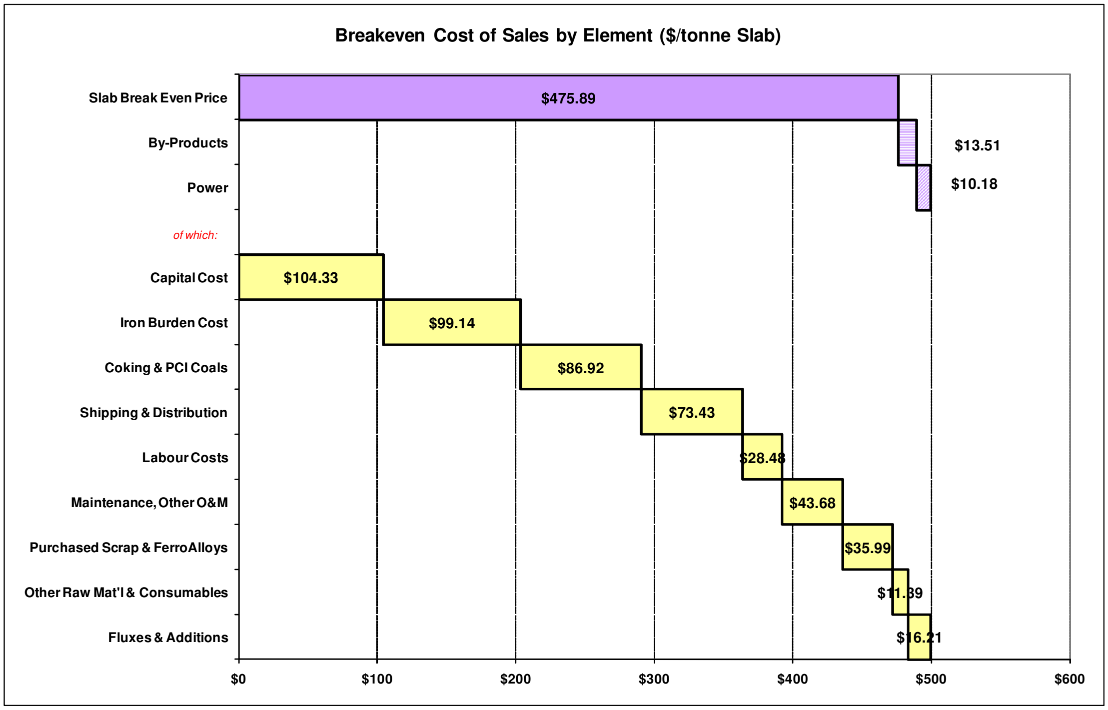
PROJECT IRON BOOMERANG east west line parks pty ltd




This case shows the effect of scale on the breakeven slab cost reducing the cost by some $26.03/tonne over the equivalent 4.4MTPA plant. The result however is still some $16.23/tonne more than the base case.

## 12.6 CASE 2A - 8.8 MTPA PLANT - ABBOT POINT – CHINESE MANUFACTURE

The slab cost breakdown for this case is shown below.



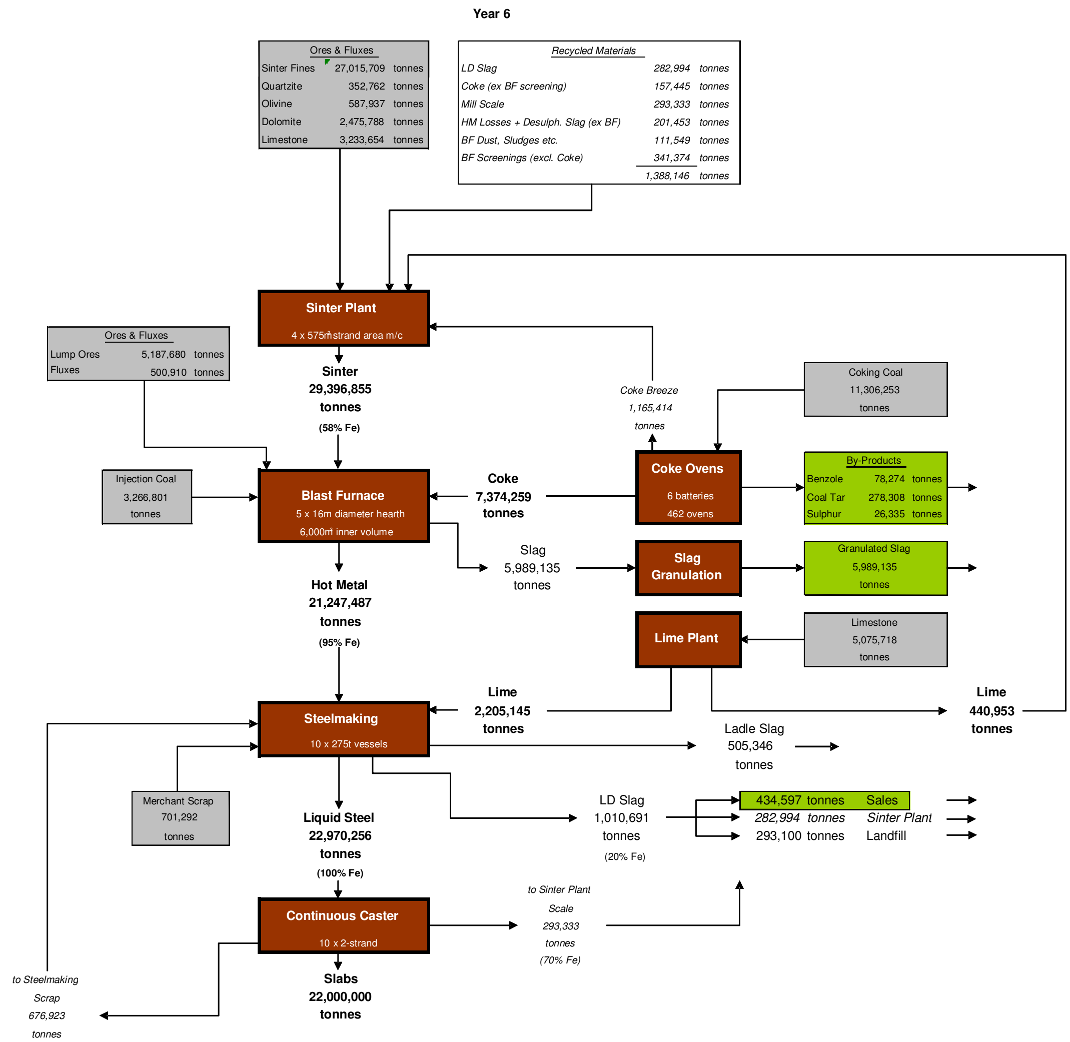

This case shows the added effect of cheaper Chinese manufacture together with scale on the breakeven slab cost. The cost of $475.89/tonne is only $3.35/tonne more than the Korean base case.

## 12.7 CASE 3 - 22 MTPA PLANT - ABBOT POINT, QLD, AUS

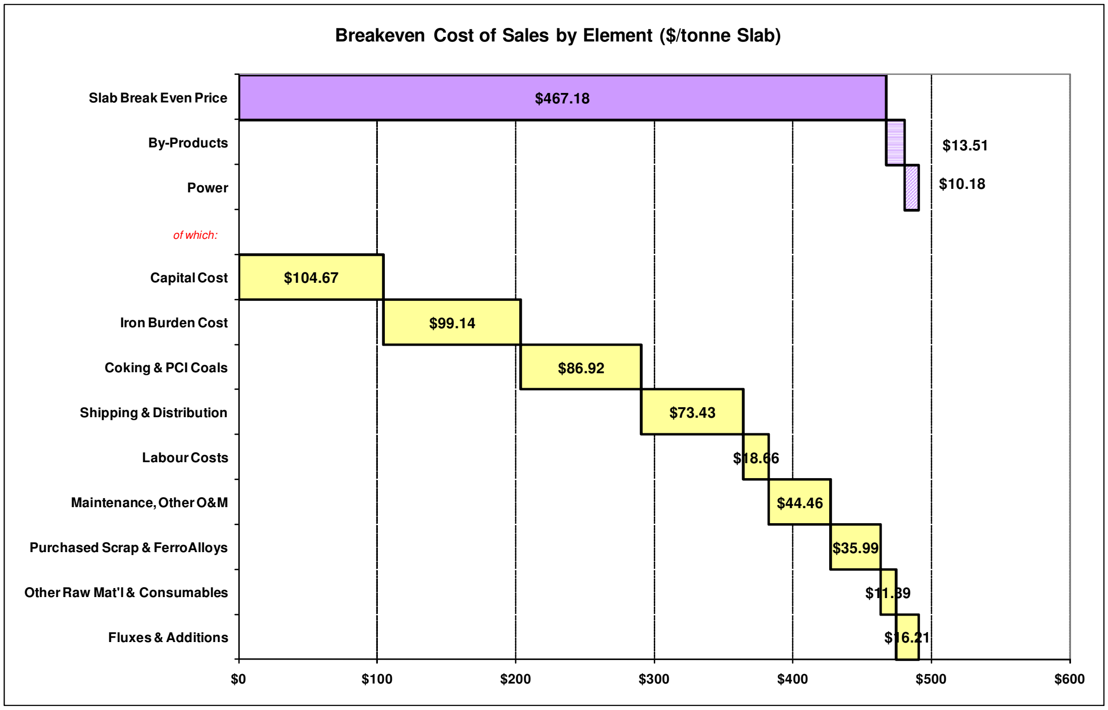
For this case, the material flowsheet is shown below.

## Flow Sheet (Materials)

**PROJECT IRON BOOMERANG - east west line parks pty ltd.**
**Case 3 - 22m tpy Slab Plant - Abbot Point Smelter Park, QLD**



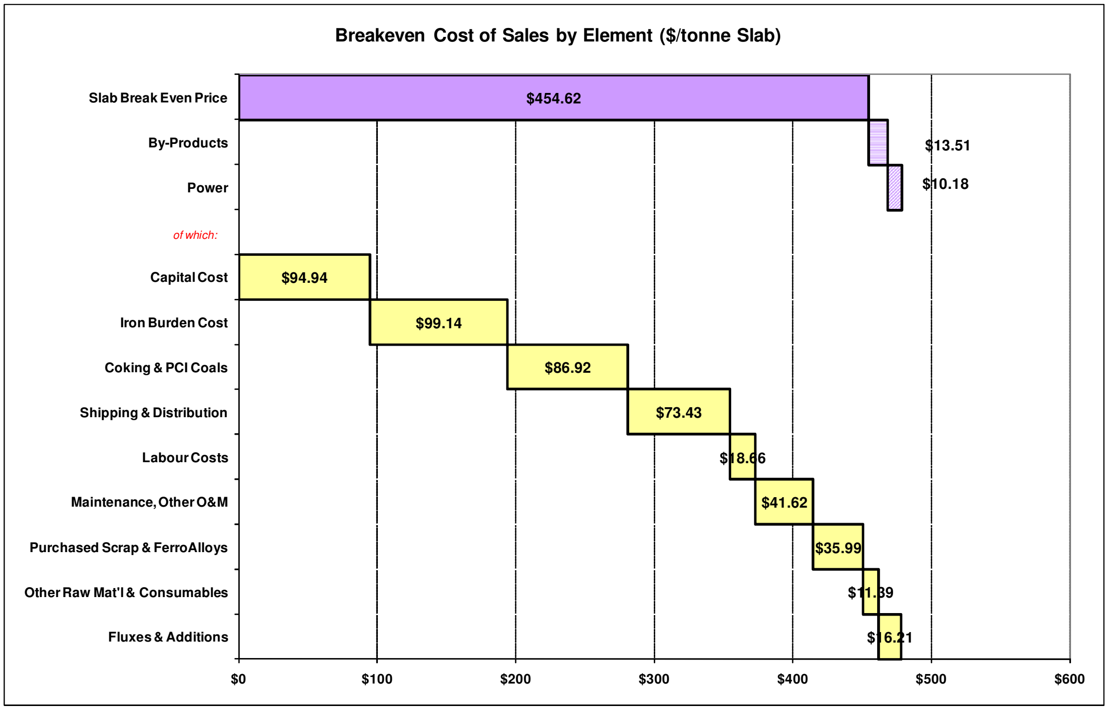

The slab breakdown cost for this the developed case with western supply is shown below.




The breakeven cost of this case of $467.28 is $5.26/tonne cheaper than the Korean base case.

## 12.8 CASE 3A - 22 MTPA PLANT - ABBOT POINT – CHINESE MANUFACTURE

The breakeven cost for this case is shown below.




This case shows that the addition of scale and Chinese manufacture, the breakeven slab cost can be reduced to some $454.62/tonne which is some $17.92/tonne less than the Korean base case.

## 13. CONCLUSIONS

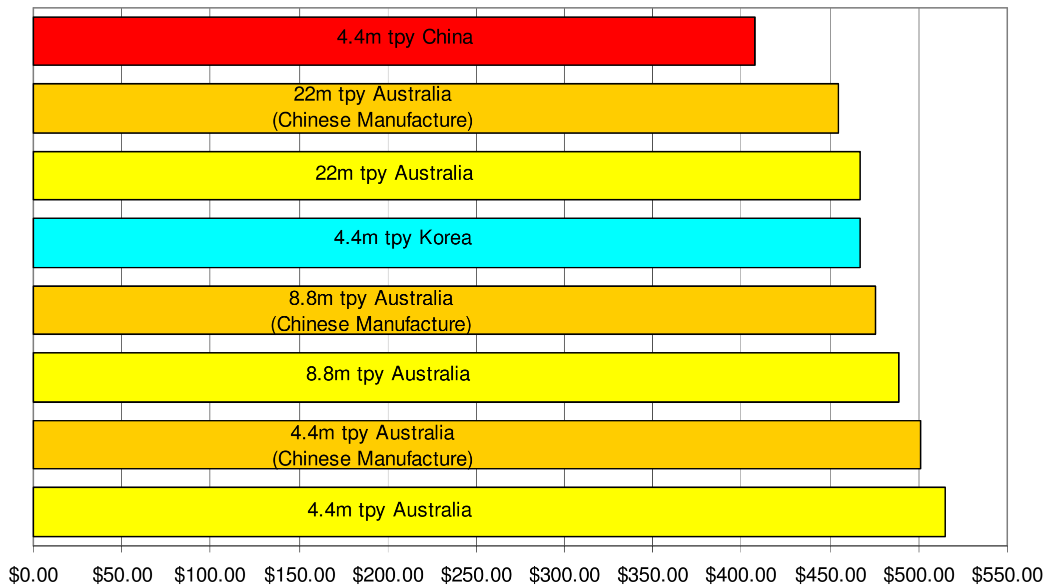
This report has reviewed a number of pre-feasibility options for the development of primary slab production in Australia and compared the production cost against a base case of a new 4.4MTPA slab making facility located in Korea.

The main findings of the report are as follows:

- Based on the developed case in Australia (22MTPA plant in QLD.) the estimated cost per tonne is some $17.92/tonne of slab cheaper in terms of delivered slab FOB Korea compared with a 4.4MTPA slab plant located in Korea.
- The scale of the fully developed case provides the opportunity for the export of substantial quantities of surplus energy to the surrounding economy. There are various options (considered in section 7 of this report) to utilise the estimated 4.6GJ/tonne surplus of energy in the form of blast furnace, coke oven and BOS gas.
- Energy consumption of the facility is estimated to be approximately 16GJ/tonne of slab, which is the order of 15-20% better than typical world practice.
- A further benefit of the scale of the developed case is that it should allow PIB to approach "world's best" productivity benchmarks for slab production, TSC estimates a productivity figure of 0.25 manhours/tonne of slab produced will be achieved compared to a typical world figure of around 0.5 manhours/tonne.
- There will be substantial savings of green house gas (GHG) emissions mainly due to the supply chain consolidation by only shipping finished slab outside Australia, rather than shipping iron making raw materials (coal and iron ore) as is currently the case. In volume terms this represents a saving of over 50% in the quantities of materials shipped.
- Due to the reduced energy consumption of the developed facility there will be significant savings in GHG emissions during the iron and steelmaking process compared to world steel average. As yet this has not been evaluated.
- On the basis that the proposed Steel Producers will co-operate in terms of process routes, significant savings can be made by standardising on the design of the main iron and steel making processing units, this will generate savings in the following areas:
    - Design costs for repeat designs
    - Economies of scale in ordering & scheduling multiple units through procurement and subsequent erection
    - Savings in spares holding due to the commonality of design
    - Savings in project management and execution
    - Manufacture of equipment in low cost markets such as China
    - Savings associated with the above equate to an estimated US$B3.8 for the developed case as opposed to having 5 stand alone facilities in Korea.
- In evaluating the relative cost of shipping ore and coal from Australia to Korea as opposed to moving the ore and coal within Australia and subsequently shipping the slab to Korea, the original savings identified by EWLP in 2007/8 have been eroded due to the collapse of the bulk freight price. This is demonstrated in the shipping and distribution element of the base case being $56.25/tonne of slab verses the developed case being $73.43/tonne of slab.
- Whilst there are substantial savings in productivity levels for the developed scheme compared to the base case and world benchmark levels, due to the relative high level of employment costs in Australia, these benefits are eroded. This shown in the labour cost, $14.79/tonne of slab compared to $18.66/tonne of slab for the developed case. The labour

cost differential also impacts on the capital and maintenance costs of the equipment.

The financial summary of the various options considered in this report is presented in the chart below in terms of breakeven slab cost.




The detailed make up of slab cost is shown in the table below:

| | Slab Breakeven Price | By-Products | Power | | Capital Cost | Iron Brden Cost | Coking & PCI Coals | Shipping & Distribution | Labour | Maintenance, Other O & M | Purchased Scrap & Ferroalloys | Other Raw Materials & Consumables | Fluxes & Additions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.4m tpy China | $416.23 | $13.51 | $10.18 | | $87.28 | $106.56 | $93.90 | $51.98 | $5.51 | $31.09 | $35.99 | $11.39 | $16.21 |
| 22m tpy Australia (Chinese Manufacture) | $454.62 | $13.51 | $10.18 | | $94.94 | $99.14 | $86.92 | $73.43 | $18.66 | $41.62 | $35.99 | $11.39 | $16.21 |
| 22m tpy Australia | $467.18 | $13.51 | $10.18 | | $104.67 | $99.14 | $86.92 | $73.43 | $18.66 | $44.46 | $35.99 | $11.39 | $16.21 |
| 4.4m tpy Korea | $472.54 | $13.51 | $10.18 | | $121.62 | $106.56 | $93.90 | $56.25 | $14.79 | $39.51 | $35.99 | $11.39 | $16.21 |
| 8.8m tpy Australia (Chinese Manufacture) | $475.89 | $13.51 | $10.18 | | $104.33 | $99.14 | $86.92 | $73.43 | $28.48 | $43.68 | $35.99 | $11.39 | $16.21 |
| 8.8m tpy Australia | $488.77 | $13.51 | $10.18 | | $114.33 | $99.14 | $86.92 | $73.43 | $28.48 | $46.56 | $35.99 | $11.39 | $16.21 |
| 4.4m tpy Australia (Chinese Manufacture) | $501.24 | $13.51 | $10.18 | | $116.98 | $99.14 | $86.92 | $73.43 | $38.78 | $46.09 | $35.99 | $11.39 | $16.21 |
| 4.4m tpy Australia | $514.80 | $13.51 | $10.18 | | $127.54 | $99.14 | $86.92 | $73.43 | $38.78 | $49.09 | $35.99 | $11.39 | $16.21 |

## 14. RECOMMENDATIONS FOR FURTHER WORK

In developing and evaluating this project the following further study work is recommended.

- Explore means to increase the OPEX differential between the PIB case and the base case. This might include raw material costs, labour costs, detailed exploration with suppliers of savings in capital costs as scale increases, cost of rail transportation(for example use of additional freight other than ore and coal on the E-W rail line),etc
- Gain a more detailed appreciation of the iron ore and coal chemistries available to this project and evaluate their impact on the blend and production cost of slab, particularly with regard to the magnetite ores that may be available from mines along the proposed E-W rail line.
- Gain a greater understanding of the proposed Steel Producers product mix to further develop the steel complex operational configuration with particular regard to the steel plant layout and logistics.
- This developed facility will "extend the envelope" in terms of the scale of the main processing units. There are currently very few equipment manufacturers with references producing plants of this size it would therefore be prudent to develop high level facility specifications and approach the technological equipment designers and manufacturers to gain latest budget information on operating and capital cost of equipment taking into account economies of scale, Chinese manufacture etc. Once this is established review the impact on the cost estimates produced to date.
- Investigate further the logistical flow of material from the steel complex to the port and subsequent loading onto the proposed "roll-on-roll-off" facility and the impact on slab cost.
- Look at further shipping options in terms of long term Charter or buying the necessary cargo vessels. In particular reviewing further the effects of the roll-on roll off slab vessel on shipping costs
- Investigate further the effect of green house gas emissions, not just from a transport viewpoint but to include the potential emission savings from the developed facility due to the much improved energy efficiency of this project compared to world steel average.
- Start to develop equivalent proposals for the Newman steel complex in WA, taking into account the particular differences in logistics with regard to slab transfer to the port.

# Appendix 11


PROJECT
IRON BOOMERANG
east west line parks limited

# Project Iron Boomerang

Rail Corridor Identification Pre-feasibility Study

**EAST WEST LINE PARKS PTY LTD**

**“The Australian East-West Line & Global Smelting Parks Project”**

Submitted to: 30 March 2007

Shane Condon
EWLP Pty Ltd
Brisbane, Australia

Ref No: 00941

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# 1.0 EXECUTIVE SUMMARY

The Iron Boomerang Project is East-West Line Parks P/L (EWLP) vision for a trans-continental railway linking the Central Queensland coal fields with the Pilbara iron ore region in Western Australia. Iron ore smelting plants at both ends of the railway will provide pig iron and/or steel for export from Queensland and Western Australia.

The objective of this pre-feasibility investigation into the rail line is to conduct a wide area search for potential corridors and to identify macro level land use constraints and opportunities. In assessing alternative feasible corridors, comparative construction cost estimates were also made.

The investigation was carried out using the Quantm corridor identification and alignment optimisation system. The use of this sophisticated technology allowed a much higher level of information to be generated at this pre-feasibility stage than would have been possible if a conventional approach had been adopted.

The project database was assembled from publicly available digital terrain models, land use and topographic information. EWLP provided unit construction costs and the operational requirements of the rail line, including maximum grade limits and minimum horizontal and vertical curve values.

EWLP stipulated that the Queensland end of the railway (start point) be located near Moranbah, with EWLP to use the existing Newlands system and proposed extension of this line to North Goonyella (the Northern Missing Link). In Western Australia the railway was to end (finish point) adjacent to Poonda Siding, located approximately 50km north of Newman on the existing Mt Newman – Port Hedland railway.

Significant waypoints for the corridors were also identified and included proposed crew change depot locations near Kynuna in Central Queensland, and near Ti Tree in the Northern Territory. An intermediate crew change depot in Western Australia was likely to be remote from any established settlement.

Based on this set of data, the Quantm system was utilised to generate up to 50 alignments in each 200km section of the study area between the start and finish points of the rail line. Sorting the alignments in order of construction cost identified the generally lower cost corridors. The topographical maps overlaid on the corridors and terrain facilitated the identification of potential issues that will need to be investigated in more detail in subsequent studies. Features of note within the identified corridors included:

- several major non-perennial river crossings,
- proximity to National Parks and mining leases,
- the need to secure access for the corridor to cross several areas that are under Aboriginal ownership/control, and
- located the approximate position of crossing points on existing rail and road infrastructure, and location relative to existing settlements.

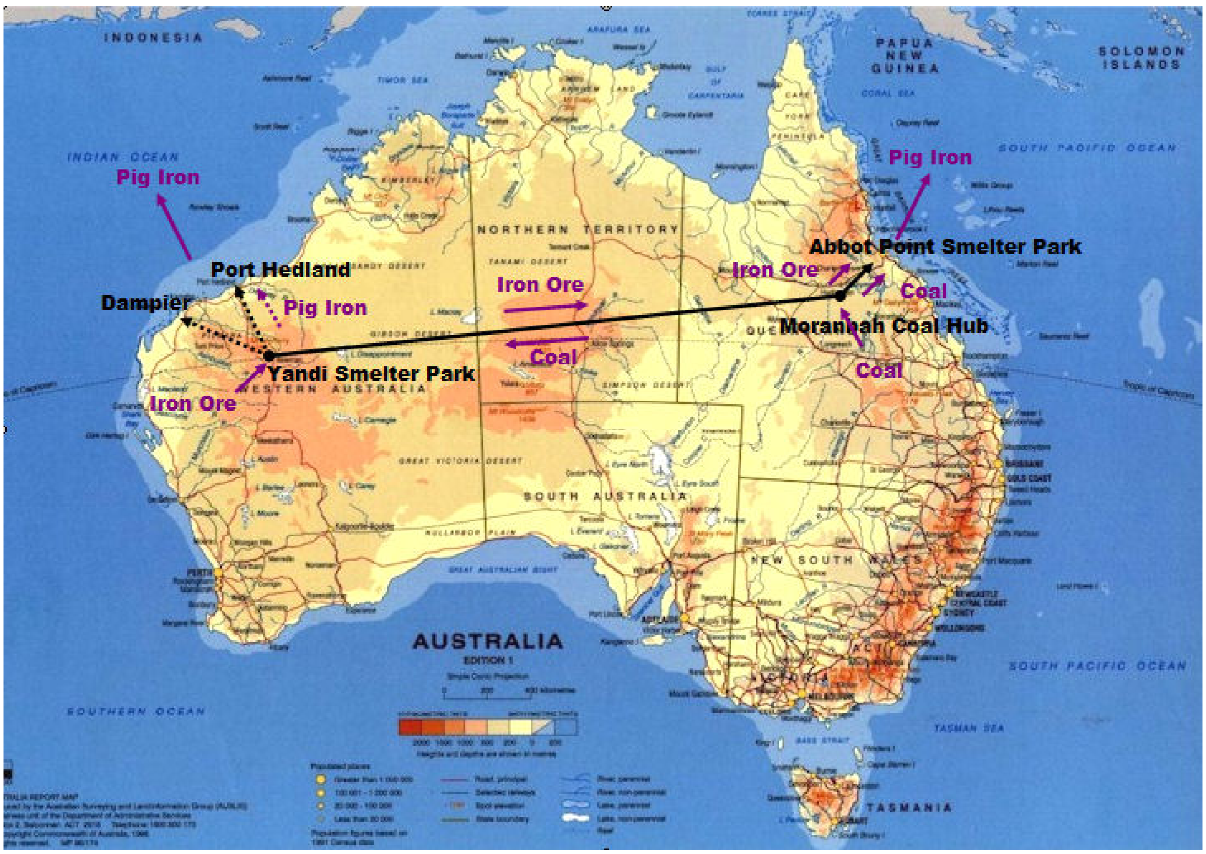
The investigation showed that the straight line distance between the East and West start/finish points was some 2,900km. With the initially targeted maximum gradient restricted to 0.5%, the lowest cost corridor that complied with this limit was 3,120 kms at an overall construction cost at 2006 prices of approximately $6.5 billion AUD.

The information in this report forms the foundation for subsequent, more detailed studies that would assess further the relative merits of the alternative corridors, develop optimum alignments within those corridors and to provide a higher level of certainty of cost outcomes.

## 2.0 BACKGROUND

The Project Iron Boomerang (PIB) concept is to construct and operate a heavy haul railway from coast to coast across the Australia continent near the Tropic of Capricorn. The line will travel from the North Queensland port of Abbot Point, through the coalfields of Central Queensland and extend to the iron ore region in the Pilbara, Western Australia where it will link into the existing iron ore railways to the Western Australia port of Port Hedland.

The East West Line railway (EWL) will be standard gauge, built to contemporary Pilbara iron ore railway standards, and linking to the existing and planned rail lines and iron ore mines in the Pilbara, and to proposed steel smelter parks at each end of the line. The EWL will link with the existing narrow gauge coal network in the Bowen Basin, accessing the existing and future coal mines in that region, via a transhipping facility near Riverside Mine (the Moranbah Coal Hub). The EWL will also be connected to the Adelaide to Darwin railway.




*(Fig 2.a) Proposed Project Route, Smelter Parks and Movements of Mine Haul Materials.*

The EWL will carry iron ore or coal in either direction to iron ore smelting plants located near Newman in Western Australia, and at Abbot Point. The coal hub near Moranbah will transfer coal from the narrow gauge network in Central Queensland for back-loading on trains heading to the west. Smelters will be located near the mine sites or ports, and will produce pig iron or steel, primarily for export. The EWL trains, running predominantly loaded in both directions, underpins a dramatic improvement in transport efficiency and environmental performance compared with current practices of shipping raw materials offshore for processing.

EWLP Pty Ltd has retained Quantm Pty Ltd to carry out the initial corridor identification and alignment development using Quantm's specialised software, which is an innovative and unique system for transport infrastructure optimisation. This Report describes the outcomes of this initial study and will form the basis for undertaking subsequent detailed feasibility work.

# 3.0 OBJECTIVES

The primary objective of this work is to demonstrate that a comprehensive search for favourable corridors has been made and to provide confirmation that there are a range of corridors where alignments are compatible with macro land use constraints and railway operational and engineering requirements.

Identified corridors will highlight the main land use considerations and flag potential opportunities and issues that will be addressed at subsequent, more detailed stages. The potential corridors should also be compatible with the geometric requirements of the rail line, i.e. be within maximum gradient and minimum curvature requirements for a heavy haul rail line.

Strategic construction cost comparisons between alternative corridors will also be made to identify least cost corridors that maintain compliance with land use, rail operational and engineering requirements.

It is recognised that at this pre-feasibility desk top study stage that many unknowns have been left out, particularly in regards to detailed topography, site specific geology, hydrology and flood impacts and localised land use. So as not to unduly skew the study results to one alignment or another on assumed data, the cost impacts of these items will be considered in the comparative cost, and an allowance made in the general contingencies for railway capital costs. This method is to give confidence that a railway which meets the required heavy haul gauge horizontal and vertical alignment criteria can be achieved within the overall route.

# 4.0 PROJECT AND RAIL OPERATIONAL CRITERIA

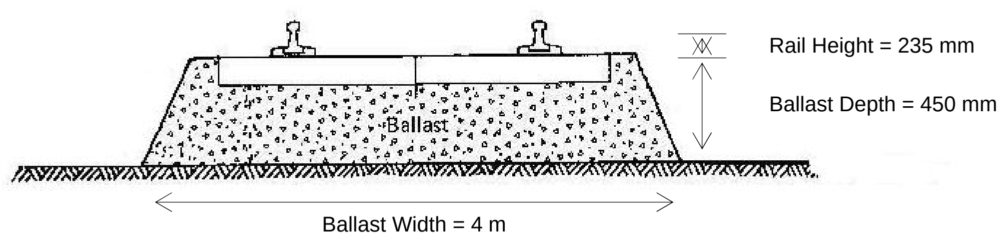
## 4.1 Specific Rail Requirements

### 4.1.1 Grades

Rail operational criteria used within the Quantm analysis was to account for the heaviest of haul requirements, this being the movement of iron ore eastwards from the Pilbara to the smelter parks in Queensland. Although slightly steeper grades heading westwards for coal / coke loading could be accommodated due to the different product density and volumes needed, EWLP decided that a maximum design grade of 1 in 200 (i.e. 0.5%) would account sufficiently for fully loaded diesel-electric locomotives moving in either directions for this initial stage evaluation.

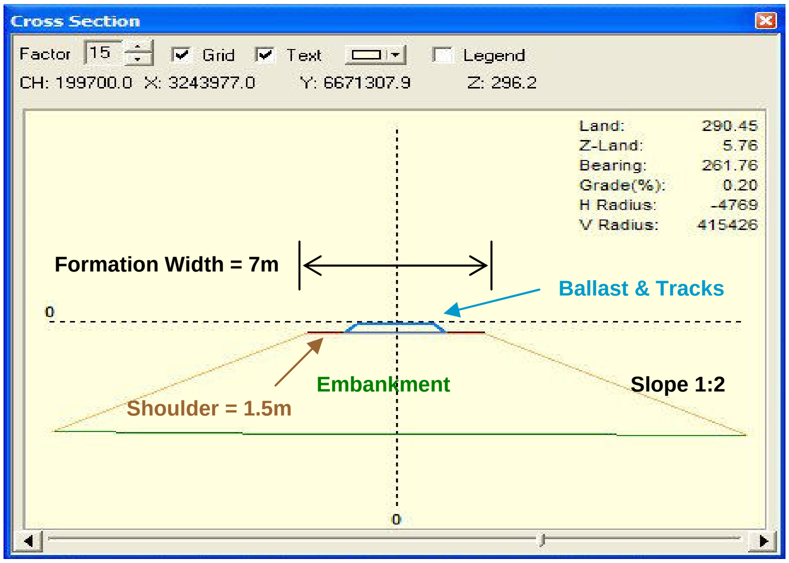
### 4.1.2 Standard Heavy Gauge & Cross Section

Rail alignment design was based on the standard heavy gauge system (1,435 mm). Ballast depth was specified as 450mm from top of sleeper, with a total depth of rail structure to sub-ballast of 685mm.




*(Fig 4.a) Rail & Ballast Specifications.*

The formation width of the rail corridor was 7m in both cut and fill, which included a 4m width for ballast and 1.5m shoulders. Although not included in the determination of alignments for this analysis, an overall corridor width of 50metres to include for an access track along the corridor was assumed.




*(Fig 4.b) Rail Corridor Cross Section.*

## 4.2 General Project Requirements

### 4.2.1 Start / Finish Points

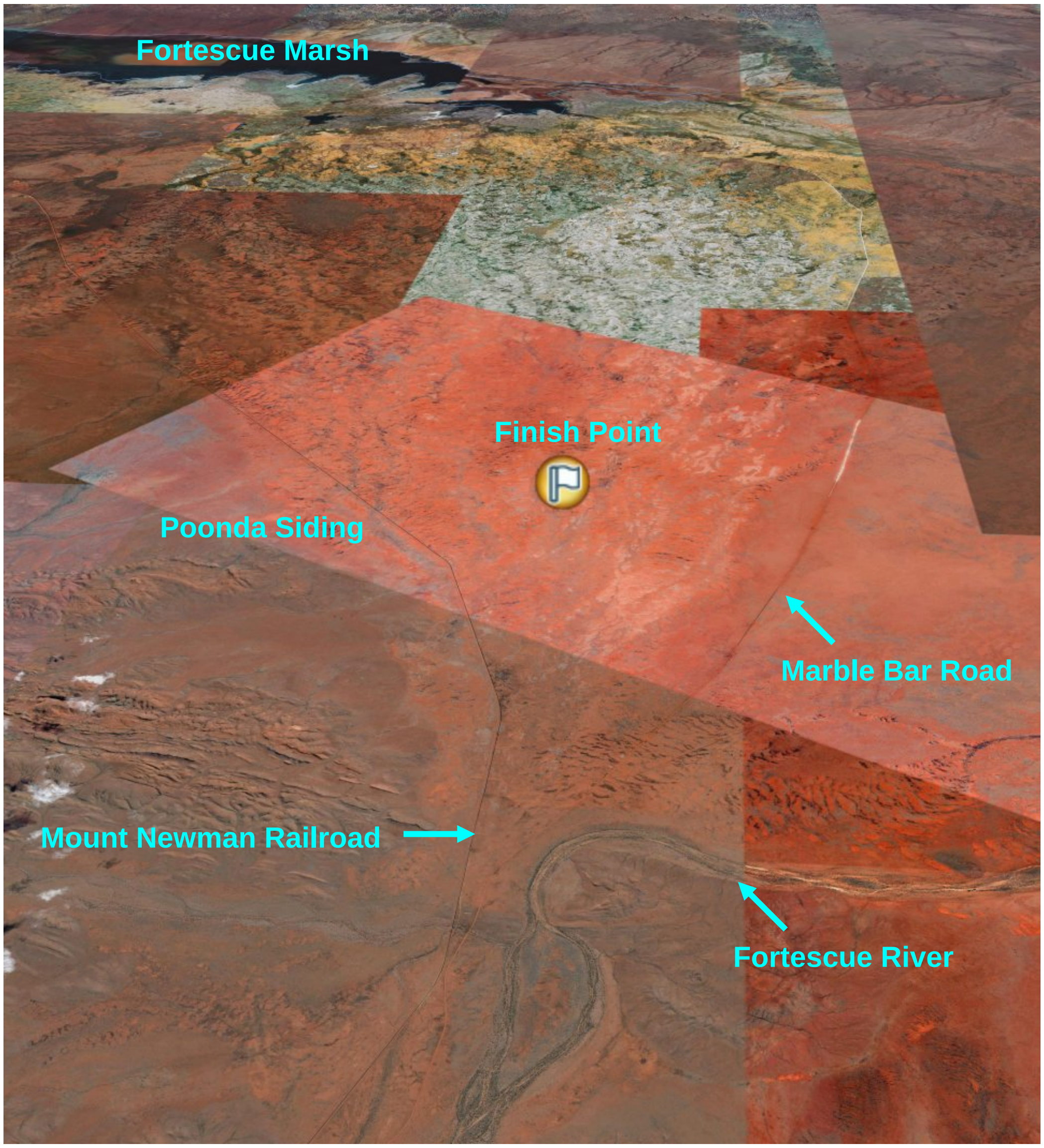
EWLP stipulated the following start, finish and way points for the rail corridor.

**Start Poin**t: Immediately West of the Goonyalla Riverside Mine, which is located approximately 30km north of Moranbah and 180km west of Mackay in Central Queensland.

.


*(Fig 4.c) Rail Corridor Start Point: West of Goonyalla Riverside Mine, Qld.*

**Finish Point:** East of Poonda Siding located at the 334km point on the existing Mt Newman Railway, approximately 50km north of Newman, in the Fortescue River Valley, Pilbara, Western Australia.




*(Fig 4.d) Rail Corridor Finish Point: East of Poonda Siding, Pilbara, WA.*

### 4.2.2 Tie in Points with Existing Mine Haul Infrastructure

At the Queensland end, the Initial Smelter Park is proposed to be located adjacent to the existing export coal terminal at Abbot Point (near Bowen). The EWL is proposed to be co-located with the existing narrow gauge Newlands Line and along the proposed extension of this line to North Goonyella (the Northern Missing Link), which will be owned and operated by Queensland Rail (QR). The feasibility of constructing this section of railway has been carefully studied and established by Queensland Rail. This existing rail corridor will require selective widening to accommodate the EWL and future narrow gauge upgrades, and limited deviations to satisfy EWL grading requirements.  For this level of analysis, no Quantm work was required on this section.

A narrow gauge electrified spur-line will be built to connect the existing QR Goonyella network near Riverside, to a transfer facility (the Moranbah Hub) for the transhipping of coal onto EWL trains for delivery to the WA smelters. Coal for the smelters at Abbot Point will be delivered via the QR narrow gauge network.

Similarly, at the Western Australian end the proposal for a smelter park east of the Poonda siding on the existing Mount Newman railway line will facilitate a means of rail connections with the Hammersley and Mt Newman systems (and possibly other new systems) to allow the transportation of the product to an export port (currently Port Hedland). It is believed that BHP Billiton will share the use of their existing Newman line with EWLP as the PIB will complement the marketing of iron ore from their existing mines.

#### 4.2.3 Waypoints

EWLP require a number of waypoints along the rail corridor to serve as refuelling stations, maintenance depots, crew change over points, etc. If possible, these waypoints should be within close proximity to existing settlements where EWLP workers will reside and integrate into these communities, but far enough away that any adverse impact on the nearby community such as rail operating noise would be minimised.

Possible way-points suggested by EWLP included; Winton and Kynuna in Queensland, Ti-Tree in the Northern Territory, which is located approximately 185km North of Alice Springs, and a third location halfway between Ti-Tree and the Pilbara.

# 5.0 METHODOLOGY

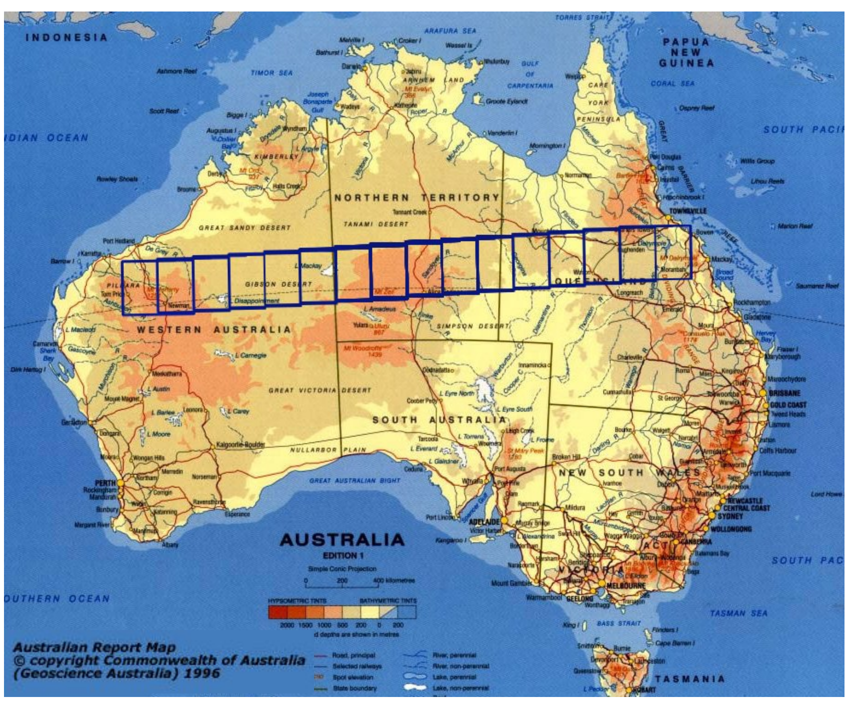
## 5.1 Quantm System

The Quantm system for corridor identification and alignment optimisation was the technology utilised to generate the results. This system identifies viable corridors and optimises alignments for rail carriageways. The system can take into consideration the land use constraints, unit construction costs [eg rails, sleepers, ballast, earthworks and structures], design geometry for the rail, existing linear features [eg roads, rail lines and rivers], and generates sets of alignments that comply with the criteria and are of lowest cost. The system is very fast at generating alignments compared to conventional methods, which allows a comprehensive search for corridor opportunities to be made and facilitates rapid sensitivity analysis of key parameters.

Quickly re-optimising alignments as new constraints emerge during investigations, stakeholder consultations or geotechnical studies can also significantly reduce planning times. The Quantm system is a great tool within the community consultation process in that it provides a transparent alignment selection methodology and an electronic audit trail of alignment development decisions. The Quantm System also provides a high level of confidence that an alignment which meets the engineering criteria can be achieved over the entire length.

## 5.2 Methodology Description

Total length of the rail line is in the order of 3,000km and to obtain the level of accuracy and detail required to meet the objectives, the rail study area was broken into 15 sections. Each of approximately 400km, made up of a 200km section plus a 100km overlap with each adjacent section as shown in the diagram below:




*(Fig 5.a) Rail Corridor Study Area.*

In order to ensure the set of lowest cost overall corridors are identified, the methodology utilised a floating start and finishing points for each section of the overall line. The cheapest corridors were then used as a basis for determining the transfer points between sections. The corridor and sub-corridor alternatives were then spliced together to form composite corridor options for the full 3,000km line.

The sequential steps in this methodology are summarised as follows:

**Step 1:** Data acquisition: Digital terrain data, existing roads and rail, water features, mining leases, ownership maps, topographic maps.

**Step 2:** Compile the geographic information into a single data base using a common projection system.

**Step 3:** Break the study area into 15 x 400 km sections.

**Step 4:** Utilising the Quantm system, generate sets of 50 alignments in the first section to identify corridor options.

**Step 5:** On the adjacent section, generate sets of 50 alignments from each of the corridor end points of the previous section to identify corridor options in the section.

**Step 6:** Continue process until all 15 sections have been processed.

**Step 7:** Compile a composite map of the corridor options across the full length of the rail line.

**Step 8:** Assess each of the corridors and sub-corridors for opportunities and issues relating to land use constraints and surface features.

**Step 9:** Prepare report on results.

**Note:** EWLP provided the engineering requirements, operational requirements, unit construction costs and the definition of constraints that were used in the Quantm system to generate the corridor options and identified the initially preferred corridor options from the Quantm generated alignments.

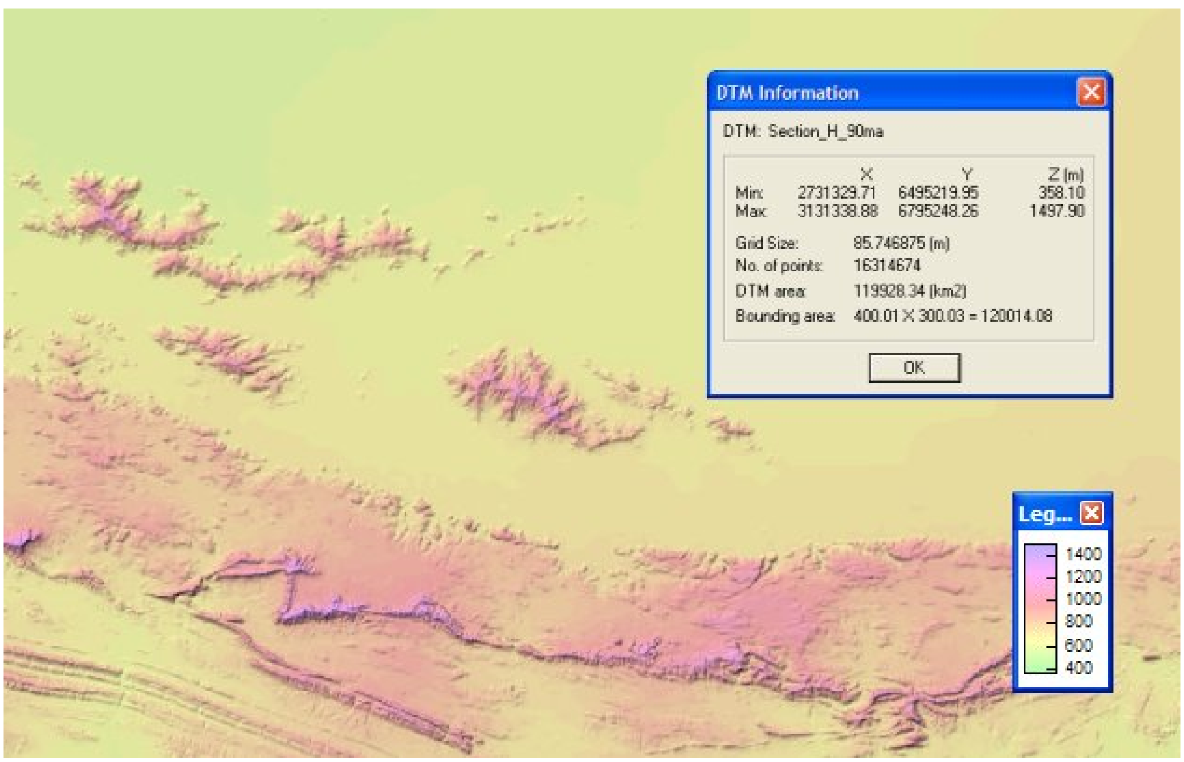
# 6.0 DATA ACQUISITION AND APPLICATION

## 6.1 Projection System

The Quantm system operates using Cartesian (X, Y, Z) co-ordinates and therefore requires a projection system to convert spherical (i.e. latitude, longitude) co-ordinates into Quantm compatible Cartesian co-ordinates. Due to the extreme scale of this project, a custom projection system was created to reduce the distorting effects of the earth's curvature. Since the project is primarily East-West oriented a Mercator projection with origin latitude -22°30'00" and central meridian 134°00'00" was deemed most appropriate. The standard WGS84 spheroid was used along with a 3,000,000m false Easting and 9,000,000m false Northing.

## 6.2 Terrain Data

Digital terrain data was acquired from the U.S. Geological Survey EROS Data Centre. This 3 arc second SRTM (Shuttle Radar Topography Mission) data was projected then converted into Quantm format. Once projected the final Quantm DTM (Digital Terrain Model) had a resolution of approximately 86m.



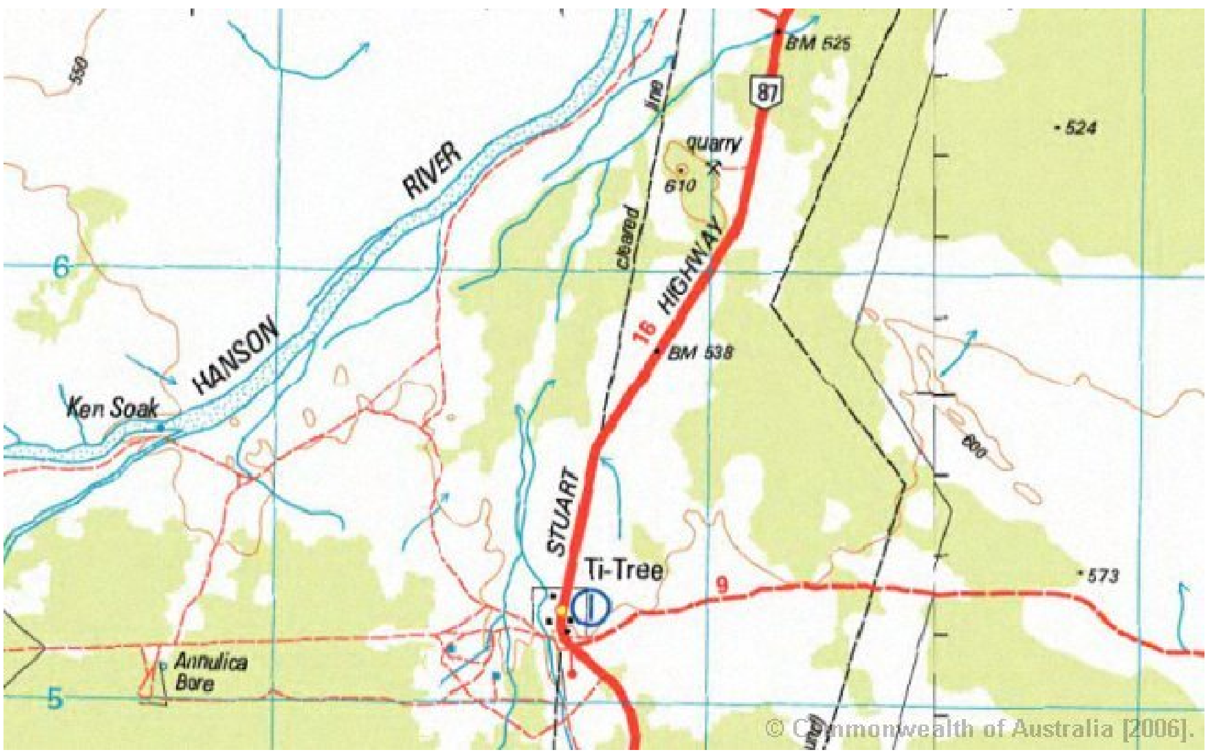

*(Fig 6.a) Sample Image of Quantm 3D Digital Terrain Model.*

## 6.3 Topographic Data

Topological maps obtained from the Australian Government's Geoscience Australia Website were used within Quantm to provide a seamless coverage of digital topological data across the entire study area. The maps form part of the GEODATA TOPO 250k 3rd Series and exist at a 1:250,000 scale resolution - i.e. 1cm on a map represents 2.5 km on the ground.

The series of maps were acquired in Enhanced Compressed Wavelet (ECW) format and then projected into the project coordinate system to align them within the project database. The drawings provide a vector representation of features on the earths surface and include natural and constructed features such as, but not limited to; existing road and rail infrastructure, land use areas, hydrography, vegetation, terrain, elevation, utilities and environmental boundaries.

The information gained by loading these maps within Quantm Integrator as a background image enabled more informed decisions on the appropriateness of corridor options, whilst ensuring their potential impact on communities and critical infrastructure would be noted and included in future analysis.

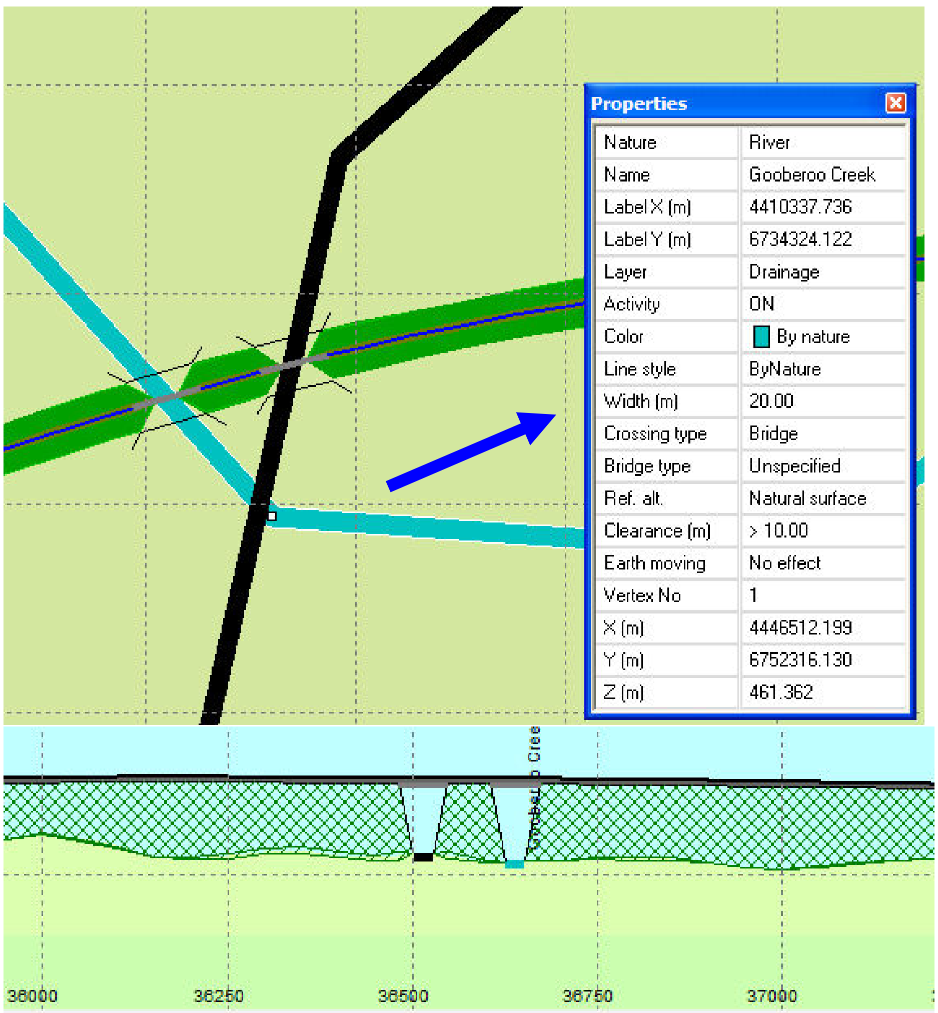



*(Fig 6.b) Sample Image of Topological Map.*

## 6.4 Roads, Rail, Water Courses

Existing road and rail infrastructure, together with water management areas, lakes and perennial/non-perennial drainage basins were acquired in digital format from Geoscience Australia. Although these were not included within this first stage of Quantm analysis and therefore did not actively influence the location of corridors, their influence on possible corridor options and the required structure crossings was noted for future consideration.

At this stage no hydrology studies have been carried out, nor have the necessary alignment adjustments and extra culvert or bridge structures across flood plains been considered. A key study requirement for the feasibility stage will be the determination of the required heights for crossing these flood plains.

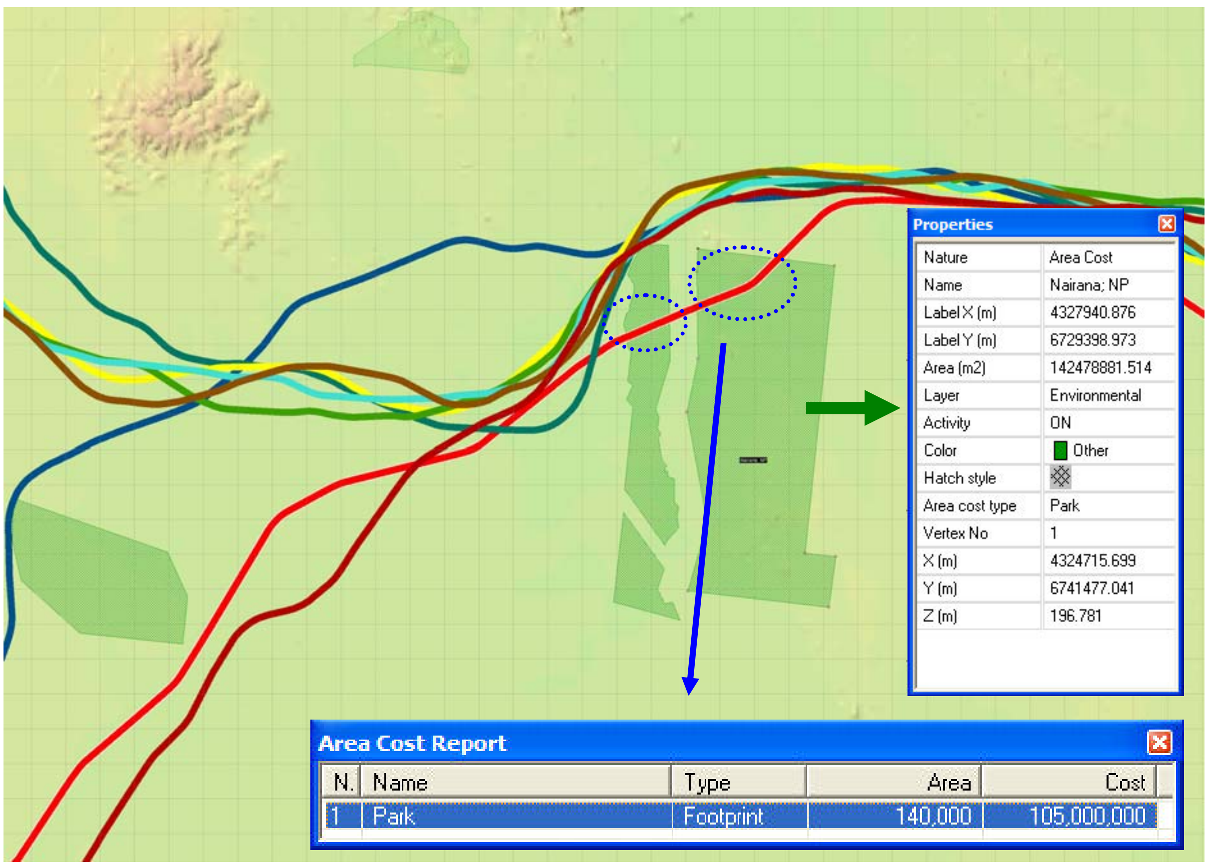



*(Fig 6.c) Using Quantm to Constrain River & Highway features with Structure Crossings.*

## 6.5 Land Usage / Environmental

Land-use and environmental data was assembled from Geoscience Australia and other state agencies which included populated places, utilities, national and state parks, crown lands and indigenous reserves. These constraints were not included within the system at this stage of the analysis. However, their influence on possible corridor options and the required structure crossings was noted for future consideration.

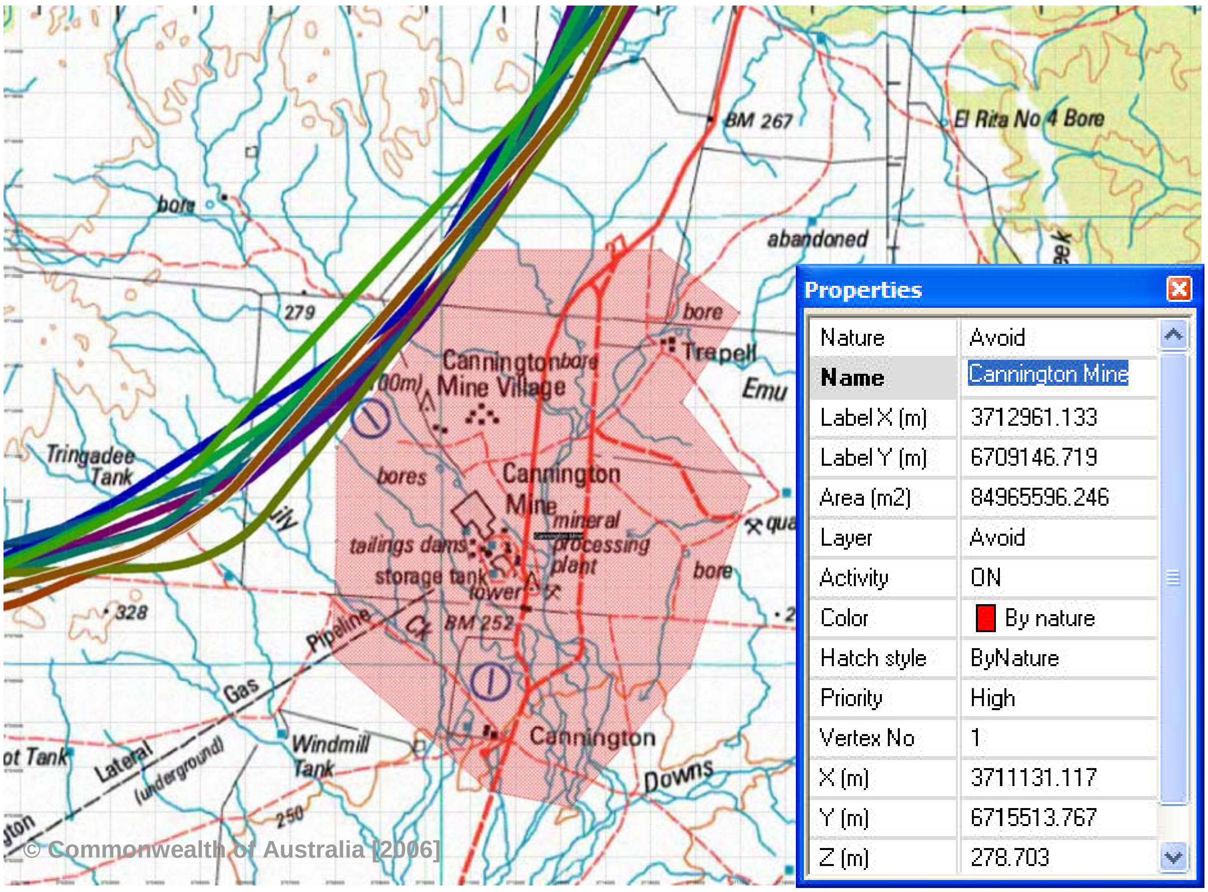
The following is an example that illustrates how these constraints could be included in future Quantm analysis to minimise their impact on sensitive environmental and land-use areas. The alignment marked in RED passes through the Nariana National Park. To minimise the impact on the National Park, but retain the low costs associated with this alignment, the alignment was "seeded" back into the Quantm system with the National Park attributed with a land acquisition cost. The resultant refined alignment options [shown in other colours] complied with this new constraint at a minimal or no extra cost.




*(Fig 6.d) Using Quantm to define Areas of Land Acquisition such as Nairana National Park, Queensland.*

## 6.6 Mineral Exploration Leases

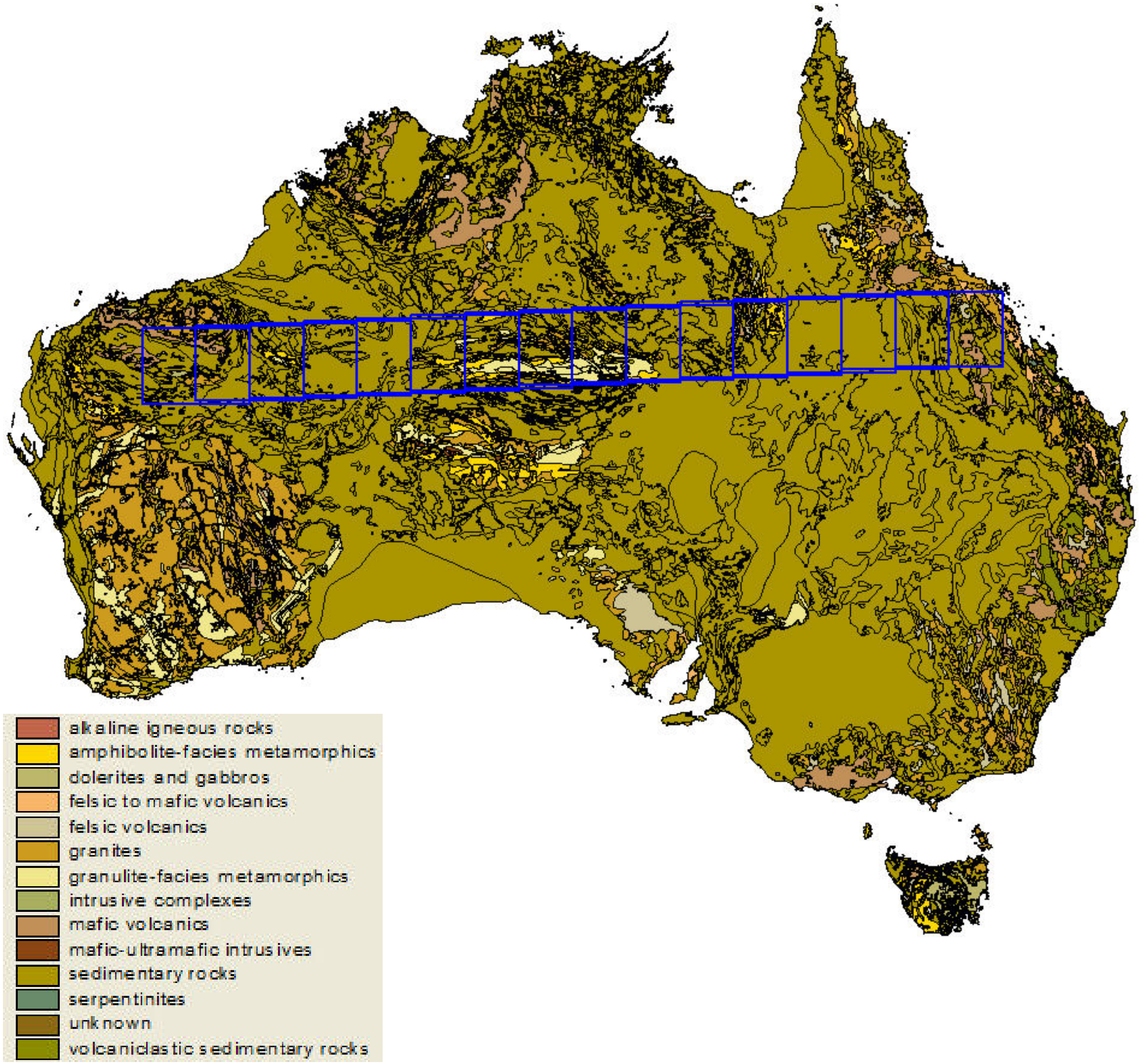
Current and proposed mining leases, exploration permits and licenses were sourced from the Queensland Government Department of Mines and Energy; Northern Territory Department of Primary Industry, Fisheries and Mines; and Western Australian Department of Industry and Resources. The datasets consisting of spatial information featuring boundary and attributes for the mining areas, where not constrained within Quantm and instead used to isolate areas that required further consideration in future studies.




*(Fig 6.e) Defining existing Mining leases such as Cannington Mine, Queensland to avoidance will result in the system generating all alignments around these sensitive areas.*

## 6.7 Geology

Data defining various geological regions was sourced, however due to the preliminary nature of this study was not utilized. It was noted that the real geological cost influence on the rail alignment would be site specific, and for this stage the geology could only be used to determine major obstacles as opposed to actual costs influences. Further fieldwork will be necessary to determine the relative properties of these different geological formations. For the purposes of this study a single default geology was used across the entire study area.




*(Fig 6.f) Varying Geological Formations across Study Area.*

## 6.8 Data Application

During this Pre-feasibility work, the primary data set that was used to generate corridor alternatives was the digital terrain model, rail geometric requirements and unit construction costs. The data sets pertaining to land use land ownership, roads, water courses, geology and mining leases etc were not used to influence the location of the corridors during this stage of the investigation. At this stage, these data sets were however used to note and highlight specific issues, opportunities and constraints that will be addressed in subsequent work.

# 7.0 MAJOR ASSUMPTIONS AND UNCERTAINTIES

## 7.1 Cost Estimates

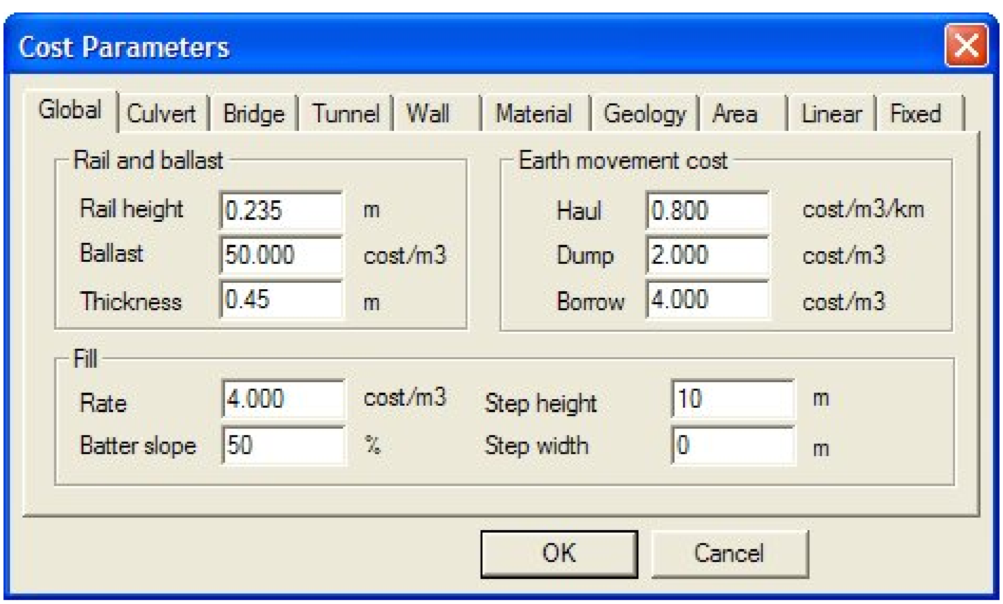
### 7.1.1 Global costs

Global costs are those that are applied over the entire study area and do not vary locally. A linear cost of $750/m was used throughout the study to cover track materials supply and track laying costs.

Other global cost rates include:

- Fill placement: $4.00/m^3$
- Borrow material (import): $4.00/m^3$
- Dump material (export): $2.00/m^3$
- Haulage: $0.80/m^3$/km
- Ballast supply & placement: $50.00/m^3$

For the purpose of this study, and for comparative purposes in alignment selection, it was assumed that unit costs were independent of any variability in materials transport logistics, such as availability of suitable gravel for sub-ballast layer, crushed stone ballast, water for construction and pre-cast materials, which may vary significantly over the corridor length. Any extra costs for construction in remote areas will be accounted for in overheads and special costs at a later stage. All rates are in 2006 dollars and are based on recent historical data only.



*(Fig 7.a) Global costs as utilised within the Quantm system.*

### 7.1.2 Structure costs

The Quantm system required these rates to decide where it was more economical to place a structure rather than constructing very high embankments or generate deep cuttings. Viaduct, tunnel and retaining wall rates were estimated at the following values:

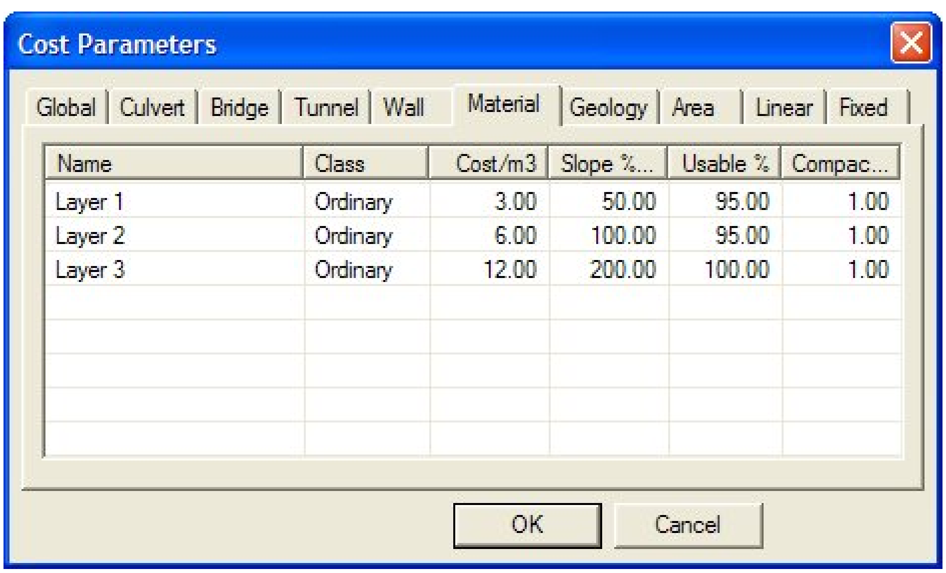
- Bridge (based on plan area): $3,000/m²
- Tunnel (linear cost): $1,000,000/m
- Retaining wall (surface area): $1,500/m²

## 7.2 Geotechnical Requirements

While digital data for geology had been acquired by Quantm, for this level of analysis the structure and properties of geological formations as these may impact on railway design and construction costs, were assumed to be consistent across the entire study area with respect to the global cost rates used to cost the overall capital costs.

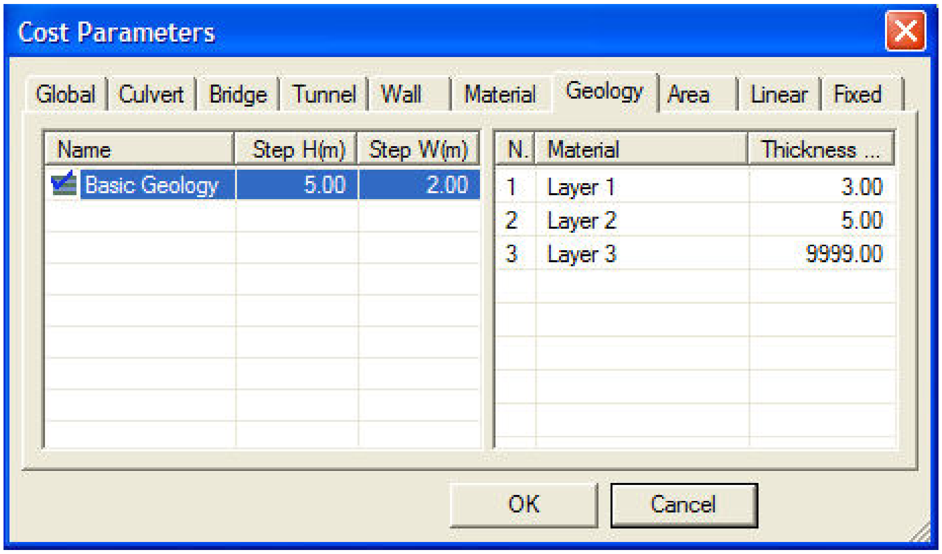
It was noted that to a large extent, the study area was across flat terrain with isolated areas of semi-rough and sandy formations that would require further consideration in future studies.

Three separate layers of material were defined with associated excavation rates, batter slopes, compaction rates, the fraction of usable material that could be used for fill, and the unusable part to be hauled away and discarded as dump. The material costs entered into the system for each material reflected the depth of excavation and material hardness, with an easily worked surface material, overlying harder, more costly material.




*(Fig 7.b) Material structure & properties used within the Quantm system.*

The default geology was based on three horizontal stratums, with the first starting at the natural surface and travelling down to a depth of 3m, second a further 5m deep, and the final stratum being of infinite thickness. Rail corridor cross section would requiring benching every 5m and be stepped 2m across.

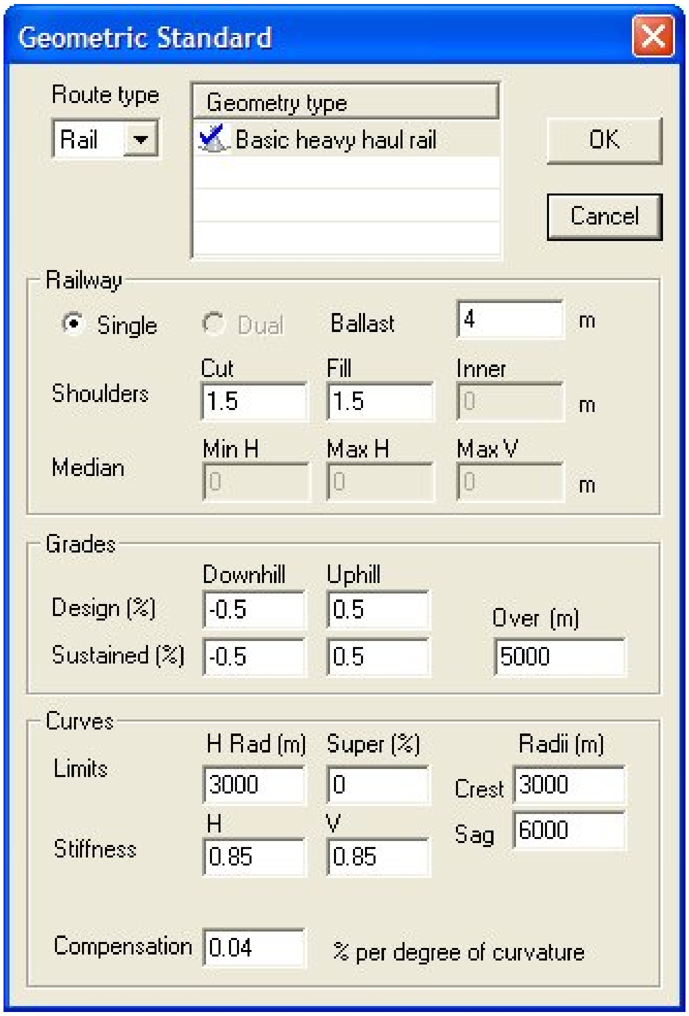



*(Fig 7.c) Geology used within the Quantm system.*

## 7.3 Geometric Criteria

Preliminary estimates of rail engineering parameters for curvature and compensation were selected based on similar heavy haul rail projects. These values were reviewed and confirmed by EWLP in an email to Quantm on 15/12/06. EWLP advised that these criteria are suitable for the heavy haul standard gauge trains to operate at a design speed of 80km/hr.

- Min Horizontal Radius: 3000m
- Min Vertical Radius for Crest: 3000m
- Min Vertical Radius for Sag: 6000m
- Gradient: 0.5%
- Curve Compensation: 0.04%




*(Fig 7.d) Geometric standards used within the Quantm system.*

## 7.4 Earthwork Limits & Mass Haul Considerations

Earthwork limits restricting the maximum height of embankments and maximum depth of cut were not deemed necessary for this first stage of work. This was based on the assumption that the small sections of terrain that were not flat would not generate high/deep escarpments across the landscape and therefore would not effect corridor location on a macro scale.

With the Rail Line broken up into 200km sections it was also assumed that mass haul would be balanced at the end of each section. It was noted however that mass haulage over this distance may be too excessive and a more practical mass haul balance would require the identification of possible natural spots for mass haul barriers, sources of fill or dump sites for spoil.

## 7.5 Sandy Desert Crossings Requirements

There is some uncertainty associated with crossing through Western Australia where the rail corridor will need to negotiate desert crossings through sandy areas such as The Gibson Desert, Great Sandy Deserts and the Little Sandy Desert. This may involve several hundred kilometres of track through or parallel to sand ridges of varying density, reaching heights of 15-20m in some locations.

Such crossings although not given any special attention within this stage of the analysis, will require consideration due to the effects of dune instability, soil erosion and acceleration of wheel and rail wear from drifting sands, if applicable. Mitigation of these effects in future studies using Quantm may come in the form of paralleling ridges, following an existing track where possible (e.g. Talawana Track), employing a flatter more stable cross section, using a wider formation to allow for fabrication and vegetation banks, and minimising the lengths of tracks crossing these desert areas, and further detailed engineering assessment of these areas will be required during the Detailed Feasibility stage.

## 7.6 Dry Creeks and Floodplains

There are numerous perennial/non-perennial river systems, wetlands and lakes located throughout the study area and at this stage their impact on rail corridor location and costs is uncertain. Some of the more major drainage systems that may have some level of impact on the rail corridor include; Wokingham Creek, the upper reaches of the Diamantina, Burke and Georgina Rivers in North West Queensland, together with Lake Mackay, Napperby Creek, Hanson River, Lander and Fortescue Rivers in Western Australia.

Catchment features, water levels, channel and flow patterns, discharge distribution and flood frequency could all have a bearing on the crossing type and clearance required over these systems. Crossing clearance will need to be at levels that ensure the track remains operational during the infrequent but possibly extended periods of inundation. Some may necessitate an expensive bridge made lengthy by the requirement to reach a certain clearance at a fairly low gradient. Others such as dry lakes and floodplains may only require the use of regularly spaced culverts to allow sheet flow to pass underneath, or raising the railroad onto an embankment to meet a minimum height above expected flood levels. There may also be the need to minimize the environmental impact of crossing over the sensitive ecosystems.

## 7.7 Indigenous & Environmental Areas

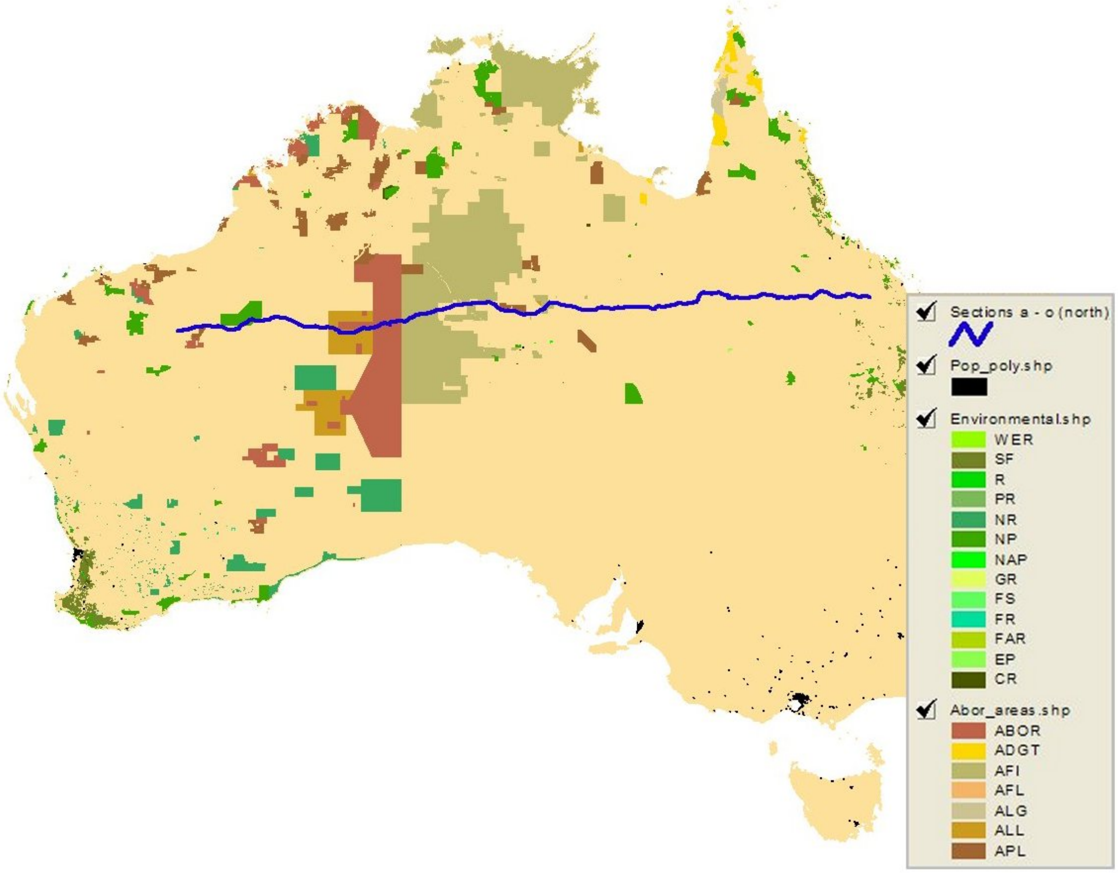
Visualisation of the GIS datasets identified various regions of land which may be affected by the proposed rail route. The two major types of regions, Indigenous and Environmental, will likely require avoidance or land access permitting in order for the railway to pass through them.

Whilst the entire corridor will be subject to need to identify and manage cultural heritage issues, and potentially be subject to Native Title claims from the traditional owners, the rail corridor will need to traverse current Aboriginal controlled lands, such as the Central Australia Aboriginal Reserve and Kiwirrkurra Aboriginal Reserve, both of which lie in Western Australia. There are also a small number of national and state reserves located across the study area including The Rudall River National Park in Western Australia and

Nairana and Bladensburg National Parks in Queensland. The impact of these social / environmental areas on the rail corridor is somewhat uncertain, and will be subject to further investigation, consultation and agreement with the various stakeholders.

There was no data included within this analysis to represent the boundaries of these sensitive constraints, however for future investigations various socially / environmentally sensitive areas can be defined as mitigation costs areas, and then changed to avoidance criteria to determine the engineering cost to protect these sensitive sites.  The system can then demonstrate compliance with these criteria, and therefore demonstrate environmental consideration and avoidance to ensure a better public and environmental outcome.

The map below shows at a macro scale, where indigenous and environmental areas are located in relation to the favoured corridor. These are primarily Aboriginal controlled lands in the Northern Territory and Western Australia.




*(Fig 8.b) Map showing major Indigenous and Environmental areas.*

## 7.8 Cost Relativities

The raw corridor costs generated in this initial round of processing are based on assumed unit cost, terrain and alignment geometric requirements, for selected items used in comparative assessment of the various corridor options. They are a good guide as to the relative construction costs in 2006 dollars of the alternative corridors within the sections evaluated, but do not indicate full rail project costs such as contingences, overheads and profits, nor the impacts of remote areas and differential costs along the extended corridor.

The unit rates exclude the variable impacts of yet-to-be-determined sources of supply and the associated haul distances for major construction inputs such as water, gravel sub-ballast layers and track materials. In addition costs such as project management, detailed design, land acquisition and associated costs, train control, signaling and communications systems, and contingency provisions etc have are not included in the raw construction costs being calculated in Quantm for each of the corridors/alignments generated.

At this stage of the project development, an allowance for the total capital cost of the rail line will be the Quantm raw cost plus approximately 10% construction contingency, $500 million for bridges allowances and 65% for overheads and profit (percentages provided by EWLP). The anticipated capital costs hence total $6.4b. Note that the Quantm model and costing does not include the section from the Riverside stating point to Abbot Point.

During the next more detailed stage of alignment development factors such as:

- Drainage structures
- River crossings (culverts/bridges)
- Minor linear costs (fencing, etc.)
- Grade separated crossings of major highways/railways
- More accurate and detailed geological information and likely sources of ballast and gravel
- Design standards for crossing desert sections
- Avoidance or land mitigation of environmental areas
- Avoidance or land mitigation of other incompatible land-use areas

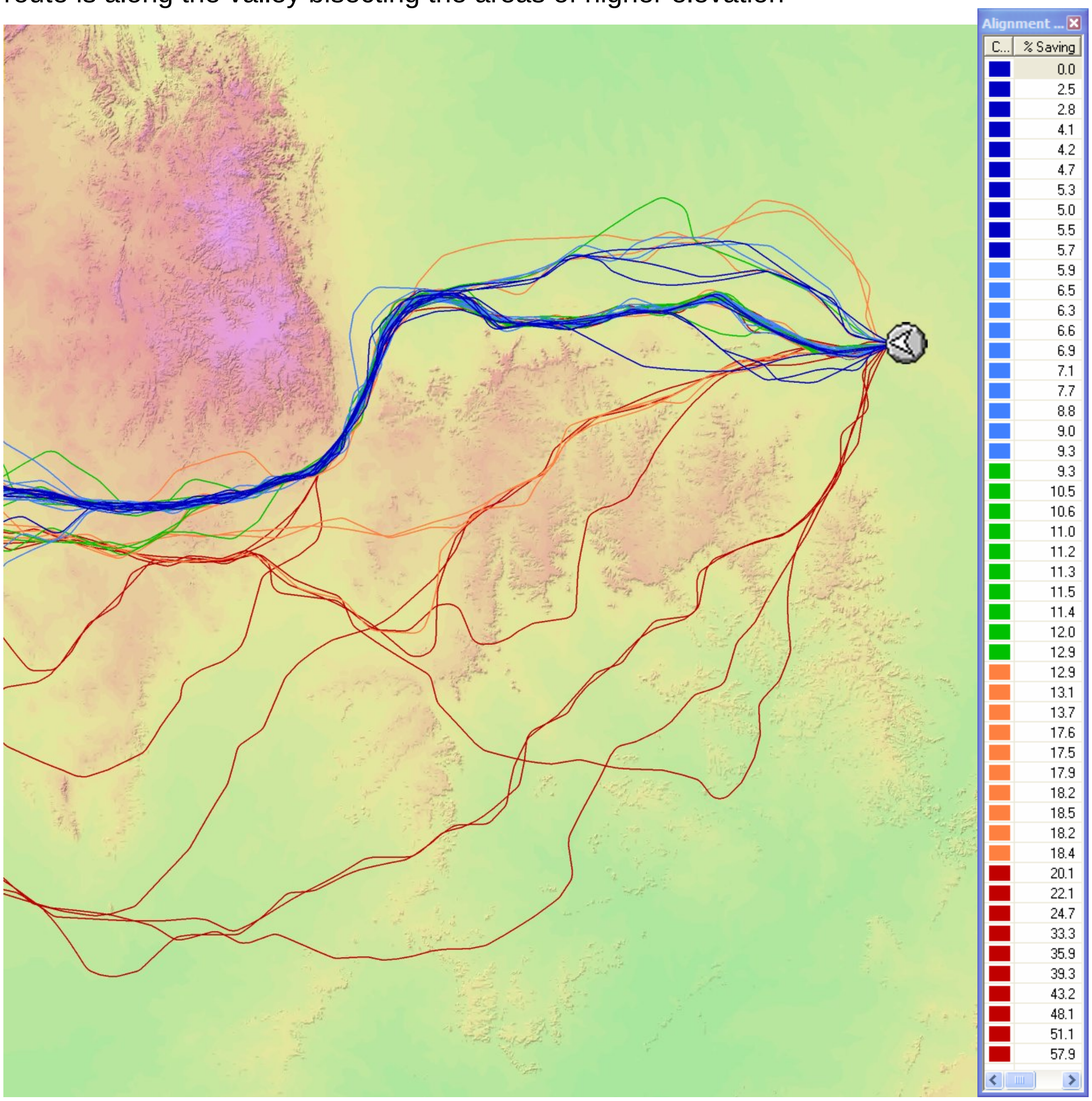
will be assessed individually as to their cost impact, which will increase the certainty and reduce the contingency factor.

# 8.0 CORRIDOR SEARCH

## 8.1 Corridor Search - Full Area

Quantm was used to perform free-to-roam searches across each of the fifteen sections comprising the study area. In free-to-roam mode, the Quantm system searches the whole terrain for low cost alternatives. The output is a range of up to fifty rail alignments spreading across the terrain model. Clumping of alignments indicates a favourable corridor. Colour coding the alignments in order of cost, highlights the lowers cost corridor. Using this functional capability of the Quantm system, provides evidence that the whole of the available area has been searched for viable corridors.

In the example below, which shows a set for results generated in Section D1, the lowest cost corridor is shown by the clumping of blue alignments. It can be seen that the cheapest route is along the valley bisecting the areas of higher elevation




*(Fig 8.a) Example results set from Section D1 of 50 alignments coloured by cost.*

## 8.2 Corridor Descriptions

Analysis of these results showed the key driver of corridor location to be grade related. The overall trend in the results is that the low cost corridors tended to favour the most direct route from section to section. Deviations from a straight line were forced by the very low maximum grade which resulted in to the corridors deviating to avoid any rough or mountainous terrain.

After the initial low cost corridors that met the geometric and grade constraints were identified, a collaborative review was carried out between Quantm and EWLP. The purpose of this was to identify any macro level features of importance which could impact the more favoured corridor alternatives. Each of these significant features will require special attention at the next level of investigation to modify the corridor in those specific areas to address each issue. These features have been summarised in the following table.

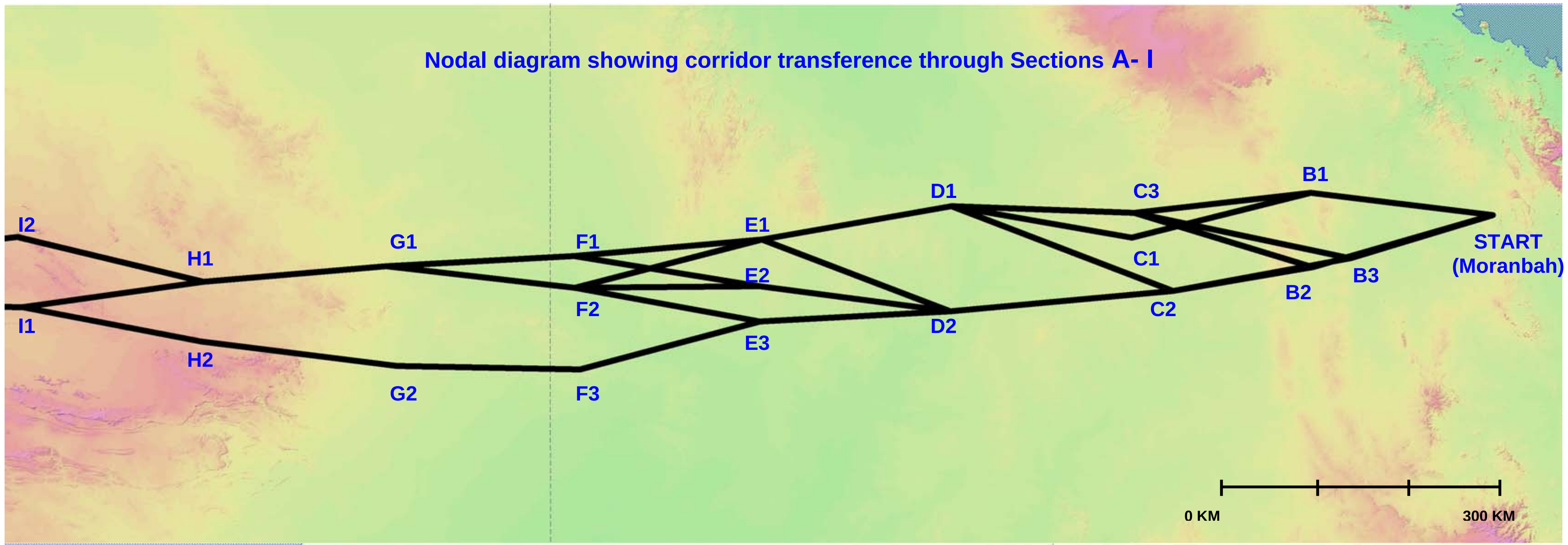
*Table 8.a: Summary of Length, Cost and Significant features for Corridor Sections.*

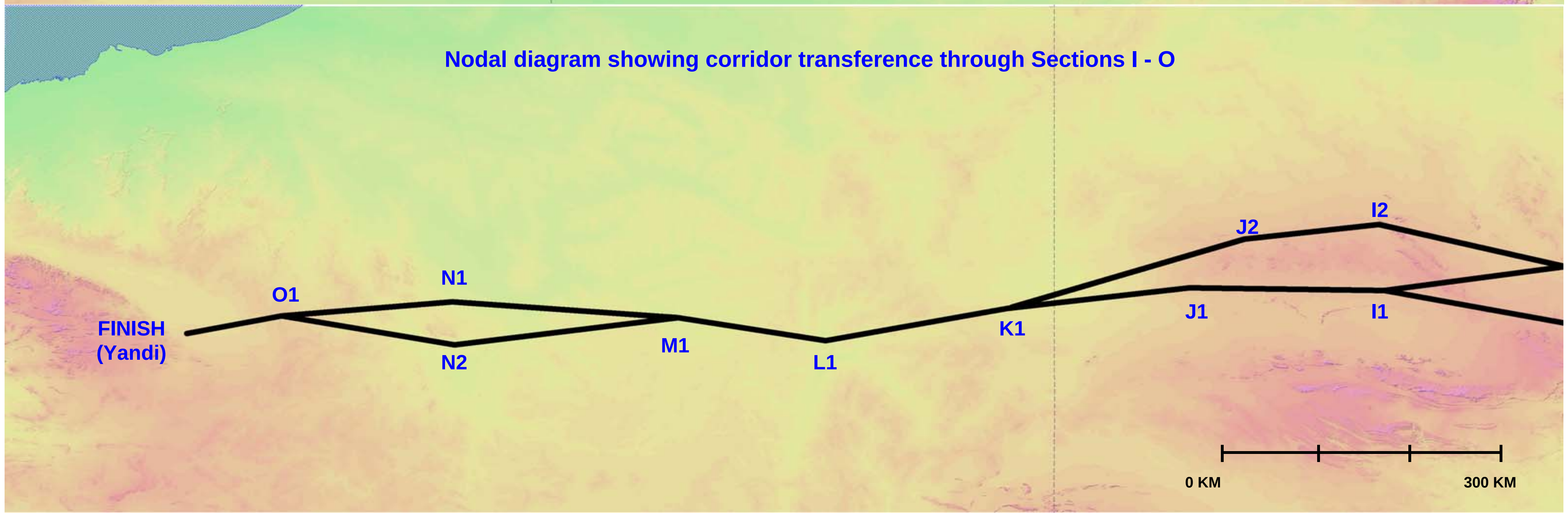
| Corridor Section | Distance (km) | Raw Cost* ($) | Significant Features |
|---|---|---|---|
| A – B1 | 216.2 | $238M. | Consideration to existing Mining leases, Gregory Developmental Road, Nairana National Park |
| A – B2 | 212.7 | $232M. | Gregory Development Road, Twin Hills |
| A – B3 | 169.9 | $179M. | Gregory Development Road, Twin Hills |
| B1 – C1 | 218.5 | $215M | Small Dry Lakes, Lake Buchanan, Landsborough Creek |
| B1 – C3 | 224.9 | $217M | Landsborough Creek |
| B2 – C2 | 172.6 | $164M | Towerhill Creek, Lake Galilee, Lake Barcoorah |
| B2 – C3 | 228.9 | $225M | |
| B3 – C2 | 217.4 | $220M | |
| B3 – C3 | 264.4 | $268M | |
| C1 - D1 | 222.4 | $218M | Winton Highway, Winton Branch Railway, Wokingham Creek Landsborough Highway, Diamantina Creek, Winton Township |
| C2 – D1 | 273.7 | $282M. | |
| C2 – D2 | 267.4 | $282M. | Winton, Western River, Bladensburg National Park, Diamantina River |
| C3 – D1 | 221.0 | $219M. | Kynuna |
| D1 – E1 | 246.6 | $235M. | Diamantina River, Landsborough Highway, Mckinly River System, Cannington Mine (BHP), Chatsworth, Phosphate Hill Mine |
| D2 – E1 | 239.7 | $236M. | |
| D2 – E2 | 231.7 | $232M. | |
| D2 – E3 | 235.6 | $238M. | |

| | | | |
|---|---|---|---|
| E1 – F1 | 223.4 | $221M. | Phosphate Hill Mine, Diamantina Development Road, Georgina River |
| E1 – F2 | 227.0 | $230M. | |
| E2 – F1 | 226.2 | $236M. | |
| E2 – F2 | 213.8 | $232M. | |
| E3 – F2 | 225.9 | $225M. | |
| E3 – F3 | 226.8 | $254M. | |
| F1 – G1 | 210.4 | $198 | Some Small Sand Dunes |
| F2 – G1 | 213.1 | $207M. | |
| F3 – G2 | 223.0 | $222M. | |
| G1 – H1 | 227.4 | $217M. | Ooratippra Creek System, Sand Ridges, Bundey Creek, Sandover Highway, Sandover River |
| G2 – H2 | 225.0 | $227M. | |
| H1 – I1 | 226.6 | $211M. | Ti-Tree, Hanson River, Lander River |
| H1 – I2 | 223.8 | $219M. | Stuart Highway, Alice Springs Darwin Railway, Darwin Gas Pipeline |
| H2 – I1 | 213.7 | $199M. | |
| I1 – J1 | 216.7 | $202M. | |
| I2 – J2 | 147.2 | $139M. | Cockatoo Creek, Tanami Road, Yaloogarie Creek |
| J1 – K1 | 208.5 | $203M. | |
| J2 – K1 | 279.6 | $265M. | Sand Dunes, Lake MacKay, Central Australia Aboriginal Reserve |
| K1 – L1 | 219.0 | $226M. | Kiwirrkurra Aboriginal Reserve , Sand Ridges through Gibson Desert |
| L1 – M1 | 170.9 | $186M. | Patchy Sand Dunes |
| M1 – N1 | 274.2 | $276M. | Rudall River National Park |
| M1 – N2 | 271.1 | $293M. | Corridor not reviewed |
| N1 – O1 | 232.4 | $238M. | Talawana Track, Little Sandy Desert |
| N2 – O1 | 228.3 | $230M. | |
| O1 - Finish | 105.0 | $92.4M. | Fortescue River |

* *Raw costs do not include contingencies, overheads, distance impacts, overheads or profits.*

In each of the following corridor drawings, the corridor marked as BLUE is the initial preferred corridor due primarily to its shorter length and lower raw cost.

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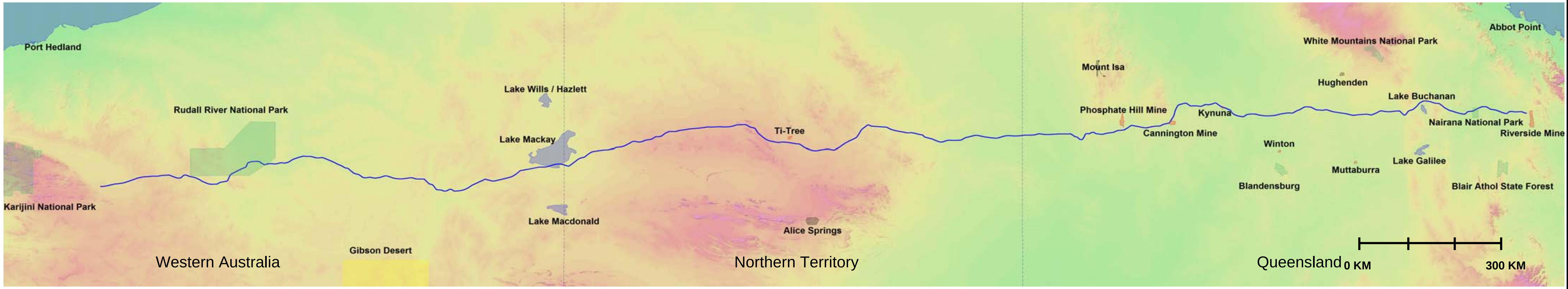


*(Figure 8.b) – Illustration showing the Preferred Northern Corridor Route.*

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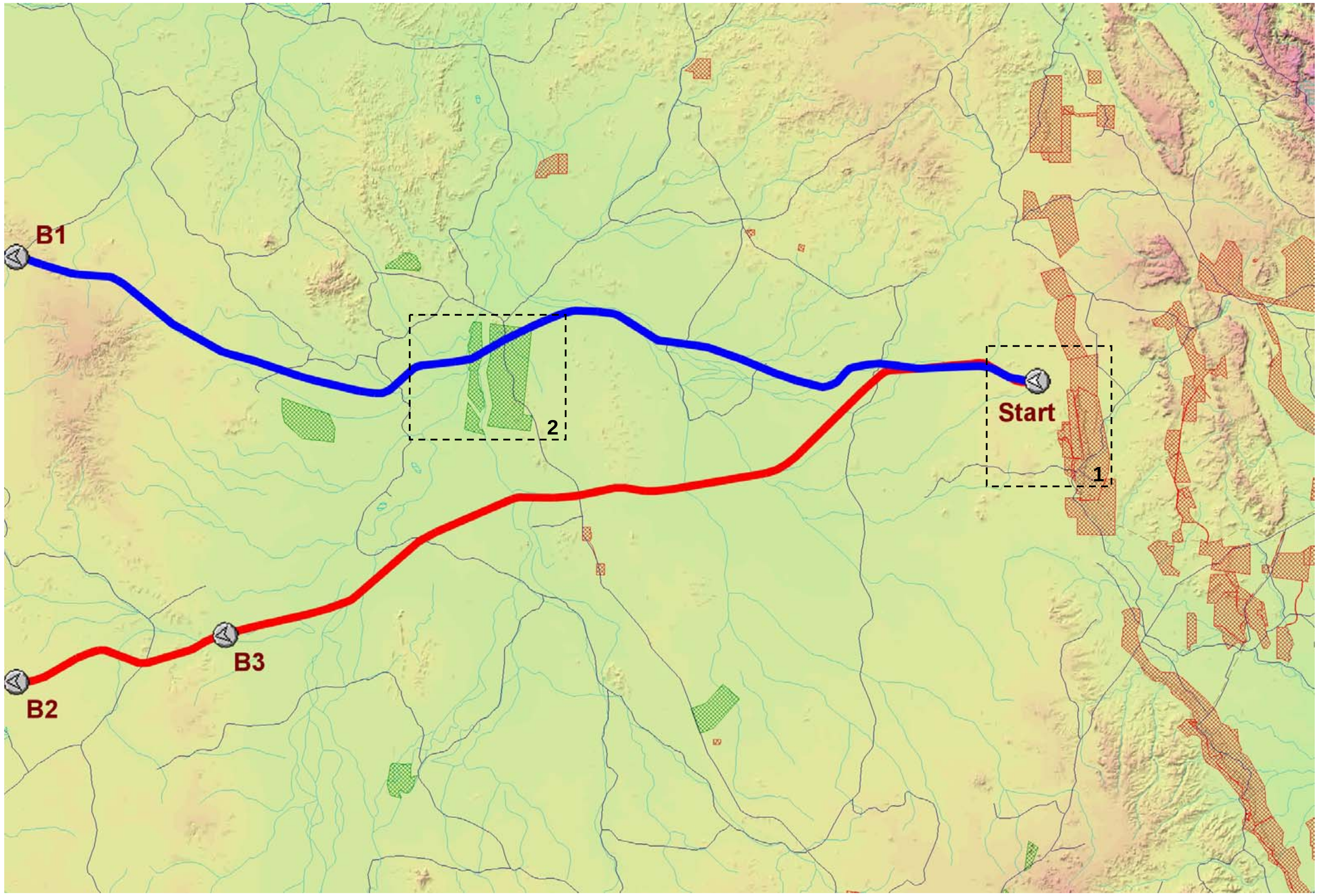
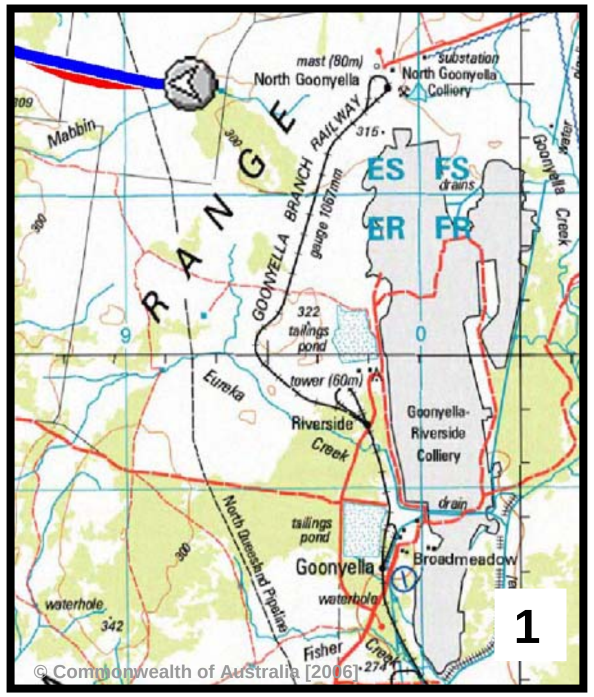
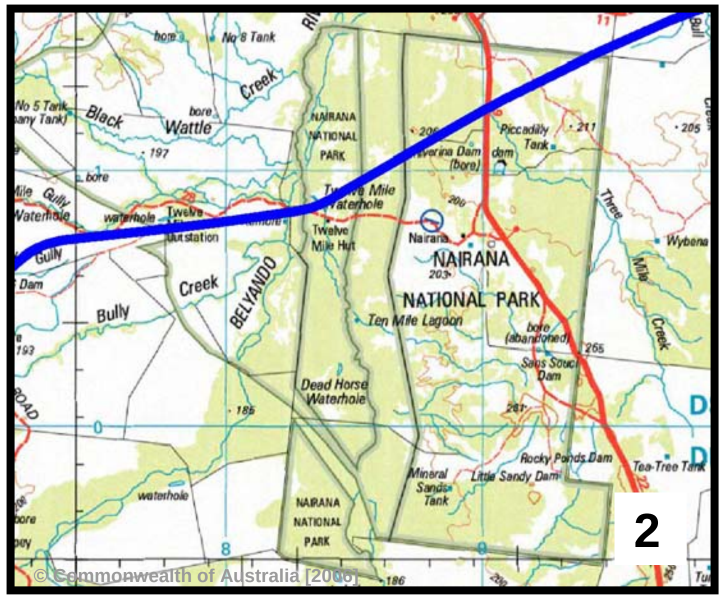



Goonyella-Riverside Mine




Nairana National Park

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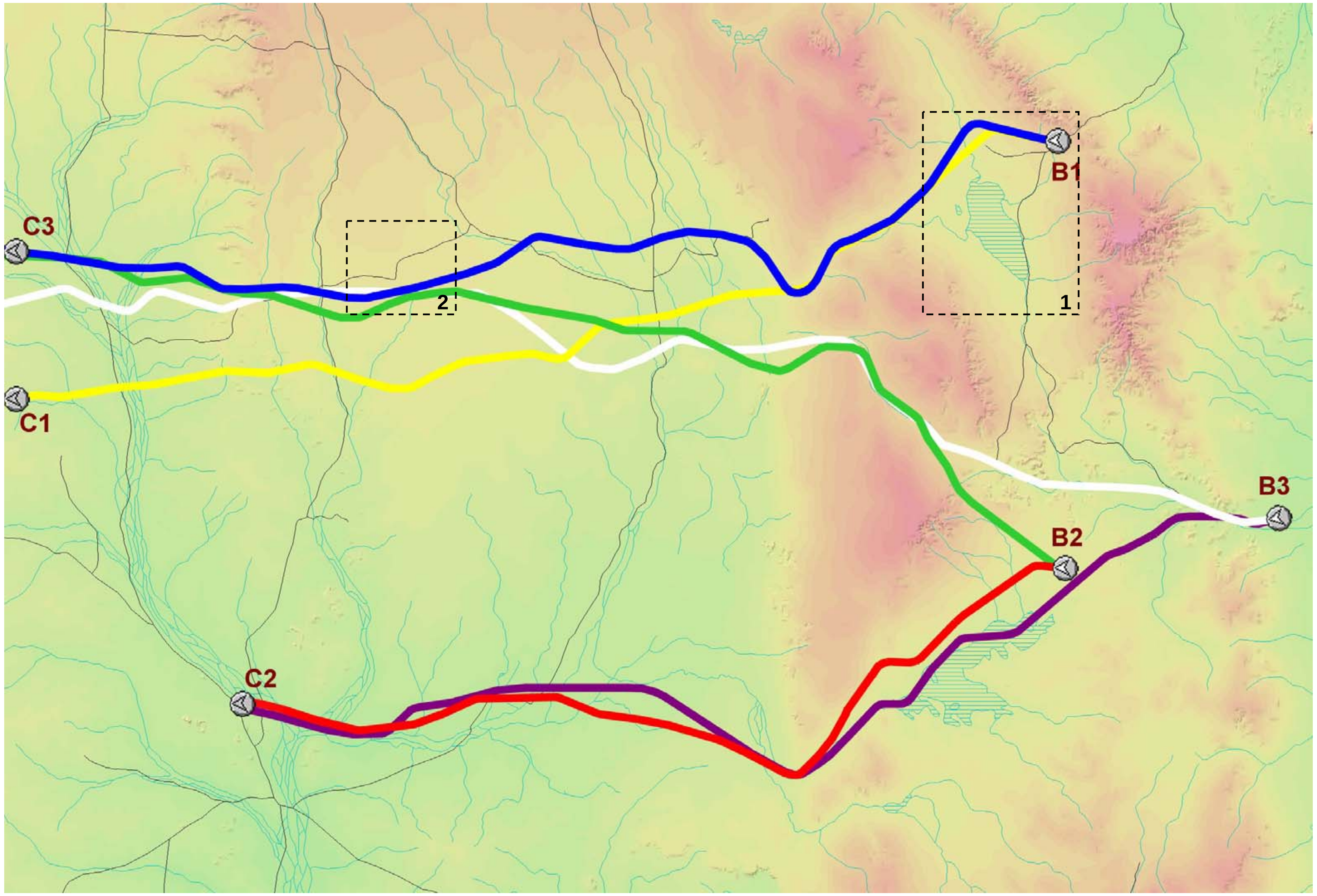
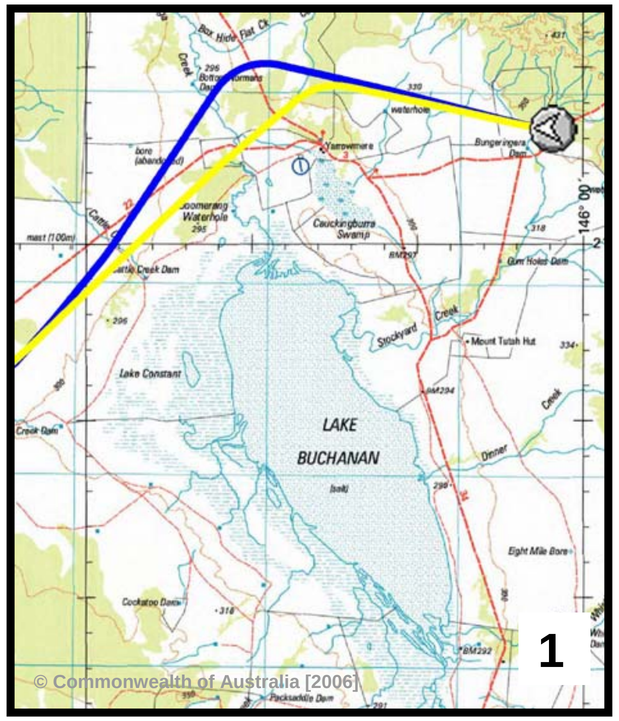
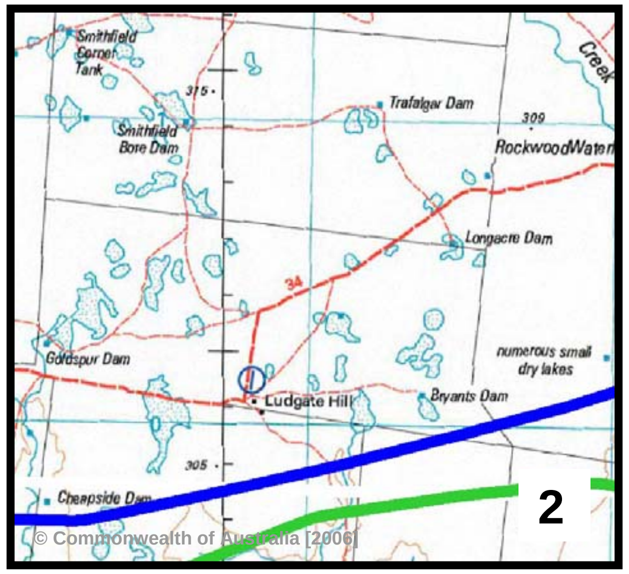
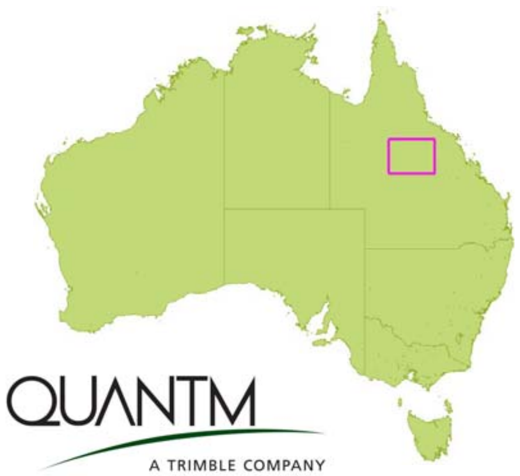



*Lake Buchanan*




*Numerous small dry lakes*



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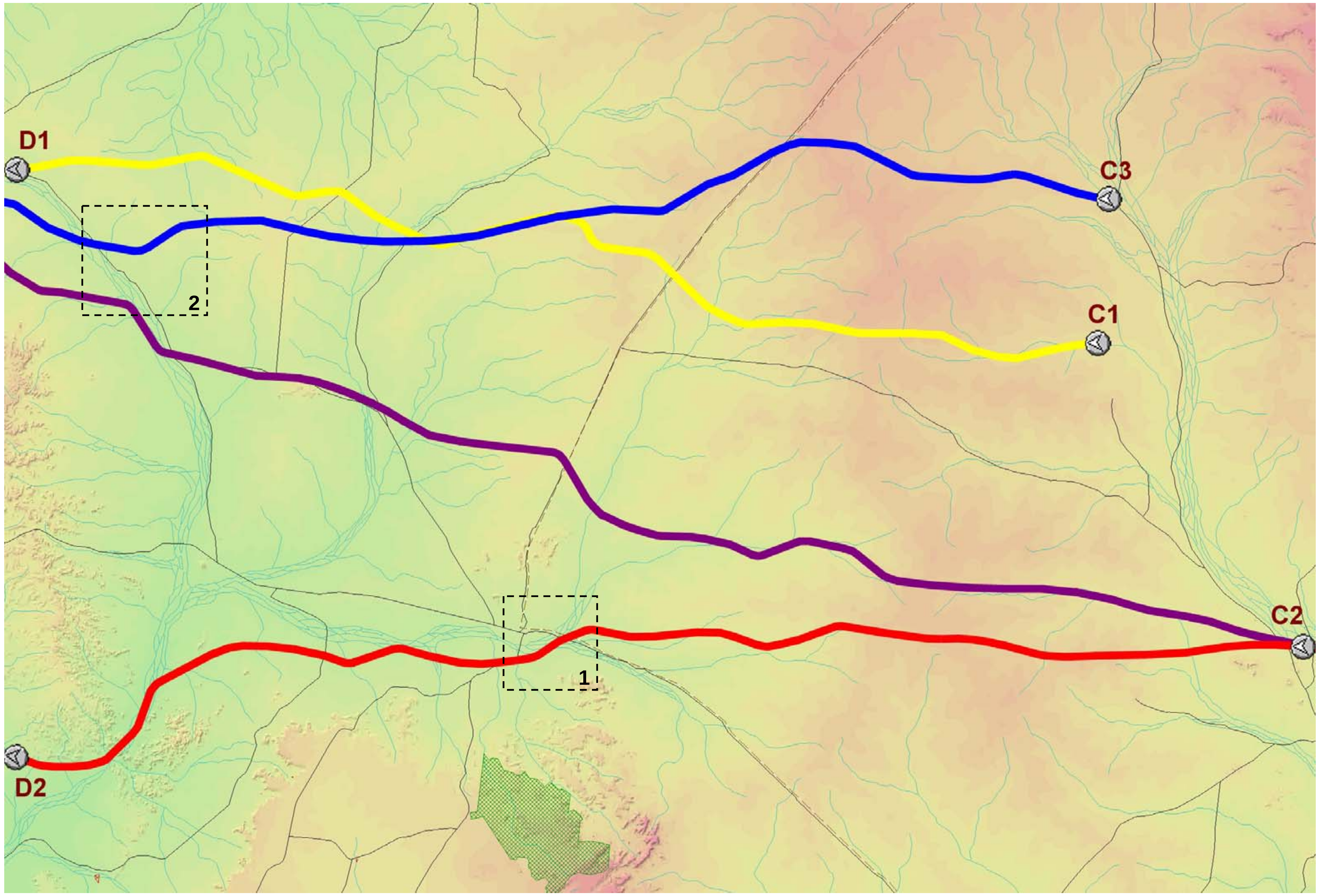
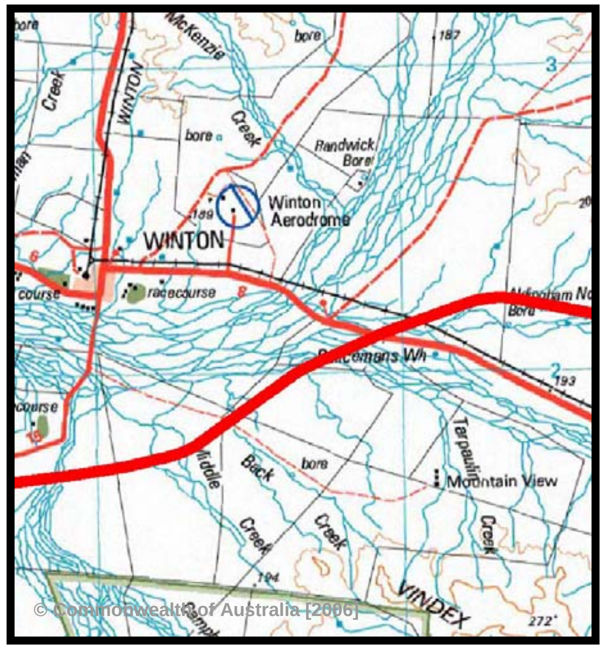
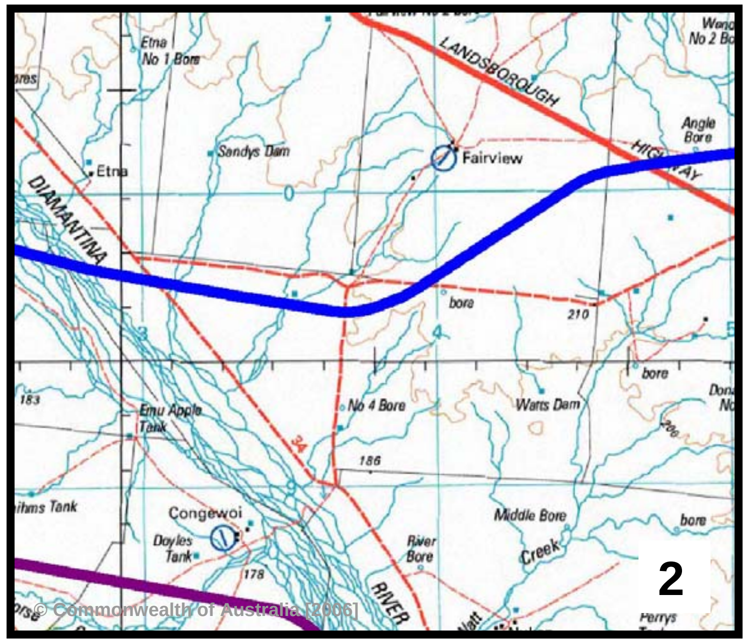
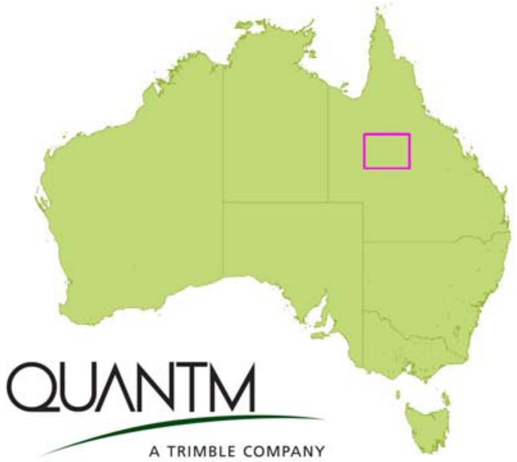



*Winton Township*




*Diamantina River*



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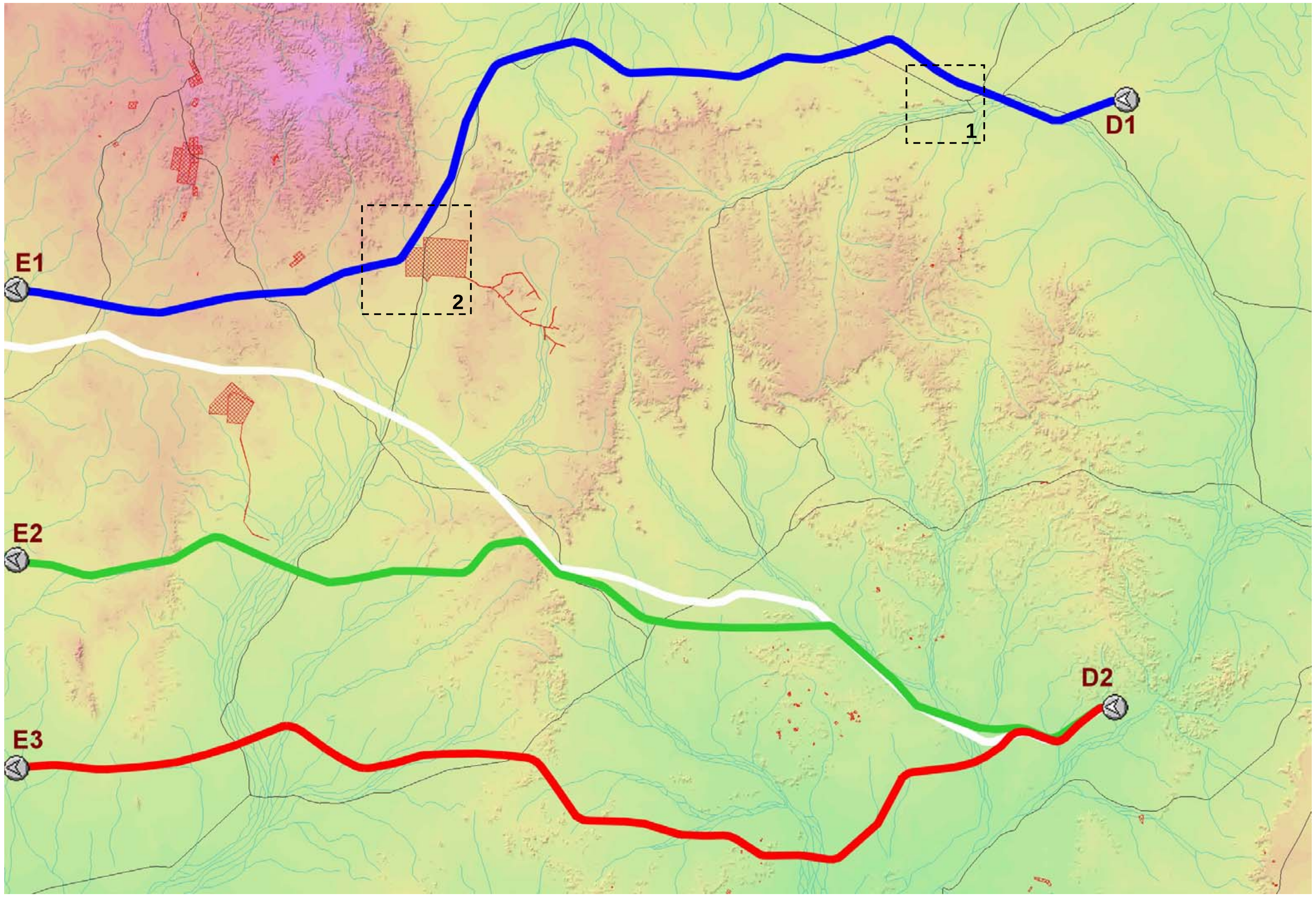
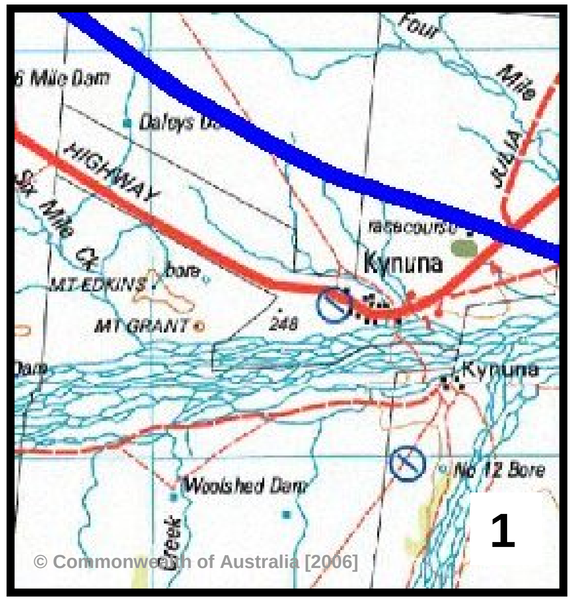
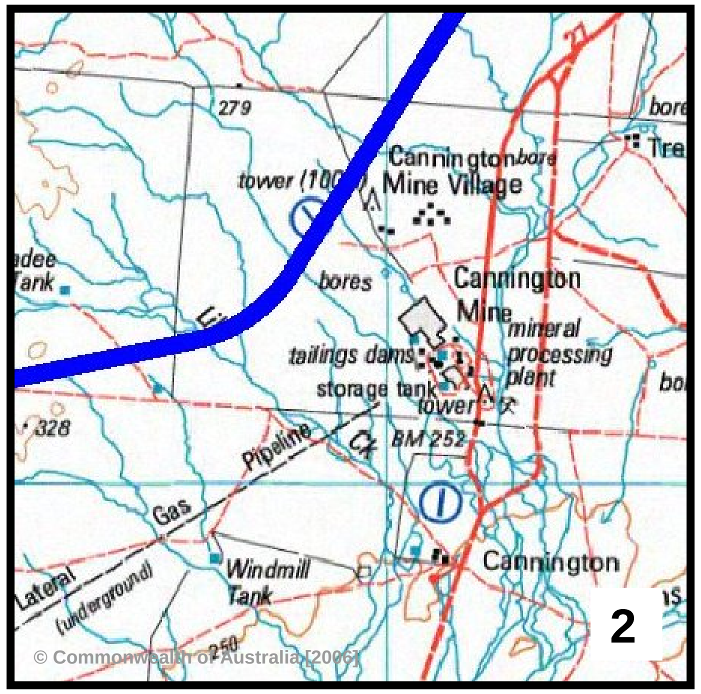
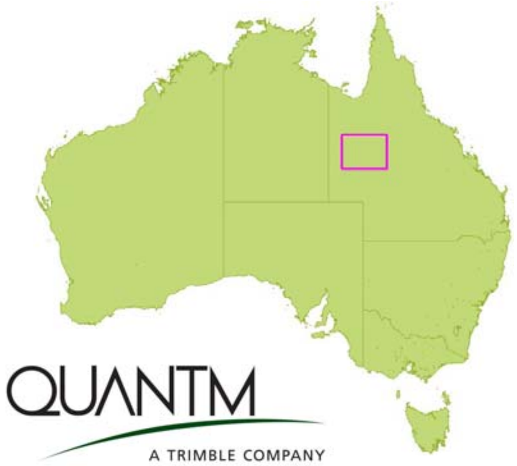



*Kynuna Township*




*Cannington Mine*



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Scale: NTS
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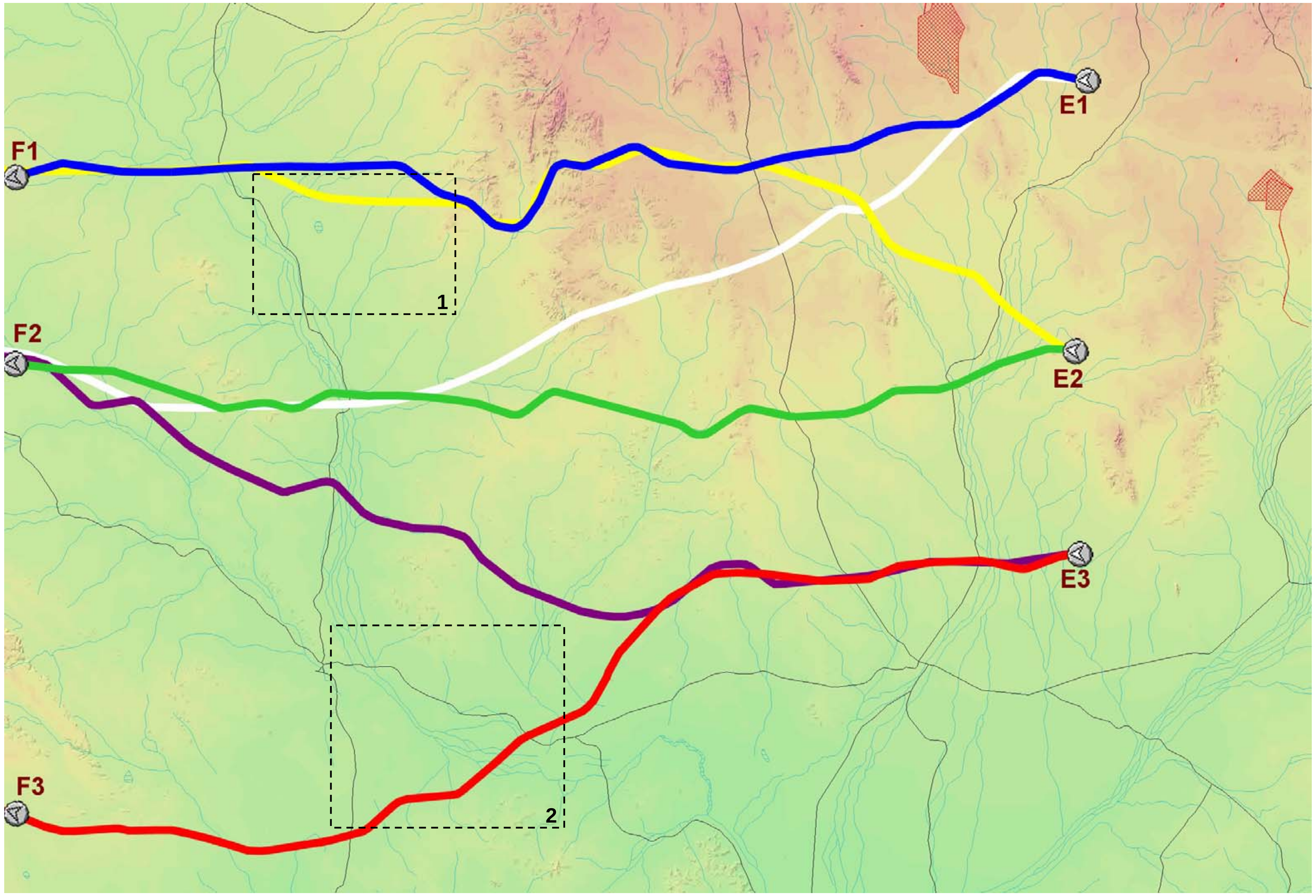
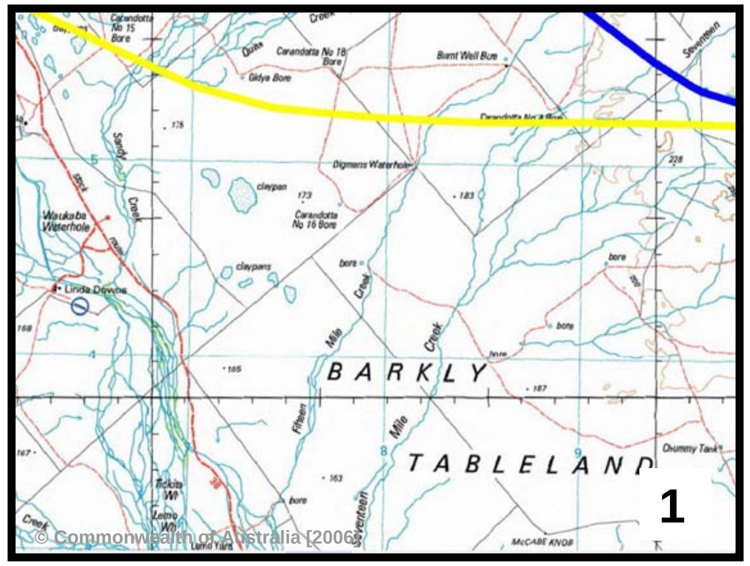
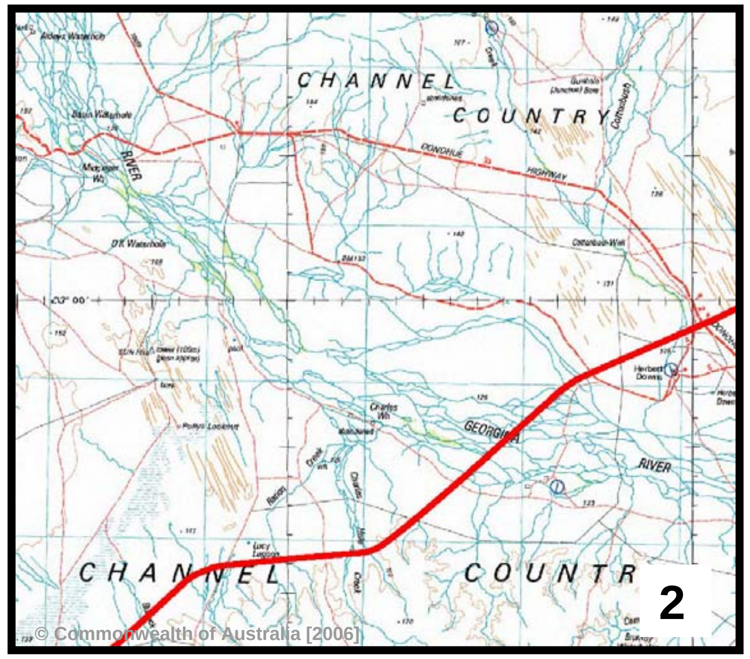
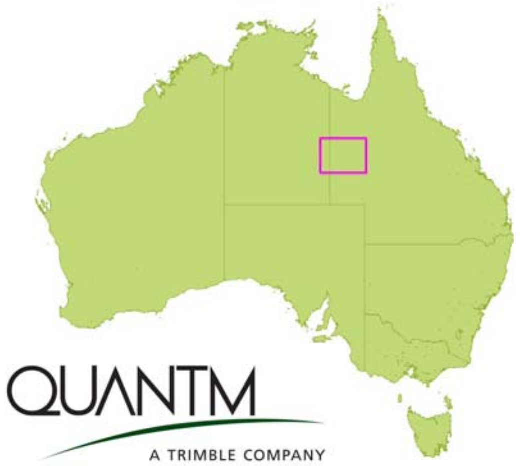



*Barkly Tableland*




*Channel Country*



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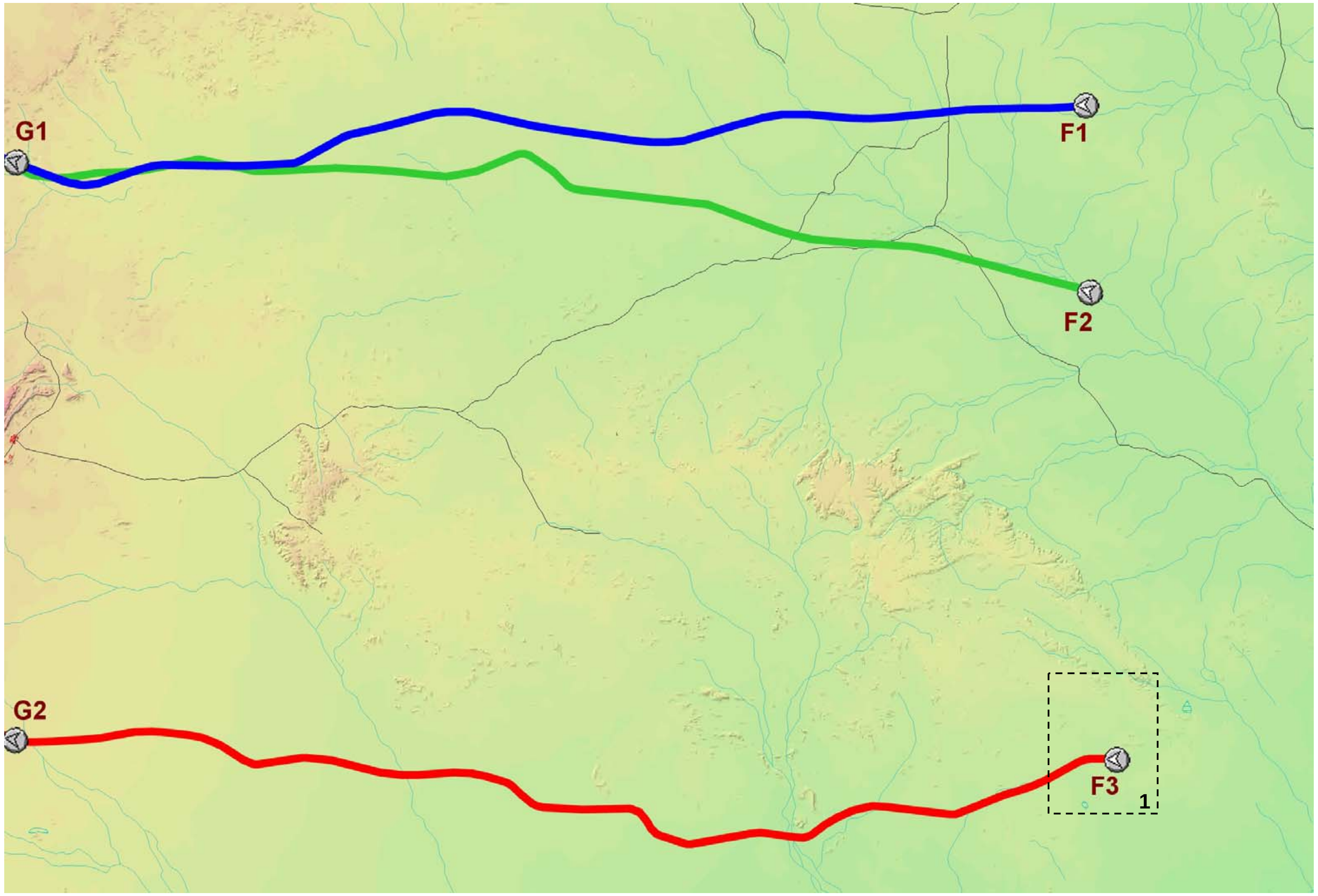
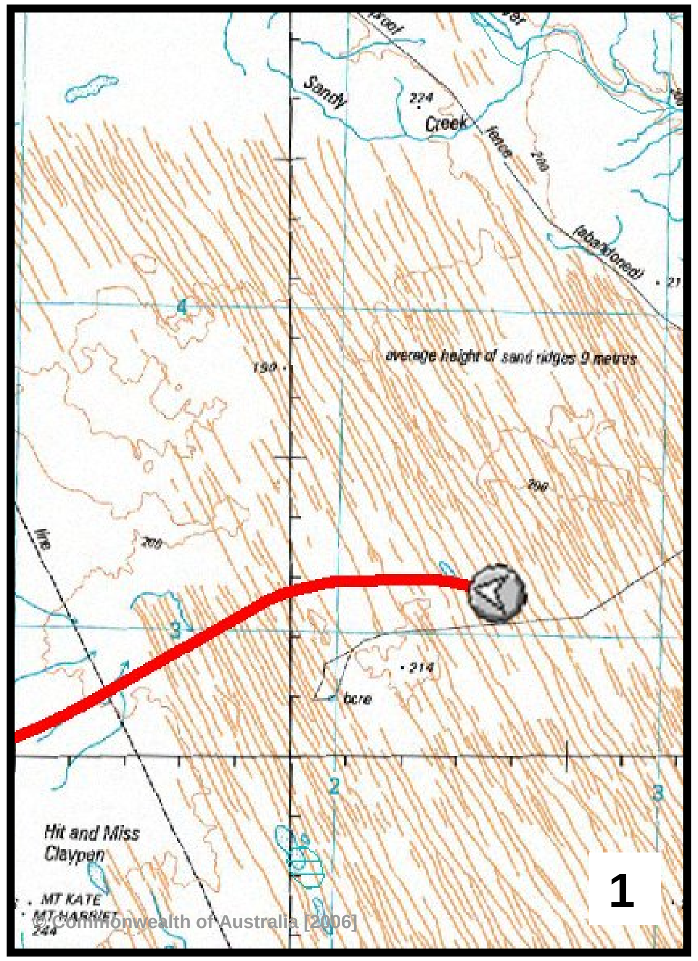
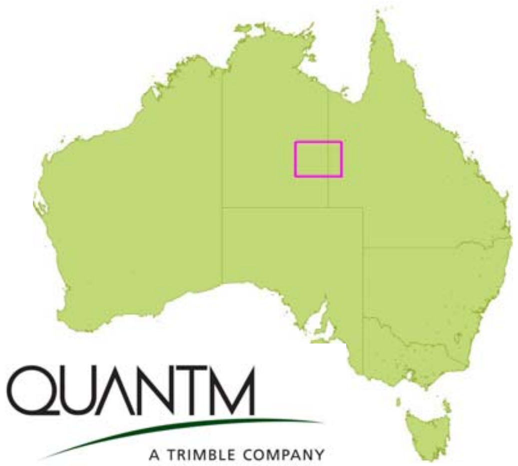



*Simpson Desert*



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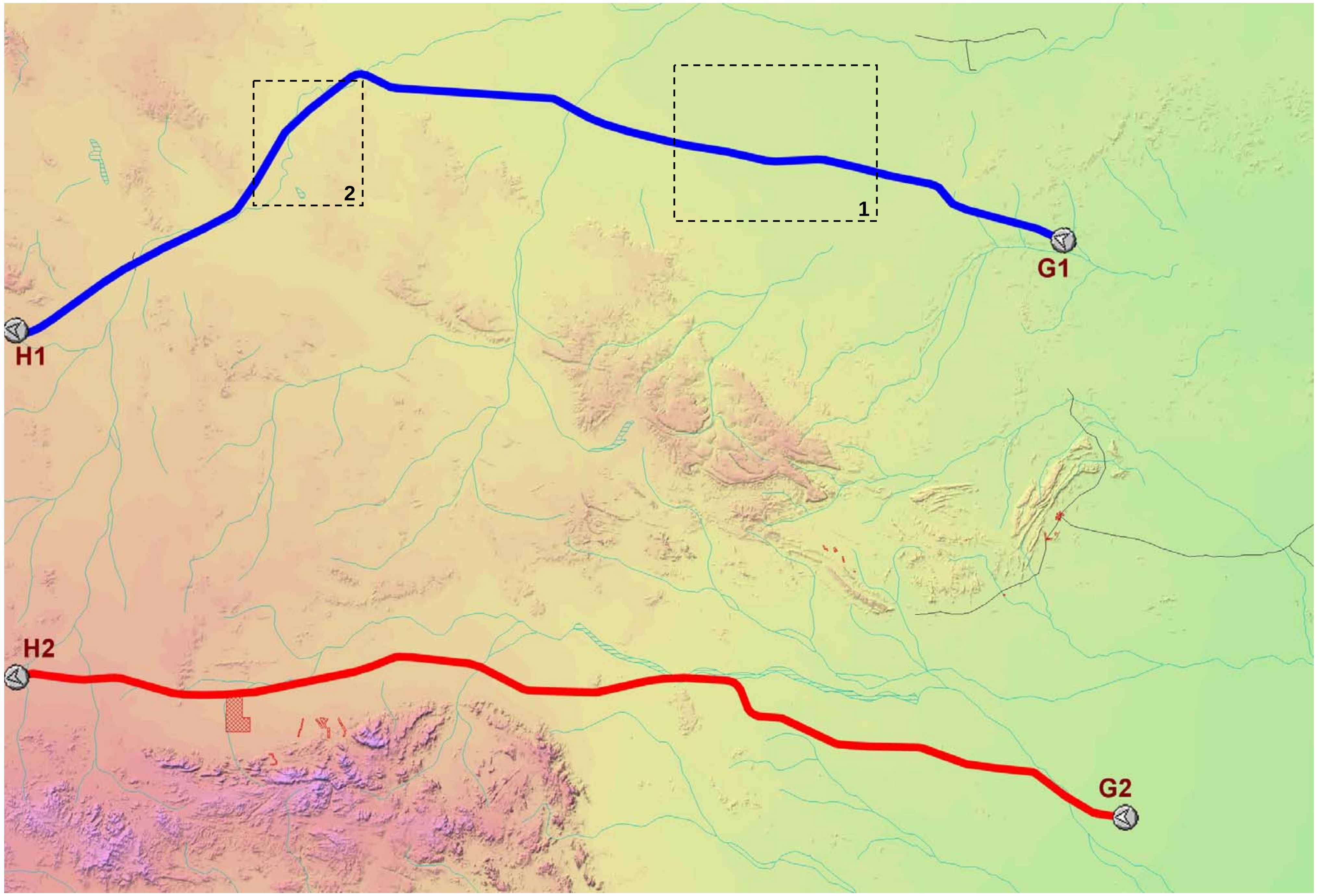
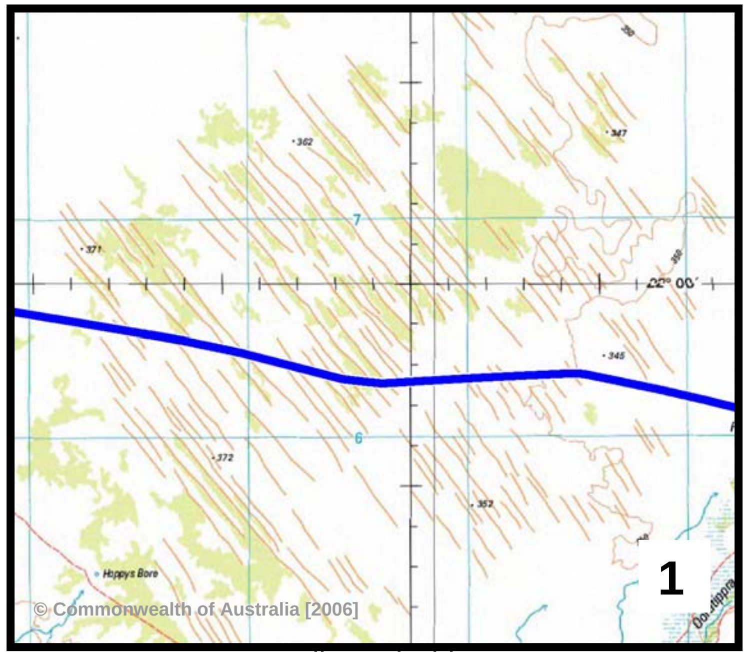
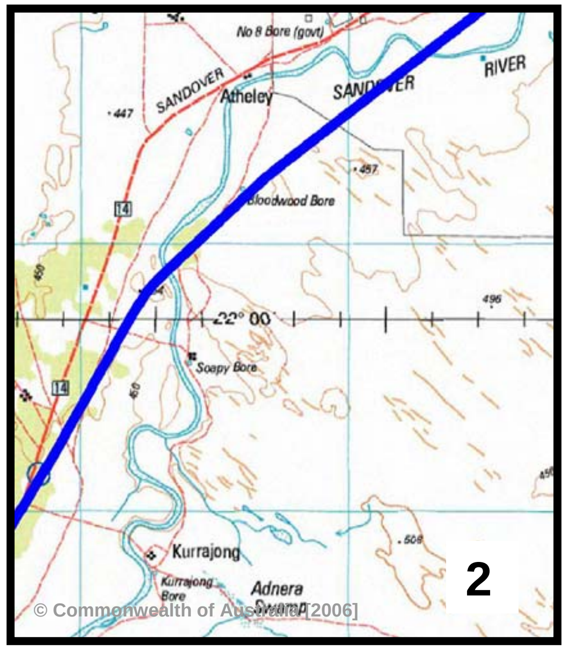
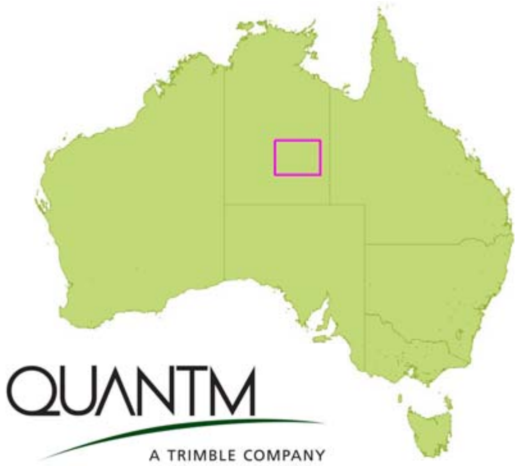



*Small Sand Ridges*




*Sandover River*



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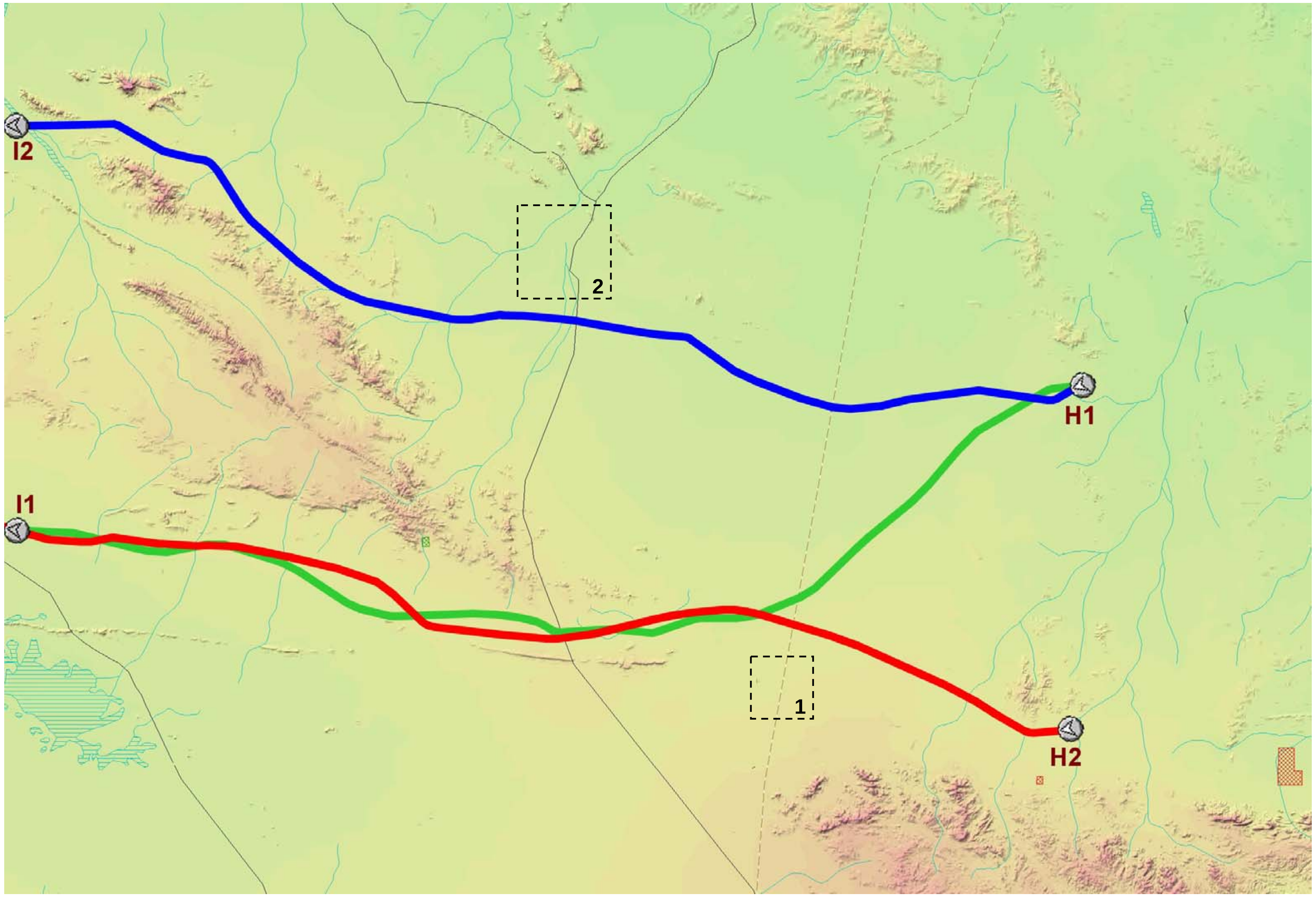
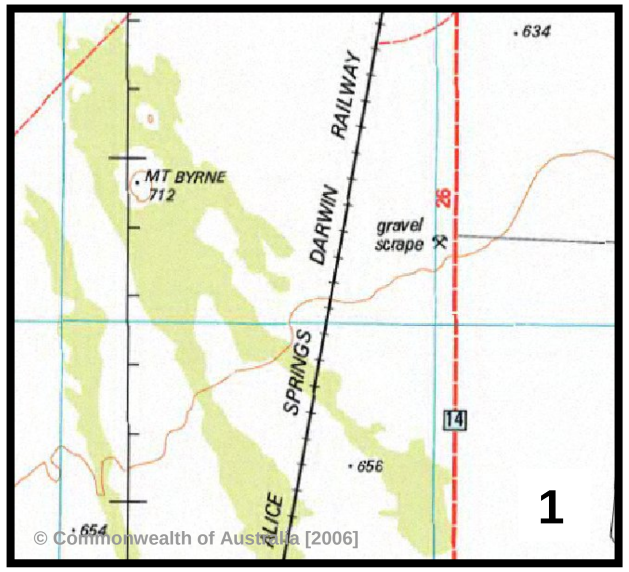
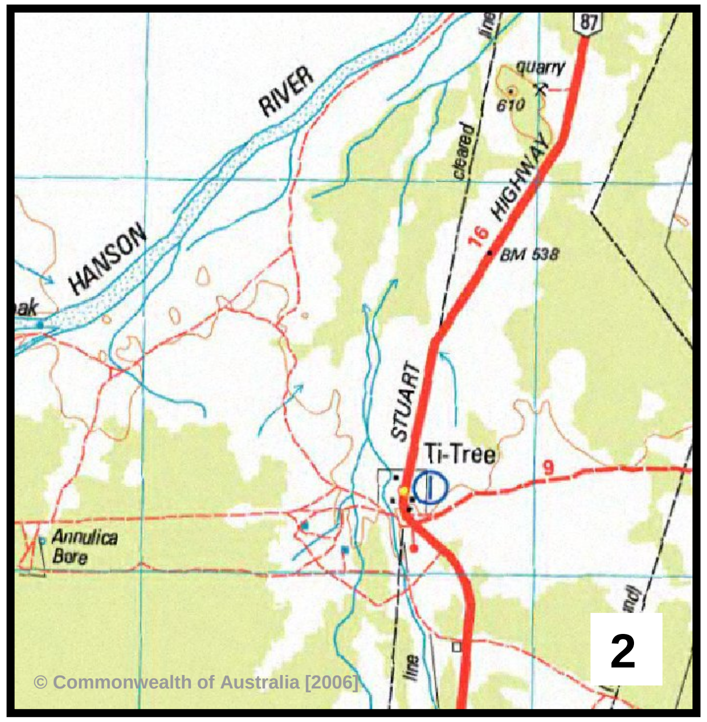
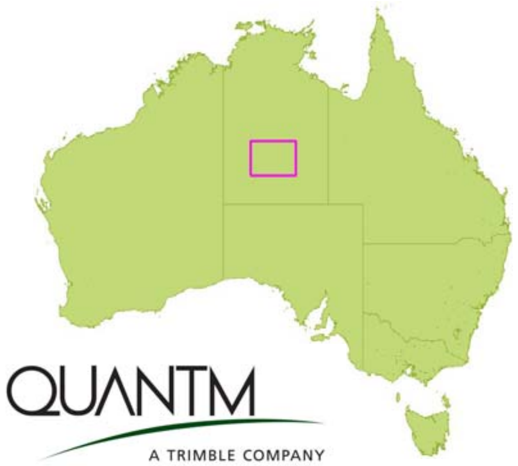



*The Ghan*




*Ti-Tree Township*



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Scale: NTS
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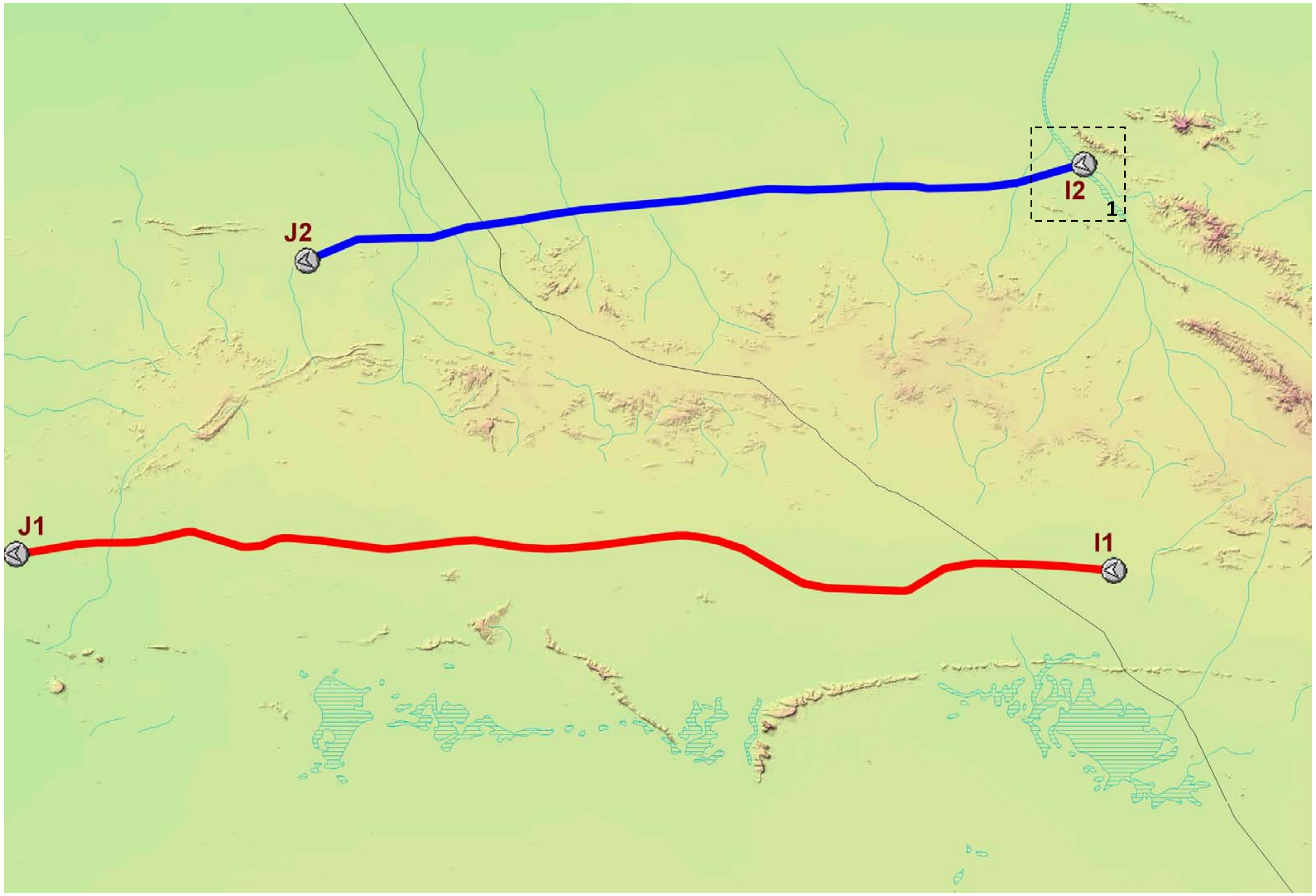
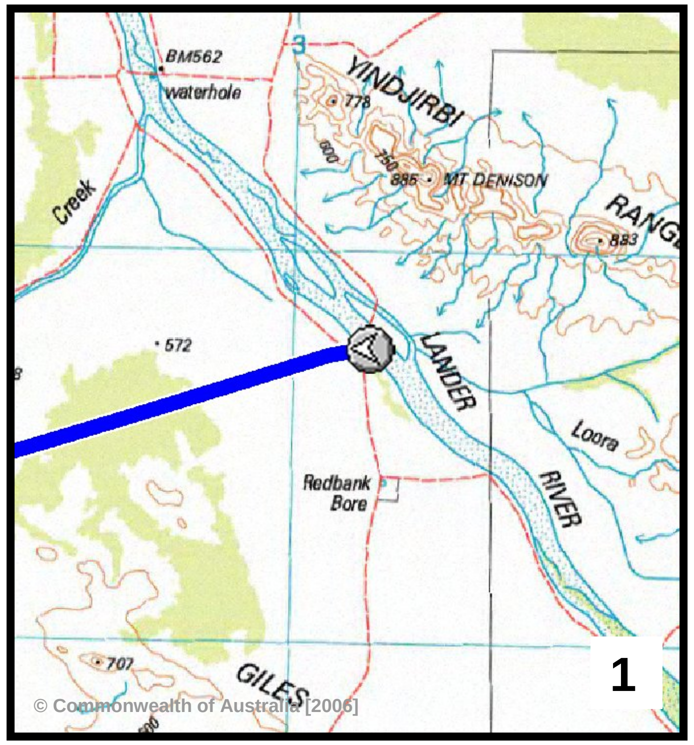
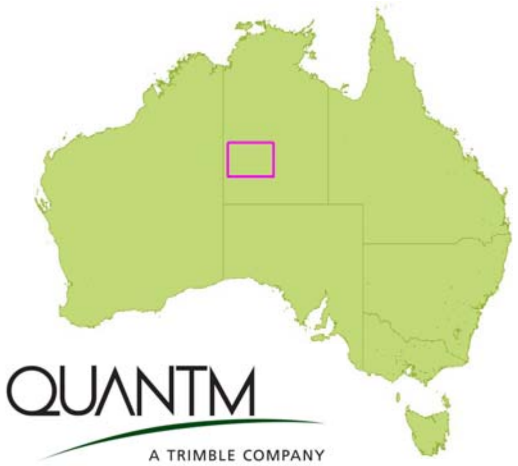



*Lander River*



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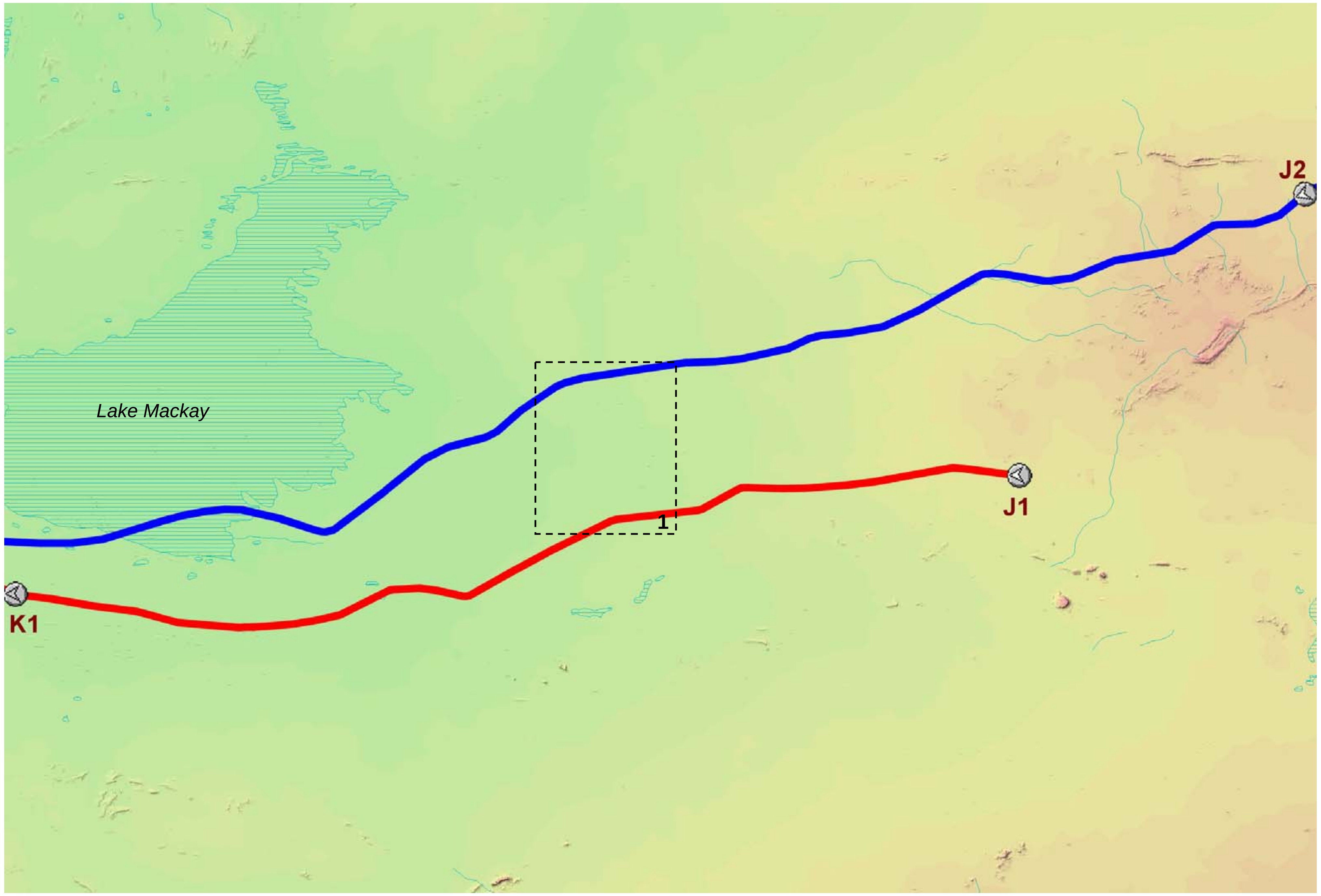
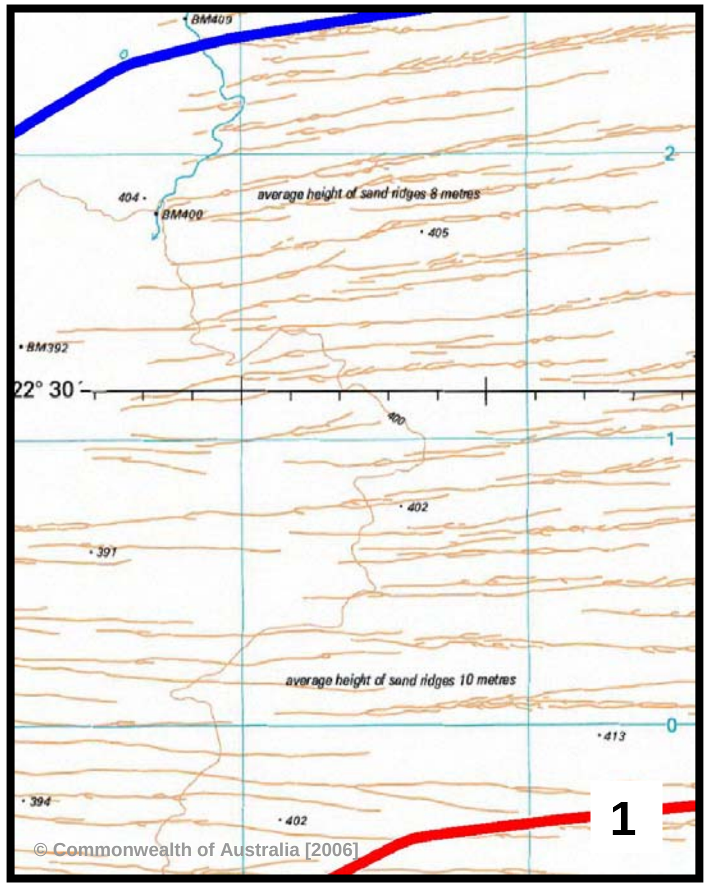
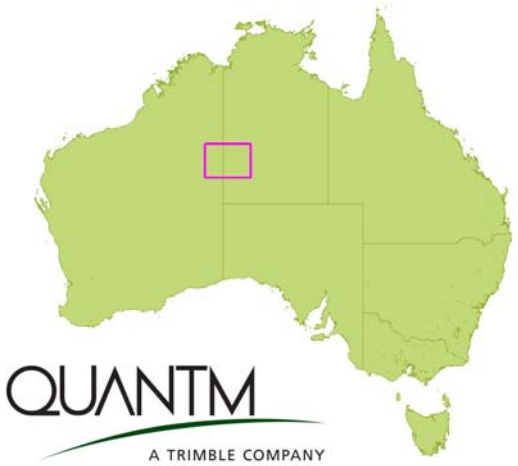



Sand Ridges



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Scale: NTS
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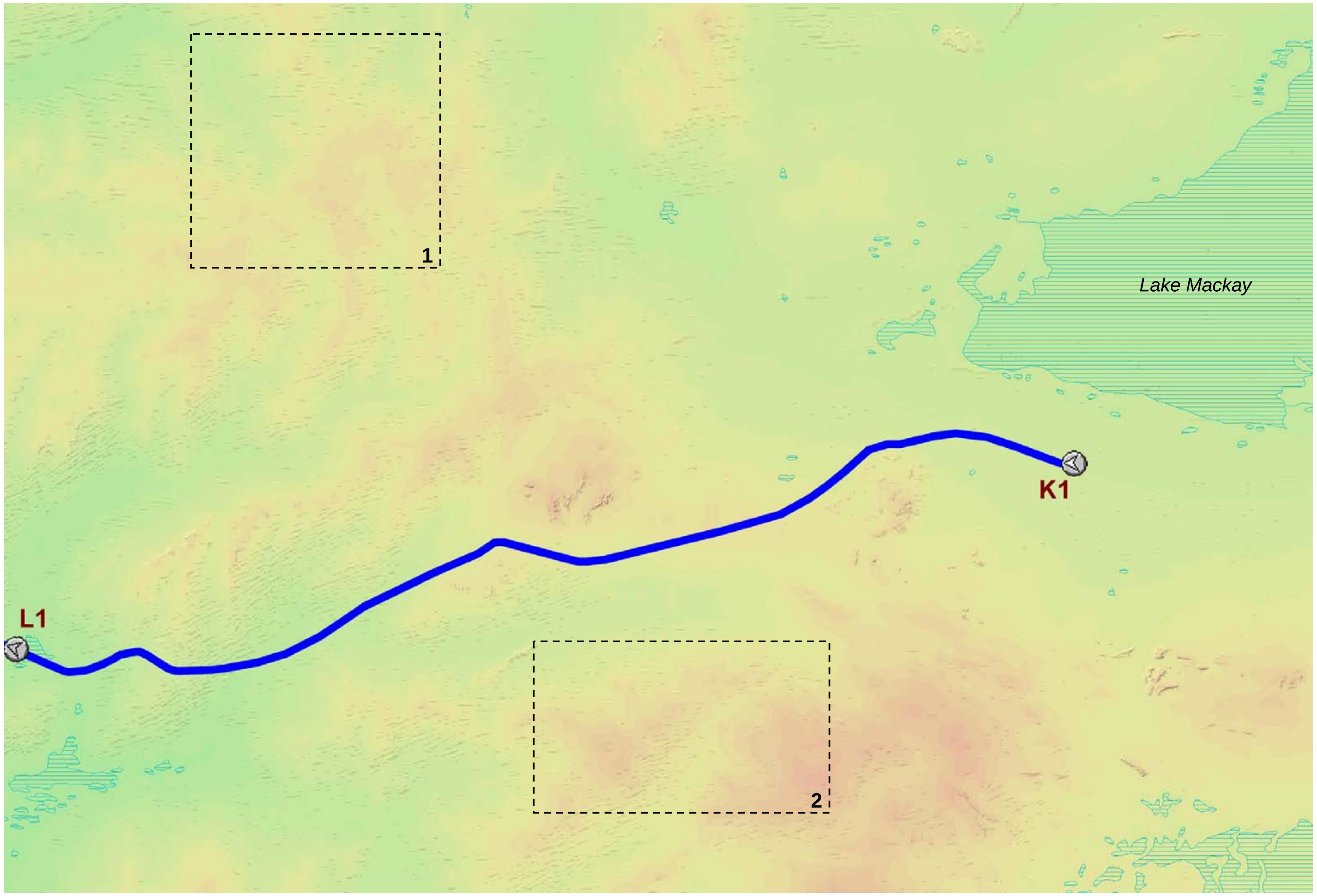
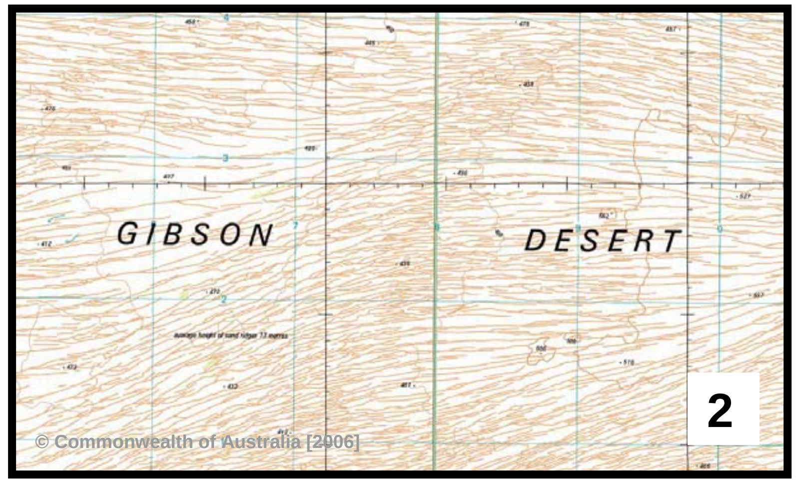
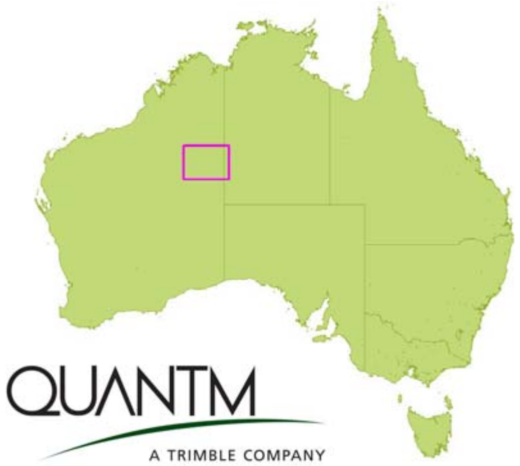




Great Sandy Desert




Gibson Desert



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Scale: NTS
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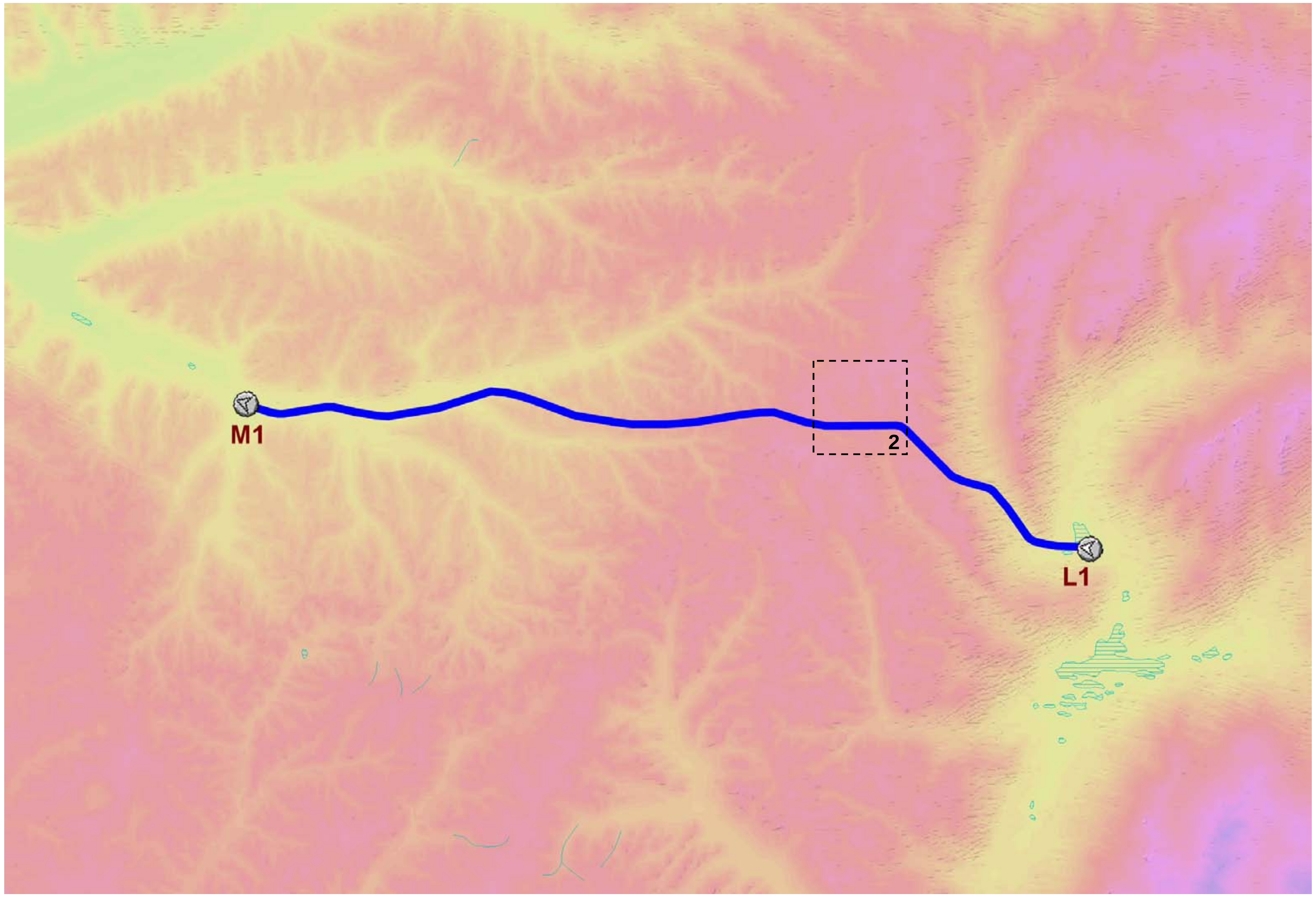
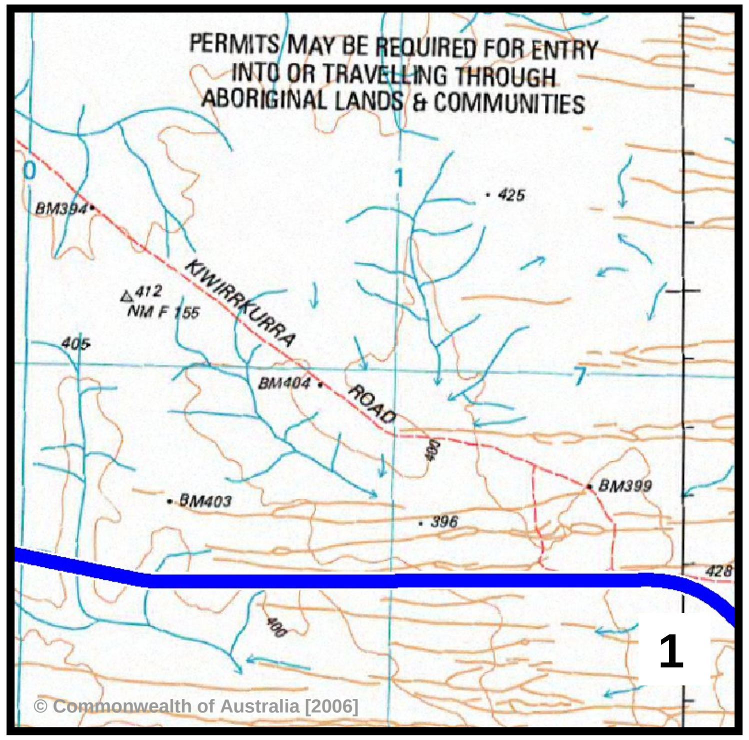
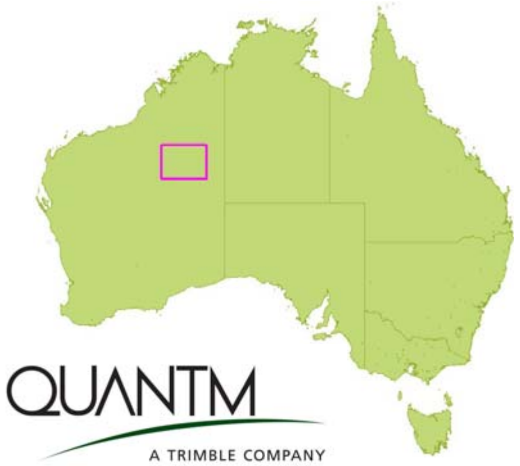



*Kiwirrkurra Road*



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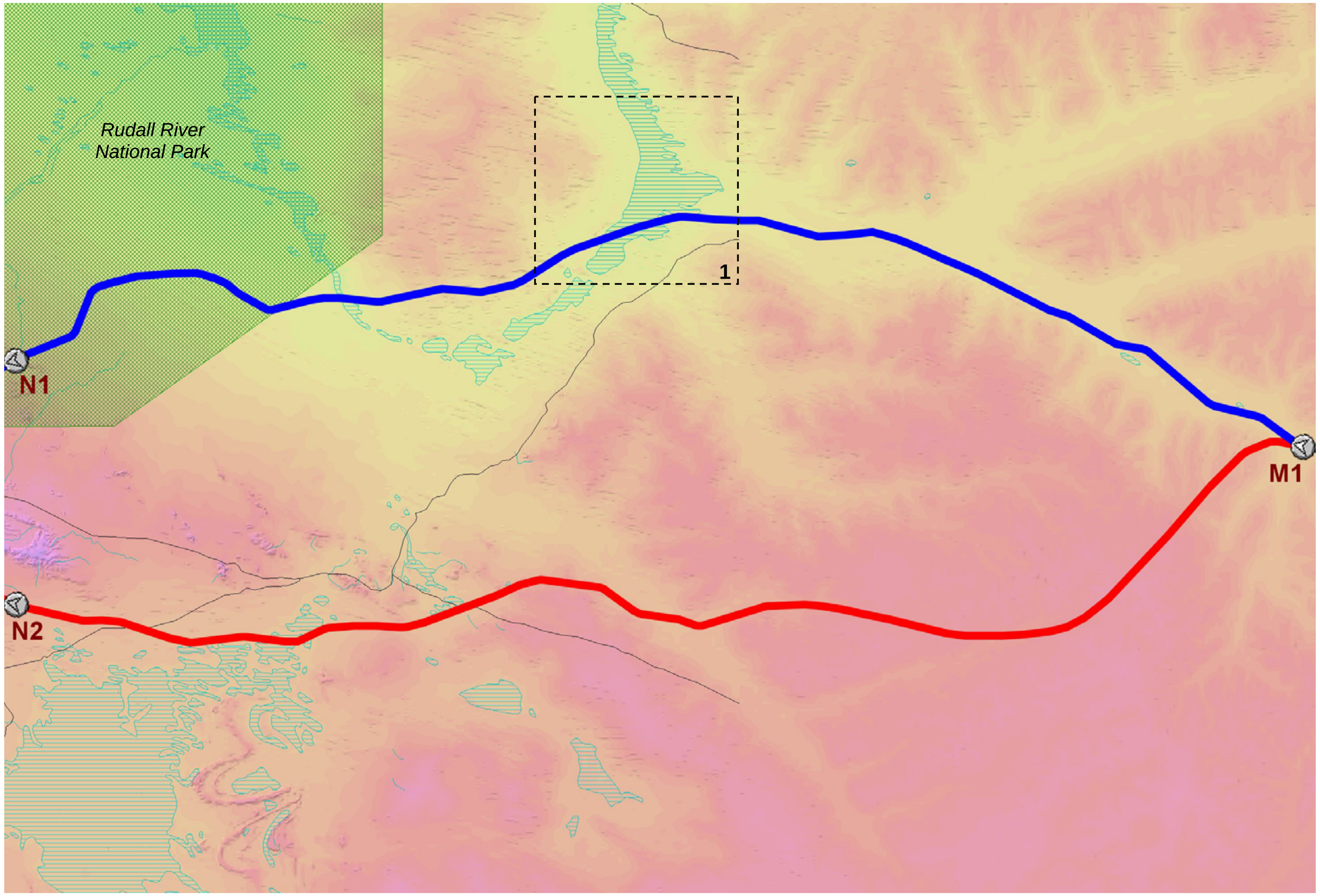
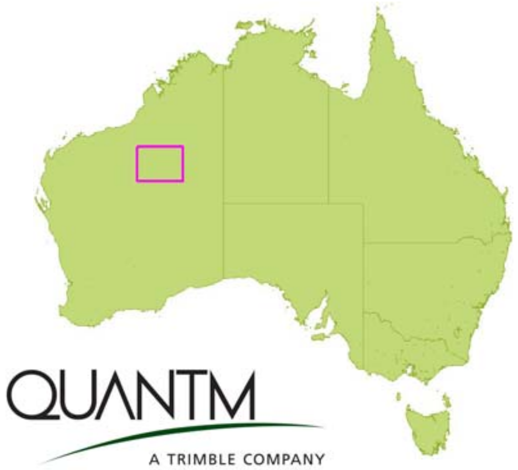
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Section L**





*Lake Auld*



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Scale: NTS
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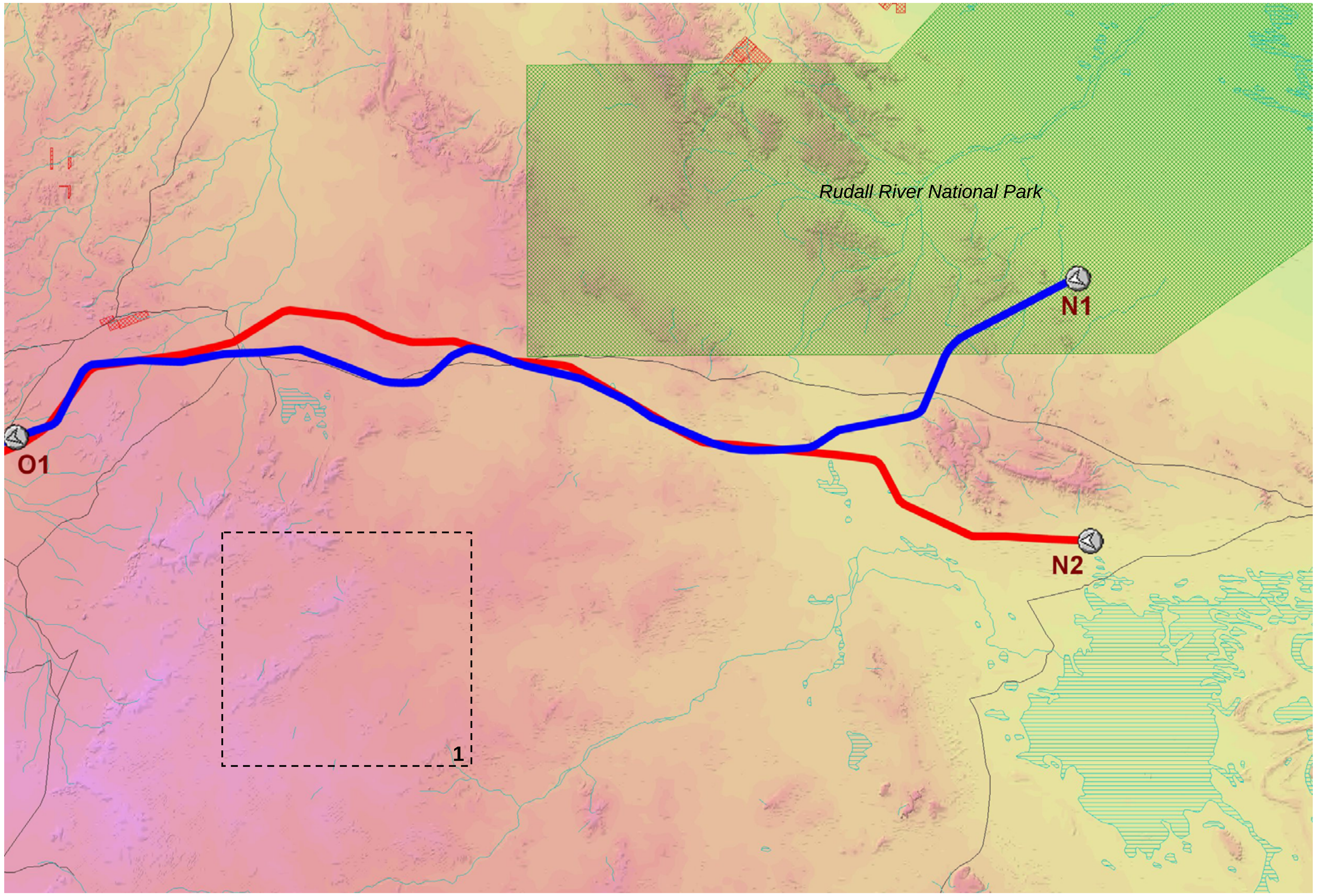
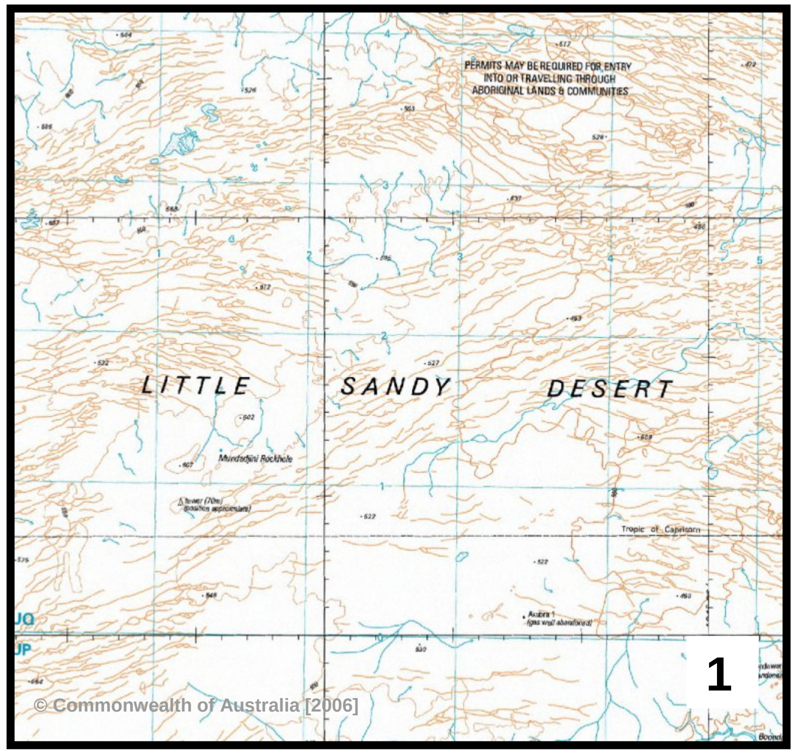
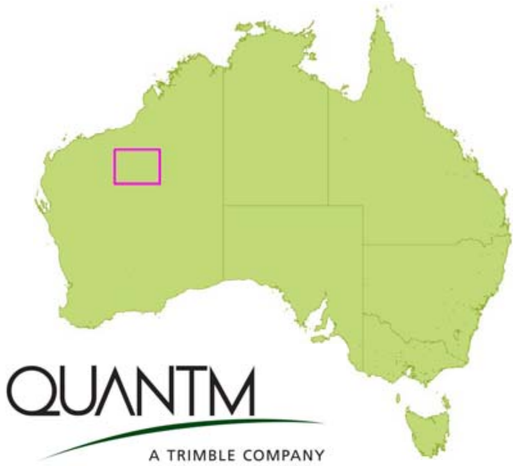



Little Sandy Desert



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Date 5/2/2007
Scale: NTS
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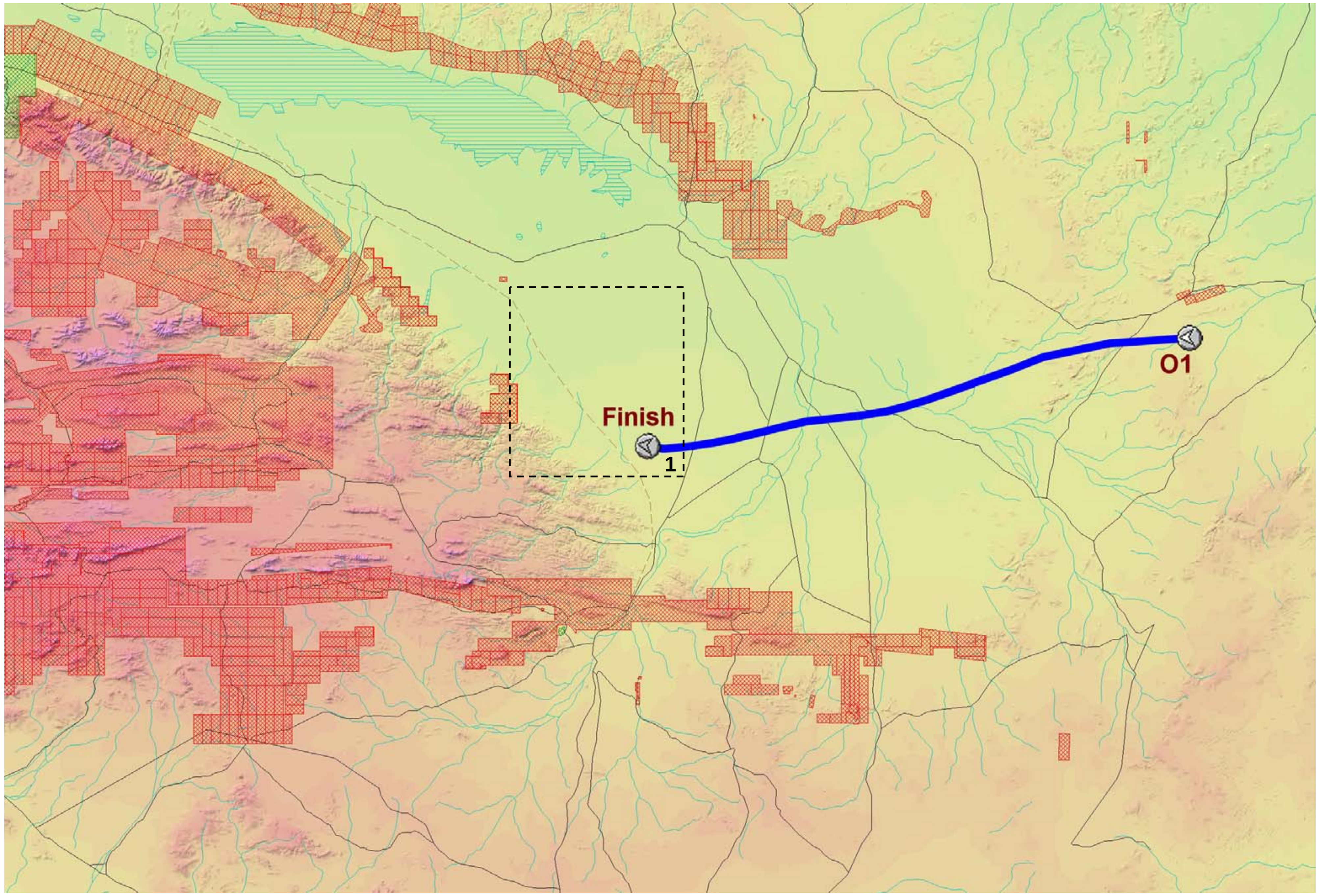
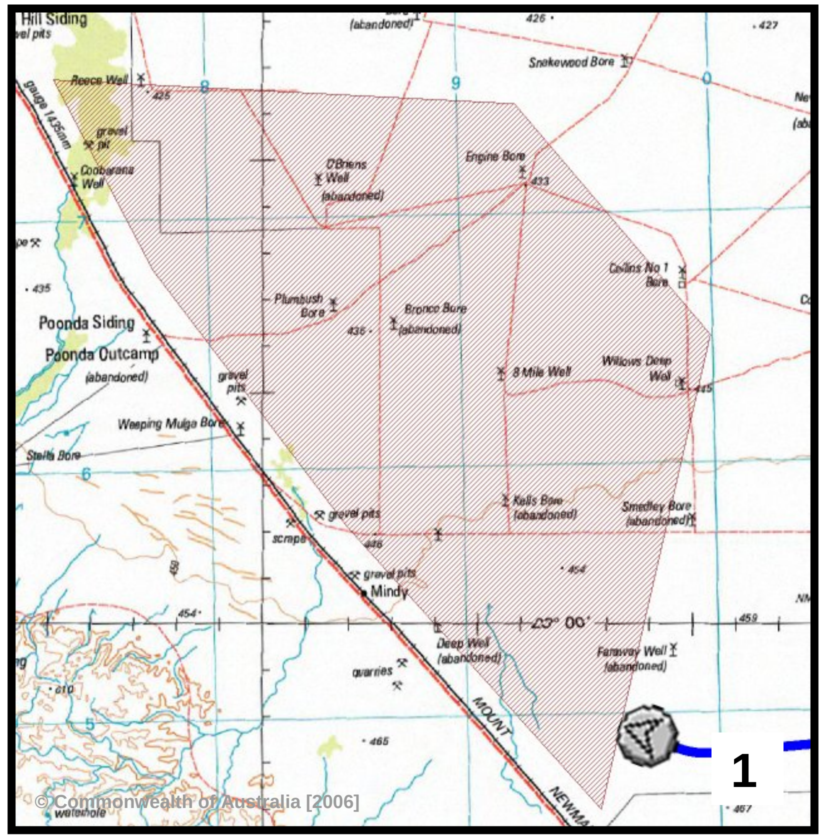
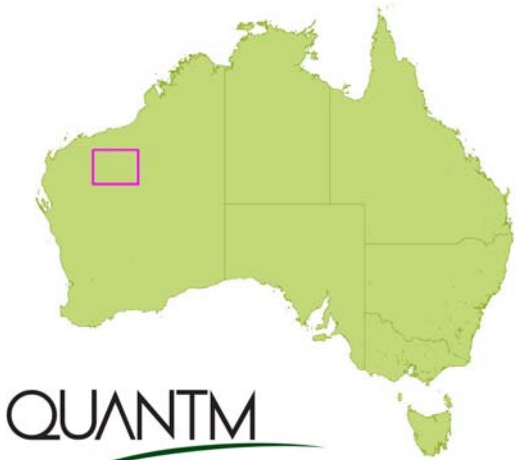



*Proposed location of Newman Smelter Park*



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Date 5/2/2007
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Section O**

# 9.0 TYPICAL ALIGNMENT CHARACTERISTICS

## 9.1 Preferred Corridor

During the session held between Quantm and EWLP on the 23/01/2007, the results and outcomes for each corridor section were presented to the team. This revealed that a comprehensive search of the terrain model had already identified a number of favourable corridors. Alternatives were individually reviewed and critiqued within the Quantm software. Strategic construction cost comparisons were made on each, while their localised impact on macro scale environmental and land-use constraints were investigated by viewing the options super-imposed over topological maps. This led to the selection of the northern corridor route being preferred over others, mainly due to it meeting more of the project requirements and criteria for an early stage rail corridor route. The alignments shown in blue in the sectional drawings represent the EWLP preferred corridor (*refer to Section 8.3*).

The northern route was chosen for the following reasons:

- Exhibited minimal impacts on river systems, national parks, townships and existing mining leases. Those that were impacted could be easily constrained and avoided in further more detailed studies.

- More suitable site for the railway crew change, maintenance and refuelling depots along the route, in the vicinity of existing settlements (for example near Ti Tree in the Northern Territory and Kynuna in NW Queensland).

- Achieved the economic objective of minimising construction costs, with the 3120 km route having an approximate total raw construction cost of $3.3 billion AUD.

- In comparison to some of the other corridor options, the preferred route exhibited less intrusion across the sensitive deserts of Western Australia.

- Preferred route commenced immediately east of the Riverside Mine and finished near Poonda Siding on the Mt Newman rail system, within the proposed smelter park precinct. The EWL will utilise the existing Queensland Rail corridor from near the Riverside initiation point to access Abbot Point (via the Newlands Railway and the approved Northern Missing Link from North Goonyella to Newlands). This section was not evaluated by the Quantm model as it follows the existing rail corridor.

- Showed compatibility with the engineering requirements of heavy haul rail, such as maximum gradient and minimum horizontal and vertical curvature. At this early stage the key geometric requirement from an operational viewpoint is maintaining a 1:200 gradient (0.5%) in both directions. The Quantm generated route achieved this, with the majority of the route being under 0.2% grade.

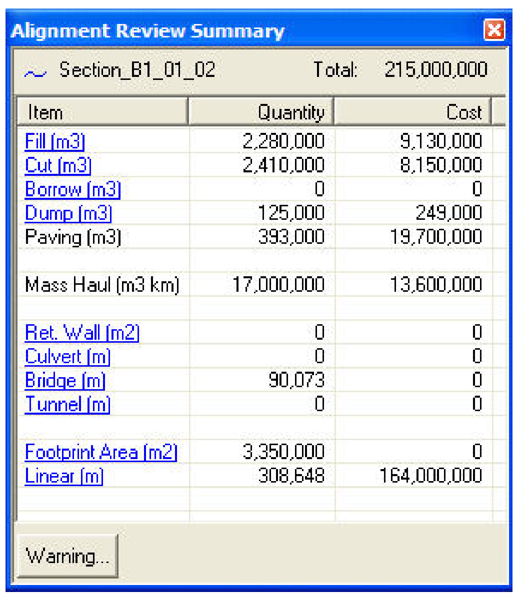
*(Table 9.a) Break down of Gradient for Preferred Northern Route.*

| Category | Grade (%)* | Distance (km) |
|---|---|---|
| I | 0.500 to 0.201 | 480 |
| II | 0.200 to 0.051 | 885 |
| III | 0.050 to -0.050 | 520 |
| IV | -0.051 to -0.200 | 720 |
| V | -0.201 to -0.500 | 500 |
| | Total | **3120** |

## 9.2 Civil works raw cost summary & reports

The Quantm system provides a much improved ability to analyse corridors and alternatives. To investigate rail corridors at a more detailed scale the Alignment Review Summary was used as a cost estimation tool to review the breakdown of construction quantities and costs. A number of consistent observations along the route where noted:

- Cut and Fill quantities provided a close balance within most sections.
- Mass Haul was not extensive in the context of the total comparative construction cost, indicating the system had minimised where possible excess cut and deficits of fill.
- There were very few, if any structures (bridge, tunnel and retaining wall) generated along the route, however this will change significantly when the impact of flooding is considered.
- Typically 70%-75% of construction cost was attributed to the linear cost which is the rail, sleepers and ballast. Due to this high cost penalty, the system tended to straighten out alignments where possible to minimise the route distance, which is also a desirable outcome for trip duration, crew shift considerations and fuel consumption.



Alignment Review Summary

Section_B1_01_02 Total: 215,000,000

| Item | Quantity | Cost |
|---|---|---|
| Fill [m3] | 2,280,000 | 9,130,000 |
| Cut [m3] | 2,410,000 | 8,150,000 |
| Borrow [m3] | 0 | 0 |
| Dump [m3] | 125,000 | 249,000 |
| Paving [m3] | 393,000 | 19,700,000 |
| | | |
| Mass Haul (m3 km) | 17,000,000 | 13,600,000 |
| | | |
| Ret. Wall [m2] | 0 | 0 |
| Culvert [m] | 0 | 0 |
| Bridge [m] | 90,073 | 0 |
| Tunnel [m] | 0 | 0 |
| | | |
| Footprint Area [m2] | 3,350,000 | 0 |
| Linear [m] | 308,648 | 164,000,000 |

Warning...

*(Fig 9. a) Alignment Review Summary Window.*

In addition to the summary window, the system also has comprehensive reporting capabilities detailing location, geometrics, quantities and costs within user-defined intervals. In this study these were used to analyse the gradient along the route. The reporting functionality was also used to create a seamless composite route of the northern preferred corridor from each of the individual corridor sections.

Quantm Alignment Customised Report
Date: 02/07/07 17:55:50

Project: East-West Coal Line
Project ID: 941
Scenario: Section_B1_01
Alignment: Section_B1_01_02

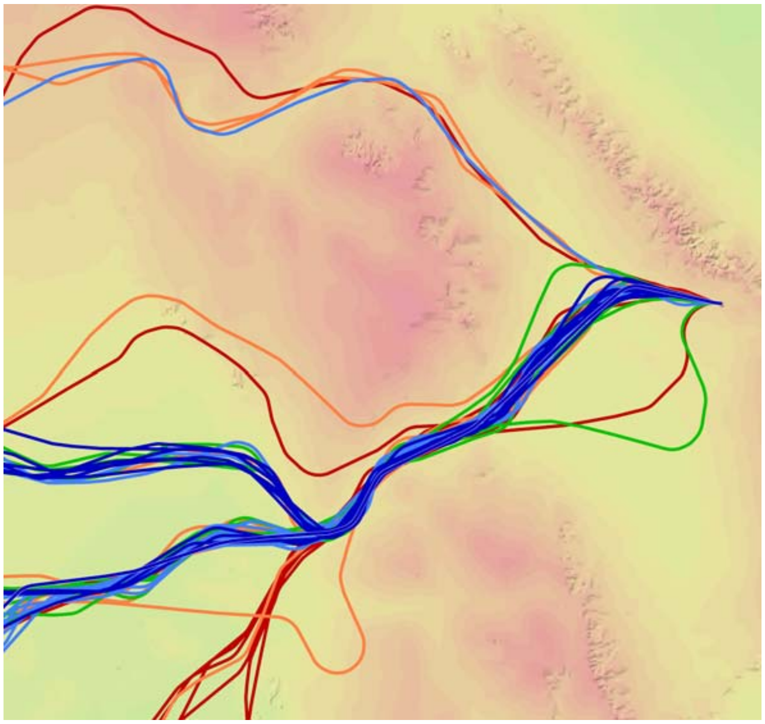
| | | | | | | | | | Local quantities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dist 2D (m) | Dist 3D (m) | X (m) | Y (m) | R.E. (m) | Land (m) | R.E-Land (m) | Bearing (degrees | Grade (%) | H Radius (m) | V Radius (m) | Fill (m3) | Cut (m3) | Pavement (m3) | Mass Haul (m3 km) | Area (m2) | Wall (m2) | Culvert (m) | Bridge (m) |
| 0 | 0 | 4232560 | 6754646 | 352.2 | 344.115 | 8.085 | 275 | -0.31 | -14365 | 581889 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 100 | 100 | 4232460 | 6754655 | 351.8984 | 344.075 | 7.824 | 275.3 | -0.297 | -14365 | 581889 | 15649 | 0 | 180 | 6820 | 3606 | 0 | 0 | 0 |
| 200 | 200 | 4232361 | 6754665 | 351.614 | 344.196 | 7.418 | 275.7 | -0.28 | -14365 | 581889 | 14518 | 0 | 180 | 8303 | 3477 | 0 | 0 | 0 |
| 300 | 300 | 4232261 | 6754675 | 351.3467 | 344.391 | 6.956 | 276.1 | -0.263 | -14365 | 581889 | 12954 | 0 | 180 | 9639 | 3292 | 0 | 0 | 0 |
| 400 | 400 | 4232162 | 6754686 | 351.0967 | 344.41 | 6.687 | 276.5 | -0.246 | -14365 | 581889 | 11813 | 0 | 180 | 10844 | 3152 | 0 | 0 | 0 |
| 500 | 500 | 4232063 | 6754698 | 350.8638 | 343.684 | 7.18 | 276.9 | -0.229 | -14365 | 581889 | 11915 | 0 | 180 | 12018 | 3169 | 0 | 0 | 0 |
| 600 | 600 | 4231963 | 6754711 | 350.6481 | 343.883 | 6.765 | 277.3 | -0.211 | -14365 | 581889 | 12525 | 0 | 180 | 13274 | 3241 | 0 | 0 | 0 |
| 700 | 700 | 4231864 | 6754724 | 350.4472 | 343.707 | 6.741 | 278 | -0.198 | -6624 | 837706 | 11583 | 0 | 180 | 14447 | 3124 | 0 | 0 | 0 |
| 800 | 800 | 4231765 | 6754739 | 350.2583 | 343.625 | 6.633 | 278.9 | -0.186 | -6624 | 837706 | 11623 | 0 | 180 | 15610 | 3128 | 0 | 0 | 0 |
| 900 | 900 | 4231667 | 6754756 | 350.0813 | 344.6 | 5.481 | 279.7 | -0.174 | -6624 | 837706 | 9659 | 0 | 180 | 16644 | 2864 | 0 | 0 | 0 |
| 1000 | 1000 | 4231568 | 6754774 | 349.9163 | 345.35 | 4.566 | 280.6 | -0.162 | -6624 | 837706 | 6444 | 0 | 180 | 17362 | 2387 | 0 | 0 | 0 |

*(Fig 9. b) Alignment Report generated at 100m intervals.*

## 9.3 Alignment sections: Plan, profile and cross sections

The Quantm system has an extensive reviewing capability that allows the operator to display the optimised rail alignment in plan, profile and dynamically in cross section. In this macro-level study these were predominantly used to identify low cost areas of the terrain and other patterns of alignments which can reveal much about potential corridors and the need to stick to certain locations and the freedom to deviate.

For example the figure below shows the rail alternatives clumping into two distinct corridors as they pass through the Great Dividing Range in Queensland. This strongly suggests that, from this particular start point, there are only two narrow passes available to negotiate the range at reasonable costs, however west of this there is more scope to deviate.

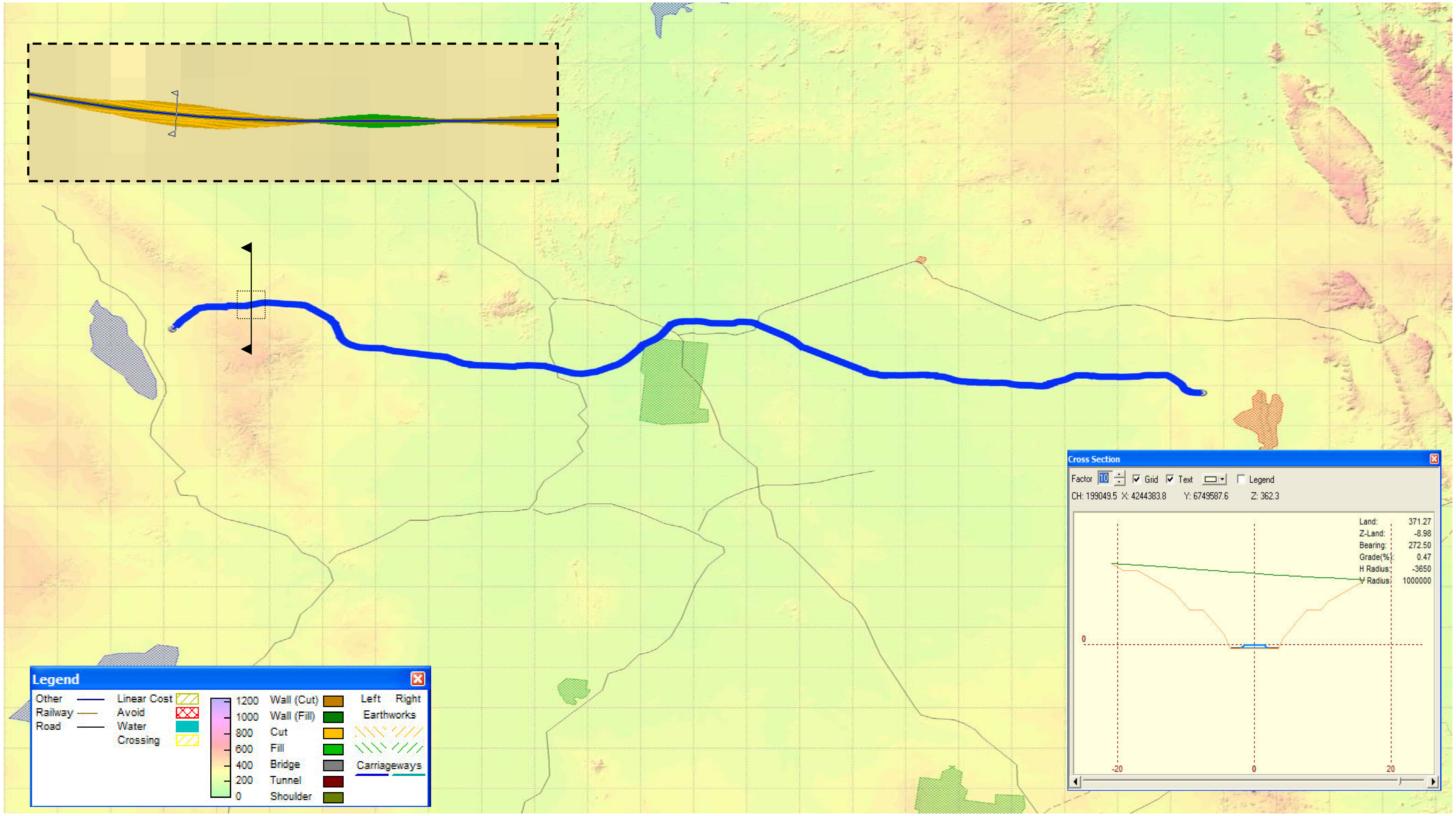


*(Fig 9. c) Two corridors traversing different valleys in Section B.*

In general rail routes converging into a narrow corridor indicates its importance in containing costs, whereas where routes fan out (such as across the deserts areas in Western Australia) indicates that cost is not an important driver in the alignment in plan and therefore provides more flexibility to satisfy other criteria with minimal impacts to costs.

Rail corridor cross sections were studied along the route using the Dynamic Cross Section tool. This allowed the altitude of the centreline to be viewed in relation to the natural surface and provided values of bearing, gradient, radius and horizontal curvature at any chainage along the route. During this study this information was mainly used to gain insight into where rail alternatives were approaching the maximum gradient when traversing difficult terrain, or tight corridor where the minimum radius was being approached.

Mass haul diagrams can also be generated within the Quantm System for each rail alternative showing the magnitude and direction of mass haul. This allows the rail engineer to gain insight into the dispersion of material throughout the alignment and determine where the balance points are.  Figure 10.c shows a typically mass haul diagram generated from an alignment representing the northern corridor in section B. This could be used in future work to identify areas of surplus material or deficit of fill and therefore be used to designate areas for borrow and dump pits.




*(Fig 10.d) Section A of the northern preferred corridor showing alignment in plan and dynamically in cross section.*

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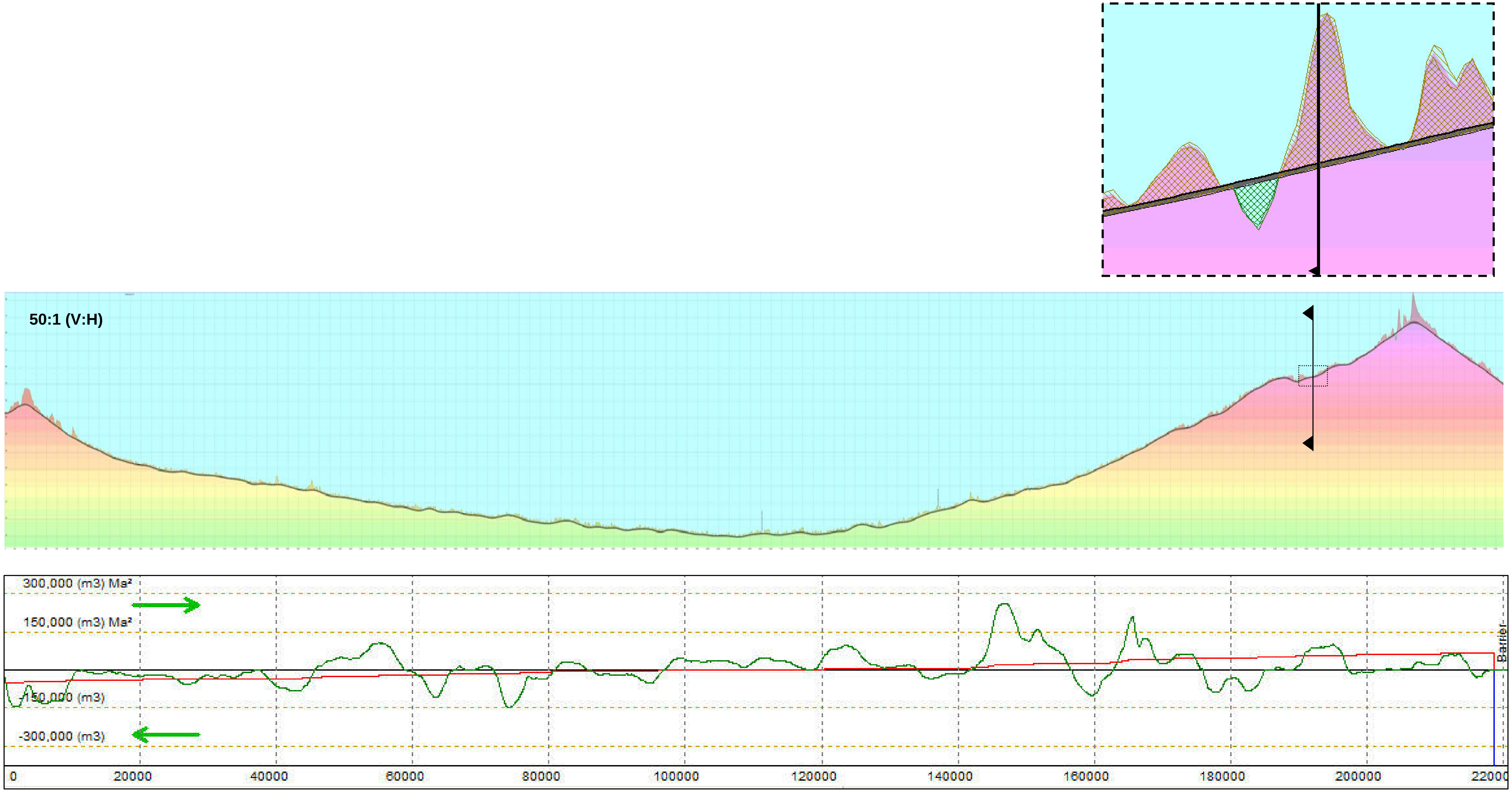
east west line parks pty ltd

**East West Line Parks Pty Ltd**
**Project Iron Boomerang:**
Rail Corridor Identification Pre-feasibility Study

Date 5/2/2007
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Plan**




*(Fig 10.e) Section B of the northern preferred corridor showing alignment in profile and mass haul movement underneath*

QUANTM
A TRIMBLE COMPANY

| No | Revisions and Issues | Date |
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PROJECT IRON BOOMERANG
east west line parks pty ltd

**East West Line Parks Pty Ltd**
**Project Iron Boomerang:**
Rail Corridor Identification Pre-feasibility Study

Date 5/2/2007
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Profile**

# 10.0 Conclusion

## 10.1 General Conclusions

The Quantm system has been used to demonstrate the engineering feasibility of the PIB rail project and had identified key to environmental, geological, mining and land-use constraints. The PIB provides for 3,120km of heavy standard gauge railway from Moranbah in Queensland to near Newman in Western Australia, at a maximum grade of 1:200 and a design speed of 80 km/hr.

QUANTM

A TRIMBLE COMPANY

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# Appendix 12


PROJECT
IRON BOOMERANG
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McKinsey Global Institute




August 2012

# Beyond the boom: Australia's productivity imperative

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MGI research combines the disciplines of economics and management, employing the analytical tools of economics with the insights of business leaders. Our "micro-to-macro" methodology examines microeconomic industry trends to better understand the broad macroeconomic forces affecting business strategy and public policy. MGI's in-depth reports have covered more than 20 countries and 30 industries. Current research focuses on six themes: productivity and growth; global financial markets; technology and innovation; urbanization; the future of work; and natural resources. Recent reports have assessed job creation, resource productivity, cities of the future, and the economic impact of social technology.

MGI is led by three McKinsey & Company directors: Richard Dobbs, James Manyika, and Charles Roxburgh. Susan Lund serves as director of research. Project teams are led by a group of senior fellows and include consultants from McKinsey's offices around the world. These teams draw on McKinsey's global network of partners and industry and management experts. In addition, leading economists, including Nobel laureates, act as research advisers.

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McKinsey Global Institute

August 2012

# Beyond the boom: Australia's productivity imperative

Charlie Taylor
Chris Bradley
Richard Dobbs
Fraser Thompson
Daniel Clifton

# Preface

With a strong banking sector and an enviable unemployment rate hovering just above 5 percent, Australia stands among the fortunate few advanced economies that are currently generating significant income growth. An outsized boom in the resources sector, driven by demand from developing nations in Asia, has led to a surge in income from record export prices and historic levels of investment. But the boom belies a clear decline in Australia's productivity.

The sheer scale of the expansion in mining and energy makes it more difficult to assess the long-run performance and prospects of the economy as a whole. Typically labour productivity is a useful measure of performance and is rightly a focus of national policy. But Australia's recent investment boom has changed the growth equation, placing greater emphasis on the role of capital productivity. Drawing on expertise from 20 years of productivity studies, including a 1995 report on the Australian economy, the McKinsey Global Institute aims to create an analytical framework that acknowledges the complex structural shifts currently under way. This report develops a new method of "growth accounting" that emphasises the distinct roles of capital and labour while also separating the terms of trade (especially rising commodity prices) from output.

How to maximise the benefits of the current resource windfall to Australia's public finances is already a heated topic. While we completely agree that this is an important issue, attention must also focus on ensuring that the nation's underlying prosperity continues. If it doesn't, discussion of how to spend the windfall will be moot. By shoring up productivity *now*, while the benefits of the boom are still accruing, business and policy leaders can position Australia to better withstand external risks beyond its control.

Charlie Taylor, head of McKinsey's Public Sector Practice in Australia, and Richard Dobbs, a director of MGI, oversaw the project. This project was led by Chris Bradley, a partner in McKinsey's Sydney office, and Fraser Thompson, an MGI senior fellow, supported by a project team in McKinsey's Australia office of Ben Austin, Daniel Clifton, Alice Hudson, and Jonathan Humphrey.

We are grateful for the advice and input of many McKinsey colleagues, including Nigel Andrade, Angus Dawson, Parag Desai, Emiliano Di Vincenzo, Ryan Geraghty, Brett Grehan, Jasper van Halder, Duncan Kauffman, Olivier Legrand, John Lydon, Tim McEvoy, Gary Pinshaw, David Pralong, Michael Rennie, and Joseph Tesvic.

Many experts in academia, government, and industry have offered invaluable guidance and suggestions. Our particular thanks go to Martin Baily, Gordon Cairns, Andrew Charlton, Richard Cooper, Diane Grady, Warwick McKibbin, Robert McLean, Mick Reid, and John Stuckey.

The team benefited from the contributions of Josh Dowse; Janet Bush and Lisa Renaud, MGI senior editors, who provided editorial support; Robert Skeffington and Rebeca Robboy for their help in external relations; Julie Philpot, MGI's editorial production manager; and designers Marisa Carder and Therese Khoury.

This report contributes to MGI's mission to help leaders understand the forces transforming the global economy, improve company performance, and work for better national and international policies. As with all MGI research, we would like to emphasise that this work is independent and has not been commissioned or sponsored in any way by any business, government, or other institution.

**Richard Dobbs**
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**Susan Lund**
Director of Research, McKinsey Global Institute
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August 2012

# Past performance

# 6th

among OECD countries in GDP per capita … up from 16th in 1990

**58%** of income growth since 2005 has been driven by temporary boom factors

35% of income growth came from resources … but so did **99%** of the drop in capital productivity

**0.7%** annual decline in productivity between 2005 and 2011 … compared with a 2.4% increase from 1993 to 1999

Kings Canyon, Watarrka National Park, Northern Territory Australia

# Threats and opportunities

If the boom slows and productivity doesn't improve, income growth could potentially drop to **0.5%**

Investment in the resources sector could rise between 50% and **170%**

National income could be **A$90 billion** higher by 2017 if productivity is restored to long-term averages … while up to **A$135 billion** of 2017 income depends on continued strength in investment and terms of trade

# Contents

# Executive summary

Although they may not always feel it, Australians are more prosperous than ever. As recently as 1990, the nation ranked 16th among OECD countries in terms of per capita GDP; just two decades later, in 2010, it stood in sixth place.[1] Australia overtook the United States in terms of income per head back in 2005.

Capitalising on its geography and geology, Australia has been riding the wave of Asia's rapid growth, providing many of the raw materials used to power new industry and build the vast infrastructure needed in China and other emerging markets. As commodity prices have spiked in recent years, Australia has attracted a flood of investment into its mines, processing plants, pipelines, and ports—in fact, there has been greater investment in resource projects over just the past five years than in the previous 20.

Asia's economic and demographic trends point to sustained demand in the decades ahead, but growth fuelled by natural resources carries risk. Australia's reliance on its resource sectors could leave the economy vulnerable to any growth slowdown in China, volatility in commodities markets, and the eventual normalisation of resource prices when supply catches up with demand (or potentially a precipitous drop in resource prices if supply gets *ahead* of demand).

The boom also belies some weaker fundamental trends in the economy that could put Australia's future prosperity at risk unless they are addressed. Notably, growth in labour productivity has fallen to 0.3 percent per annum in the last six years, down from an average of 3.1 percent from 1993 to 1999. This slowdown has taken place at a time of significant wage inflation, with average private-sector weekly earnings growing at 4.4 percent per annum over the same period. Lacklustre labour productivity growth is all the more striking in light of the substantial capital deepening that has taken place in the Australian economy. The amount of capital per hour worked is 25 percent higher today than it was six years ago—yet workers on average are producing only 7 percent more output per hour. Moreover, capital productivity is now a drag on income growth. Improving productivity performance is imperative if Australia hopes to prepare for a future that may not offer the tonic of record investment and export prices.

In this report, we first use a new MGI model for income growth accounting to explore the current dynamics of the Australian economy. We then discuss potential scenarios for future growth through 2017, and home in on individual sectors of the economy to analyse their key growth drivers and better understand what businesses and policy makers might do to maximise productivity and income growth.

We now summarise our main findings.

1 Among nations in the Organisation for Economic Co-operation and Development. Based on per capita GDP, adjusted for purchasing power parity (PPP), using OECD national accounts.

## AUSTRALIA'S CURRENT INCOME GROWTH IS BEING DRIVEN BY A NUMBER OF ONE-OFF FACTORS

The magnitude of the resources boom has distorted perceptions of the economy's overall health. Since 2005, Australia's income has risen 4.1 percent per year, a pace consistent with recent history.[2] But a closer look reveals some troubling trends: Australia has enjoyed this prosperity despite a decline in multifactor productivity of 0.7 percent per year. Indeed, without the one-off factors of an investment surge and high commodity prices, Australia's brisk income growth would have been cut in half—well below what has historically been achieved.

Among the dynamics now at work:

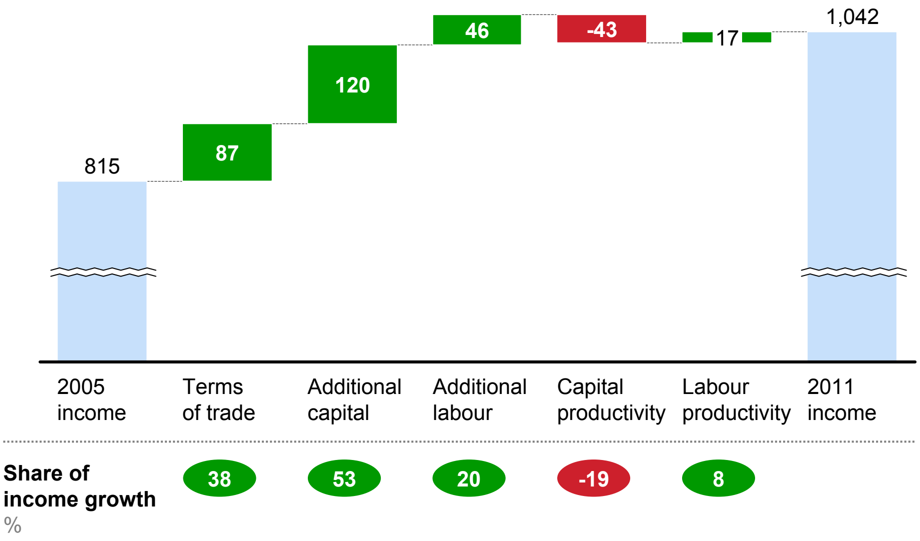
- **Capital investment and the terms of trade, not productivity, are driving growth.** Before the resources boom, productivity delivered at least half of Australia's income growth. But since 2005, both capital and labour productivity have fallen dramatically. More than 90 percent of income growth now comes from Australia's favourable terms of trade (especially the increase in resource prices) and the associated surge in capital investment (Exhibit E1). The terms of trade may be a simple ratio between the prices of Australia's exports and the prices of its imports—but a powerful story is embedded within this number. Historic highs in Australia's terms of trade reflect China's newly voracious appetite for coal and ore, which sent prices for these commodities soaring, as well as the steady flow of cheap manufactured goods shipped from Chinese factories to the Australian consumer.

**Exhibit E1**

**New capital and terms of trade have driven income growth since 2005**

**Gross domestic income (GDI), market sectors, 2005–11**

A$ billion, real 2010




SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

2 This report uses a measure of income called gross domestic income (GDI), which includes the terms of trade. We focus on income rather than GDP in this report to reflect the reality that an economy earns more when it receives higher prices for the goods that it exports and that effective incomes are higher when goods that an economy imports become cheaper, giving consumers greater spending power. For detail, see the appendix, section D, "Measuring Australia's income".

- **10 percent of the economy has driven a third of recent income growth.** Since 2005, a third of Australia's income growth has been generated by a resources sector that accounts for 10 percent of the nation's output and just 3 percent of its direct labour. Resources have absorbed 64 percent of the terms of trade improvement and half of the investment increase. This shift in emphasis has caused huge disparities among both sectors and regions.

- **More than half of recent income growth is due to temporary boom-time effects.** Underlying growth in income is not as significant as the headline number suggests. The biggest one-off impact has been an A$87 billion boost from the terms of trade, but capital deepening (an increase in capital per hour worked above historical rates) also gave an A$39 billion boost.

- **Capital productivity is the biggest drag on growth.** Capital productivity actually lowered income by A$43 billion from 2005 to 2011, or A$53 billion when including the impact of a shift in capital to more productive industries. While A$24 billion of the deterioration can be explained by large investments sunk in projects that have yet to be completed and A$13 billion represents declining yields (a factor that cannot be controlled), A$16 billion in income has been lost economy-wide since 2005 to higher costs and inefficiencies (which can be at least partially addressed).

## IF PRODUCTIVITY GROWTH DOESN'T RECOVER, AUSTRALIA MAY HAVE LITTLE OR NO INCOME GROWTH IN THE FUTURE

The Australian economy has enjoyed uninterrupted annual growth for more than two decades, but that track record is not guaranteed to last. Future income growth hinges on two major factors: 1) the duration and intensity of the resources boom; and 2) productivity growth. This report examines likely high and low projected outcomes for the major drivers behind these two factors and then builds four scenarios based on possible combinations of these results to illustrate a range of potential impacts on Australia's future income growth.

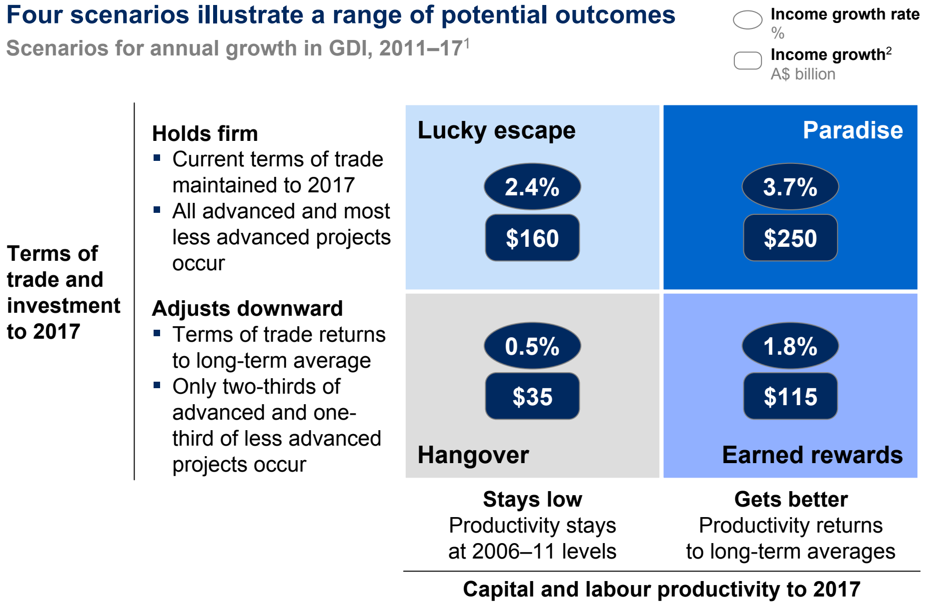
The best possible scenario involves productivity growth returning to its longer-term average, the current terms of trade being maintained, and all advanced capital projects plus three-quarters of less advanced projects coming onstream. Even then, our projections suggest that income growth would amount to 3.7 percent, weaker than its historical rate of 4.1 percent.

But the worst-case scenario is sobering. It involves the terms of trade trending toward their long-term average, only two-thirds of advanced capital projects and one-third of less advanced projects coming to fruition, and no improvement in recent productivity growth. Under those conditions (and excluding any dynamic economic feedback loops that may result from the scenario), there is a risk that Australia could see only 0.5 percent income growth to 2017 (Exhibit E2).

**Exhibit E2**

**Four scenarios illustrate a range of potential outcomes**

Scenarios for annual growth in GDI, 2011–17[1]




1 Adjusted for lagged returns from capital recently added.
2 Difference in income between 2011 and 2017, rounded to the nearest A$5 billion.
SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

Looking ahead to 2017, national income could vary by up to A$135 billion depending on the direction of the terms of trade and the strength of associated investment trends—but unfortunately, Australia cannot control the intensity and duration of the resources boom. It *can*, however, take steps to boost productivity. Although slower income growth is probably unavoidable, improved productivity can ensure a much softer landing if and when the resources boom abates. Returning to good productivity performance can add A$90 billion to national income by 2017.

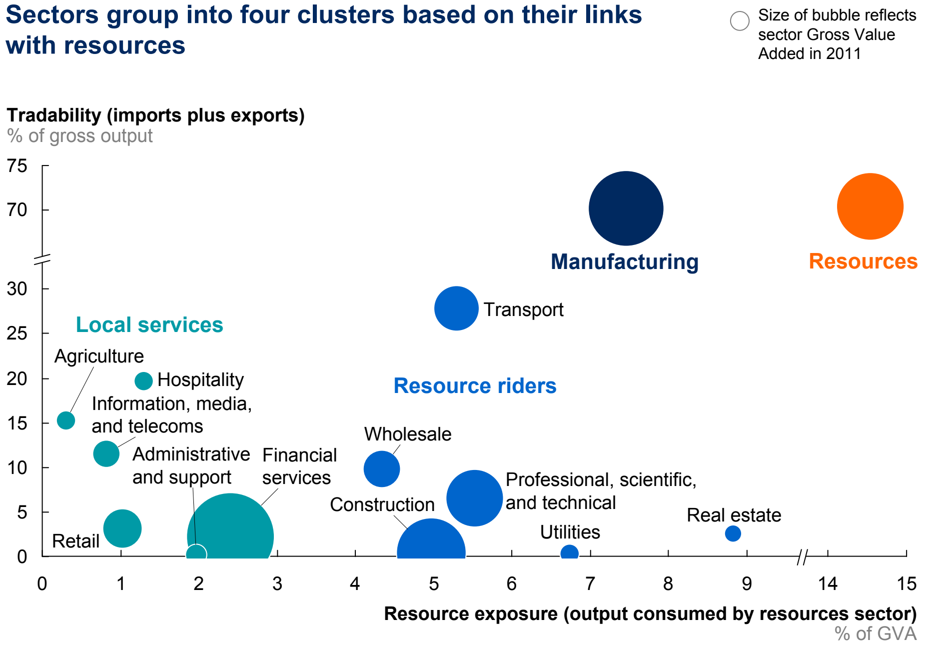
## CAPTURING THE A$90 BILLION PRODUCTIVITY PRIZE REQUIRES ACTION IN FOUR SECTOR CLUSTERS

Before a serious productivity push can begin, it is crucial to understand the particular nature of the challenges facing individual sectors.

Conventional wisdom says that Australia has a two-speed economy: a thriving resources sector versus all other sectors, which are growing more slowly. But our analysis finds it more useful to describe Australia as a four-part economy, with clusters defined by their proximity to the resources boom and their exposure to trade competition (Exhibit E3). When the productivity challenge is viewed through this lens, priority areas for future action begin to come into focus.

Exhibit E3

**Sectors group into four clusters based on their links with resources**




SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

1. **Resource sectors: Drive capital productivity to make good on investment.** Resource sectors have experienced rapid growth but falling capital productivity. Some A$40 billion in new net capital stock was added in 2011, a number projected to rocket to A$71 billion in 2012 and past the A$100 billion mark in 2013. We estimate that Australia is less than halfway through the capital boom; even the lowest projection used in the scenarios for future income growth illustrated in Exhibit E2 predicts that investment in the resources sector over the next six years will exceed the already historic levels posted since 2005. This underscores the urgency of getting capital productivity right; it is a priority area that can reap large rewards in future income growth.[3] Major capital projects are complex undertakings that are prone to inefficiencies and overruns, but the analysis reveals opportunities to boost performance by up to 30 percent. Both individual companies and policy makers can help capture these gains. There is a clear role for government in influencing the time and cost of major resource projects. This includes ensuring that environmental approvals, infrastructure development, and

3 For further commentary, see Ed Shann, *Maximising growth in a mining boom*, Minerals Council of Australia, March 2012.

industrial relations deliver the right balance between development and other social good, and that regulators provide maximum clarity, certainty, and speed to companies while fulfilling their mandates.

2. **Resource rider sectors: Improve efficiency, especially in utilities.** Resource riders, such as transport and professional services, have grown rapidly because of their links with the mining and energy boom, but at the same time, they have experienced a decline in productivity. These sectors attracted the vast majority of the overall economy's increase in labour from 2005 to 2011, but the contribution of labour productivity to sector output fell to virtually zero during this period. This stagnation is especially notable because it occurred in spite of 37 percent growth in net capital stock between 2005 and 2011. Finding new ways to make infrastructure development more cost-efficient and adopting a more integrated cross-sector approach to resource productivity that can reduce the need for expensive new infrastructure will be crucial.

3. **Local services: Recommit to microeconomic reform.** Sectors such as retail trade and telecommunications have been largely unaffected by the resources boom and have posted solid productivity growth (albeit with gaps to international benchmarks). This cluster contributed A$49 billion to income growth in 2005 to 2011. But there is room for further gains, given the average productivity gap of A$32 per hour with the equivalent US sectors from 2005 to 2010. MGI research shows that new operating models within individual companies and sectors (automating supply chains, for example) can boost productivity, as can actions by governments to streamline regulation, encourage innovation, and promote competitive markets. To close the gap, Australia needs to re-embrace the cause of microeconomic reform that drove growth in the 1990s.

4. **Manufacturing: Build the foundation for long-term competitiveness.** Like other developed economies, Australia has experienced a long-term erosion in manufacturing output and employment. Capital productivity has fallen significantly over the past six years and has been only partly offset by gains in labour productivity. But the decline has not been uniform across all subsectors. Unsurprisingly, the subsectors facing the greatest threat from low-cost overseas producers have posted the greatest job losses and the greatest productivity increases. At the same time, productivity growth in more innovative manufacturing sectors has lagged below international benchmarks. Improvement will depend on three factors: further cost efficiencies in those subsectors that compete primarily on price (with a particular focus on the neglected area of management quality); higher labour mobility within the manufacturing sector; and a more supportive ecosystem for innovative manufacturing (the area in which Australia has the best long-term potential to be competitive).

Successful action along these lines could deliver additional national income of up to A$90 billion a year over and above a business-as-usual scenario by 2017.

□ □ □

Thanks to the resources boom, Australia has had strong growth but has also been able to avoid confronting some deteriorating fundamental trends, a luxury that it cannot afford indefinitely. This report describes both the challenge now facing the economy and the size of the prize if productivity is improved. We hope it will also contribute to a constructive debate on the best way to capture that prize and build a more balanced, resilient Australian economy.

# 1. The shifting drivers of income growth

Australia has been largely immune from the high unemployment, sluggish growth, and banking woes that plague other developed economies. It now ranks sixth among OECD nations in GDP per capita, a huge gain from its 16th-place standing in 1990. In terms of income per head, Australia overtook the United States in 2005.

The world's leading exporter of coal and iron ore, Australia is also a major source of minerals such as bauxite, alumina, lead, uranium, and zinc. In addition, the presence of huge reserves and the development of coal seam gas have raised hopes that Australia will soon become a leading global supplier of natural gas. Investment has flooded into the booming resource sectors.

Below the headline figures, however, lurk some worrying trends. Since 2005, income has risen 4.1 percent per year, a pace consistent with recent history.[4] But that growth has been due to Australia's ability to capitalise on its natural endowments of resources at a time of soaring demand from Asia's emerging economies. If not for extremely positive terms of trade and high capital investment, both of which are temporary factors, income growth would have been only half as strong—coming in well below its historical rate. Productivity, the traditional driver of growth, has been weakening to the tune of 0.7 percent a year.

## OVER THE LAST TWO DECADES, PRODUCTIVITY HAS BEEN ECLIPSED AS THE DRIVER OF GROWTH

Australia has enjoyed two decades of brisk income growth. This time frame spans three distinct periods marked by shifts in the dominant contributors that produced a 4 percent annual growth rate (Exhibit 1).[5]

- **"Golden age."** Between 1993 and 1999, Australia reaped the dividends from major economic reforms begun in the 1980s, including floating the dollar, liberalising banks, dismantling wage fixing, reducing tariffs, and granting independence to the central bank. Supported by these reforms, multifactor productivity growth increased at an impressive annual rate of 2.4 percent.

- **"Riding momentum."** The years from 1999 to 2005 saw a slower pace of economic reform and productivity growth decelerating to 0.9 percent. But the terms of trade began to improve, helping to bridge the resulting income gap. This era was characterised by all income factors reverting to roughly their trend levels.

- **"Capital boom."** A remarkable surge in investment and the terms of trade became the engines of Australia's growth from 2005 to 2011. But the

4 This paper uses a measure of income called gross domestic income (GDI). GDI includes the terms of trade and is thus a more complete measure of the economy's well-being than more frequently used measures of production (e.g., GDP, GVA).

5 For detail, see the appendix, section D, "Measuring Australia's income".

prosperity generated by the boom camouflaged underlying problems, as productivity growth declined to negative 0.7 percent per annum.

Exhibit 1

**Australia has grown through three recent eras**

Compound annual growth rate, real values, 1993–2011

%

Above trend[1]
Trend[1]
Below trend[1]

| | | Golden age 1993–99 | Riding momentum 1999–2005 | Capital boom 2005–11 |
|---|---|---|---|---|
| | Income[2] | 4.2 | 4.0 | 4.1 |
| Income drivers | Capital stock | 2.9 | 3.6 | 5.4 |
| | Hours worked | 2.3 | 1.4 | 1.5 |
| | Multifactor productivity | 2.4 | 0.9 | -0.7 |
| | Terms of trade | 0.2 | 4.2 | 7.7 |

1 Based on average growth, 1960–93.
2 Gross domestic income.
SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

## TERMS OF TRADE AND CAPITAL INVESTMENT—BOTH EXPERIENCING TEMPORARY SPIKES—EXPLAIN MORE THAN 90 PERCENT OF RECENT INCOME GROWTH

MGI's analysis looks at the five factors that determine income:[6]

1. **Terms of trade:** The effect of changing prices for imports and exports
2. **Additional capital:** The increase in capital stock
3. **Additional labour:** The increase in the total number of hours worked in the economy
4. **Capital productivity:** The amount of output generated per unit of capital stock
5. **Labour productivity:** The amount of output generated per hour worked

Australia's income has risen from A$815 billion in 2005 to just over A$1 trillion in 2011. More than 90 percent of this growth is attributable to a significant improvement in the terms of trade and to a surge in capital investment (Exhibit 2). Declining productivity in aggregate actually reduced income by 11 percent, while a steady expansion in hours worked explains the remaining 20 percent of growth.

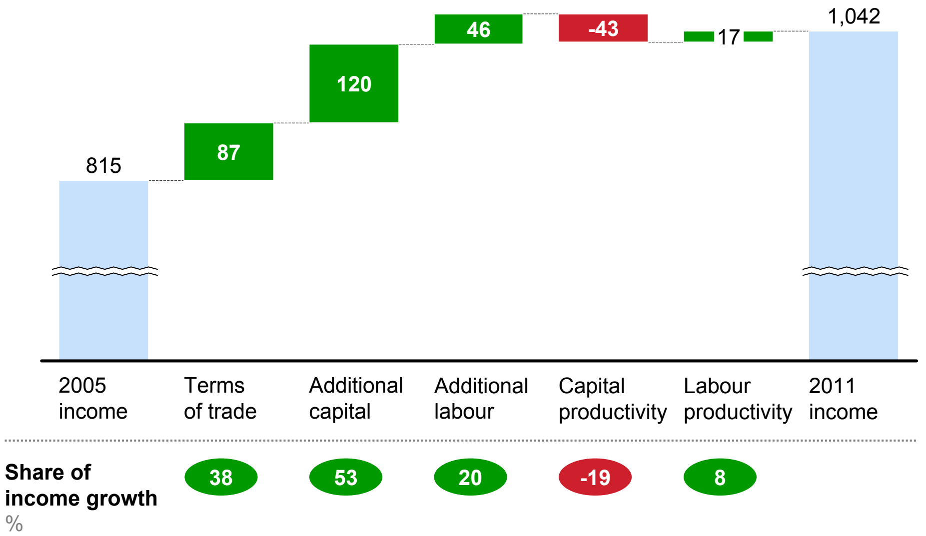
6 These growth decompositions typically focus solely on labour productivity—or, in some cases, on multifactor productivity. However, we found that focusing exclusively on labour productivity is misleading in the Australian context because this metric doesn't take into account the fact that the typical Australian worker now has 25 percent more physical capital available per hour worked than in 2005. For more on the productivity measurements used in this report, see the appendix, section A, "Measuring productivity: Splitting capital and labour".

## Exhibit 2

### New capital and terms of trade have driven income growth since 2005

Gross domestic income (GDI), market sectors, 2005–11

A$ billion, real 2010




SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

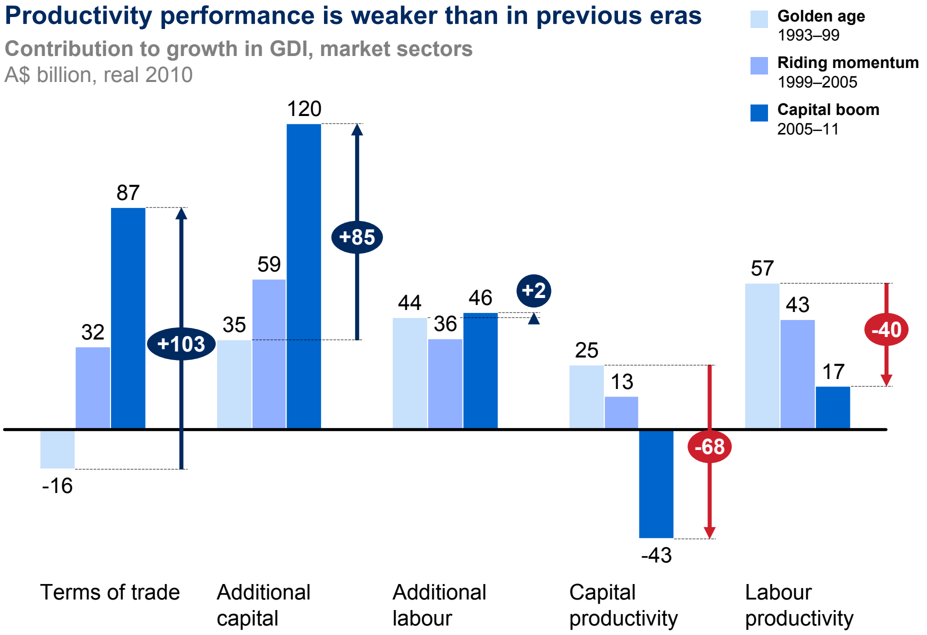
The contributors to income growth have changed significantly since 1993 (Exhibit 3). While labour growth was one steady trend during all three periods, capital and labour productivity together caused a negative A$108 billion swing in income between the golden age (1993–99) and the recent capital boom era (2005–11). In the golden age, capital and labour productivity accounted for A$82 billion of income; during the capital boom, they caused an A$26 billion deterioration (labour productivity slowed to make a weak but still slightly positive contribution, while capital productivity became an actual drag on income). The two major accelerators of growth have been the terms of trade and capital, which together explain an A$188 billion swing in income between the periods 1993–99 and 2005–11.

## Exhibit 3

### Productivity performance is weaker than in previous eras

Contribution to growth in GDI, market sectors

A$ billion, real 2010



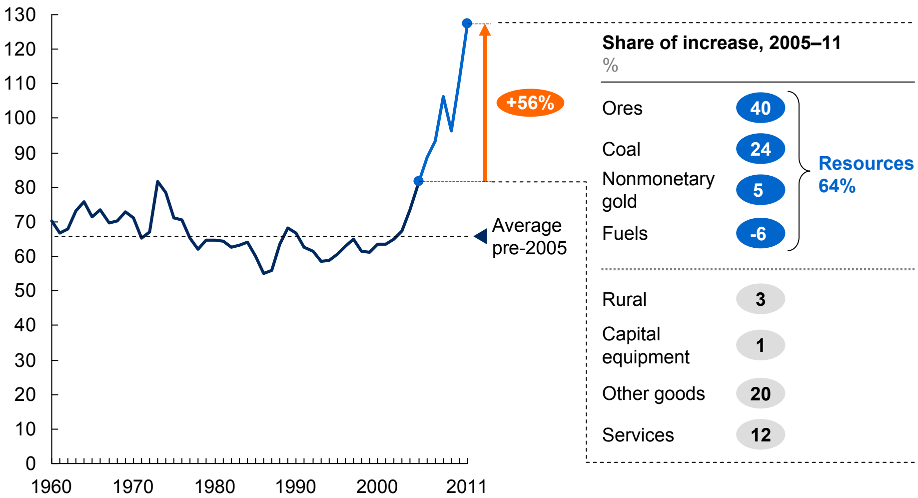

SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

- **Terms of trade.** Over the past decade, Australia has benefited from higher-than-usual prices for key exports, particularly mineral resources (Exhibit 4), while the cost of many of its imported consumer goods and capital equipment has fallen. Underpinning this shift is the extraordinary economic transformation in China and other emerging markets, which has created unprecedented demand for resources and lowered the price of imports (see Box 1, "The new resource era"). As Reserve Bank of Australia Governor Glenn Stevens noted, "In 2005, one shipload of iron ore going to China was worth 2,200 flat-screen TVs coming back the other way. Today, due to the surge in iron ore prices and falling price of TVs, one shipload of iron ore is equivalent to 22,000 TVs".[7] However, the terms of trade dividend will not continue indefinitely. It would take an even further increase from already historically high levels to maintain an ongoing positive impact on income. In the more likely event that the terms of trade maintain current levels or even deteriorate (as per Treasury forecasts[8]), this driver will become neutral for growth at best. At worst, it could drive significant downward pressure on incomes, even if output in the resource sector continues to grow.

Exhibit 4

**Resources have pushed Australia's terms of trade to unprecedented levels**

**Historical terms of trade**
Index: 2010 = 100




NOTE: Numbers may not sum due to rounding
SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

7 Glenn Stevens, "The challenge of prosperity", address to the Committee for Economic Development of Australia annual dinner, November 29, 2010.

8 Budget paper *No. 1: Budget strategy and outlook 2012–13*, Australian government, May 2012.

### Box 1. The new resource era

During the 20th century, the price of key resources, ranging from wheat to steel to oil, fell by almost half in real terms, as measured by the McKinsey Global Institute's commodity index. This was astounding given that demand for different resources jumped from 600 to 2,000 percent as the world population quadrupled and global economic output increased approximately 20-fold. But prices declined thanks to technological innovation and the discovery of new, low-cost sources of supply. Moreover, in some cases, resources were not priced in a way that reflected the full cost of their production (because of energy subsidies or unpriced water, for instance) and externalities associated with their use, such as carbon emissions.[1]

The surge in demand from emerging markets such as India and China has reversed this 100-year decline in just a decade. Growth in these countries is happening on a scale and with a speed that has never before been witnessed. With a combined population of more than 2.5 billion, China and India are doubling real per capita income every 12 and 16 years, respectively. This is about ten times the speed at which the United Kingdom achieved this transformation during the Industrial Revolution—and on around 200 times the scale.

The fundamentals of future demand for Australia's raw materials look strong: the consuming class (urban residents with more than $10 a day in income) will grow by a further one billion individuals by 2025, injecting $20 trillion into the world economy.[2] As demand soars, the cost and difficulty of finding and extracting new sources of supply is also rising, notwithstanding technological improvements. This provides long-term support to resource prices.

However, with the exception of the energy shocks of the 1970s, the volatility of resource prices today is also at an all-time high. Dramatic swings have become the new norm. Compounding the challenge are stronger price and substitution effects among resources, increasing the risk that shortages and price changes in one resource can rapidly spread to others. While the fundamental drivers of the resources boom may be strong, Australia is more exposed to the risks of a complex, volatile market in the short term.

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1 *Resource revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute and McKinsey & Company's Sustainability and Resource Productivity practice, November 2011 (www.mckinsey.com/mgi).

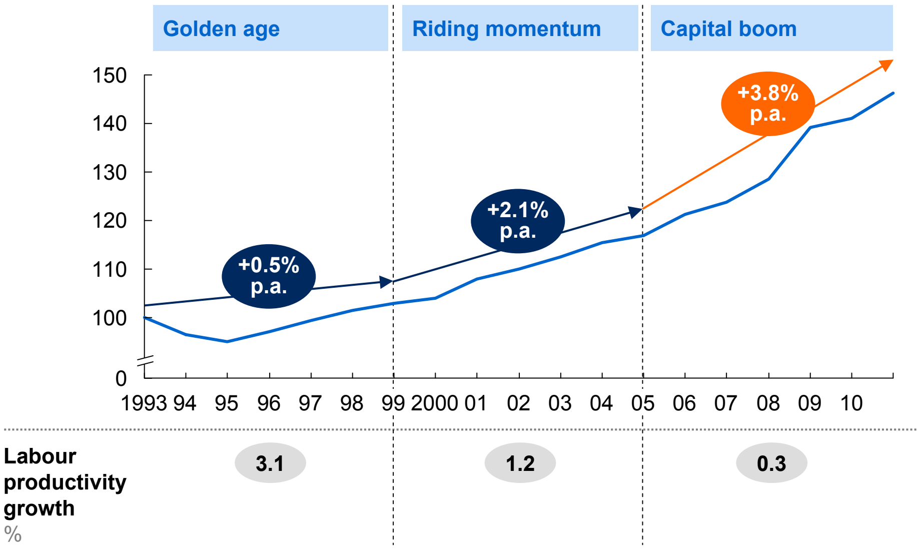
2 *Urban world: Cities and the rise of the consuming class*, McKinsey Global Institute, June 2012 (www.mckinsey.com/mgi).

- **Additional capital.** The most immediate result of Australia's favourable terms of trade has been a flood of new investment in sectors benefiting from higher international prices and demand. Multiple large-scale projects—including new mines, coal seam gas ventures, processing plants, and pipelines—are under way or on the drawing board, with many requiring sophisticated engineering and major construction. Over the 12 years from 1993 to 2005, the amount of capital invested per hour of labour increased by 1.3 percent annually, an effect known as capital "deepening". By comparison, since 2005, capital has been added at a rate of 3.8 percent per year for each hour worked (Exhibit 5). By 2011, 25 percent more physical capital was available per hour worked than in 2005. The recent rate of capital deepening is rare for a developed economy and well above Australia's own long-term trend. While it could persist for some time into the future as resource companies continue to launch large projects, capital investment will eventually slow to its long-term averages (or potentially undershoot them) as resource markets come into balance. Capital investment has been vital to Australia's recent performance, but it cannot be fully counted upon to sustain growth in the future; the part that represents an aberration from long-term trends in capital per worker must be considered a "one-off".

Exhibit 5

**Capital intensity per hour worked began to take off in 2005**

**Net capital stock per hour worked**
Index: 1993 = 100



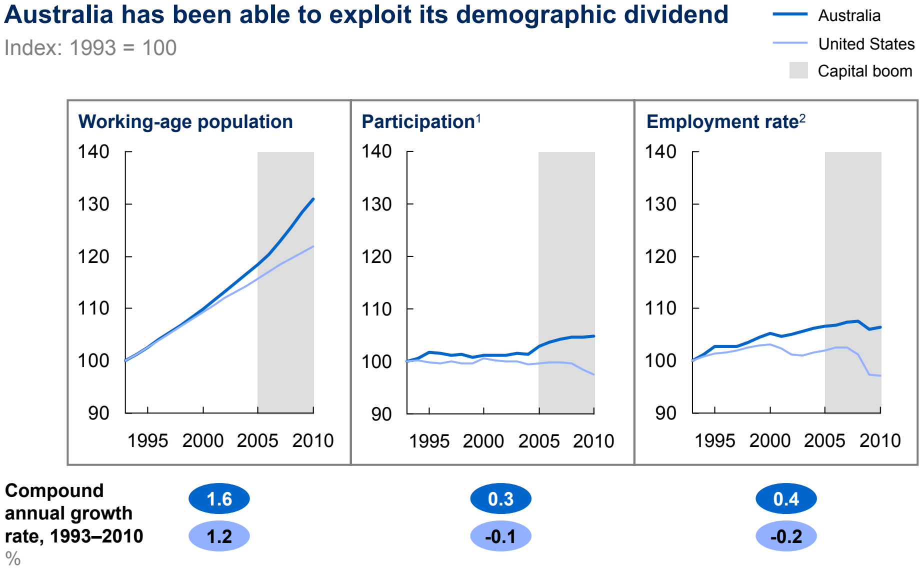

SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

- **Additional labour.** An expanding labour force has continued to be an important part of Australia's growth story (Exhibit 6). Since 1993, labour growth in Australia has been firing on all cylinders with a higher working-age population (which yields a demographic dividend as more people are available to work), a higher participation rate (more people looking for work), and a higher employment rate (more people able to find work). This is a stark contrast to the story playing out in other developed economies such as the United States, which has struggled with slow rates of growth in the working-age population, declining participation, and higher unemployment. Immigration is behind much of the increase in Australia's population: an average of 143,000 immigrants arrived each year between 1993 and 2011, compared with average annual population growth of 130,000 from natural increase. The quantity of labour has been the steadiest contributor to Australia's modern growth, but this contribution is not guaranteed into the future given the nation's aging population.

**Exhibit 6**

**Australia has been able to exploit its demographic dividend**

Index: 1993 = 100




1 Defined as labour force/total working-age population.
2 Employment rate comprises all persons above a specified age who, during a specified brief period, were in either paid or self-employment, as a share of the labour force.

SOURCE: Organisation for Economic Co-operation and Development; McKinsey Global Institute analysis

- **Capital productivity.** A large recent decline in capital productivity led to A$43 billion in total lost income between 2005 and 2011 (or A$53 billion including the impact of capital moving to more productive sectors). Ninety-nine percent (A$42.5 billion) of this loss is attributable to the resources sector. Our analysis finds that A$24 billion of the decline in productivity in the resources sector is due simply to the time lag between investments in major projects and the payoff realised once new capacity actually goes into production. It can take months or even years to complete planning, approvals, and construction on mines, wells, large-scale plants, pipelines, and transport networks, but these projects will eventually be operational. A further A$13 billion of this income loss can be explained by yield depletion.[9] The remaining A$5 billion capital productivity loss in the resources sector is driven by higher costs and inefficiencies, which can be at least partially addressed. This decline is a matter of growing urgency in light of the massive A$443 billion pipeline of projects still to come.[10] We will explore this topic in greater depth in chapter 3.

9 Yield depletion is a phenomenon that cannot be easily controlled. When the most readily available reserves are depleted, mining and energy firms begin to explore and tap sites that are more difficult to access if global demand is strong enough to induce less efficient supply into production.

10 This issue has been identified by the Australian Government Productivity Commission. For example, see Dean Parham, *Australia's productivity growth slump: Signs of crisis, adjustment or both?*, visiting researcher paper, April 2012.

- **Labour productivity.** Labour productivity improvements added A$17 billion to income over the past six years. Although this is a positive contribution, it is weak when compared with the A$57 billion it generated in 1993–99 and the A$43 billion it contributed in 1999–2005. It is especially surprising considering that each worker finished 2011 backed by 25 percent more capital than in 2005 but producing only 7 percent more output. Restoring labour productivity to its role as the primary driver of income growth is critical to ongoing prosperity.

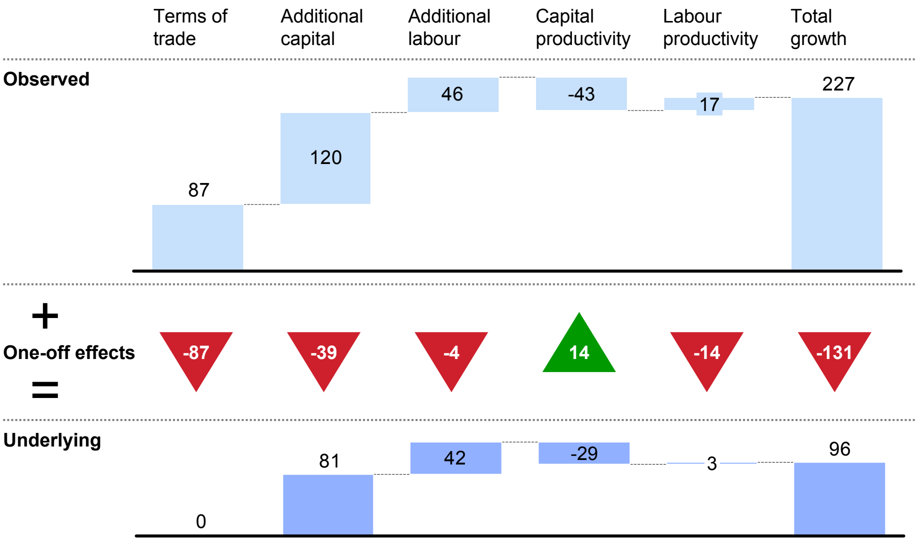
Looking at all five factors and their trend lines, we find that more than half of income growth since 2005 has been driven by transitory effects related to the resources boom (Exhibit 7).[11] The fact that Australia has replaced the steady grind of ongoing productivity improvement with a far more ephemeral formula raises questions about the economy's underlying resilience.

Exhibit 7

**Temporary effects have driven more than half of income growth**

**Income growth 2005–11, market sectors**

A$ billion, real 2010




SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

□ □ □

The factors currently driving Australia's income growth are increasingly temporary in nature and unlikely to be sustained at the same strength in the future. The terms of trade and the capital inflows closely related to them are largely outside Australia's control, while the driver of growth that *can* be influenced—productivity—has been lacklustre. In the next chapter, we examine a range of possible outcomes for these drivers and combine them to construct potential scenarios for Australia's economic future.

11 We arrive at this figure by separating income growth drivers into underlying and one-off factors. For detail on our methodology, see the appendix, section B, "Calculating underlying performance".

# 2. Australia's future income growth: Hard fall or soft landing?

There is no guarantee that Australia's recent pace of income growth will continue. Indeed, our analysis finds that slower growth is likely unavoidable. The key questions that will determine the severity of a potential slowdown are how long the resources boom is likely to last and whether the nation can reverse recent declines in productivity.

In this chapter, we will discuss likely high and low outcomes for both of these factors and combine them into four "what-if" scenarios to estimate a range of potential impacts on growth in Australia's gross domestic income (GDI). Our findings indicate that as the effects of the resources boom moderate, Australia can create a much softer landing by boosting productivity.

## AUSTRALIA'S FUTURE HINGES ON TWO MAJOR UNCERTAINTIES

Australia's growth prospects depend on four of the five key drivers discussed in chapter 1: two related to the resources boom (terms of trade and capital investment) and two related to productivity (capital productivity and labour productivity). The fifth driver, growth in labour, has stayed within a relatively narrow band in comparison with the other more variable drivers and therefore does not have such a large effect on shaping our scenarios.

We can consolidate our perspective on the future around two critical questions:

- **How long will the boom last?** Terms of trade and capital investment are inextricably linked to the duration of booming demand conditions. MGI's analysis of the investment pipeline tracked by the Bureau of Resources and Energy Economics (BREE) suggests that even in the low case, Australia will still experience continued record investment in the short term.[12] In fact, Australia is less than halfway through the investment boom: A$166 billion has been added so far, and at least A$252 billion more is yet to come. These numbers are even more striking given the fact that they include only projects currently identified by BREE. But a huge variation exists between the low case and the high case, which sees capital investment boosted by an additional A$191 billion (Exhibit 8)—and the difference has a major impact on future income growth. Investors' decisions on whether to deploy that additional A$191 billion will be determined by the terms of trade (a sharp decline in resource prices would render some capital projects still in the planning stages unprofitable, leading to delays or cancellations) as well as the cost competitiveness of Australian projects compared with alternative investments overseas. Moreover, lower terms of trade reduce cash flow and therefore the

12 *Mining industry major projects*, Australian Government Bureau of Resources and Energy Economics, April 2012. Projects in the pipeline are characterised as either advanced or less advanced. Oil and gas projects are the major focus of investment for advanced projects, accounting for 69 percent of total project value, while iron ore is 10 percent, infrastructure 9 percent, coal 7 percent, and other commodities 5 percent.

capacity and confidence needed for some of these major investments to take place.[13]

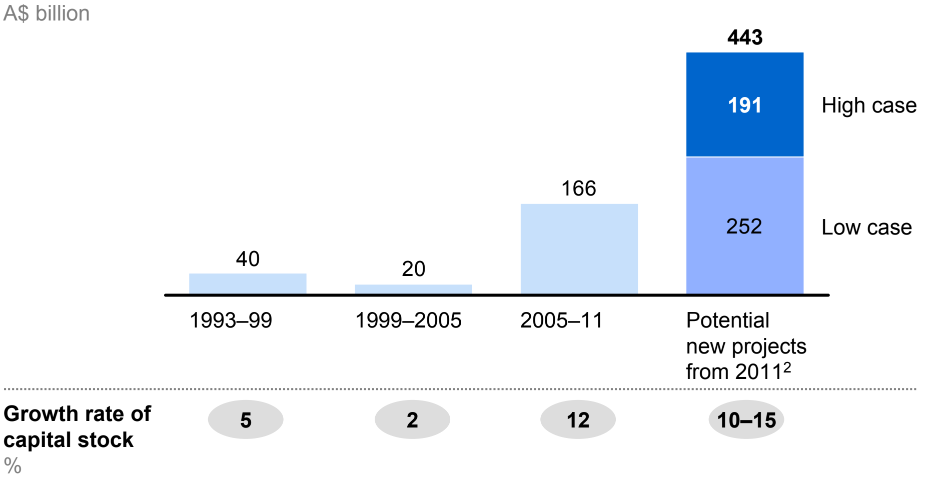
Compounding this investment swing, the terms of trade in and of themselves have a substantial effect on income. Australia experienced a gain to the upside of A$87 billion in income from this effect from 2005 to 2011.

Future movements in the terms of trade are very difficult to predict. However, we can posit reasonable "bookends" to illustrate the range of possible outcomes. The upper threshold involves sustained high prices through 2017, resulting in flat terms of trade. This would require not only continued strong demand but also continued slow and inadequate supply response despite prices being well above the level required to induce investment. The lower threshold is for the terms of trade to revert toward their long-term average, declining by 11 percent by 2017 (the same rate by which they increased from 2004 to 2010). While demand is likely to continue to grow, this case assumes a faster supply response that results in normalisation of prices (as a point of reference, the Australian Treasury forecasts a decline in the terms of trade of 5.75 percent in 2012–13 and 3.25 percent in 2013–14).[14]

**Exhibit 8**

**The scale of future capital projects is high, but uncertain**

**Total value of new capital stock in resources sector**[1]
A$ billion




1 Represents growth in the capital stock in the resources sector, net of depreciation.
2 High case assumes all "advanced" projects and 75 percent of less advanced projects are completed. Low case assumes 66 percent of advanced projects and 33 percent of less advanced projects are completed. No specific time frame is provided for completion of projects in the Bureau of Resources and Energy Economics list.

SOURCE: Bureau of Resources and Energy Economics list, April 2012; Australian Bureau of Statistics; McKinsey Global Institute analysis

- **How will Australia respond to the productivity challenge?** While capital lags and other one-off effects will work through the system over time, the big question remains whether or not Australia can get back on track with productivity. In the high case, we assume that labour productivity grows at 2.1 percent annually (the rate at which it grew from 1993 to 2005) and capital productivity for new projects is 24 percent (defined as value added by capital divided by capital investment), which is still well below the 39 percent

13 Fortunately, the forecast price levels used in resources business cases are typically based on long-run numbers that are below the highs of 2011, so the effect of short-term price volatility is somewhat muted.

14 *Budget paper No. 1: Budget strategy and outlook 2012–13*, Australian government, May 2012.

productivity achieved during 1993–99 because of yield decline. In the low case, we assume 0.3 percent annual growth in labour productivity (the rate from 2005 to 2011) and capital productivity for new projects is 16 percent (the current level of capital return). Australia's ability to boost productivity will directly affect its future income: The analysis shows that restoring both labour and capital productivity to their historic long-run performance trajectory under a high terms of trade scenario could result in A$90 billion in additional income per year by 2017.

## FOUR SCENARIOS FOR AUSTRALIA'S FUTURE INCOME GROWTH ILLUSTRATE A RANGE OF POTENTIAL OUTCOMES

Combining the high and low cases for the outcome of the resources boom and the high and low cases for Australia's productivity responses into all the possible combinations yields four potential scenarios for income growth to 2017 (Exhibit 9).[15] There are infinite possibilities, of course, but these scenarios are useful "what-ifs".

- **"Hangover"** (low case for terms of trade plus low case for productivity). In this scenario, which combines the low cases for both factors, Australia's income would grow at an annual rate of 0.5 percent between 2011 and 2017. Headwinds from reduced terms of trade would put the brakes on Australia's notable gains in prosperity. Though investment would remain at historic levels, at least in the short term, that would not be enough in and of itself to sustain robust income growth, and many projects currently under consideration would not break ground. Note that in this scenario, Australia's GDP growth—which does not reflect changes in the terms of trade—would remain positive.

- **"Lucky escape"** (high case for terms of trade plus low case for productivity). Income would grow at an annual rate of 2.4 percent, about half its recent performance, as firms would have incentive to continue investing heavily in the resources sector. But without improved productivity growth, income growth would largely depend on continuing high prices for Australian commodity exports.

- **"Earned rewards"** (low case for terms of trade plus high case for productivity). In this scenario, we posit a downturn in the terms of trade that would significantly slow Australia's income growth to only 1.8 percent. However, improved productivity growth helps to mitigate this negative shock.

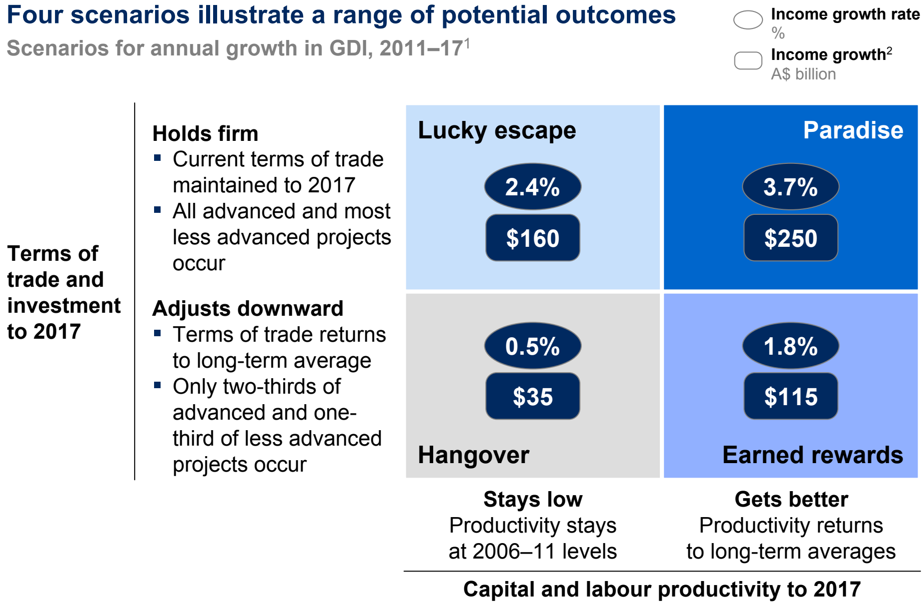
- **"Paradise"** (high case for terms of trade plus high case for productivity). If Australia's terms of trade are maintained and productivity rises, income could grow at a healthy clip of 3.7 percent annually. While this is slower than in the boom years, it represents fundamentally sustainable growth based on better use of capital and labour to generate output. This scenario would create an economy that is more resilient in the face of a global downturn or volatility in commodity prices.

15 Further details on the specific assumptions used in the scenario analysis can be found in the appendix, section E, "Assumptions underpinning the scenario analysis".

Exhibit 9

**Four scenarios illustrate a range of potential outcomes**

Scenarios for annual growth in GDI, 2011–17[1]




1 Adjusted for lagged returns from capital recently added.
2 Difference in income between 2011 and 2017, rounded to the nearest A$5 billion.
SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

There are two notes regarding methodology to keep in mind when interpreting the results. First, these are scenarios and not forecasts. We characterise the high and low cases for each factor that goes into the scenario as "bookends". We have attempted to outline a range of feasible outcomes for critical aspects of Australia's future growth looking toward 2017, but we do not represent these as model-driven forecasts.[16] Second, the results incorporate only the primary impacts of the factors considered and do not include any dynamic equilibrium adjustment for additional economic effects that may result from the scenarios themselves. For example, we do not attempt to calculate the effect of a potential global reduction in ore supply as a result of lower prices, which could cushion a fall in Australia's terms of trade.

## THIS UNCERTAINTY BRINGS THE PRODUCTIVITY IMPERATIVE INTO SHARP FOCUS

This scenario analysis produces three major implications for Australia:

- **Income growth is likely to moderate.** Australia does not achieve its recent levels of income growth in any scenario. To match recent income growth would require further improvement in the terms of trade, an outcome that cannot be assumed. Our best-case assumption is that commodity prices stay at current high levels, with any greater demand offset by new supply coming online. If, however, the terms of trade deteriorate, Australia's income growth would slow significantly. Improved productivity growth offers a way to mitigate this potential negative shock, as shown in the "earned rewards" scenario.

- **The duration of the boom is of crucial short-term importance.** The continuation of the boom, with its attendant high investment and high terms

16 In terms of probability, it could be argued that lower terms of trade would induce higher productivity benefits (as low-yielding projects may be cancelled), and vice versa, so the "hangover" and "paradise" scenarios may be less likely than the other two scenarios.

of trade, makes a bigger difference to income growth than does productivity between now and 2017. The difference between the high and low cases for terms of trade and investment is a 1.9 percent swing in annual income growth, or up to A$135 billion of income per year at risk by 2017. Restoring productivity growth to its longer-term average makes a 1.3 percent difference, delivering up to A$90 billion in 2017 income.

- **But productivity is critical for longer-term prosperity.** Because the intensity and duration of the resources boom cannot be controlled, boosting productivity is Australia's central challenge. Improving productivity growth is by no means easy, but this change could be set in motion by any number of forces, including international competition in sectors that are able to respond, a return to normal terms of trade that shifts capital and labour to more productive sectors, or a renewed focus by firms and government on innovation and improvement.

□ □ □

The degree to which Australia can boost productivity will have a major impact on future income growth. Capturing the full growth potential will require a forensic understanding of the dynamics and challenges in different sectors of the economy. In the next chapter, we take a sector-by-sector look at the issues affecting productivity performance.

# 3. The productivity challenge of a four-part economy

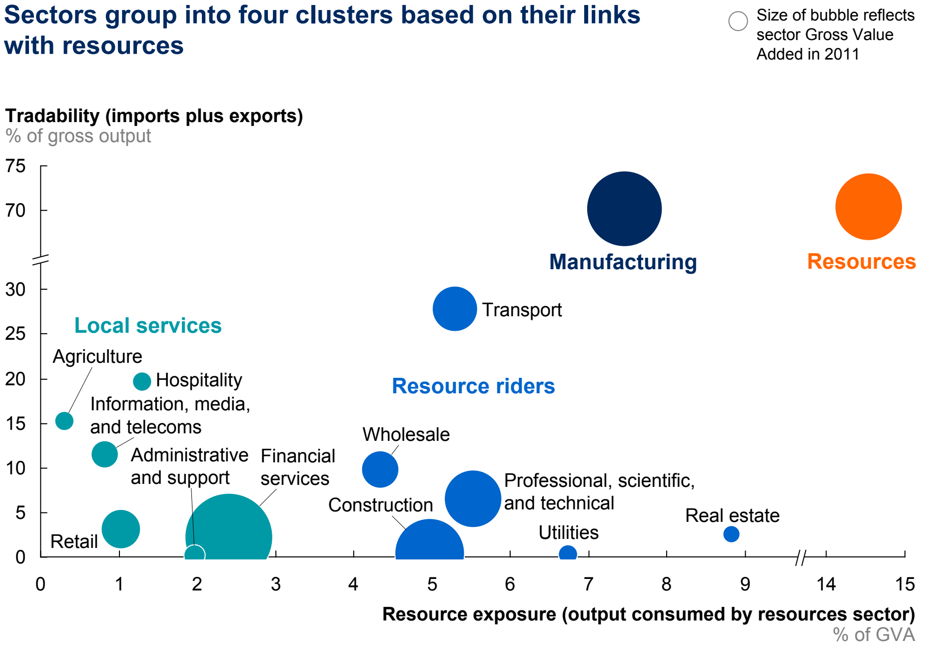
Australians often speak of their "two-speed" economy, made up of a rapidly growing resources sector and everything else, which is expanding more slowly. Much debate tends to focus on how other sectors can benefit from the resources boom or whether they have been crowded out by it.

However, we find this a somewhat oversimplified view of the Australian economy. If we examine sectors on the basis of their exposure to a surge in mining activity and high exchange rates—the two major factors of the boom—we find that Australia has a four-part economy. The first variable used to define the four clusters of sectors was their "resource exposure"—the proportion of output consumed by the resources sector.[17] The real estate sector, for example, has the highest exposure, with almost 9 percent of its income coming directly from the resources sector. The second variable was "tradability"—a sector's imports and exports combined as a share of its total gross value added. A higher share indicates that the sector is more sensitive to changes in Australia's exchange rates and terms of trade.

We have called the four sector clusters that result from this approach "resources", "resource riders", "local services", and "manufacturing" (Exhibit 10). This chapter aims to understand the specific productivity challenges faced in each of these clusters.

**Exhibit 10**

**Sectors group into four clusters based on their links with resources**




SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

17 This is an imperfect proxy because it ignores other transmission channels between resources and other sectors (e.g., higher wages from mining resulting in greater demand for consumables), but it is the best readily available measure of the strength of these linkages.

The drivers of growth vary widely by group (Exhibit 11). Resources, resource riders, and local services all achieved output growth of 3.4 to 3.5 percent but in very different ways. Resources and resource riders absorbed huge inflows of inputs but delivered poor productivity performances. Moderate amounts of new inputs went into local services, but this group delivered much better on productivity than the other clusters. Manufacturing, meanwhile, suffered a contraction in labour as well as poor productivity to post annual output growth of just 0.4 percent over the boom era.

Exhibit 11

**The four clusters have varied in their economic performance over the past six years**

2005–11

Contribution to GVA growth
A$ billion

Compound annual growth rate
%

| | | Additional capital | Additional labour | Capital productivity | Labour productivity | Total |
|---|---|---|---|---|---|---|
| Resources | A$ billion | $55 | $10 | -$41 | -$6 | **$18** |
| | % | 11.7% | 10.5% | -7.3% | -6.3% | **3.5%** |
| Resource riders | A$ billion | $32 | $31 | $4 | $0 | **$67** |
| | % | 5.3% | 3.0% | 0.0% | -0.6% | **3.4%** |
| Local services | A$ billion | $18 | $6 | $13 | $12 | **$49** |
| | % | 3.3% | 1.1% | 2.1% | 1.0% | **3.4%** |
| Manufacturing | A$ billion | $10 | -$4 | -$13 | $9 | **$2** |
| | % | 3.7% | -1.3% | -4.8% | 2.8% | **0.4%** |
| Market[1] | A$ billion | **$119** | **$46** | **-$43** | **$17** | **$140** |
| | % | **5.4%** | **1.5%** | **-1.5%** | **0.3%** | **2.7%** |

1 Market total includes two small sectors—arts and recreation and "other"—that are not part of the clusters.
SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

This chapter examines each of the four sector clusters in turn, highlighting their unique productivity challenges.

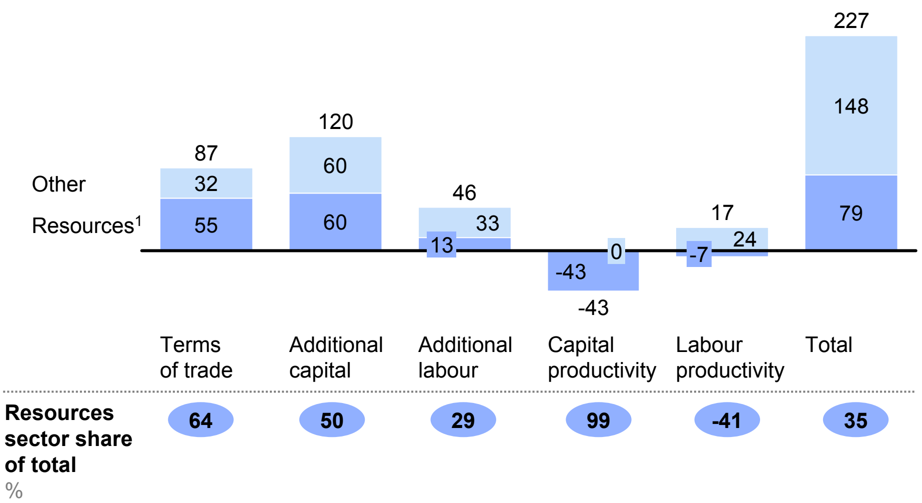
## RESOURCES: CAPITAL PRODUCTIVITY IS THE KEY CHALLENGE

The resources sector accounts for 10 percent of Australia's economic output and just 3 percent of its labour but has generated 35 percent of Australia's income growth since 2005. This sector has captured 64 percent of the improvement in the terms of trade and half of the increase in capital investment (Exhibit 12). The resources boom has also created huge regional disparities in economic performance (see Box 2, "Uneven growth, unevenly shared").

Exhibit 12

**The resources sector has been a large driver of recent income growth**

**Growth in GDI 2005–11, market sectors**
A$ billion, real 2010




1 Represents extractive industries including mining, and oil and gas.
NOTE: Numbers may not sum due to rounding.
SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

## Box 2. Uneven growth, unevenly shared

One implication of the predominant role played by the resources industry in Australia's growth has been the uneven distribution of economic activity across states. Whether viewed in terms of hours worked, capital invested, or final demand, Western Australia and Queensland have grown more quickly than their eastern seaboard counterparts.

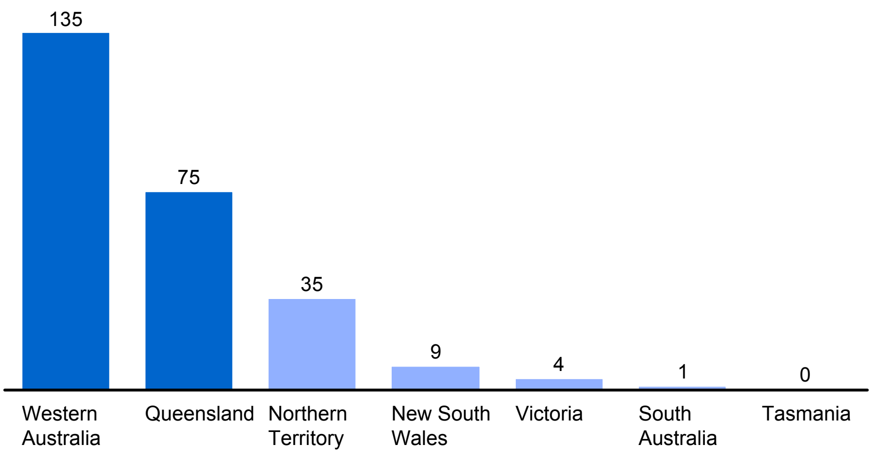
Private capital investment in Western Australia grew at a remarkable 12.1 percent annually between 2005 and 2011, compared with just 2.4 percent in Victoria and 1.4 percent in New South Wales. Growth in labour was also higher in resource-rich states, though the differences were less marked: 2.8 percent in Western Australia and 2.3 percent in Queensland compared with 2.2 percent in Victoria and 1.4 percent in New South Wales.

This booming growth is also reflected in demand: Western Australia represented 11 percent of total final demand in 2005 but accounted for 25 percent of its growth to 2011. This is largely driven by the large share of advanced projects based in the state (Exhibit 13).

### Exhibit 13

**81 percent of advanced projects are in Western Australia and Queensland**

**Total value of advanced projects in resources by state**
A$ billion




SOURCE: Bureau of Resources and Energy Economics list, April 2012; McKinsey Global Institute analysis

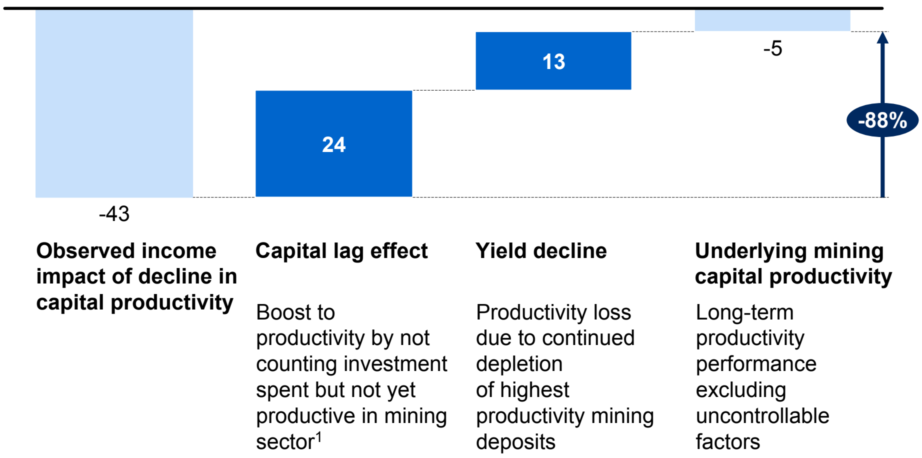
However, while favourable terms of trade have provided strong momentum, they have also obscured a brewing problem: the sector accounts for around 99 percent of the national decline in capital productivity. This means that while resources have added significantly to Australia's income since 2005, the number could have been much higher. More than 70 percent of the higher income generated by increased capital and labour has been swallowed up by lower productivity. Because the resources sector has become such an outsized driver of Australia's economy, shoring up its flagging capital productivity is crucial to achieving sustained national income growth.

When we look at the range of factors that may contribute to this fall in capital productivity, we find that the decline is not as large as the headline figure suggests. Most of it can be attributed to capital lag effects (with the benefits of some investment still to be realised in the future) and declining yields (which have a serious impact, but cannot be easily controlled). Setting aside these factors, we estimate that the resources sector has still experienced a A$5 billion decline in income as a result of lower capital productivity (Exhibit 14). While this is substantially lower than the headline figure of A$43 billion, it points to a real underlying issue—particularly when compared with past performance.

Exhibit 14

**Capital lag and declining yields explain most of the decline in mining capital productivity**

**Income growth contribution, 2005–11**
A$ billion, real 2010 dollars




1 Includes non-dwelling construction in mining lagged by five years and machinery and equipment lagged by three years.
NOTE: Numbers may not sum due to rounding.
SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

Between 1999 and 2005, Australia added A$3 billion in new capital stock each year on average. In 2011, that number had rocketed to A$40 billion. But even that surge in investment could be dwarfed by what is set to come. As shown in Exhibit 8, planned investment in the resources sector totals A$443 billion.

Since Australia now relies heavily on investment as a driver of growth, ensuring that this new capital is maximised efficiently will be critical for long-term income generation. In fact, improving capital productivity in Australia is important to ensuring that these projects are launched at all. There is a difference of A$191 billion between the low and high cases of planned investment (as shown in Exhibit 8). Higher capital productivity can improve the economics, and thus the competitiveness, of Australian resource projects. This is particularly important if global demand growth slows. The investment pipeline has been amassed during an era of low interest rates and global liquidity. But in the long term, access to capital may prove more challenging. Past MGI research has found that while a three-decade decline in global investment helped drive real interest rates down to their pre-crisis lows, an impending worldwide investment boom may drive rates higher over the next two decades.[18]

The potential for tighter financing terms in the future underscores the need to make sure that all investment that is currently committed is as productive as possible. Major capital projects in the resources sector are exceptionally complex undertakings, prone to cost overruns and delays caused by inadequate value optimisation, inefficient regulatory approval processes, agency failures (contractual arrangements and incentive schemes that fail to sufficiently align the interests of owners with those of advisers), and a shortage of talent. When commodity prices are high, an operational project may yield such lucrative returns on investment that there is solid business justification for rushing to completion. But without historically high prices, the focus must turn back to maximising the efficiency of operations for the long haul.

The huge size of the current project pipeline means that improving capital productivity in the resources sector could offer large rewards. Based on 23 recent projects completed by McKinsey in Australia and overseas, we estimate that opportunities exist in the resources sector to boost capital productivity by around 30 percent by addressing these barriers (see Box 3, "Improving capital productivity in major projects"). Widespread adoption of proven best practice techniques in the resources sector could free up between A$50 billion and A$133 billion for potential reinvestment in additional projects within Australia. This additional capital stock, at historical rates of capital productivity in the resources sector, would generate between A$8 billion and A$34 billion for the Australian economy each year, which translates to 0.6 to 2.3 percent of additional GDP.

Realising this potential will require resource firms to rethink their approach to capital management, focusing on value improvement at every project stage. There is also a clear role for government in influencing the time and cost of major resource projects. This includes ensuring that environmental approvals, infrastructure development, and industrial relations deliver the right balance between development and other social good, and that regulators provide maximum clarity, certainty, and speed to companies while fulfilling their mandates.

18 *Farewell to cheap capital? The implications of long-term shifts in global investment and saving*, McKinsey Global Institute, December 2010 (www.mckinsey.com/mgi).

## Box 3. Improving capital productivity in major projects

Past McKinsey work has identified three critical underlying drivers of capital productivity:

- **Top-level focus on value:** The global champions in capital productivity display a continuous improvement mindset that focuses on capturing all value-creation opportunities during the life of a project. Those mindsets are often reinforced by the introduction of top-down targets on final production cost to balance the engineering objectives against cost considerations, and strong performance management to ensure minimum leakage and deviation from these plans.

- **Adoption of a best-practice "tool kit":** High-performing companies generally employ a well-structured optimisation tool kit. Far from being a mere checklist, the tool kit is more of a "how-to guide" to extracting value from an asset. It provides the process for reviewing an investment end-to-end as well as the analytical tools to identify value opportunities. Key tools include: (a) concept and design optimisation, using techniques like system balance, design-to-cost, and minimum technical solutions; (b) flawless construction and approvals involving idea-generation processes, tight performance management, and visual management; (c) ramp-up acceleration deploying preventive problem-solving techniques before issues arise; (d) procurement optimisation that draws on lowest-cost-country sourcing, clean sheet costing, and best-of-best benchmarking; and (e) a contracting strategy that defines the role of the owner's team for optimal risk allocation and establishes the contractual foundations to drive continuous improvement.

- **Project team with superior execution skills:** All companies aspire to have the best talent on their projects. Unfortunately, Australian firms are finding that talent with experience in major projects is in short supply. High-performing companies have focused on investing in internal capability development, as well as on partnering with companies with complementary needs to address internal capability gaps while maintaining aligned incentives with the asset owner.

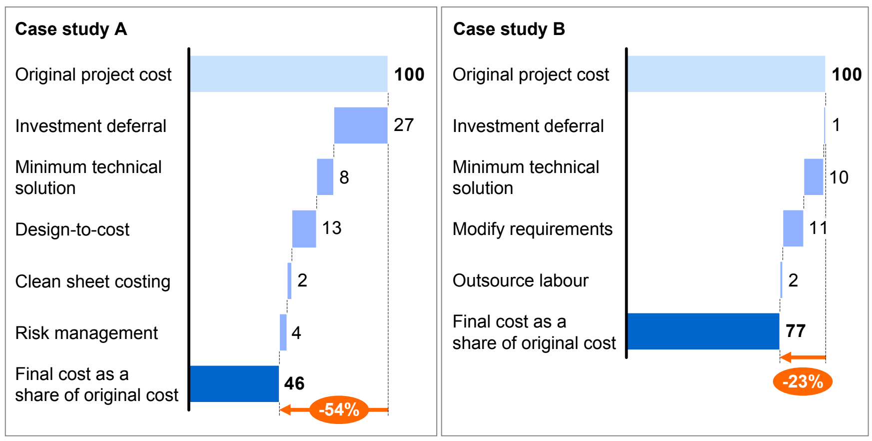
Employing these techniques can lead to significant savings. In one example, optimisation techniques allowed a project team to reduce the original estimated cost of a large-scale infrastructure build-out by more than 50 percent (Exhibit 15). In another case study, the cost of a complex resources project was reduced by more than 20 percent thanks to a rigorous focus on value creation on the part of the senior management team that led to re-scoping the original project design (Exhibit 15). A third example saw the productivity of the construction crew for a major resources project double through the adoption of lean construction techniques, thereby reducing costs and accelerating the project's time to completion.

### Exhibit 15

**Case studies have demonstrated the potential to generate savings of more than 20 percent from the use of best-practice capital productivity tools**

SELECTED EXAMPLES

**Project capital savings by lever**
Index: 100 = Original project cost




SOURCE: McKinsey Global Institute analysis

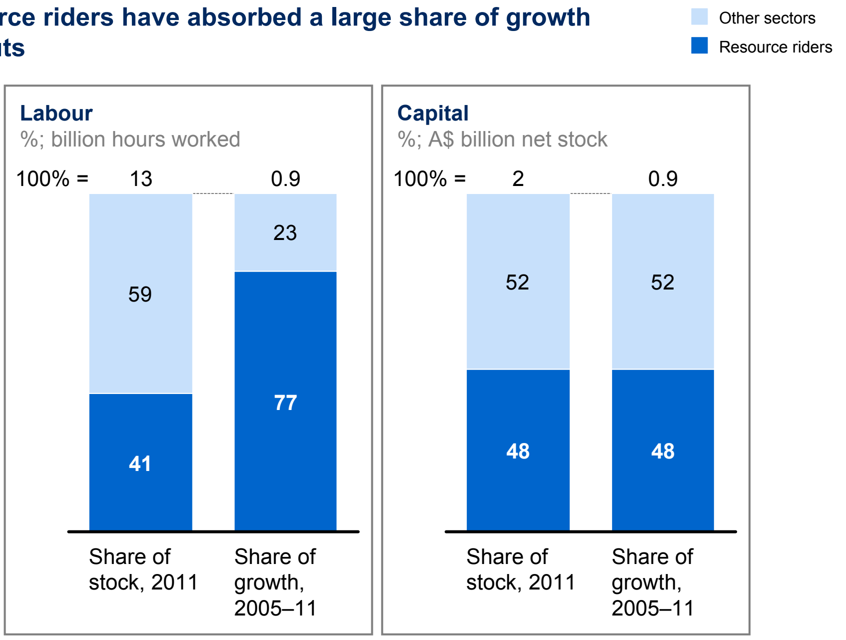
## RESOURCE RIDERS: UTILITIES, IN PARTICULAR, NEED TO REFOCUS ON PRODUCTIVITY

Resource riders include transport, construction (conducted outside resource firms but often for the benefit of the resources sector), professional and technical services, real estate, wholesale goods, and utilities. This varied group shares high exposure to the resources sector and moderate to low import competition. This cluster has built on strong momentum from the mining and energy boom, but its rapid growth has been accompanied by a worrisome decline in productivity. The performance of individual sectors has been mixed. However, looking at the group as a whole, combined income growth from productivity of labour and capital declined from A$25 billion added from 1993 to 1999 to only A$4 billion added from 2005 to 2011.

The major culprit has been labour productivity. These sectors have attracted the vast majority of the overall economy's increase in labour, increasing their combined total hours worked by 919 million (or 19 percent) from 2005 to 2011 (Exhibit 16). However, the contribution of labour productivity to sector output has fallen to virtually zero during this period.

Exhibit 16

**Resource riders have absorbed a large share of growth in inputs**




SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

This fall in labour productivity is particularly notable because it occurred in spite of large capital investment. These sectors have invested heavily to take advantage of the resources boom, increasing their net capital stock by 37 percent between 2005 and 2011—double the rate observed in our next cluster, local services. However, the impact of this increased investment has not yet led to higher labour productivity.

Within the resource riders group, the utilities sector (including energy and water) stands out for its sluggish productivity performance. Recent analysis by the Australian Productivity Commission has found that multifactor productivity growth in the utilities sector was strongly negative between 1997–98 and 2009–10 (falling, on average, by 3.2 percent per year).[19] But the analysis shows that the story is more complex. One factor driving down performance is the effect of cyclical investment; the cost base has been increased by expenditures that have yet to yield their benefits. Utilities have also invested in unrecorded quality improvements (such as the shift to underground cabling) and reducing their environmental impact by moving away from coal power. For electricity suppliers, the largest subsector, customers' need to beat the heat has been a vexing issue: spikes in power usage during midday hours, when consumers turn on their air conditioners en masse, have dramatically increased the ratio between peak use and average use, driving up costs for capacity that sits idle at cooler times of the day.

When new capital investment in mining and energy projects eventually slows, the resource riders will once again have to look to productivity gains as a source of future growth. Among the priorities, finding new ways to make infrastructure development more cost-efficient and adopting a more integrated cross-sector approach to resource productivity that can reduce the need for some expensive new infrastructure (for example, addressing food waste to save water and energy) will be crucial.

## LOCAL SERVICES: MATCHING INTERNATIONAL PRODUCTIVITY BENCHMARKS WILL REQUIRE FURTHER MICROECONOMIC REFORM

The local services group, which includes sectors such as retail trade and telecommunications, has neither high exposure to resources nor significant import competition. It accounts for a major share of the Australian economy: 42 percent of hours worked, 40 percent of value added, and 25 percent of capital stock. This cluster has not benefited as much from the boom as the resource riders category, but neither has it faced the full impact of higher exchange rates and low-cost import competition that have affected manufacturing.

The productivity of these sectors has been reasonably healthy, with solid gains that predate the resources boom. Capital productivity has been growing at 2.1 percent per year while labour productivity has been growing at 1.0 percent per year, making an A$25 billion contribution to income growth from 2005 to 2011. Indeed, this is the only cluster that has improved both capital and labour productivity.

Nevertheless, sectors within this group lag behind international best practice, and a comparison with their US counterparts reveals an average gap of A$32 per hour in labour productivity (Exhibit 17).[20] Past MGI research shows that changes

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19 *Productivity in electricity, gas and water: Measurement and implementation*, Australian Government Productivity Commission staff working paper, April 2012.

20 There are methodological issues with cross-country sector productivity comparisons, and MGI has traditionally preferred to use operational-level metrics (e.g., number of cars produced per worker when estimating automotive productivity). However, in the absence of operational-level metrics, these estimates can be used as rough indicators of relative productivity levels. The results were found to be broadly consistent when compared to estimates deived from EU KLEMS data (www.euklems.net), which user sector-level price data to convert sector value-added measures into common currencies.

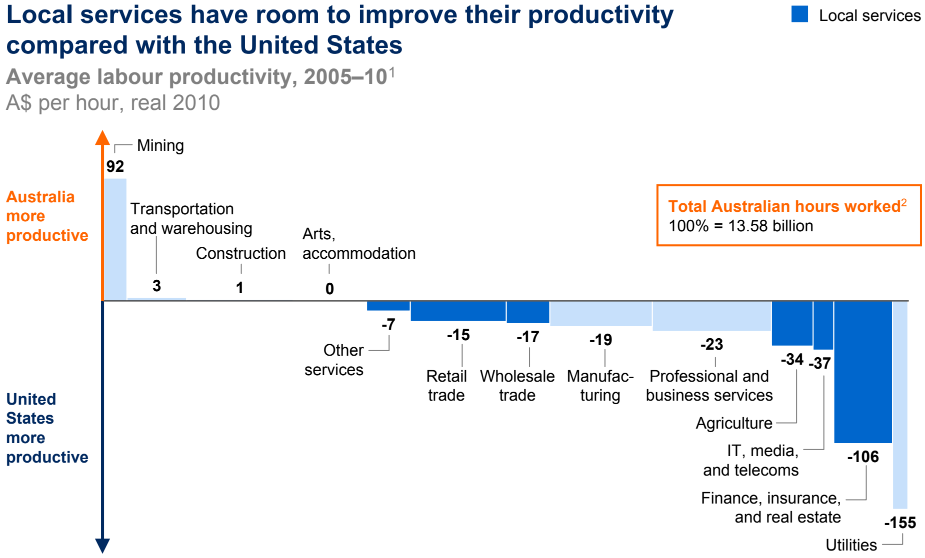
in operating models within individual companies and sectors (e.g., supply-chain automation) can have significant productivity benefits. In addition, a concerted effort by policy makers to streamline regulation, encourage innovation, and promote competitive markets can boost productivity. To close the gaps between these sectors and their international counterparts, Australia needs to re-embrace the cause of microeconomic reform, which drove so much of its growth in the 1990s.

Exhibit 17

**Local services have room to improve their productivity compared with the United States**

**Average labour productivity, 2005–10**[1]

A$ per hour, real 2010




1 Attributes all output to labour inputs (i.e., does not include differences in capital inputs).
2 Includes private sectors only, weighted by Australian hourly sector weights (2010).
3 The real estate sector is considered a "resource rider" in the Australian context but cannot be separated from finance and insurance in the US source data.

SOURCE: US Bureau of Economic Analysis; Australian Bureau of Statistics; McKinsey Global Institute analysis

## MANUFACTURING: THERE IS POTENTIAL FOR REALISING GAINS IN KEY SUBSECTORS DESPITE A BROADER SECULAR DECLINE

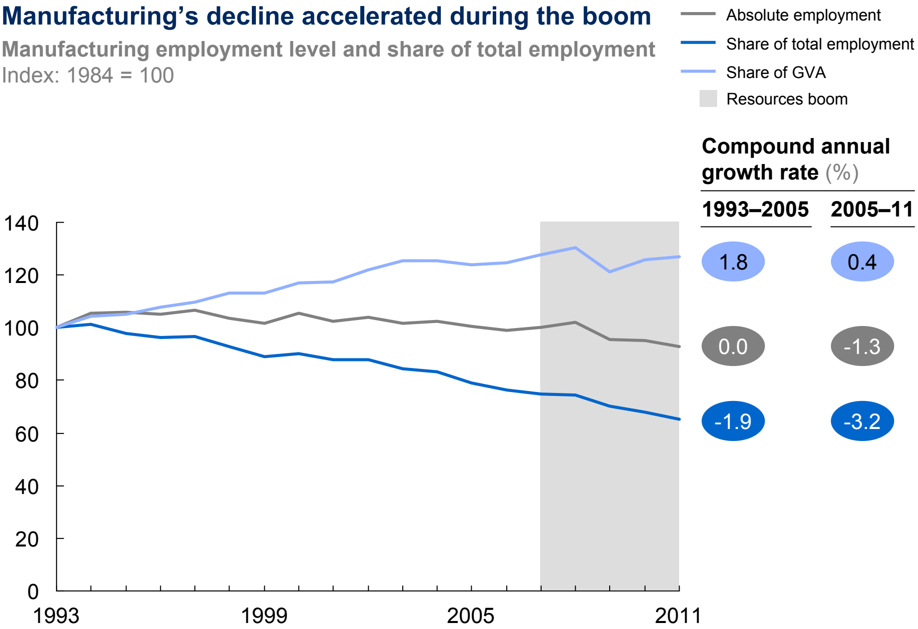
Like other developed economies, Australia has experienced a long-term secular decline in manufacturing (Exhibit 18). Capital productivity has fallen significantly over the past six years and has been only partly offset by gains in labour productivity. Moreover, manufacturing firms have lost skilled talent to the resources and resource-rider sectors. While the erosion has accelerated over the last few years, it reflects fundamentally long-term and international trends, and cannot be attributed to the resources boom.

The decline in manufacturing has not been uniform across subsectors.[21] To improve our understanding of the factors driving productivity in this cluster, we have divided manufacturing into five categories defined by the nature of their competitiveness challenge.[22] These are (1) innovation-driven sectors such as aerospace and pharmaceuticals that rely on heavy technologies and have long R&D cycles; (2) strongly branded sectors including publishing that are dependent on brand image and sustained through innovation in design and concept; (3) location-based sectors such as food manufacturing that depend on proximity to customers; (4) somewhat exposed sectors such as automotive and electrical machinery that depend on quality but also face cost pressures; and (5) highly exposed sectors including apparel and consumer electronics that are largely driven by cost.

**Exhibit 18**

**Manufacturing's decline accelerated during the boom**

**Manufacturing employment level and share of total employment**
Index: 1984 = 100




SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

Using this segmentation, we find that the subsectors that face the greatest threat from low-cost overseas producers have suffered the biggest job losses (Exhibit 19). These losses have occurred despite significant efforts to improve efficiency. Labour productivity in these sectors grew by an average of 4 percent between 1995 and 2005 (although this growth still lagged behind the productivity gains of counterpart sectors in the United States). Subsectors that are less

21 Even at the subsector level, the picture is not homogeneous. The Productivity Commission noted that "there appear to be islands of competitive advantage within almost all broad manufacturing categories": *Trends in Australian manufacturing*, Australian Government Productivity Commission, August 2003. An Australian House committee noted that "Clothing production now only accounts for less than 3 percent of manufacturing and what remains is increasingly high-end fashion or specialist wear such as fire-resistant clothing": *Australian manufacturing: Today and tomorrow*, House of Representatives Standing Committee on Economics, Finance, and Public Administration, July 2007. The Future Manufacturing Council identified significant potential for such niches even within the textiles manufacturing subsector, including smart protective textiles for the military and emergency services and textile composites for aerospace, automotive, and marine: *Trends in manufacturing to 2020*, Future Manufacturing Industry Innovation Council, September 2011.

22 This approach builds on analysis from *Reinvigorating industry in France*, McKinsey Global Institute, October 2006 (www.mckinsey.com/mgi).

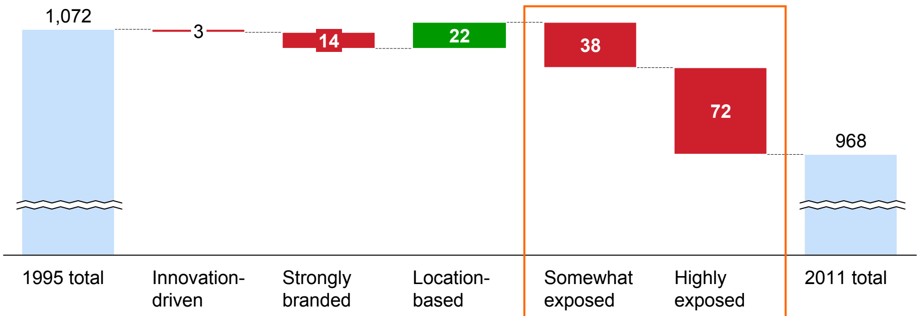
exposed to international competition have experienced more modest job losses but have posted weaker productivity gains.

Exhibit 19

**Job losses have been greatest in exposed sectors**

**Change in manufacturing employment, 1995–2011**

Thousand




| | Innovation-driven | Strongly branded | Location-based | Somewhat exposed | Highly exposed |
|---|---|---|---|---|---|
| **Example sectors** | Transport equipment; pharma-ceutical | Publishing | Printing; food and beverage | Automotive; metals and machinery | Apparel; consumer electronics |
| **Employment** | | | | | |
| 1995 | 89 | 61 | 204 | 418 | 301 |
| 2011 | 86 | 47 | 226 | 379 | 229 |

NOTE: Numbers may not sum due to rounding.
SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

Although there is a lack of recent data on the productivity performance of Australian manufacturing subsectors, a comparison of all five manufacturing categories to various international benchmarks from 1995 to 2005, using available evidence, unearths some disturbing trends. Labour productivity growth in all five categories lagged behind that of their counterparts in the United States. The gap was particularly pronounced in innovation-driven sectors, where US productivity growth was 1.5 percentage points higher per year (4.9 percent versus 3.4 percent) during this period. To strengthen the long-term competitiveness of its manufacturing sector, Australia will need to tackle a number of issues, including encouraging further innovation in technology-driven manufacturing sectors, promoting labour mobility in the manufacturing sector, and addressing management quality concerns (see Box 4, "Management matters").

□ □ □

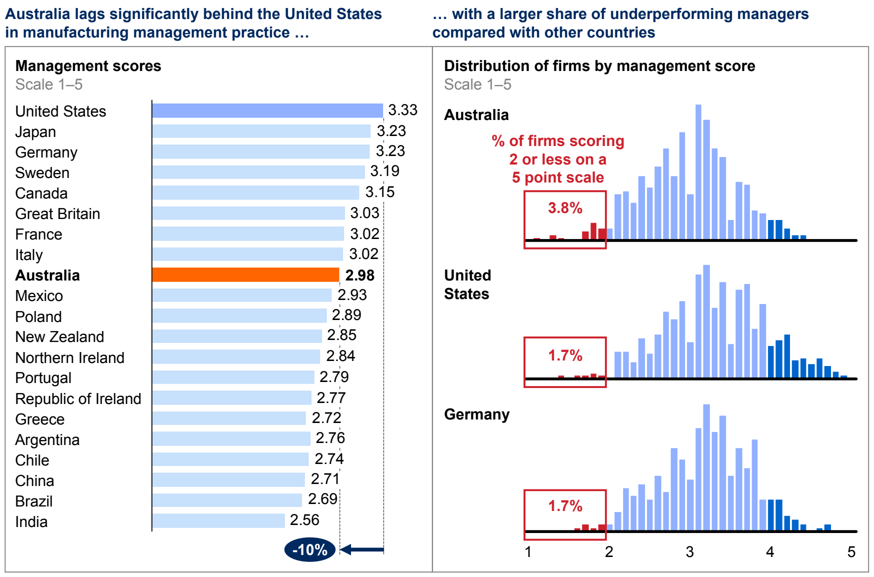
Securing Australia's future prosperity will require a renewed focus on boosting productivity, innovation, and efficiency—and each sector faces unique challenges that will have to be addressed. But successful action along these lines could deliver additional national income of up to A$90 billion per year over and above a business-as-usual scenario by 2017.

## Box 4. Management matters

McKinsey, together with the Centre for Economic Performance at the London School of Economics, has examined the relationship between management quality and firm performance. Interviews were conducted at more than 6,000 manufacturers across 21 countries, focusing on lean operations, performance management, and talent management.[1] This research reveals that Australia has a larger tail of low-performing firms than other advanced economies—Australian scores were 10 percent lower than US scores on average, for instance—and a shortage of managers with university degrees (Exhibit 20). Left unaddressed, this problem is poised to grow more acute over time, since present difficulties in attracting skilled employees to manufacturing points to a shortage of future management candidates. Already, manufacturers worry that "the senior technical staff and the manufacturing managers of the future won't be available because they have not been developing their skills and experience in the industry".[2]

### Exhibit 20

**Management practice could be improved in some Australian manufacturers**




SOURCE: McKinsey and Company, Management Matters 2008, 2009; McKinsey Global Institute analysis

1 Nick Bloom et al., "Management practice & productivity: Why they matter", *Management Matters*, November 2007.

2 *A more competitive manufacturing industry: Management and workforce skills and talent*, Australian Industry Group and University of Technology, Sydney, February 2012.

# Conclusion: Thinking beyond the boom

Australia has a complex relationship with the coal, ore, and minerals beneath its soil. While this wealth of natural resources has fuelled enviable income growth, it has also caused distortions across the economy—and to a certain extent, it has allowed Australia to avoid confronting its deteriorating fundamentals.

Thanks to the prosperity generated by the resources boom, Australia's productivity problem has not been acutely felt—yet. But the good luck might not last forever. Yes, economic and demographic trends in the developing world point to sustained global demand for resources in the decades ahead, but there is risk in relying heavily on a single sector (especially one marked by extreme short-term price volatility) to deliver growth.

The determinants of past income growth are not assured into the future. The continuation of the incredible growth story in China and other emerging markets can only sustain the terms of trade at current levels, not increase them further. In a worst case, growth in the developed world slows and Australia's terms of trade and investment slow with it.

Australia has a window of opportunity to insure against a potential slowdown by addressing the productivity of both capital and labour. A major focus on capital productivity is crucial to maximise the unprecedented investment that has flooded into mining and energy, ensuring that it pays dividends in the years ahead. And across the broader economy, business and government leaders can tackle key priority areas to encourage innovation and build a more competitive workforce.

We estimate that a concerted effort to shore up productivity could deliver a major prize, adding up to A$90 billion in national income per year by 2017. Beyond that potential gain, the rewards could be even more lasting: meeting the productivity challenge could build a more balanced and resilient economy that is better prepared to meet changing conditions and market opportunities in the years ahead.

# Appendix: Methodology



## A. MEASURING PRODUCTIVITY: SPLITTING CAPITAL AND LABOUR

Productivity is the growth in outputs generated through efficiency, rather than through adding more inputs. It arises through improvements in technology as well as social capital.

Multifactor productivity, calculated and reported by the Australian Bureau of Statistics (ABS), is the most sophisticated approach to measuring this. It takes into account the fact that in a modern (nonagricultural) economy, output is the result of the two primary factors of production: labour and capital, which are combined and in many situations are substitutable. It is calculated by attributing a share of output to capital and a share to labour, and then combining the weighted productivity of each share according to the amount of capital and labour used to produce each respectively.

This report uses multifactor productivity as the basis of all its analysis. Income weights to labour and capital used in this report have been derived by the ABS using a Cobb–Douglas production function methodology.

But throughout this report, values for labour productivity and capital productivity are presented separately, as are their respective contributions to growth in output and income. This separation relies on the same income attribution produced and used by the ABS, with the distinction that rather than being combined to a single measure (multifactor productivity), they are reported as separate series.

This separation ensures that effects such as capital deepening (which would improve labour productivity) are stripped out of the results. It gives a clearer view of the underlying or intrinsic performance of productivity for each of the two fundamental factors of production.

When we talk about inputs in this report, we use volume-based measures: hours for labour and volume measures of capital. This approach excludes the fact that the real dollar cost of labour (wages) and capital (priced fixed capital formation) may diverge from volume-based measures over time. Divergences between volume-based measures and price-based measures of performance are dealt with in section C below.

The issue of declining productivity in the Australian economy has received wide comment, with the Reserve Bank of Australia, the Productivity Commission, and the Australian Treasury weighing in with analysis.[23]

Recently, debate has emerged on the issue of whether the decline in productivity primarily afflicts the resources sector or is more widespread across sectors. In its 2010–11 annual report, the Productivity Commission estimated that approximately 80 percent of the decline in multifactor productivity was attributable to just three sectors: mining, agriculture, and utilities. This number compares productivity growth between 1999 and 2004, and then between 2004 and 2009.

Since then, Saul Eslake calculated that removal of the mining and utilities sectors from an overall assessment of labour productivity resulted in only a 10 percent reduction in the decline in growth, hinting at a labour productivity issue that was much more widespread.[24]

These two assessments need not be contradictory. The labour productivity lens used by Eslake in his research indeed demonstrated a productivity issue across sectors that we discuss in this report. However, this perspective isolates labour without considering the impact of capital deepening and productivity on the multifactor result.

Multifactor productivity growth, as calculated by the Productivity Commission (drawing on ABS data) represents the growth in output attributable to both capital and labour. Our results support the importance of capital as part of the overall productivity story. Splitting output into its labour and capital components shows a greater reduction in capital performance than in labour, and a prominent role for mining in driving the reduction in capital productivity over the last six years.

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23 Ellis Connolly and David Orsmond, *The mining industry: From bust to boom*, Reserve Bank of Australia research discussion paper number 2011–08, December 2011; *Annual report 2010–11,* Australian Government Productivity Commission, October 2011; and David Gruen, “The macroeconomic and structural implications of a once-in-a-lifetime boom in the terms of trade”, speech delivered to the Australian Business Economists Annual Conference in Sydney, November 24, 2011.

24 Saul Eslake, “Productivity: The lost decade”, paper presented to the annual policy conference of the Reserve Bank of Australia in Kirribilli, August 2011.

## B. CALCULATING UNDERLYING PERFORMANCE

In Exhibit 7 and throughout this report, we distinguish between observed and underlying performance. The purpose of this distinction is to understand how much of the recent contribution to income from various factors has been based on temporary or cyclical factors. With that knowledge in hand, we can try to assess how much of that growth may continue into the future. For each of the five major components of income growth, we define temporary effects as follows:

- **Additional capital:** Capital has been added to the economy at a rate well above the long-term trend.
- **Additional labour:** A$4 billion of the growth in income from additional labour is attributable to increases in the participation rate—a factor that cannot be repeated in the long term to provide additional labour force growth.
- **Capital productivity:** Of the observed downturn in capital productivity, A$24 billion is attributable to the temporary effect of capital lag (the time lag between the investment of new capital and when it begins to actually produce output).
- **Labour productivity:** Of the observed income boost from labour productivity improvement, A$6 billion was attributable to changes in the sector mix rather than intrinsic within-sector improvement.

## C. VOLUME VERSUS PRICE-BASED CAPITAL PRODUCTIVITY MEASURES

We base our analysis of productivity on volume measures of input and output: hours worked for labour, gross fixed capital formation, and net capital stock. This allows us to isolate the impact of the terms of trade. While the volume-based view is suitable for macroeconomic analysis, a price-based view that values inputs and outputs drives business investment decisions.

The difference between these two metrics is most marked in sectors such as agriculture, manufacturing, and resources that heavily export or import goods. Changes in the terms of trade may mean that realised income differs significantly from volume-based, gross value added measures. In other sectors, realised income is very close to sector value added as recorded by the ABS.

Resources experienced the largest divergence between headline productivity and income of any sector. The price-related income boost from ore and coal alone generated A$80 billion of additional income between 2005 and 2011. Despite declining headline productivity, rising prices triggered an investment boom. However, the prices of capital inputs have also risen. In the Australian economy overall, real prices for capital goods have been relatively flat since the early 1990s, but the resources sector has had capital price inflation of about 3 percent per year since 1990. From 2005 to 2009, the rate nudged toward 5 percent, although it has since started to wane once again. In a sector where more than 70 percent of multifactor inputs are capital, these developments have significant implications for the sector's future income prospects. See chapter 3 for a more detailed discussion.

## D. MEASURING AUSTRALIA'S INCOME

Throughout this report, we draw a distinction between "output" and "income". Output is a measure of the actual production or consumption of the economy. GDP and gross value added (GVA) are both measures of output. These metrics are adjusted for changes in the prices of goods produced to reflect "real" changes in how much is being produced in the entire economy (in the case of GDP) or in a particular industry (in the case of GVA). Measuring output is useful because it provides us with a view of the efficiency or productivity of production, which is a key topic for this report. A company may become more profitable if the prices of what it produces rise. But if that company requires more inputs for a certain amount of production, it has still become less productive.

By comparison, income measures reflect the reality that an economy earns more income when it receives higher prices for the goods that it exports and that effective incomes are higher when goods that an economy imports become cheaper. In Australia, the ABS measures income as GDI (GDP adjusted for changes in the relative prices of imports and exports).[25]

There are limitations to the way income is measured. GDP and GDI are assumed to be equal for the previous year, so only one year's worth of deviation is shown in any given year. In the long run, assuming that relative import and export prices remain constant, this is not problematic. However, Australia is in the middle of a historically long deviation between income and output because of sustained higher prices for commodities, and a long-term decrease in the prices of its imports. To account for this, we assume (as the ABS does) that GDP and GDI are equal in the base year of 1993 used in this report (the beginning of the first "era" of our analysis). From this point, we have used annual growth rates of each series to show the deviation between output and income. We treat any growth in GDI that is in excess of GDP growth as purely a result of changing terms of trade.

In our review of GDI, we do not distinguish between locally and foreign-owned capital and income. These distinctions would be available in a review of GNI, but this metric includes income from Australian investment in foreign economies, which have their own productivity stories and are outside the scope of this study.

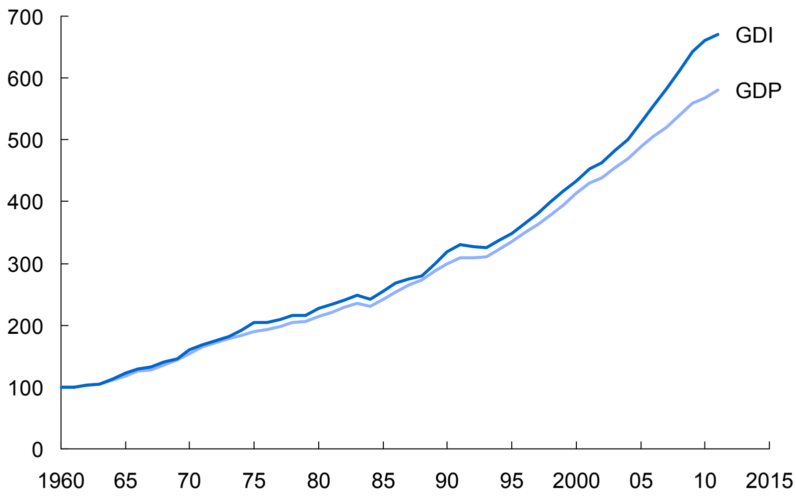
Growth in the terms of trade has meant the first significant divergence between GDI and GDP (which does not take into account changes in international purchasing power) in more than 50 years (Exhibit A1). In the past, policy makers and the media have been comfortable using GDP as the main measure of the country's prosperity. However, in an era when the terms and volume of trade have become more volatile, we believe that a sole focus on GDP may no longer be appropriate. Looking at GDP and GDI in parallel shows a gap that may be explained by productivity performance.

25 For a detailed discussion of the methodology used to calculate income, see the ABS documentation or an excellent discussion in Robert Gregory's recent paper, *Living standards, terms of trade and foreign ownership: Reflections on the Australian mining boom*, Australian National University, Centre for Economic Policy Research discussion paper number 656, December 2011.

Exhibit A1

**GDI and GDP have diverged in recent years**

Index: 1960 = 100




SOURCE: Australian Bureau of Statistics; McKinsey Global Institute analysis

## E. ASSUMPTIONS UNDERPINNING THE SCENARIO ANALYSIS

As outlined in chapter 1, Australia's growth prospects depend on five key drivers: the terms of trade, growth in inputs (additional capital and labour), and productivity growth (capital productivity and labour productivity). Combining various bookend assumptions for these drivers, we have created four scenarios illustrating a range of outcomes for income growth as discussed in chapter 2. Below are details on the specific assumptions used for each of the five drivers:

- **Terms of trade:** The terms of trade measures the difference in price levels between exports and imports. An increase in the terms of trade signifies that prices for Australian exports have risen higher than the price of imports, effectively increasing Australia's buying power on the world market (and therefore, increasing Australia's income). In the high case scenario, we assume that terms of trade remain at their current record levels until 2017, which would mean no impact on Australia's income. In the low case, we assume that terms of trade begin to revert to their long-term average. Under this scenario, we assume that the rate of decrease will match the rate of increase seen during the boom from 2004 to 2010, producing an 11 percent decrease by 2017.

- **Additional capital:** Our assumptions for capital investment are based on MGI's analysis of the investment pipeline tracked by the Bureau of Resources and Energy Economics.[26] Under the high case scenario, we assume that 100 percent of advanced projects and three-quarters of less advanced projects will be completed by 2017, equating to A$443 billion of capital investment. In the low case, we assume only two-thirds of advanced and one-third of less advanced projects will be completed (A$252 billion). In both cases, we have assumed that it will take on average three years to realise income

26 *Mining industry major projects*, Australian Government Bureau of Resources and Energy Economics, April 2012.

from 80 percent of mining capital invested, which reduces the immediate income derived from new capital expenditure. Future capital investment will be determined by Australia's terms of trade and the cost competitiveness of Australian projects compared with alternative investments overseas. For simplicity, we have linked the high and low cases for capital investment to the high and low cases for the terms of trade.

- **Additional labour:** The growth in labour has stayed within a relatively narrow band compared with the other, more variable, drivers and does not have such a large effect on shaping our scenarios. For simplicity, in all four scenarios we have assumed that Australia's working-age population (ages 18–65) will grow at 0.9 percent per annum, in line with ABS estimates.[27]

- **Capital productivity:** In the high case scenario, we assume that capital productivity for new projects (measured as value added associated with capital divided by invested capital) is 24 percent, which is still lower than the 39 percent return on capital achieved during 1993–99 because of yield decline. In the low case, we assume that capital productivity for new projects is 16 percent (the current level of capital return).

- **Labour productivity:** In the high case scenario, we assume that labour productivity grows at 2.1 percent annually (the rate at which it grew from 1993 to 2005). In the low case, we assume 0.3 percent annual growth in labour productivity (the rate from 2005 to 2011).

The impact of these assumptions on Australia's income is outlined in Exhibit A2.

**Exhibit A2**

**We created four potential scenarios by adjusting key variables**

Impact on Australian income[1]
A$ billion

| | | 2011–17 | | | |
|---|---|---|---|---|---|
| | 2005–11 | Hangover | Earned rewards | Lucky escape | Paradise |
| Terms of trade | ▲ 87 | ▼ 109 | ▼ 109 | ■ 0 | ■ 0 |
| Additional capital | ▲ 120 | ▲ 107 | ▲ 107 | ▲ 124 | ▲ 124 |
| Additional labour | ▲ 46 | ▲ 28 | ▲ 28 | ▲ 28 | ▲ 28 |
| Capital productivity | ▼ 43 | ■ 0 | ▲ 18 | ■ 0 | ▲ 27 |
| Labour productivity | ▲ 17 | ▲ 8 | ▲ 72 | ▲ 8 | ▲ 72 |
| **Total income[2]** | ▲ **227** | ▲ **34** | ▲ **117** | ▲ **160** | ▲ **251** |

1 Difference in income between ending year and starting year.
2 In chapter 2, total income numbers are rounded to nearest A$5 billion.
NOTE: Numbers may not sum due to rounding.
SOURCE: McKinsey Global Institute analysis

27 *3222.0 Population Projections, Australia, Table C9: Population projections, by age and sex*, Australian Bureau of Statistics, 2008.

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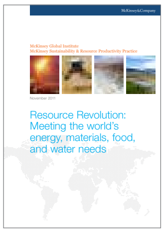


**Resource Revolution: Meeting the world's energy, materials, food, and water needs (November 2011)**

We might be entering a new era of high and volatile resource prices over the next two decades as up to three billion people join the middle class. In addition, environmental deterioration, driven by higher consumption, is making the supply of resources—particularly food—more vulnerable. But the challenge can be met through a combination of expanding supply and a step change in the way resources are extracted, converted, and used.


**Farewell to cheap capital? The implications of long-term shifts in global investment and saving (December 2010)**

MGI analysis suggests that the low interest rate environment that many have come to take for granted is likely to end in the coming years. By 2020, half of the world's saving and investment will take place in emerging markets, and there will be a substantial gap between global investment demand and the world's likely savings.


**How to compete and grow: A sector guide to policy (March 2010)**

Drawing on industry case studies from around the world, MGI analyses policies and regulations that have succeeded and those that have failed in fostering economic growth and competitiveness at the sector level. What emerges are some surprising findings that run counter to the way that many policy makers are thinking about the task at hand.


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This MGI report looks at the myths and realities behind industrial decline in France and analyses the competitiveness issues at work. It proposes a new framework for public and private action to bolster the country's industrial base.

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# Appendix 13


PROJECT
IRON BOOMERANG
east west line parks limited

# Executive Summary

*'The modern world is built on steel which has become essential to economic growth. In developing and developed nations alike, steel is an indispensable part of life … The future growth in demand for steel will be driven mainly by the needs of the developing world.'*[1] Note: 87% of all world metals consumed are iron and steel.

Australia is rich in natural resources. Among the key resources in abundance are iron ore and thermal and coking coal; the key feedstock for steel. Queensland has an abundance of coal, while Western Australia has an abundance of iron ore. Australia has a small population with limited steel production, so these resources are shipped internationally to be used as inputs to steel production.

Strong growth in raw steel production and consumption, driven by the rapid industrialisation of China and India in particular, is expected to continue. This will necessitate substantial investment in new global steelmaking capacity. Australia plays a significant leading role in the export steelmaking supply-chain as it has an estimated 40% of the world's high grade seaborne iron ore and 65% of the world's seaborne coking coal.

Project Iron Boomerang was developed by East West Line Parks Pty Ltd ("EWLP") to explore the economic feasibility of establishing first-stage steel mill semi-finished steel production in Australia, close to the major raw materials inputs.

This Pre-Feasibility Study provides strong evidence that the construction of first-stage smelter precincts offers many cost effective consolidation and efficiency savings, and that a dedicated railroad with all supporting infrastructure is feasible and economically favourable for steelmakers. The project will also deliver major energy savings for related global environmental benefits. This study outlines a convincing case for steel manufacturers and others to participate in the full Feasibility Study of PIB.

**1. Project Iron Boomerang**

There is a clear need for additional global steelmaking capacity. Project Iron Boomerang ("PIB"), being located in Australia, is uniquely suited to meet a portion of that expanding demand as a result of five major advantages.

- Proximity to the major global demand for steel, particularly in Asia;
- Availability, sustainability and quality of the major steelmaking raw material inputs;
- Competitiveness and blending capability for the supply of these resources;
- Availability of large sites to accommodate the smelter precincts; and

[1] Ian Christmas, IISI Secretary General, Dec 2007, UNFCCC Conference, Bali.

- Stability and low sovereign risks involved in major investments.

The PIB business case is focussed on facilitating the construction of twelve 10,000 hot-metal tonnes per day (3.6m tpy) first-stage steel smelter units, producing a total of 44 million tonnes per annum of slab steel. Iron ore and coal will be transported to common points for processing. Iron ore will be transported to Queensland to be combined with the coal, while coal will be transported to Western Australia to be processed with the iron ore.

The steel smelters will be constructed in industrial precincts (smelter parks) in Queensland and Western Australia. PIB will develop the precincts, which will include shared ore reception facilities, ore stockpiles (iron ore and coking coal), stacker/reclaimers, conveyor systems, coke, oxygen and electricity production, water and other utilities, and steel slab export facilities. Participating steelmakers will construct, own and operate their steel smelters.

The second major feature of PIB's business case is the construction of a new transcontinental railroad to transport the raw materials. Among the economic and environmental advantages of PIB is that the trains will be fully utilised during their transits in both directions. Figure 1 illustrates the railway and its connections to the major resources in Western Australia and Queensland and to the ports from which the steel slabs will be shipped.

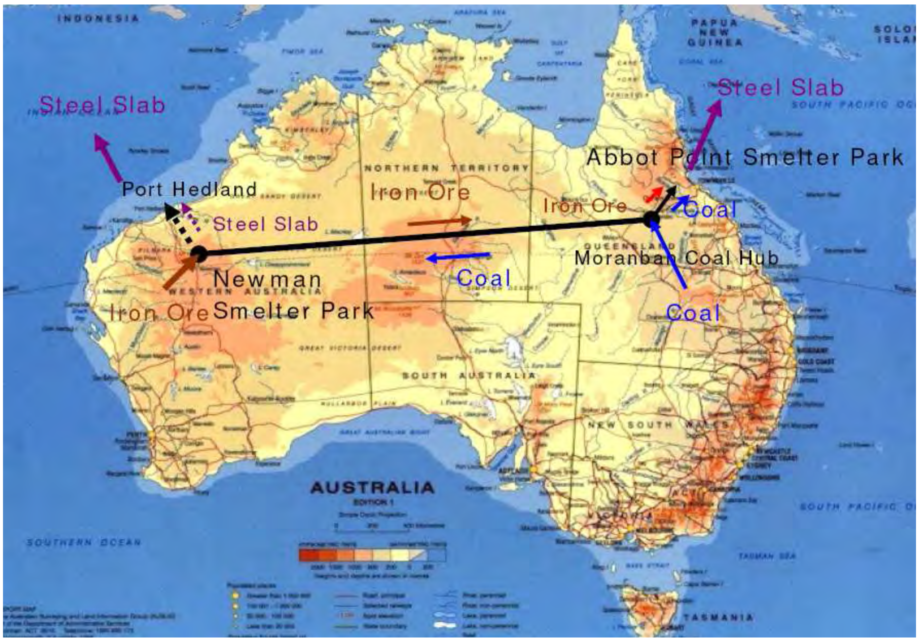


Figure 1 Transcontinental railway connecting iron ore and coal

## 2. Key Value Drivers

The key value drivers of PIB relate to efficiencies in the supply-chain, precinct economics and environmental benefits. The drivers are:

- Reduce transport and other supply-chain costs by a three times consolidation of major raw material inputs before shipping, and to maximise back-loading of ships and trains (coal railed west and iron ore railed east);

- Develop synergies in co-location of raw material production and make available large smelter park sites suitable for the consolidation of industry;
- Facilitate construction of high efficiency steel smelters using world-class technology;
- Provide benefits of co-location of steel smelters, shared services and efficiencies in managing energy inputs and outputs; and
- Deliver major global environmental benefits from improved transport efficiencies, modern first-stage steel production techniques and optimised efficient energy utilisation through co-generation use of secondary and tertiary heats.
- New inland prospect mine developments up to US$50 billion; stemming from the PIB transcontinental rail transport infrastructure services
- $9 billion (as at Sept 2007) in infrastructure expansion CAPEX is saved by locating the first-stage production in Australia; PIB consumes 116 million tonnes of iron ore, coal and limestone which is transformed to 44 million tonnes of slab steel, shipped overseas. The consolidated "takeout factor" is 72m t of infrastructure capital expenditure not needed; ships, trains wharves in both sending and receiving countries. This greatly reduces the strain and the resultant financial risk overexposure for an ordinary or bad market time.

## 3. Project Stages

There are five stages to the development of Project Iron Boomerang.

- **Pre-Feasibility**: establishment of project concepts and operational requirements, financial models and major steelmakers and/or investor commitment to the Feasibility Study;
- **Feasibility Stage**: proof of concept and definition of project operational requirements, detailed project scoping, preliminary engineering environmental impact assessment, cost estimates, market viability, planning and other regulatory approvals, risks assessments, management and allocation strategies, resulting in confirmation of the business case and a "bankable" Feasibility Study;
- **Commitment and Financial Closing**: develop investment agreements and briefing requirements to gain commitments from steelmakers to build smelters, reach necessary agreements with governments, develop major procurement contracts and call tenders for EPCM and/or DCM contracts, and completion of due diligence processes by investors and suppliers;
- **Implementation**: land acquisitions by government, as required, for lease to EWLP, engagement of project managers, detailed engineering and

environment management plans, procurement of design and construction, procurement of rolling stock and precinct plant and equipment; and

- **Operations:** commissioning and commencement of operations.

This report marks the conclusion of the first stage and transition into the second stage, as the necessary funding is obtained for the Feasibility Study.

## 4. Key Project Elements

There are a number of key project elements.

- **Smelter Parks** – Each precinct will provide sites for six steel smelters and supporting industry (such as coke production plants) at each end of the East West Line ("EWL"). Smelter park locations are proposed for near Newman in the Pilbara in Western Australia and Abbot Point in Queensland. The possibility of further development is discussed in Section 8 of this report, and will be evaluated during the Feasibility Study.
- **Infrastructure** – The facilities necessary for servicing the smelter parks and steel smelters (water, precinct transport logistics, power, gas, waste management, etc.) will be constructed. This will include the effective management of environmental outcomes within the smelter parks.
- **Rail link** - EWL will be a standard gauge railway to current "world's best practice" heavy-haul standards. It will be approximately 3,370 km long.
- **Port facilities** – Ports at Abbot Point and at Port Hedland (or other proposed ports in Western Australia) will be used for the export of the steel slabs to the consuming markets in Asia for finishing and sale.

Details of the concept, the precincts and the transport arrangements are provided in this report. The Project Case adopts the assessed EWL rail charges and the materials handling logistics costs of stockpiling and delivering the iron ore and coal in the precincts to the individual steel smelter gate, and the costs of transporting steel slab from each smelter to the Australian port.

## 5. Market Overview

The implications of the business environment for PIB are:

- Australia is well placed geographically with very competitive, high quality iron ore and coking coal resources and very large reserves;
- The smelter parks and railway are located in sparsely populated regions, and will have minimal impact on existing land uses and populations;
- PIB's financial feasibility and global environmental benefits are strongly positive; and
- There is a continuing need to replace existing production capacity that is obsolete, or economically or environmentally requiring replacement.

PIB is not a threat to major trading nations' maintenance of steelmaking capacity. The project case provides for only 44M tpy of production out of a forecast world-wide new steelmaking capacity of over 500M tpy over the next decade. So PIB is targeting less than 10% of projected global greenfield capacity growth and in another context under 8% of China's total 2007 steel production.

## 6. Precinct Economics and Advantages

Precinct economics and the major advantages of co-locating smelters in the PIB precincts include:

- Sharing of input and output materials handling infrastructure outside the steel smelter gate to achieve the scale economies of high asset utilisation;
- Economies of scale of building and operating the supporting industrial plant for steel smelters, including the stockyards, coke plant, oxygen plant, and sintering plant, etc;
- Sharing of support services provided in the smelter park, including water supply, new and waste water treatment, power supply and reticulation, and the economies of scale in initial capital costs and ongoing operating and maintenance costs;
- Reduced total inventory holdings, covering much lower supply-chain reliability risks (and much closer proximity to major input suppliers);
- Ability to permanently optimise the inputs into the steel smelter charge to improve efficiency and consistency of slab steel quality, due to location, quantity and quality of the resource base available;
- Opportunity for shared design and construction costs of steel smelters, including the anticipated commonality of designs and extensive use of modular construction techniques; and
- Maximising the efficiency of energy use in purpose designed precincts, with co-generation from utilisation of waste heat and treatment of volatile gases from both the coke and steel mill making process producing substantial surplus electricity for sale, world's best practice emissions and potential carbon credits for efficient energy utilisation against current expanding supply chain and operations infrastructure logistics system practices.

## 7. Railway

The Pre-Feasibility Study Report identifies a number of key issues and preliminary conclusions with respect to the railway.

- An EWL is technically feasible, with a very economic route and grading, and minimal impact on existing land uses or the environment;
- The EWL costs are sensitive to volume, with average rail costs reducing as the tonnages increase, hence increasing the overall logistics savings; and

- The total transport savings for the Project Case of six steel smelters in each precinct is assessed as US$406 million per annum.

A transcontinental railroad is supported because the notional alternative of coastal shipping around Australia is economically and environmentally inferior.

## 8. Additional Economic Advantages

The economics of the PIB concept and the major fixed infrastructure costs of the EWL are driven by volume. The initial two smelter parks could be expanded beyond six steel smelters each or additional precincts opened, depending upon demand. This would substantially improve economies of scale of the precincts, supporting infrastructure and the railway.

The environmental advantages to steelmakers are significant, and an economic dimension to this is rapidly emerging. Carbon credits are a part of the international emissions trading schemes that are being developed. These schemes provide a way of moving the control of greenhouse gases into markets, and will be investigated during the Feasibility Study.

The railway will pass close by many known resource deposits that have not been economical to mine. Many of these mines will be opened once access through PIB is established. It will also provide the opportunity to effectively use cheaper lower grade iron ore reserves without the added transport penalty involved in exporting these ores to an overseas smelter.

## 9. Government Approvals

Key government related issues involved with the project include:

- planning and environmental approvals;
- land acquisition;
- project business environment; and
- government support services.

An Environmental Impact Statement ("EIS") is mandatory, responding to an approved Terms of Reference, which will be subject to prior consultation with advisory agencies.

## 10. Feasibility Study

The primary objective of the Feasibility Study is to establish the economic and environmental benefits of Project Iron Boomerang to steelmakers and governments. This will require the following key outcomes:

- Fully developed Scope of Works and Project Plan (for the railway and smelter parks and industrial plants);
- Environmental and Planning Approvals for the overall project;

- Finalise the rail corridor, smelter park locations and agreement in respect of land acquisition and passage rights;
- Detailed capital and operating cost estimates;
- Detailed analysis of the project time frames and procurement packages to ensure key milestones can be achieved;
- Government approvals in respect of the regulatory and policy settings required to support the project;
- Preliminary procurement activities to support the Business Case and a fast track project implementation stage;
- Finalise the detailed business framework for the project; and
- Finalise agreements with other key service providers in commitment to their associated project works.

Key inputs into the Feasibility Study will be the specific requirements of the steelmakers in their proposed developments in the smelter parks, including:

- Technical: scale, technologies, layouts, environmental impacts;
- Market: knowledge of the steel industry and steelmaking, major risks and opportunities as perceived by the steelmakers;
- Commercial: how precincts will function with respect to the "common user" facilities, timing of developments, procurement practices and construction resourcing arrangements; and
- Expertise: commitment of the steelmakers' individual expertise to the Feasibility Study through Management Advisory Committee participation.

Key timings for the Feasibility Study are:

- Project planning approvals (April 2009)
- Financial close (December 2010)
- Award major contracts (March 2011)
- Complete land procurement (September 2010 – February 2011)
- Railway construction (commence April 2011– complete June 2014)
- Precinct construction (commence April 2011)
- Smelter construction (commence June 2011 – complete June 2014)
- Commissioning (July 2014 – December 2014)
- First steel production (December 2014)

## 11. Feasibility Study Budget

The proposed Feasibility Study budget is A$150 million as detailed below. The expenditures during the Feasibility Study will predominately be incurred in Australian dollars.

| | A$million |
|---|---|
| Preliminary engineering and surveys | $50.0 |
| Environmental Impact Study | 48.0 |
| Consultants - engineering | 7.5 |
| Consultants - environmental, economic, legal, tax | 8.0 |
| Project management, administration and overheads | 11.5 |
| Contingencies (20%) | 25.0 |
| Total | $150.0 |

**12. Team Capability**

EWLP has established a management group of experienced senior executives and specialists with many years of leadership and management experience. The senior management group has worked for major international and domestic companies across a number of different industry sectors and major projects including banking, consulting, finance, government, logistics, transport, supply-chain management and technology. They have demonstrated leading analytical, business and managerial skills at strategic levels in the functional areas outlined in the EWLP organisation structure. Their experience provides significant risk mitigation to lead the project during the Feasibility Study. Profiles of the management group are included at Appendix E.

**13. Conclusion**

This Pre-Feasibility Study Report outlines a convincing case for steel manufacturers and others to join together to commence a full Feasibility Study of PIB. There is sufficient evidence here that the construction of first-stage smelter precincts offers many cost effective savings and that a dedicated railroad with all supporting infrastructure is feasible and economically favourable for steelmakers. The Feasibility Study will test these early findings in depth and further establish the validity of the Business Case.

The potential savings for steelmakers estimated in this preliminary analysis are significant. Capital expenditure required for each steel smelter is expected to be reduced by US$900 million by use of standard modular construction of the smelters and shared services for facilities such as stacker/reclaimers and conveyor systems. For a representative coastal steel mill in East Asia, the delivered cost of slab steel will be reduced by US$107 per tonne. The savings projected as compared to current practices are based on conservative estimates; and do not include savings likely to be realized with the likely continuing increases in transportation costs under the existing practices of shipping ores and coal to smelters in international locations. EWLP will provide a table to steelmakers where the details of a specific steel mill site can be inputted to estimate the specific savings to be realised through PIB.

The projected cost of the Bankable Feasibility Study is A$150 million. Steelmakers, the ultimate beneficiaries of PIB, are being asked to be the principal funders of this study. Funding for this study is based upon 12 steelmakers and three other investors that have an interest in the project contributing A$10 million each. The contribution will entitle the company to have a seat on the Management Advisory Committee, which will advise the EWLP Board of Directors and management during the study and subsequently during construction.

Steelmaker participants will select a precinct and construction sequence at that precinct on a first-come, first-served basis. For example, the first contributor may choose to construct the third steel smelter at the Queensland precinct. The second contributor would then choose from the remaining eleven positions.

Project Iron Boomerang delivers triple bottom line benefits (financial, environmental and social) that are very positive to all participants, particularly steelmakers. You are invited to participate in this major project. Section 11 in the report explains how to proceed.

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## Acknowledgements

This is an important and, some would say, ambitious but practical and common sense project with positive, long-term implications for the world's steel industry. The project is expected to deliver sustainable competitive advantages and positive global environment outcomes. Many people and their supporting organisations have contributed to the vision, planning and progress of Project Iron Boomerang and to the completion of this Pre-Feasibility Study Report.

Companies in the steel, resources, infrastructure services, rail, engineering and finance industries have provided strategic planning, information, data and comments on the project as it has progressed. We have benefited from the expert assistance of Calibre Engenium, Deacons, Leighton Contractors Pty Limited, Pro-Met Engineers Pty Ltd, Corus Consulting and particularly, Xstrata Coal, for their early support. As can be seen in the Attachments to the report, AustralAsian Resource Consultants, Hill Michael Associates Consulting and in particular, Trimble/Quantm Limited have all provided their continuous professional and valuable assistance. The Ranbury Management Group has provided leased office support service facilities and made CFO David Hallam available to the project for advice on corporate structure, accounting and tax issues. As of 1 October 2008, 19 of the world's top steel companies have signed the three-year Confidentiality Agreement. Many of these companies have shared data with us, which has been most useful in developing this report.

We have also benefited from the assistance and close working cooperation of the government agencies, in particular, both the Sovereign State Governments of Queensland and Western Australian, the Northern Territory and the Federal Australia Government, plus the Governments of China, India, Japan and South Korea.

The team with major responsibility for conducting this study, however, are the founder group. The team is led by Shane Condon as the founder of the project and its driving force. Other founding group members include Gordon Thomson - WA (Dep Project Leader), Prof Jerry Bowman, Saul Eslake, Ross Hunter, Steve Kennedy, Anton Michielsen, David Russell QC, Prof Art Shulman, Graham Tew, and Prof Clem Tisdell. All have donated substantial amounts of their time and expertise to the project.

Administrative support and international stakeholder management in China, India, Japan and South Korea has been ably provided by Yi-Ling Chan, Haruhiko Kinase, JunWon Lee and Nick Meng. Jim Handford, co-founder with Shane Condon, has been an important supporter throughout, including financially, and provided initial aerial and ground survey work of potential corridors.

The Project's unique concept and strategy calls upon the unity of all such parties in this great enterprising endeavour.

# 1. Project Concept Overview

Australia is a resource rich country. Among the many resources in abundance are iron ore and coking coal, the key feedstock for steel. Queensland has an abundance of coal, while Western Australia has an abundance of iron ore. Australia has a limited domestic market and steel production, so these resources are shipped to steelmakers in a range of major trading countries as inputs to their international steel production cycle. In global seaborne supply terms, Australia is the pre-eminent supplier of these mutually dependent key steelmaking ores.

East West Line Parks Pty Ltd ("EWLP") has been established to facilitate the establishment of first-stage steelmaking in Australia. Subsequent second-stage steel mill processing is anticipated to occur close to international mass market distribution locations (centres of high population), to considerable finished steel transport logistics and distribution economic cost advantage.

Project Iron Boomerang ("PIB") is EWLP's means of creating a first-stage steel mill operations paradigm shift in international steelmaking that delivers multiple bottom line benefits to all participants.

Capital expenditure is expected to be reduced by US$1.15 billion for each smelter (compared to a standalone OECD greenfield turnkey plant benchmark cost) by use of standard modular construction of the smelters and shared services for facilities such as stacker/reclaimers and conveyor systems. The analysis in this Pre-Feasibility Study Report supports a fob cost-of-slab-steel production reduction of US$107 per tonne (over 30% compared to the world benchmark (September 2007) average of US $340 per tonne) for slab steel delivered to a coastal East Asia steel mill. As part of the provision of information to steelmakers who have signed the Confidentiality Agreement, EWLP has developed and provided steelmakers with a PIB calculator application tool; a pro-active cost comparison table. With this tool, independent assumptions can be applied to the circumstances of a specific operating steel mill and/or to a greenfield alternative international investment site, and direct comparison made to the economies of a smelter located in PIB. The table is a one page summary of key comparative advantages of Project Iron Boomerang.

Iron ore and coking coal would be transported to common points (smelter parks) for processing. Iron ore would be transported to Queensland to be combined with the coal. Similarly, coal would be transported to Western Australia to be processed with the iron ore.

The method of transportation will be a new transcontinental railroad. A transcontinental railroad is proposed because the notional alternative, coastal shipping around Australia is economically and environmentally inferior to a railroad in many aspects. The costs of building inwards-loading port facilities in already overcrowded and congested out-loading ports that are not currently meeting expansion growth needs is a major constraint issue. A key component of the economic advantages of Project Iron Boomerang is that the trains will be fully utilised during their transits in both directions. Furthermore, it is clearly evident that the PIB continental rail will open up many new inland Australia prospect development mines of immediate and future world resource supply significance. The value of new mines is estimated to be up to US$50 billion. (refer to Appendix F).

Industrial precincts will be established in Queensland and Western Australia. The precincts will include ore reception facilities, ore stockpiles (iron ore and coal), stacker/reclaimers, conveyor systems, coke production batteries, electricity production, water and other utilities, and steel slab export facilities.

Central to all this industrial activity will be multiple steel mill smelters producing steel slab. This places the first-stage production of steel close to the necessary raw materials and in close proximity to ports. This results in efficient shipping of the three-times consolidated steel products to market.

Strong world growth in raw steel production and consumption, primarily driven by the rapid industrialisation of China and India, is expected to continue and require substantial investment in new steelmaking capacity. This makes the very large world class natural resources of Bowen Basin coal in Queensland and Pilbara iron ore in Western Australia strategically very important.

Project Iron Boomerang will meet a portion of the long-term global demand for sustainable, cost effective steel production. In addition, the project will deliver a dramatic reduction in environmental outcomes compared to the current steelmaking paradigm.

This Pre-Feasibility Study Report shows emphatically that PIB will deliver substantial economic and environment benefits. The estimated cost reduction for slab steel delivered to a representative coastal second-stage steel mill in East Asia is over 30%. The environmental benefits include an estimated reduction in carbon emissions of 8.7 million tonnes annually, against the existing supply chain and steelmaking operating practices.

The key business drivers of PIB are:

- Three-times consolidation of steelmaking feedstock close to the resources for the production of first-stage steel products;

- Operations and Production Financial Risk Mitigation Management and Reduction

- PIB reduces the need to expand the currently expanding iron ore and coal supply-chain capex infrastructures by US$9 billion (Sept.,2007); i.e. in Australia, on the sea, and in the key receiving countries of China and India by 72m tpy of coking coal iron ore and limestone. This is risk finance overexposure for the ordinary or bad market times (refer to Appendix A)

- Steelmaking ore stockpile inventory for improved just-in-time finance and supply chain risk management consolidations.

- Alternate slab steel international market delivery options are available ex Australia, if international domestic home cyclical markets become oversupplied.

- Develop synergies in co-location of raw material production with first-stage steel production and make available large smelter park sites suitable for the major operations and services scale consolidation of industry;

- Construct high efficiency smelters using world-class tested and proven technology;

- Reduce transport costs by consolidation of major raw material inputs and maximising land and sea "back-loading" (coal railed west and iron ore railed east); and

- Deliver major global environmental benefits from improved transport efficiencies, modern first-stage steel production techniques and efficient energy utilisation.

The objective of this Pre-Feasibility Study is to demonstrate the advantages of PIB such that the funding of a full Feasibility Study can be undertaken.

### *1.1 Physical Description*

Project Iron Boomerang is an "enabler" to provide for the resource-intensive first-stage of steelmaking to be sited in smelter precincts much closer to the resource feedstocks. The main resources are iron ore and coking coal. The project includes the development of a rail link between the extensive Pilbara iron ore resources in Western Australia and the coking coal mines in the Bowen Basin in Queensland. The railway will feed raw materials to steel smelters in the precincts at each end. This Pre-Feasibility Study assumes that steel smelters will produce semi-finished steel slab (plain carbon, stainless and alloys) for export to downstream processing locations. Steel billets, bloom or intermediate pig iron outputs are also possible. The decision on output will ultimately be made by the steelmakers. Infrastructure will be established to transport the semi-finished product to nearby shipping ports for export.

The construction of global steelmaking facilities in Australia will be an important attraction for the world's major steel producers under the project concept and strategy. The locations permit immediate access to competitive suppliers of the main high-quality feed stocks for steel. The proximity of production to raw material inputs delivers a competitive edge to steelmakers over the very long life of the smelters. The reserves of iron ore and coking coal in Australia are estimated to be sufficient to service demand for at least 100 years. Further, PIB will reduce the transportation costs of marginal iron ore and coal resources sufficiently to make these additional reserves more economic for mining.

This is shown in the map of Australia below.


Figure 1.1  Transcontinental railway connecting iron ore and coal

In addition to the logistical advantages of reducing the supply-chain, there are significant economic advantages of co-location of high-volume first-stage steel production in the precincts. The similarly significant environmental benefits of the project reinforce the overall project business case. It is expected that the proximity of the smelter parks to major natural gas in Western Australia and coal seam gas in Queensland will provide further production economies, potential energy security, diversity and environmental benefits. The close proximity of the smelter parks to existing and expanding port facilities further enhances the viability of the project.

The key project elements are as follows.

- **Smelter parks** – Each precinct will provide sites for six steel smelters and supporting industry (such as coke production plants) at each end of the East West Line ("EWL"). Initially, it is proposed to locate a smelter park near Newman in Western Australia and another at Abbot Point (near Bowen) in Queensland. Additional smelters may be feasible within each of the initial two smelter parks, with even greater economies of scale. The optimal number of steel smelters in a precinct will be evaluated during the Feasibility Study. A second smelter park at each end may also be required, subject to ultimate demand for smelters. This is discussed in Section 8.

- **Infrastructure** – The facilities necessary for servicing the smelter parks and steel smelters (water, precinct transport logistics, power, gas, waste management, etc.) will be constructed. This will include the effective management of environmental outcomes within the smelter parks.

- **Rail link** - The EWL will be a standard gauge railway to current Pilbara “world's best practice” heavy-haul standards. It will link iron ore resources in the Pilbara and coking coal mines in the Bowen Basin to smelter parks in Queensland and Western Australia.

- **Moranbah Rail hub** – A railway in the Moranbah area in the northern Bowen Basin will connect the EWL to the existing Queensland Rail (“QR”) narrow gauge coal network (and all Central Queensland coal mines) to allow transfer of coal to the standard gauge EWL trains for delivery to the west.

- **Port facilities** – Ports at Abbot Point and at Port Hedland (or other proposed ports in Western Australia) will be used for the export of the steel slab for further processing worldwide.

- **Additional infrastructure** – Investment will be required in the relevant communities and surrounding regions to support the construction, operation and maintenance of the smelter parks and railroads.

Transport infrastructure required includes the following.

- The 3,370 km long East West Line, rolling stock and supporting facilities.

- Construction by Queensland Rail of the 69km long Northern Missing Link to connect the Goonyella region mines to the Newlands Railway and to Abbot Point, and capacity upgrade of the Newlands and Goonyella rail systems to meet overall Queensland export coal tonnages, as well as demand from the Abbot Point Smelter Park. Coal will be delivered to both the Moranbah Coal Hub and Abbot Point Smelter Park via the QR narrow gauge rail network, hence providing existing rail access to all northern Bowen Basin coal mines.

- A narrow gauge, electrified spur line and balloon loop to the Moranbah Coal Hub to link with the EWL, and transfer coal from the QR narrow gauge system to the EWL standard gauge system for delivery to the west.

- Railroad links to one or more iron ore producers in the Pilbara to deliver iron ore via the EWL to the smelter parks near Newman and Abbot Point. There are several potential iron ore suppliers, including:

  - BHP Billiton has several existing and proposed iron ore mines in the vicinity;

  - Rio Tinto has several existing and proposed mines but may require a linking of the Newman railroad and Rio Tinto operated railroad system (possibly near Yandi and / or Mining area C) to participate in PIB as an iron ore supplier;

- Fortescue Mining Group has completed its Christmas Creek iron ore mine (with other expansion mine prospects nearby) and its new multi-user railroad is also nearing completion; and

- Hancock Prospecting is considering several mines based on its Roy Hill deposits and these are located approximately along the EWL route.

- Transport links from the smelter parks to the ports (for transporting steel slabs for export). Proposed access to Port Hedland from the Newman Smelter Park may be via the existing Newman Railroad or Fortescue Mining's recently completed railroad, upgraded to suit the additional train numbers and tonnages, and a separate rail spur and transfer facility handling product at Port Hedland. Abbot Point could involve a separate short rail system or road delivery for transport of steel slab to ship.

- Port facilities to handle the steel slabs at Abbot Point and at Port Hedland. This would involve construction of dedicated facilities (new or shared wharf and loading systems) for loading the planned 60,000 tonnes per day of product at each location (for the project case of six 10,000 hot-metal tonnes per day steel smelters at each smelter park). At this preliminary stage and for the purposes of this document, Port Hedland is the port of choice for exports from the Newman Smelter Park, but this is subject to commercial negotiations regarding port facilities, rail access and cost, and competing demands for available harbour capacity.

- Port facilities will also be required for handling the importation of construction materials, prefabricated modules during construction, and pre assembled units, diesel fuel, and other miscellaneous items.

- Transport infrastructure for other inputs to first-stage steel production (for example, limestone, magnetite, manganese). These requirements will depend on the source locations and volumes required. Options include railing, importing, slurry pipelines or road transport.

- Transport for waste products from production processes (local processing for re-use or disposal, or railing or trucking solid wastes to mine sites for incorporation in open cut mine rehabilitation).

Water resources are a key input to the production process, and the sources and infrastructure proposed for the two smelter parks are set out below.

- **Newman Smelter Park** - Surplus water piped from the dewatering of various mine pits and local groundwater from the Upper Fortescue Aquifers, with a potential to pipe water from the Fitzroy River Basin for further stages. An option to utilise a slurry pipeline for transporting beneficiated magnetite is possible, potentially providing another diverse water supply option by utilising the recovered water following treatment.

- **Abbot Point /Moranbah Smelter Park** - Pipeline/channel from the Burdekin River, with a likely requirement for an augmentation (raised dam height) of the existing Burdekin Falls Dam to guarantee adequate secure water volumes.

### *1.2 Logistics Flows*

Initial planning is premised on each steel smelter being rated at a nominal 10,000 per day of slab steel output, as per current industry standards for efficient production. Although there can be substantial variation between manufacturers, for the purpose of this report, the essential inputs and outputs for each steel smelter are assessed as:

| | |
|---|---|
| Iron ore | 5.5 million tonnes per annum |
| Coking coal | 2.6 million tonnes per annum |
| Slab steel | 3.7 million tonnes per annum |

It is expected that all participating steelmakers will opt to extend their production facilities to the Basic Oxygen Furnace stage to produce semi-finished steel, including steel slab or billets. The smelter precincts and supporting infrastructure will provide for this.

Apart from iron ore and coal, other key inputs to the project will include limestone, manganese and other process and alloying elements, and water. Natural gas and/or coal seam methane gas may also be feedstock but subject to cost and availability.

The existing and proposed logistics flows are simplified as below. PIB delivers a consolidation of the major inputs prior to shipment, reduces the number of handlings, and maximises the opportunity for back-loading, thus increasing the overall logistical efficiencies.

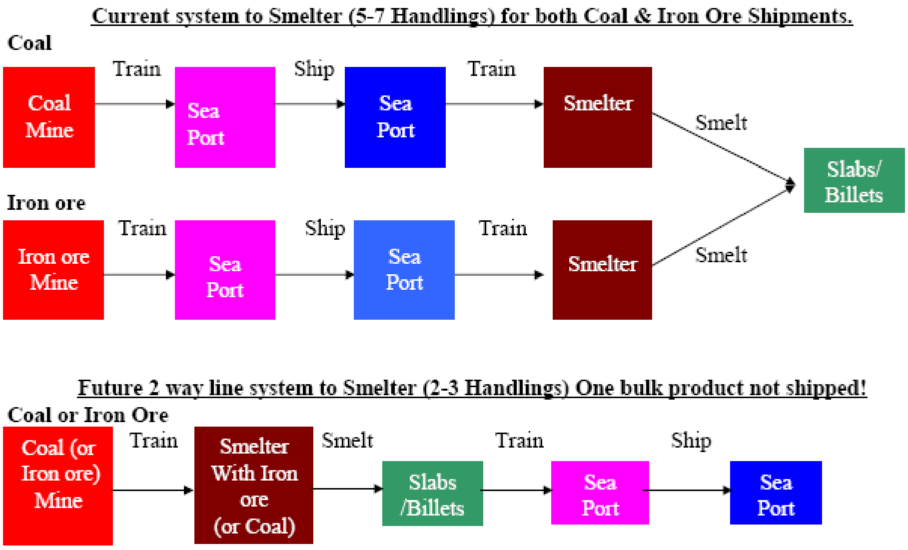


Figure 1.2 Handling and Logistics Flows

With the product consolidation and value-adding of PIB, export shipping of the steel slabs to the next processing stages will be done in Handymax and Panamax size vessels. This is in contrast to the large Capesize vessels used for iron ore and bulk coal exports from Australia. This delivers market advantages through the ability to service ports and berths which are not accessible to the larger deep-draft Capesize ships (a particular issue with most Indian ports). It also opens up direct access through the Suez Canal to Europe and the Panama Canal to the east coast of the USA. The direct access substantially reduces the overall shipping distances to these markets. The use of Handymax and Panamax ships has the potential to considerably reduce demurrage charges in congested ports. Further, they are better configured for back-loading goods or bulk materials upon return to Australia.

## *1.3 Environmental Outcomes*

### 1.3.1 Local impacts

*i) Smelter parks*

Coke plants and steel smelters can have high local impacts. Sound operations management is required to deal with air emissions, water quality and solid wastes. Proximity of the Abbot Point precinct to the Great Barrier Reef and the coastal wetlands, adds a further sensitivity to managing the environmental impacts at this location. The comprehensive Environmental Impact Study will assist in determining the requirements to manage or mitigate environmental outcomes and in determining the conditions of environmental planning approvals. Preliminary planning provides for full collection, treatment and re-use of all process water and rainfall run-off from the smelter park sites to prevent contamination of local waters and groundwater.

The supporting infrastructures for the smelter parks (ports, water supply, gas, electricity) have low to medium impacts during construction and operation.

These impacts are readily manageable with current expertise and practices, and the experience of recent and current similar activities.

The advantage of co-locating smelters in shared service precincts provides for superior environmental outcomes that are achievable and more affordable.

A key environmental consideration is the availability and effective management of water used in the production processes and maximising the re-use of this water. The proposed use of large quantities of surplus water from mine dewatering in the Pilbara should reduce the negative environmental impacts of disposing of this water in the current semi-arid natural drainage systems.

*ii) East West Line and supporting infrastructure*

Environmental impacts are expected to be relatively low and readily managed during construction. The ongoing railway operation and maintenance will also be low impact (similar to existing railway operations and recent rail construction in the Pilbara in Western Australia, the coal fields in Central Queensland and the Alice Springs – Darwin line in the Northern Territory).

The sensitivity of some relatively fragile arid environments along the rail corridor will need to be managed carefully during the construction phase. Significant alignment planning undertaken to date, however, indicates that the railway requires limited major earthworks to achieve the required grading, and that construction impacts will be relatively low. Sourcing adequate quantities of water for construction purposes along the corridor will be a short term issue to be carefully managed.

The land traversed is predominantly beef cattle grazing country or vacant land, and overall impacts on existing land uses are expected to be low.

*iii) Shipping*

By locating the first-stage production in Australia, the volume of shipping from Australia will decrease significantly. Rather than ship iron ore and coal to overseas steel smelters, the 106 million tonnes of iron ore and coal are transformed to 44 million tonnes of slab steel, which is then shipped overseas for further processing.

In addition to the environmental and economic advantages of the reduced shipping volumes, PIB will also reduce the need for port expansion in Australia and overseas.

A further advantage to the environment is the reduction in the amount of shipping that exposes the Great Barrier Reef to degradation or the possibility of a disaster.

*iv) Accommodation and community infrastructure*

Preliminary investigations indicate that the environmental impacts in the provision of short and long-term accommodation and supporting community infrastructure at Bowen (to meet the needs of the Abbot Point Smelter Park) are readily manageable. The specific requirements to meet the Newman Smelter Park are yet to be fully assessed.

### 1.3.2 Global benefits

Whilst the construction and operation of PIB has some local negative environmental impacts that need to be effectively managed, the global environmental net benefits are expected to be positive and extremely significant. The major benefits include:

- Proper planning of the smelter precincts to maximise environmental benefits from synergies between the various production processes, and particularly their energy inputs/outputs, and opportunity to use natural gas and coal seam methane gas as primary energy sources;
- Improved environmental outcomes by ultimately replacing inefficient steel smelters elsewhere with current, much lower environment-impacting technology, purpose designed to achieve best practice environmental performance (rather than the bolt-on upgrades common with existing long-life coke ovens and steel smelters );
- Presence of sufficient production scale in the smelter parks to allow effective greenhouse gas capture and potential for $CO_2$ sequestration as this technology is proven, and the economic environment for its implementation is provided, including any carbon credit schemes; and
- Transport logistics efficiencies of PIB, with reduced transport energy use and accompanying greenhouse gas emissions reductions (from consolidation and maximising back-loading).

The global environmental benefits of the project are expected to be very large compared to the local environmental impacts. Realisation of the benefits will require the involvement of Federal and State Governments affected to allow proper inter-jurisdictional recognition and realisation. The emergence of markets for the trading of carbon credits will facilitate this benefit.

### 1.3.3 Sustainability

Current iron ore market and mining practices generally involve exploitation of the premium high quality ore deposits, with the cost of mining and transport of the lower grade ores to distant markets not generally viable.

PIB, generates lower transport logistics and local processing costs, which will allow multiple lower grade iron ores to be economically beneficiated and blended into quality sustainable smelter feedstocks. The specific ore deposits and quantities will be subject to considerations of efficiency of steel smelter operations and feedstock blends, quality of outputs required, and relative cost of supply of the various iron ore grades. Though significant transport cost reductions are enabled by the positioning of the smelter parks close to ore deposits and ports, of particular interest will be the reduction in transport costs at the Newman Smelter Park, where iron ore transport costs to the steel smelter will be a small fraction (~5%) of the alternative of shipping this quality ore to overseas mills.

PIB provides the opportunity for substantially improving the sustainability of the Pilbara iron ore deposits, by providing access to surplus power from the Newman Smelter Park for the beneficiation of the large regional magnetite deposits for blending with the depreciating grade hematite deposits in the region.

This is particularly the case with the very large magnetite deposits in the Pilbara. Local beneficiation of these ores, using surplus power generated from the waste of the coke ovens, will provide economic benefits and permit more precise overall blending with the hematite ores. Higher quality steel outputs, higher steel smelter efficiencies and lower greenhouse gas emissions will result. The alternative use of natural gas for this application has not proven viable to date, given the market price of the North West Shelf gas in the world LNG market. The locally available and competitively priced electricity also will facilitate the use of a slurry pipeline to transport magnetite from the extensive deposits near Cape Preston. The water in the slurry may also provide additional water to Newman Smelter Park from the Lower Fortescue Aquifer.

PIB will improve the sustainability of existing steelmaking in the major steelmaking countries of China and India where:

- Reliance is placed on local coal and/or iron ore deposits, but the quantum of reserves and variable quality of those reserves do not match those in Australia; and

- Competition for internal transport infrastructure will likely remain for a considerable period.

Building steelmaking capacity adjacent to the major Pilbara and Bowen Basin resources will assist in overall sustainability of steelmaking in the Asia Pacific region.

The project has identified current infrastructure and transport cost savings for the importing and exporting nation to the value of US$9 billion (refer to Appendix AP 5).

### *1.4 Financial*

Project Iron Boomerang is a steelmakers' project. The Feasibility Study will be funded by supporters of PIB. These are expected to be primarily steelmakers who are interested in constructing and operating steel smelters. Supporters of the Feasibility Study will be invited to nominate representatives to the Management Advisory Committee, and to become investors in EWLP when the project proceeds to construction and implementation. Steelmaker supporters will also be entitled to become shareholders in EWLP and to build a steel smelter(s) in a smelter park when the project proceeds.

East West Line Parks Pty Ltd will build, own and operate the EWL, and build, own and operate the basic infrastructure of the smelter parks. This includes basic site works, access roads, materials handling infrastructure (conveyor systems, handling equipment, pipelines, etc) to and from the steel smelter gates, and precinct services such as water supply and treatment.

Steelmakers will build, own and operate their steel smelters and further downstream processing. Steelmakers are the principal stakeholder group in PIB. Whilst cooperation amongst the steelmakers is required in establishing the East West Line railway and the smelter parks, they will still fully compete in the business of making and selling steel, as they do now. They will buy services from EWLP, including transport logistics from mine to steel smelter gate, and from steel smelter gate to ship, and various smelter park services. However, EWLP will have no involvement in the operations of the steel smelters or of the businesses of the steelmakers.

The estimated total cost to EWLP of constructing the railway and precincts is estimated at US$12.5 billion. The funding of EWLP when it proceeds to the construction and implementation phase will be determined during the Feasibility Study. Debt is expected to provide at least half of the investment. It is anticipated that the participating steelmakers will be the principal equity providers, and hence the controlling shareholders.

The Feasibility Study may determine that it is in the best interests of the project to invite other major investors to participate in EWLP, in which case the amount required to be raised from participating steelmakers will be reduced. The budget and time schedule of the Feasibility Study are provided in Section 10 of this report.

At some point after EWLP has an attractive operating history, we expect that there will be an initial public offering and listing of shares on one or more stock exchanges. This provides an exit strategy for steelmakers.

### *1.5 Summary*

Project Iron Boomerang plans to build a transcontinental railway to connect the iron ore resources in Western Australia and the coal resources of Queensland and to establish smelter parks at each end. The railway will provide an efficient logistical means of bringing together the two principal resources for steelmaking. The smelter parks will provide the means for co-locating six steel smelters at each end. The economics of locating smelters in close proximity are strong. Standard modular construction of the smelters is expected to achieve an estimated savings of about US$700 million each. Also, there are substantial direct and indirect benefits associated with the concentration of steel smelters in purpose designed smelter parks. Sharing of services (stacker/reclaimers, conveyor systems, coke production batteries, etc.) is expected to save an additional US$450 million per smelter.

The economic benefits presented by the project translate into an estimated reduction in the cost of slab steel delivered to a representative steel mill in East Asia of US$107 per tonne. The railway will also enable the opening up of a number of new ore deposits that are not now economically viable, thus expanding the supply of raw materials to the steel makers by providing new opportunities for mine investment and ownership.

PIB will have significant positive environmental benefits. The transportation efficiencies translate to substantial reductions in the use of fuel and there will be efficiencies in managing energy inputs/outputs. The $CO_2$ savings are estimated as 8.7 million tonnes annually. In addition to the favourable implications for the environment, the development of emissions trading markets and schemes is estimated to result in savings of US$4 per tonne of slab steel.

The remainder of this Pre-Feasibility Study Report will provide details of PIB and the range of economic, environmental and strategic advantages that it will deliver for participating steelmakers.

# 2. Business Model and Corporate Governance

### 2.1 *Key Stakeholders and Proposed Roles*

Project Iron Boomerang is a visionary concept of high global significance and scale. It will entail a high degree of cooperation amongst the world's major steelmakers in committing to and implementing the project, for their individual benefits and for the substantial global environmental benefits and resource management sustainability.

This section describes the following:

- Key stakeholder groups and their respective roles and responsibilities in PIB;
- The governance structure of PIB and outlines the five phases of PIB; and
- The proposed business model for sourcing the requisite finance for each phase of development.

The key stakeholders and their respective roles in the project are:

**East West Line Parks Pty Ltd**

EWLP will manage and administer PIB through all phases of the project. During the Feasibility Study, EWLP will manage the project through one or more Engineering, Procurement and Construction Management (EPCM) contractors who will be contracted to design, build and eventually manage the construction of the project. On completion of all phases, EWLP will be responsible for operations, management and administration of the Operation phase of the project.

The execution strategy for the EPCM components of PIB will be based on subdividing the total scope of work into parts that are best suited to the following methodologies:

- Engineering, procurement and construction management package;
- Lump sum construction and supply packages (LS);
- Lump sum turn key (LSTK) packages;
- Schedule of Rate packages (SORs);
- Procurement supply packages;
- Service contracts and purchase orders; and
- Specialist engineering consultant packages.

All of the above methodologies have been, or are being, used successfully by major resource and logistics companies in Australia.

During the Feasibility Phase, the EPCM Contractors' deliverables will comprise a series of packages of engineering, design and commercial documentation, which will be used for the tendering and award of construction.

EWLP has established a senior management group comprising experienced senior executives and leading specialists with many years of leadership and management experience to assist in the completion of the Feasibility Study. The senior management group of EWLP has worked for major international and domestic companies across a number of different industry sectors and major projects including banking, consulting, finance, government, law, logistics, mineral and petroleum resources, project management (rail, bridges, power plants), transport, supply chain management, and technology. The group has demonstrated superior analytical, business and managerial skills at a strategic level in the functional areas outlined in the EWLP Organisation Structure at Figure 2.1 and Figure 2.2.

The group's collective experience is expected to mitigate risk and deliver leadership during and beyond the Feasibility Study. It also provides a sound basis for the EWLP organization in partnership with the steelmakers, to lead Project Iron Boomerang through its Execution and Operations phases. Profiles of the senior management group and individual capabilities are included in Appendix E.

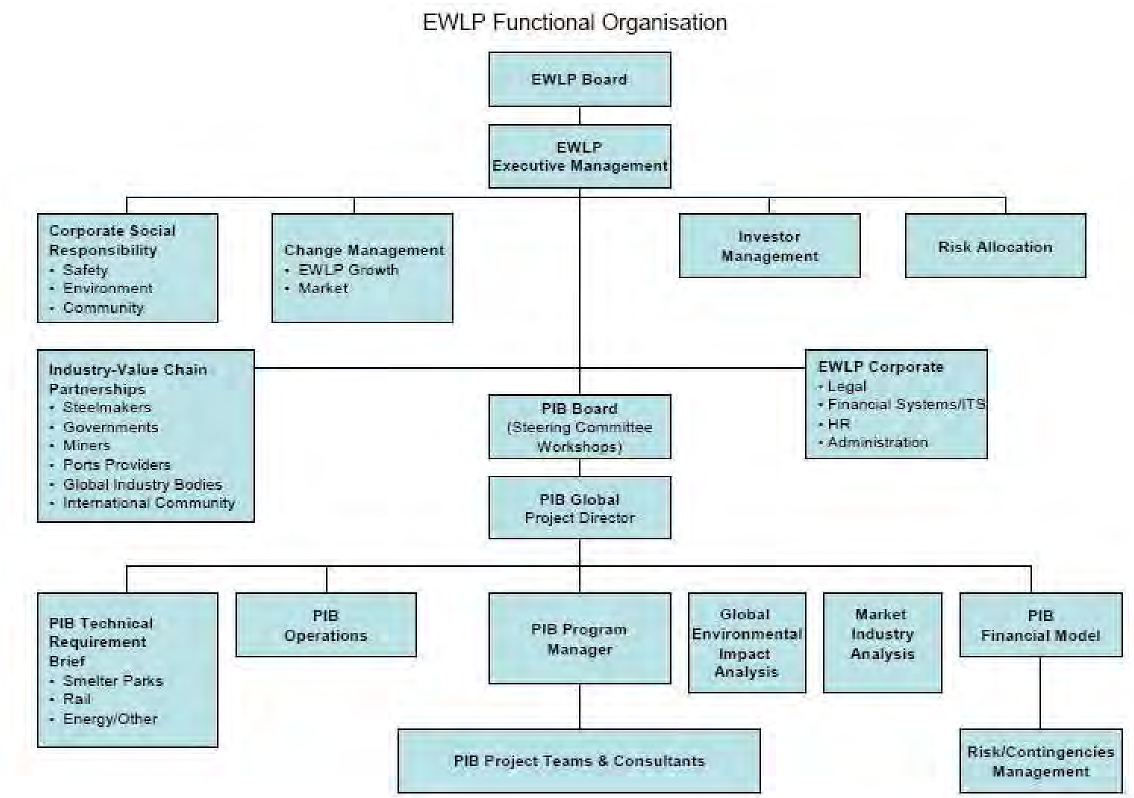


Figure 2.1 EWLP Functional Organisation

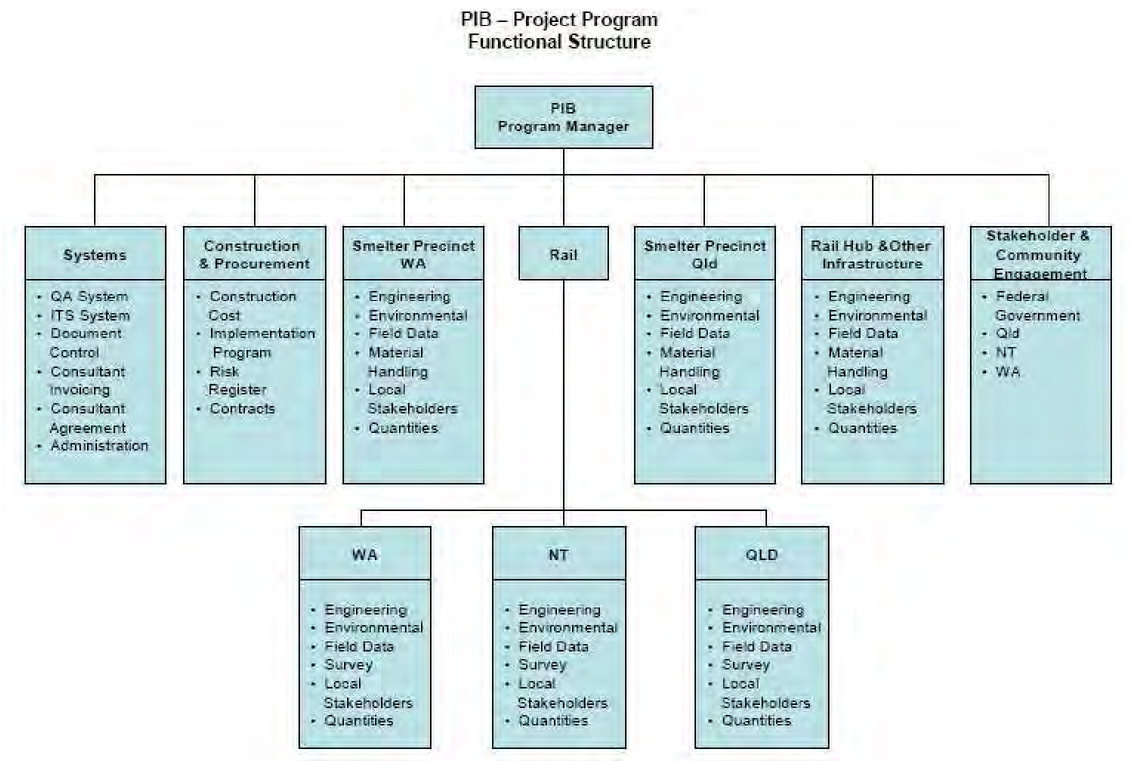


Figure 2.2 PIB Project Program Functional Structure

**Steelmakers**

Steelmakers will build, own and operate the steel smelters and downstream processing overseas. Steelmakers will be the principal stakeholder group in PIB. Whilst cooperation is required in establishing the EWL and the smelter parks, the steelmakers are likely to remain competitors in the business of making and selling steel. The common link will be purchasing the services of EWLP administration, including transport logistics from mine to steel smelter gate, and from steel smelter gate to ship, and various smelter park services. The steelmakers will also be the controlling shareholders of the consortium after the equity raising for the implementation of PIB.

**Governments**

State and Federal governments will provide the approvals to allow the project to proceed, acquire land for the rail corridor and smelter parks in accordance with legislation and regulatory frameworks.

**Existing and traditional landowners and members of local communities**

EWLP and PIB will ensure that the project contributes in meaningful ways to the long-term sustainability of community in a manner that demonstrates respect for sacred sites and practices. The project's footprint can and will be adjusted to meet these community needs. The project recognises the potential contribution that traditional and other local landowners will make to the project by their involvement and employment on the project.

**Coal, iron ore and other resource suppliers**

It is anticipated that steel raw material suppliers will continue to produce and sell raw material to the steelmakers as per current arrangements. In addition, it is proposed that the project have access to railroad infrastructure and possible surplus ground water from mine sites in the Pilbara, to provide the most efficient project outcomes. Agreement with existing iron ore producers, future producers and rail infrastructure owners (existing and future), with the support of the WA Government, will provide mutual benefit to these miners and their customers.

**Other service providers**

It is anticipated that government owned trading corporations in Queensland and WA (including rails, ports, water, etc.) will be required to undertake significant investment in their traditional areas to accommodate the project and to provide services on a commercial basis.

The smelter parks will operate most efficiently when certain production facilities, in addition to those nominated above to be supplied by EWLP, are shared. These may include coke, oxygen, and sintering plants, etc. It is envisaged that these would be operated on a collective basis by participating steelmakers within each smelter park, or by separate entities created to provide these services on a commercial basis.

The major raw material stockyards will provide the option for separate steelmakers' stockpiles (acquired separately), or for full sharing of raw materials acquired on a collective basis. The business model for acquisition of raw materials, whether on an individual basis or on a collective basis for the smelter park, will be a matter for resolution by participating steelmakers.

## 2.2 *East West Line Parks Pty Ltd*

EWLP was incorporated in Queensland, Australia in 2006. The company was initially established to assess the economic viability of the PIB concept. Having achieved that goal, as demonstrated in this report, the company will now proceed to a comprehensive Feasibility Study. If the results of the Feasibility Study support the economic advantages of PIB, project implementation and operation will then be progressed. Steelmaker support is fundamental to the project.

EWLP is led by Shane Condon, Founder and Managing Director, and is governed by a Board of Directors. Currently, the board consists of the two major funders of the project, Shane Condon, and James Handford, and Gordon Thomson who has responsibilities for the operations based in Western Australia. As outlined below, the Board of Directors and governance structure will change at the commencement of the feasibility phase.

Activities to date have included completion of the pre-feasibility phase as detailed in this report, and the marketing of the PIB concept to steelmakers and other key stakeholders.

### 2.3 *Evolution of Project Iron Boomerang*

PIB has been planned in five phases. These are shown and summarised in Figure 2.3 (Corporate Timeline).

These phases are:

- Pre-Feasibility (essentially complete) and commitment to the Feasibility Study;
- Feasibility Study;
- Commitment to the project and financial closing;
- Implementation with detailed engineering, procurement, supply and construction (EPCM) of the railroad, the two precincts and supporting infrastructure, and the twelve steel smelters; and
- Ongoing operations and further developments.

The following sections discuss the business models that will be implemented in each phase.

#### 2.3.1 Bridging phase to the Feasibility Study

After completion and distribution of this Pre-Feasibility Study Report, EWLP commences the raising of the funding to undertake the Feasibility Study. The proposed budget for the study is A$150 million, excluding in-kind contributions by the steelmakers in respect of their own steelmaking facilities activities. EWLP intends to raise this funding from 12 steelmakers and 3 investors (total of 15), with each contribution being A$10M (total of A$150M).

In return for each A$10M contribution, a steelmaker will obtain a guarantee of one steel smelter allocation in the initial 12 steel smelters proposed. Steelmakers will also become equity holders in the consortium if the project proceeds to implementation.

Contributions from non-steelmakers will entitle the sponsoring entities to an opportunity to participate in the implementation and operation phases, subject to specific negotiation on that area of participation and meeting “best for project” criteria. Non-steelmaker contributors will also have the option of having an equity participation in the consortium.

### 2.3.2 Feasibility Study

The Feasibility Study will be funded by supporters of PIB. As noted above, these are expected to be primarily steelmakers who are interested in constructing and operating steel smelters. The budget and time schedule of the Feasibility Study are provided in Section 9 of this report.

Governance arrangements for the Feasibility Study will include the establishment of a Management Advisory Committee (MAC). All contributors to the Feasibility Study will be invited to appoint a representative (or a joint representative) to the committee. In addition, EWLP will appoint an ex-officio member of the committee to chair meetings. The function of the MAC will be to:

- Keep investors fully apprised of the progress of the project;
- Provide expertise and information to the project as required and requested;
- Make recommendations to the Board of Directors of EWLP; and
- Provide a common platform for members to discuss and reach consensus on matters of common interest such as the configuration of steel smelters and support facilities.

In addition to the MAC, EWLP will expand its Board of Directors to seven members. At least two directors will be representatives of the sponsors of the Feasibility Study.

### 2.3.3 Implementation

In anticipation of positive outcomes from the Feasibility Study and a Board recommendation to proceed to project implementation, arrangements with respect to equity and debt funding will occur in parallel with the Feasibility Study. It is also possible that long-lead procurement items (e.g., locomotives) may be placed on conditional order prior to the decision to proceed to implementation.

The initial phase of the implementation period will include completion of the railroad connecting the east and west precincts. During this phase the basic smelter park precincts will be developed, and four steel smelters will be constructed concurrently, two at each end. The planned staging of steel smelter construction is due to practical construction resource constraints as well as overall steel market considerations. PIB will commence operations in late 2014 when the railroad and the initial four steel smelters are completed.

Details of the project oversight, management and control during the implementation phase will be determined during the Feasibility Phase. Concurrent with the raising of the major equity to fund the implementation phase, the Board of EWLP would be reconstituted to accommodate the new equity holders. We anticipate that steelmakers will emerge as the controlling shareholders of the consortium, and that the MAC will have a role in determining the initial members of the future Board of Directors.

#### 2.3.4 Completion of precincts and twelve steel smelters

PIB will commence operations as soon as the railroad and the initial four steel smelters are completed. Construction will then continue until the twelve steel smelters are completed.

#### 2.3.5 Ongoing operations and further developments

Although the project scope is to support the operations of 12 steel smelters, the basic railroad capacity can support in excess of 24 smelters. Capacity upgrades would involve acquisition of additional trains, construction of additional passing loops, and expansion of train servicing and railroad maintenance capability. Any further development will provide lower prices to steelmakers, as well as the other major global environmental and resource sustainability benefits. This is discussed further in Section 8 of this report.

### *2.4 Raising Capital*

The structuring of equity at the commencement of the implementation phase will be determined during the Feasibility Study. We anticipate that a public company will be established. However, alternative forms such as joint venturing will be considered if these prove to be more tax efficient or deliver higher shareholder value.

The total capital cost of the railroad, operating rolling stock and the smelter park precincts is estimated to be approximately US$12.3 billion. This excludes funding of the steel smelters and supporting industrial plant, and investment in ancillary infrastructure. For purposes of this Pre-Feasibility Study Report, we conservatively assume the project is financed with 50% debt and 50% equity, although a higher level of debt will be feasible. The final decisions on the funding will be made by the future PIB consortium Board of Directors after taking advice from the Management Advisory Committee. The decisions will be guided by the results of the Feasibility Study and the positions of the major participants.

Assuming that all of the equity will be raised from the participating steelmakers and investors, each steel smelter position will require an investment of approximately US$500 million in equity to the consortium. The Feasibility Study may determine that it is in the best interests of the project to invite other major investors to participate in the consortium, in which case the amount required to be raised from participating steelmakers will be reduced.

Various options on ownership and funding of elements of the project, such as the railroad rolling stock and servicing facilities where mature alternative models exist, will be explored during the Feasibility Study.

Debt for the implementation phase will be primarily in the form of construction loans. Subsequently, the debt will be primarily through syndicated loans, although the issuance of public bonds is expected as the operating performance of PIB develops. Backing of company bonds will be discussed with Australian and international governments. Nothing in this report is conditioned on gaining such backing.

Investors in the company at the commencement of implementation will require the existence of an exit strategy. As part of this exit strategy, at some point after PIB has an attractive operating history, we expect that there will be an initial public offering (IPO). The optimal timing of an IPO will be regularly evaluated. Significant steelmaker equity in the consortium on a continuing basis is considered desirable to provide continuity of the passing on of the benefits of PIB to the end-users.

Separate ownership and operating entities for the railroad and the smelter parks may also be desirable, and this would be determined at the appropriate time by the shareholders of PIB.

PIB is committed to environmental responsibility and sustainability and plans to conduct itself and report its actions in a manner prescribed by the Global Compact Sustainability Reporting Guidelines of the Global Reporting Initiative (GRI).

### *2.5 Subsequent Financing*

We do not currently anticipate capital raisings beyond what is achieved at the commencement of the implementation period. However, there are possible developments that could make further financing desirable, for example, a decision to expand the scope of PIB beyond 12 steel smelters would require additional financing. Also, further development that would use the railroad for other activities could require significant investment. Any such investments would be evaluated on their merits at the time.

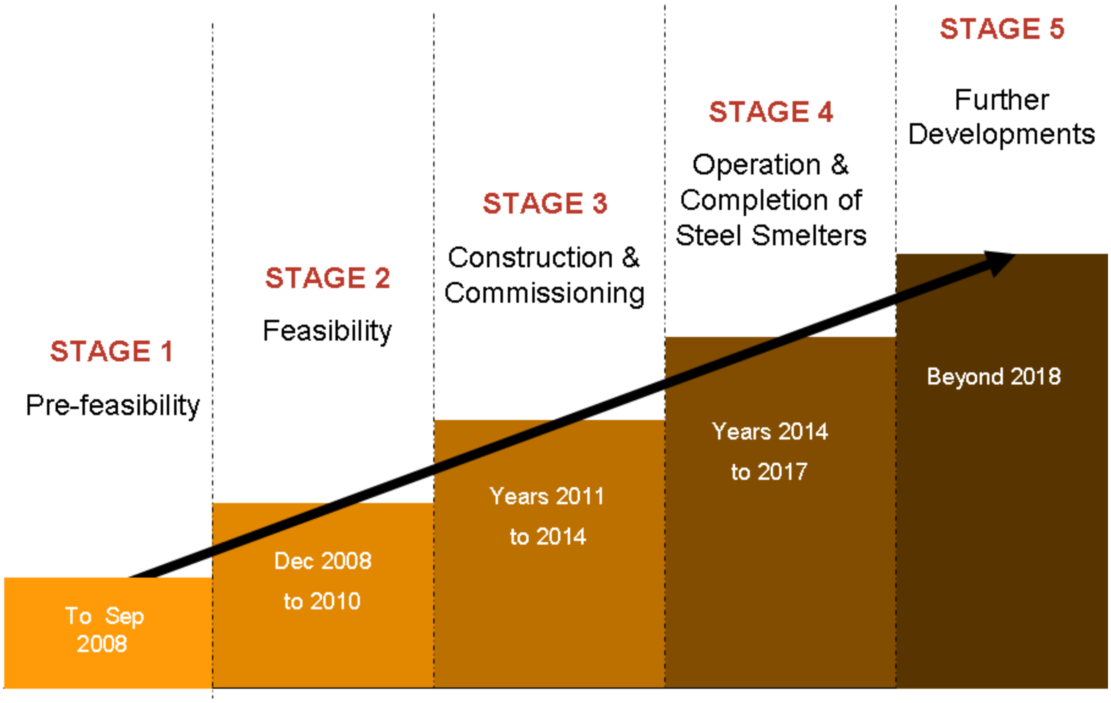


Figure 2.3 Corporate Timeline

# 3. Market Analysis

### *3.1 Market Overview*

The world steel market environment can be summarised as:

- Robust growth – Recent growth has been driven by the BRICs (Brazil, Russia, India and China). Significant production growth is predicted to continue in the BRICs, and to a lesser extent, other developing countries.

- Globalisation - The steel industry has an increasing focus on managing logistics and production chains in a global sense, rather than on the historically narrow national basis.

- Concentration – Mergers and acquisitions among steelmakers are creating fewer but larger producers, driven by market forces (e.g., Mittal/Arcelor, and Tata/Corus) or under government direction (as in China).

- Profitability - The industry has been reasonably profitable, whetting its appetite to invest sustaining and growth capital in response to the continuation of the dynamic market environment.

- Closures - There have already been shut-downs of inefficient production facilities (on financial and/or environmental grounds) and relocation to more suitable industrial areas.

- Environmental - There is a growing need and awareness of the environmental and resource demands of locating major steel smelters in densely populated regions in Asia, including consideration of the demands on available water and land transport.

- Uncertainty - Increasing transport bottlenecks (port congestion, demurrage, shipping shortages) and price volatility create uncertainty as seaborne traded volumes of major raw material inputs progressively increase their proportion of steel production inputs.

- Input quality - An expectation of increasing focus on quality of scarce resource inputs, favouring a greater trend to more trading globally in the key higher quality iron ore and coking coal inputs.

- Technology - Steel smelter technology (and use of coke as reducing agent) is expected to remain the dominant production process progressively assisted by the development of more process efficient technologies.

- Increasing prices - Raw material inputs are becoming more expensive, driven by demand growth, supply lags, and an expected continuation of high energy (oil, coal, gas), general resources and export/import infrastructure costs.

The implications for steelmakers competing in the above-described world steel markets can be profound. Some may fail and others will be acquired by stronger competitors. When the profitability of steelmaking weakens at some future date, it will be the companies with the lowest cost inputs that will survive. The opportunity for new market entrants in strong and weak markets reduces annually.

It is notable that the large steelmakers are seeking to vertically integrate into markets beyond steelmaking (e.g., ship building, automobile manufacturing, white goods). The opportunity is to profit from each stage of the manufacture of elaborately transformed goods.

In the drive for size, efficiency and profitability, it is logically consistent that the steelmakers should seek a measure of control to activities closer to the supply of raw materials.

The implications of this business environment for Project Iron Boomerang are that steelmakers now view the Project as the next logical step to increase market competitiveness.

Some issues which support this view are:

- Strong demand for steel smelters and steel slab for rolling mills is forecast to continue, covering new production capability, but also as replacement for inefficient and higher polluting old facilities.

- Australia is uniquely endowed with world-scale reserves of very competitive, high quality iron ore, coking coal and other minerals important to the steelmaking processes.

- The PIB smelter parks and railway are located in very sparsely populated regions, and will have minimal impact on existing land uses and populations.

- PIB has a strong triple bottom line, with financial, environmental and social (Australia and the steelmaking countries) attributes that are all very positive.

- There is strong developing interest and support in PIB to date from major steelmakers throughout Asia, State and Federal Governments, resource producers and infrastructure developers.

PIB should not be seen as a threat to major trading nations' maintenance of steelmaking capacity because the project is targeting less than 10% of projected global capacity growth over the next decade. Similarly, PIB does not expect to have any impact on existing arrangements between resource companies and steelmakers. The focus of PIB is on the future markets.

Individual steelmakers will have a variety of reasons and circumstances influencing their decision making regarding participation in PIB. These include:

- Need for new capacity or replacement capacity and desired timing;

- Direct, close door-to-door delivery access to major raw materials;
- Overall logistics costs and finished cost of producing and getting steel to market;
- Increased alternatives for locating steelmaking capacity (access to land, transport, etc.);
- Environmental benefits of locating new mills away from population centres and closer to material inputs (iron ore, coal, water, limestone, manganese, etc.);
- Lower operating and sovereign risk considerations; and
- Co-location in smelter parks facilitates sharing infrastructure and services with more affordable environmental outcomes.

### *3.2 Steelmaking Technology*

Current steelmaking technologies produce a first-stage melt from the iron oxide ores use the steel smelter/coke process, a smelting reduction process (such as Corex) also using coal as the reducing agent, or the DRI technologies involving direct reduction (in the form of lumps, pellets or fines) by a reducing gas produced from natural gas or coal. These latter technologies include HIsmelt, DIOS and a number of other proprietary R&D processes being trialled on a relatively small scale.

Steel smelters rely on traditional coke as the primary reducing agent for removing the oxygen from iron oxides and can use coal or gas for providing the additional process heat requirements. The steel smelter produces molten pig iron, which is then further processed into steel in the basic oxygen furnace, or to be used as an input to electric arc furnaces. The other processes mentioned above do not involve coke in the process.

Steel smelters currently provide approximately 90% of the world's primary "virgin" iron (excluding re-use of scrap steel), and in spite of significant investment in new technology that does not rely on coke, steel smelter technology is expected to remain the predominant technology for new steel production into the foreseeable future. Industry forecasters predict that steel smelter technology will account for over 85% of virgin iron production in 2025 (Dr N.J. Bristow, Future Steel and Coke Industry Trends, Intertec European Coke Conference, Dusseldorf, April 11, 2006).

Project Iron Boomerang is premised on steel smelter technology being the primary steelmaking "technology of choice" of the steelmakers building new steel smelters in the smelter parks. However, PIB remains open to other technologies being employed where these technologies are viable and contribute to the overall project benefits.

Figure 3.1 describes the basic steelmaking processes.

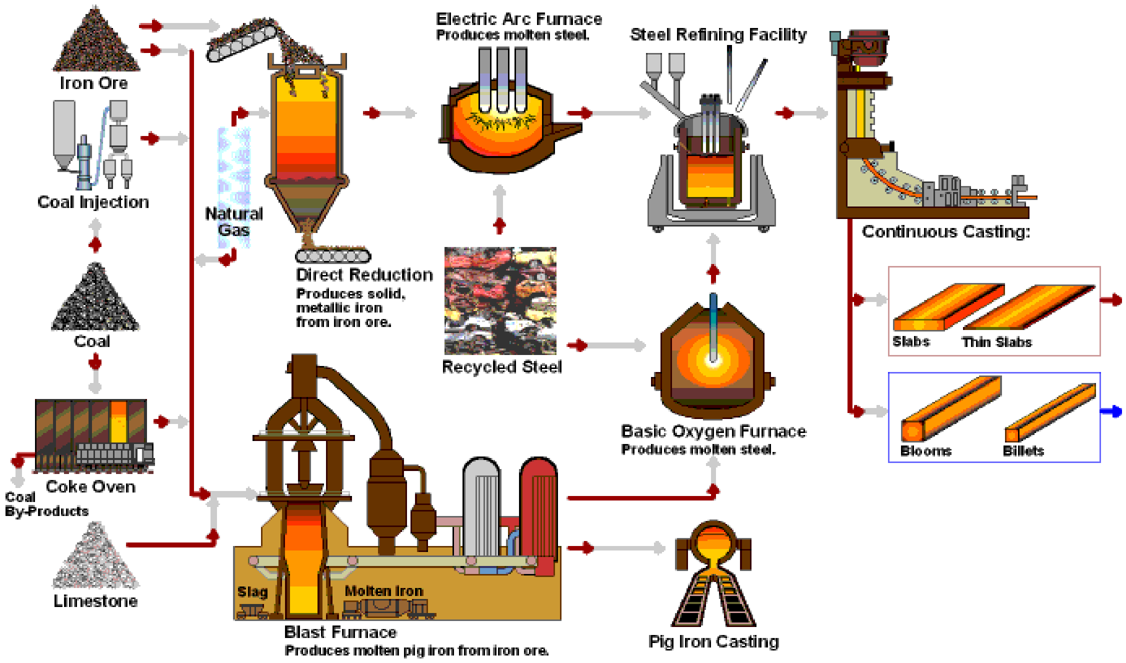


Figure 3.1 Steelmaking Process (Source: World Coal Institute)

In the absence of iron ores from other sources for blending, the Pilbara iron ores may require beneficiation for use as sole feedstock into the steel smelters, whether using some of the poor sintering hematite ores or the lower iron content magnetite ores, pelletising of part of the iron ore feedstock may also be required. Locating pelletising plants within the smelter parks, with the availability of surplus energy, will provide another advantage to the viability of some of the Pilbara ore deposits, and overall sustainability of iron ore bodies of the region. The project anticipates that beneficiation of magnetite will provide the best chemical balance efficiency feed as one of the key steelmaking attributes of the project.

### 3.3 *Steel Production Growth Forecasts*

World production of steel has increased substantially in recent years, with statistics summarised as:

| | 2005 | 2006 | 2007 | 2008 Forecast | 2009 Forecast | Annual Growth |
|---|---|---|---|---|---|---|
| **Production (Mt)** | | | | | | |
| World | 1140 | 1250 | 1344 | 1415 | 1492 | 7.72% |
| China | 356 | 423 | 489 | 533 | 586 | 16.15% |
| **Consumption (Mt)** | | | | | | |
| World | 1126 | 1239 | 1322 | 1398 | 1473 | 7.70% |
| China | 350 | 384 | 438 | 482 | 528 | 12.71% |

Table 3.1 World Steel Production

(Source: The Australian Bureau of Agricultural and Resource Economics (ABARE), Australian Commodities, June quarter2008)

Recent world growth has been predominantly driven by domestic demand in China, where production has increased by almost 150% in the past five years. Chinese steel production is now over four times that of Japan and is over one-third of total world production. In spite of this impressive growth, however, China's per capita consumption of steel still remains low by the standards of industrialised nations.

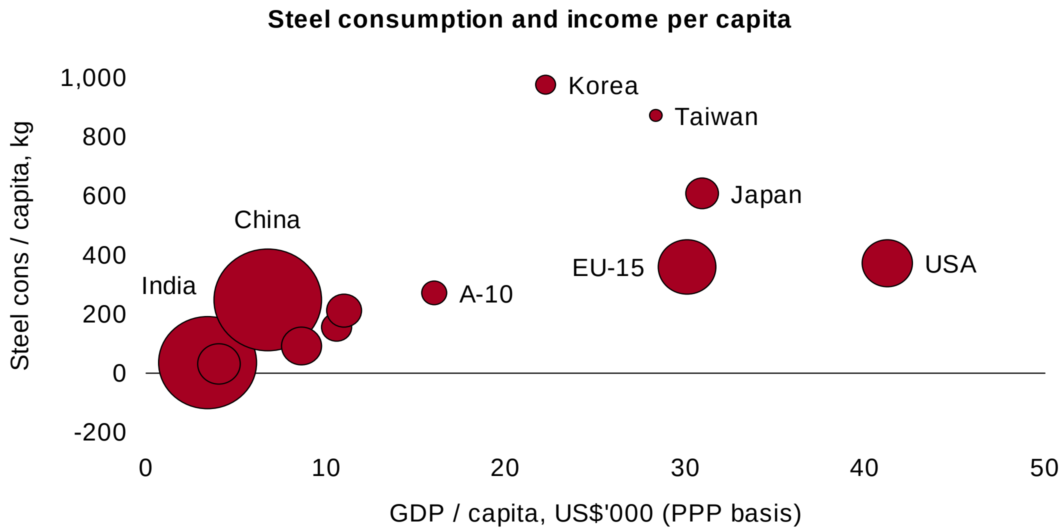


Figure 3.2 Steel Consumption and Income per Capita

(Source: Hatch Beddows. Note: PPP – purchasing power parity)

India is expected to be the next major steel growth market, with its own ambitious plans to increase its steel production five-fold over the next decade. It has an even lower per capita consumption of steel than China.

Other significant consumption growth markets are expected to be the Russian Federation countries, Brazil, and the industrialising Asean countries.

Growth forecasts in steel production over the next decade are for strong growth to continue, with projections of up to 700 million tonnes over the next decade of new capacity being required. Figure 3.3 shows the summary of research undertaken by Deutsche Bank in 2005. Virgin iron production will comprise approximately 500 million tonnes over 10 years of this growth. Other industry observers predict similar strong growth to continue.

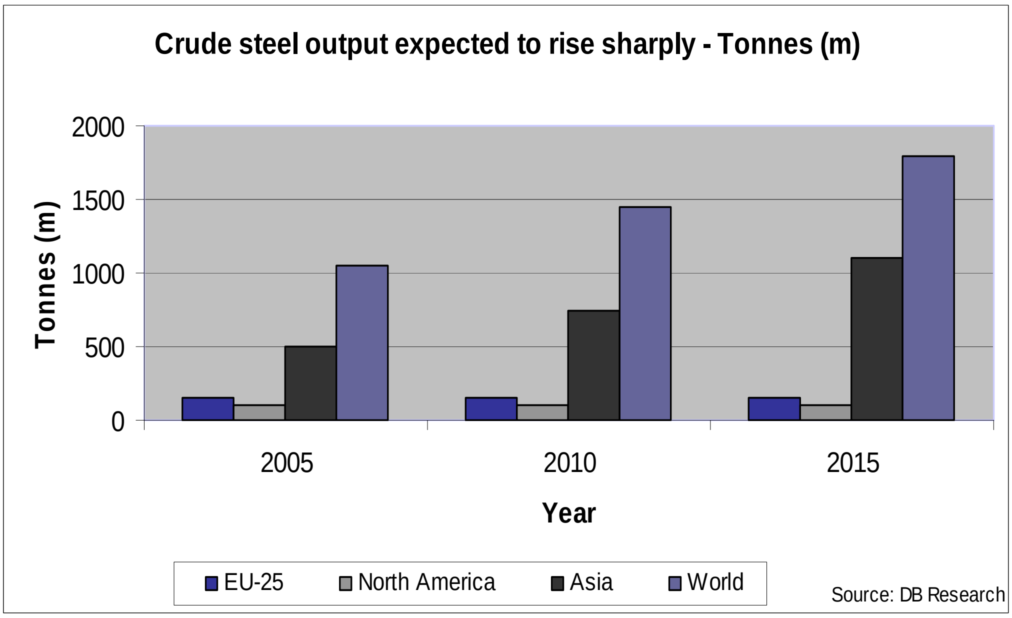


Figure 3.3 Projected Crude Steel Output

In addition to new capacity to meet growth in steel consumption, there is a continuing need to replace existing production capacity that is obsolete, or economically and/or environmentally no longer viable. This is currently occurring in Europe and the USA (with new steel mills being developed in Brazil taking advantage of the large iron ore deposits in Brazil and its relatively low cost structure compared to western Europe or the USA), and partially adopting the Project Iron Boomerang concept of back-loading. Brazilian steelmakers back-load some coal from Australia and produce steel slab for export to consumer markets.

The smelter capacity replacement process will also increasingly occur in China as the Chinese Government seeks to rationalise the number of producers and close large numbers of high polluting, inefficient and small steel mills. There are a reported 1,500 steelmakers in China, but only 26 mills have an annual output of greater than 3 M tpy. The Chinese government has set a target of a major rationalising of the industry, with the largest ten steel mills to account for 50% of total output in 2010, and 70% in 2020. Most of these companies are owned by the central government, and PIB offers a timely opportunity to the

Chinese Government to locate part of China's new and replacement capacity to environmentally responsible locations.

PIB's business case is focussed on constructing twelve 10,000 hot-metal tonnes per day steel smelters or 3.6 M tpy producing a project output total of 44 million tonnes per annum of slab steel. The choice of 10,000 tonnes per day is a notional size. The steelmakers will ultimately dictate the size of smelters that will best suit the attributes of PIB. This level of production will be reached within ten years, and potentially could double over a longer period. The tonnage represents less than 10% of the predicted (predominantly Asian-driven) global growth in steel smelter capacity over the next decade, and a lower percentage when overall replacement steel smelter capacity is considered. PIB envisages that the final processing of slab steel to finished product would be undertaken in the consuming mass market regions.

### *3.4 Major Raw Material Resource Suppliers*

Most major steel producing nations have an increasing reliance on seaborne imported raw materials. This trend is expect to continue as the steel production volumes increase and local sources of raw materials become harder to extract or quality reduces. There has also been a growing trend for major steelmakers to acquire a stake in raw material resources to secure future long-term supply.

Australia has extremely large reserves of both iron ore and coking coal and is ideally located relative to the dominant Asian growth market. The Pilbara accounts for approximately 40% of the traded iron ore market, and Queensland's Bowen Basin supplies approximately 50% of the world's seaborne traded metallurgical coal. This market share is likely to continue, given the extent and quality of the reserves, the world's best practice mining operations, proximity to the major Asian market and the existing high-grade infrastructure.

In addition, both the Pilbara and the Bowen Basin are characterised by a number of ore deposits and resource companies, either already producing or actively pursuing opportunities to develop new deposits. Opportunities exist in Australia for individual steelmakers to acquire deposits outright, joint venture with miners to develop deposits, or remain solely as purchasers of the major raw material inputs. The East West Line will open many new opportunities for the existing, undeveloped and new mines across the nation (refer to Appendix F).

The Pilbara is currently dominated by the two major iron ore miners (BHP Billiton and Rio Tinto). Both are undergoing major expansion projects. Fortescue Metals Group completed development of a 45M tpy mine and a new railroad to Port Hedland in mid-2008. Several new market entrants are seeking to capitalise on the current and projected robust demand for iron ore and current market prices. Major rail and port upgrades are underway, and Cape Preston is proposed as the next major export port for the Pilbara region.

Australian iron ore exports are forecast to grow from 269M tpy in 2007 to over 405M tpy in 2012, predominantly from the Pilbara (The Australian Bureau of Agricultural and Resource Economics (ABARE), Australian Commodities, March quarter 2007). The individual miners have even more bullish forecasts, driven by expectations of continuing robust demand, and the quality and location advantages of the Pilbara to the Asian markets.

The Queensland coking coal market has a similar dynamic, but with a wider mix of suppliers competing for market share, and with a similar major expansion underway in response to market demand and robust prices. Australian metallurgical coal exports are forecast to grow from 125M tpy in 2006 to 152M tpy in 2012, predominantly sourced from the Bowen Basin (The Australian Bureau of Agricultural and Resource Economics (ABARE), Australian Commodities, March quarter 2007). Industry forecasts are again far more bullish than the ABARE forecasts.

The first four steel smelters in PIB are planned to come on-stream in late 2014, hence it will not impact on the current round of mine developments and major rail and port infrastructure upgrades, which are generally underpinned by existing contract commitments. The other smelters will progressively come on stream over the next three to five years. PIB is expected to moderate the next major infrastructure expansion phase, by partially reducing the growth required for other non-project rail, port and shipping capacity for the export of raw materials, but not reducing the mining expansion requirements.

PIB provides steelmakers direct access to highly competitive and proven suppliers of both high quality iron ore and coal, and provides the opportunity to efficiently increase the potential suppliers in the Pilbara. It also provides the sustainable opportunity to utilise the very extensive lower grade magnetite ores beneficiated and blended with the primary hematite ores in a sustainable manner.

The lower grade ores, such as the very extensive magnetite reserves, would require local beneficiation prior to delivery to the smelter parks. This will reduce logistics costs per tonne of iron railed. Magnetite beneficiation requires electricity to power the grinding circuits and magnetic separation. PIB expects to provide competitive energy sources in the form of high-voltage electricity from the smelter parks (compared to the only current alternative of natural gas). Low cost electricity makes magnetite beneficiation viable which, in turn, lowers transport costs for local steel production.

### *3.5 Cost Advantages of Project Iron Boomerang*

This Pre-Feasibility Study documents a number of advantages of PIB to steelmakers including a substantial cost advantage per tonne of steel produced. The cost advantage arises from logistical savings from reductions in the transportation of iron ore, coal and slab steel in addition to production economies related to the co-location of six steel smelters in each precinct.

Advantages are also achieved by reductions in both capital expenditures and operating expenditures. The details are provided in later sections and supporting appendices.

To illustrate the potential cost advantage of PIB, a base case is developed in Section 7. The base case assumes the fob delivery of slab steel to a coastal East Asia steel mill. The analysis shows an estimated cost reduction of over 30% (US$107 per metric tonne).

The cost advantages of PIB that are estimated in the Pre-Feasibility Study are compelling and support the funding of a comprehensive Feasibility Study.

### *3.6 Conclusions*

The market analysis above leads to a number of key conclusions.

World steel markets will continue their strong growth, particularly in Asia. The PIB business case is premised on producing only 44 M tpy out of a forecast world-wide new steelmaking capacity of over 500M tpy over the next decade.

Steel production is now a global industry, with efficient logistics outcomes a major consideration. When the profitability of steelmaking weakens at some future date, it will be the companies with the lowest cost inputs that will survive. PIB presents steelmakers the opportunity to be competitive and profitable in both the strong and weak cyclical markets for steel.

In the drive for size, efficiency and profitability, it is logically consistent that the steelmakers should seek a measure of control of activities closer to the supply of raw materials. Steelmakers now view PIB, with its triple bottom line benefits, as the next logical step to increase market competitiveness.

PIB will give steelmakers continued ex mine site to steel mill gate direct delivery access to the premium iron ore and coking coal resources in the Pilbara and Bowen Basin, with enhanced competition between suppliers. However, PIB does not impede the current round of major rail and port infrastructure expansions underway in both Western Australia and Queensland for iron ore and coal exports.

PIB also provides the opportunity to effectively use cheaper lower-grade iron ore reserves for many decades without the added transport penalty involved in exporting these ores to overseas smelters.

PIB will provide substantial savings in the delivered cost of slab steel to international second stage steel mills in a variety of market locations to distinct advantage.

# 4. Smelter Park Precincts

### 4.1 General

Initial smelter park locations proposed are at Abbot Point near Bowen in Queensland, and adjacent to the Mt Newman Railroad near Poonda Siding, 55 km north west of Newman in the Pilbara region of WA.

Key selection considerations for each location include:

- Large flat sites available with limited existing use, and large buffer areas;
- Proximity to transport infrastructure (rail and/or port);
- Available water; and
- Proximity to existing service centres and community infrastructure.

PIB is expected to require a construction workforce in excess of 8,000 workers (refer to Appendix AS14) over an extended period, and require a permanent direct workforce of 2,000 to 3,000 workers at each precinct.

Key features in the preliminary planning for each smelter park are locating the facilities and steel smelters to make efficient use of the sites, optimise the major material handling logistics (raw material inputs, finished product and wastes), and efficiently manage the energy inputs and outputs. The rail access and major common user materials stockyard are central to planning and achieving the maximum advantages of the precinct co-location. The aggregated handlings of solid materials for the six steel smelters in each precinct, to and from the steel smelter gate, are in excess of 160M tpy.

Features common to both smelter parks (and included in budget costings) are:

- Rail reception points (tipplers for the EWL trains and bottom dump at Abbot Point for the narrow gauge coal trains);
- Large stockyards, stacking and reclaiming equipment and conveyor systems for the raw materials (iron ore, coal, coke, limestone) to access the processing plants, and provide sufficient stockpile capacity to guarantee continuity of supply and the ability to blend from separate stockpiles;
- Single large coking plant to produce coke orders for individual steel smelters, and attached co-generation power plant to utilise surplus gases and heat for base-load electrical power generation;
- Water supply, on-site storage, waste water and stormwater collection systems, and water treatment facilities to maximise water re-use and prevent environmental impacts from contaminated water run-off;
- Transport systems to deliver completed product to rail or direct to wharf for export;

- Transport systems to collect and manage the solid wastes generated, including maximising any further processing opportunities for its re-use;
- Rail servicing facilities; and
- Smelter park maintenance facilities, site management and security.

Other common user processing facilities could include sintering plants and oxygen production.

Precinct economics and the major advantages of co-location in the PIB precincts include:

- High utilisation rate (24/7) of common user infrastructure, with essential requirement for built-in redundancy able to be more effectively utilised;
- Reduced total inventory holdings covering much lower supply chain reliability risks (and much closer proximity to major input suppliers);
- Standard Modularised design and construction and economy of scale in building facilities and supporting infrastructure;
- Economy of scale in operational support and maintenance; and
- Efficient management of energy involved in the various processes and maximising its re-use will be features of the smelter park concept and the scale involved.

A notional concept layout for the major common-user stockyard is as below.

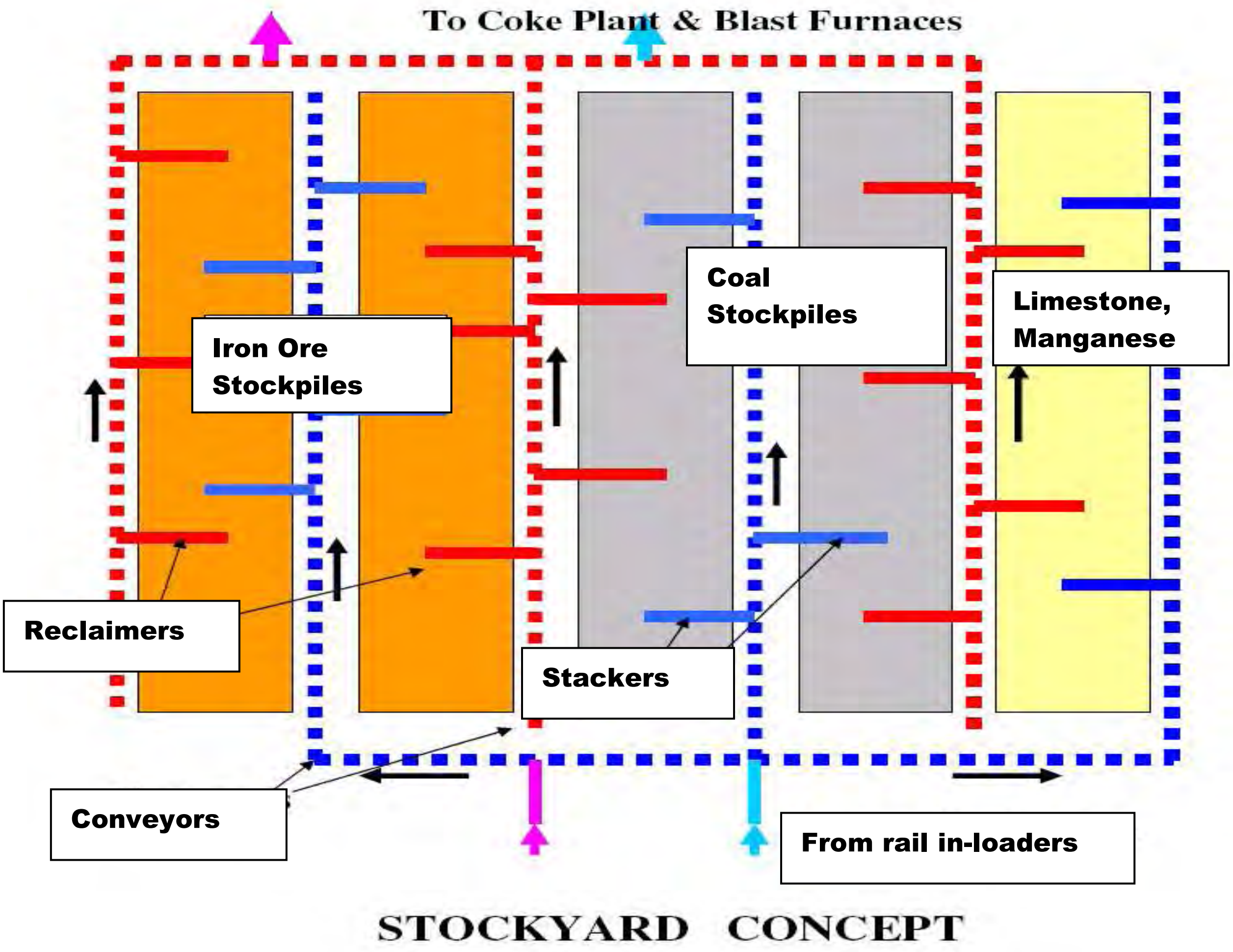


Figure 4.1 Stockyard Concept

The stockyard is scalable to meet the collective stockpile needs, storage volumes, product types, blending requirements and delivery rates for the major input materials. Preliminary costings assume a basic row module of 1500m x 60m, with yard machines staged to match required input delivery rates and output production rates. Notional stockpile quantities for the project case are 4.5Mt of iron ore (seven weeks equivalent usage) and 2.1Mt of coal (five weeks usage).

The possibility of collection of waste gases for sequestration needs to be investigated further, with the smelter park concept offering the concentrated scale to potentially make this viable.

Specific features of each initial smelter park location are discussed in the following sections.

### 4.2 *Abbot Point Smelter Park*

Proposed location for planning purposes is as indicated below. There are a number of significant features of the site.


Figure 4.2 Proposed Location of Abbot Point Smelter Park

The existing port is to be expanded by Queensland Ports Corporation to meet the requirements of PIB and other potential industrial users in the region. Deep water access for Capesize ships is available. Expansion will include additional berths, breakwaters and land access to the north west of the existing coal export terminal and jetty.

Water will be sourced from the Burdekin River via an open channel/pipeline as an extension to the "Water for Bowen" project by Sunwater. Water supply security will be achieved by an extension (two metre raising) of the Burdekin Falls Dam, which currently has a storage capacity of 1.86 million ML with very high recharge reliability from its large catchment and location within the wet tropics.

A large area of flat land is available that is currently used for cattle grazing and with residential areas remote from the site and located away from prevailing winds.

The major environmental issue will be proximity to local Caley Valley wetlands and to the Great Barrier Reef. Rainwater runoff will need to be fully contained and collected and treated on site for maximum re-use.

Rail access is via the Queensland Rail narrow gauge Newlands coal system, linking to the Goonyella and Blackwater coal rail systems, and the North Coast Line and the EWL. Road access is by way of the Bruce Highway (Highway 1) which skirts the site.

Bowen (current population approximately 8,000) will be the major local support centre and accommodation centre for construction and permanent workforces.

Air services are available at Townsville (international and domestic), Proserpine and Mackay (domestic), with international flights also at Cairns and Brisbane for transfer to domestic flights. An upgrade of Bowen Airport and commencement of regular domestic jet services is likely as a result of PIB.

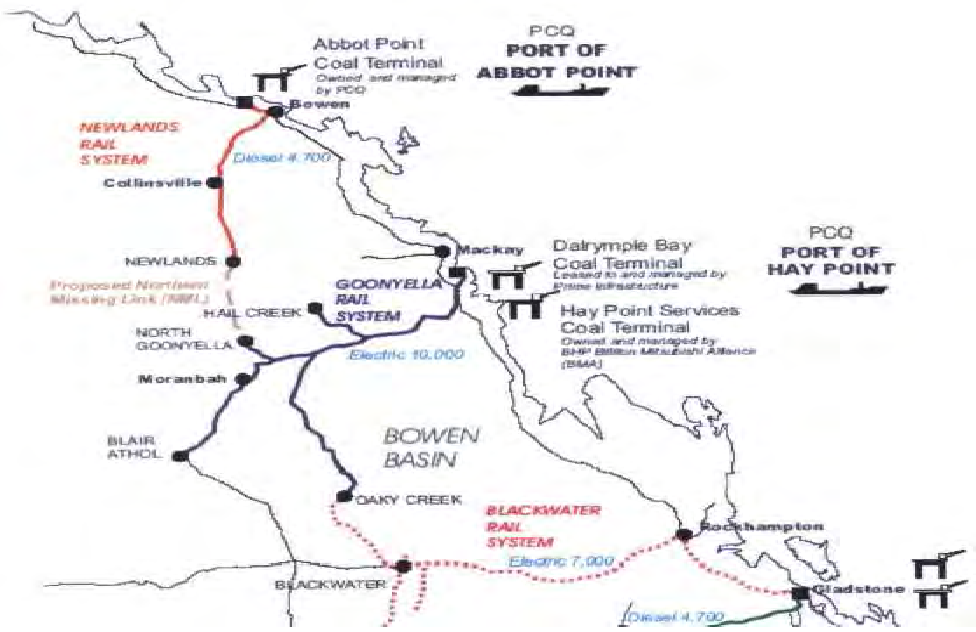


Figure 4.3 Bowen Basin Coal Rail & Port Network

The proposed area and concept precinct layout at Abbot Point is as indicated on the following.

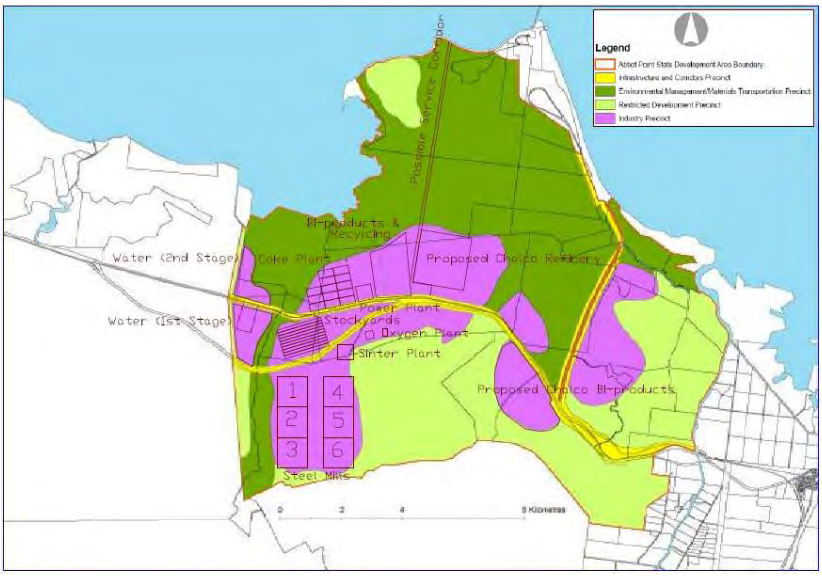


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Figure 4.4 Abbot Point Smelter Park – Notional Area

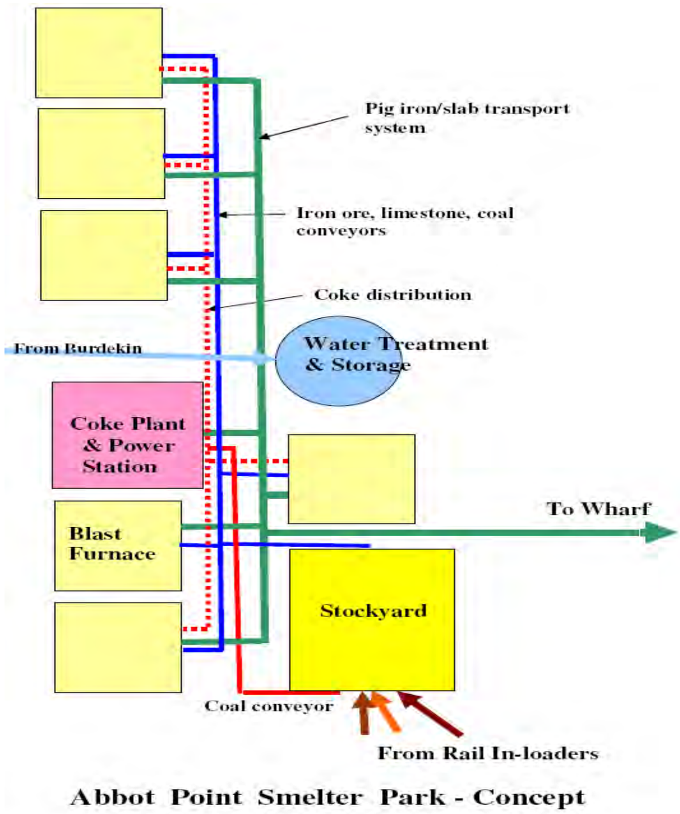


Figure 4.5 Abbot Point Smelter Park - Concept

### 4.3 *Newman Smelter Park*

The proposed location of the initial smelter park in the Pilbara is 55 km northwest of Newman, adjacent to Poonda Siding on the Mt Newman Railroad. The site is located in the Fortescue River valley but well distant from the river channels.

Significant features of the proposed site for the Newman Smelter Park ("NSP") are detailed below.

The NSP location is in close proximity to major iron mines and planned mines, accessing the BHP Billiton's Mt Whaleback and adjoining ore bodies, Yandi, and Area C, the Hamersley Iron's Marandoo, West Angelas, Yandicoogina and Hope Downs mines, and FMG's Christmas Creek and Cloudbreak deposits, all within 250km of Poonda, with only short rail connections needed to link existing rail systems to connect to these mines. These mines will have a total production capability of over 240 M tpy. Further extensive deposits are located in the Pilbara, which become more viable with short hauls and lower transport costs, and the potential for beneficiation. A slurry pipeline to link to the large Cape Preston magnetite deposits is also an option, providing greater diversity of competitive suppliers, and additional water to NSP.

The NSP location is at the upstream ends of the various rail systems, with lesser rail capacity constraints compared to those rail sections closer to the ports, which are utilised by all the mines in each rail/port system. Limited rail capacity upgrades will be needed to these rail systems to divert iron ore to NSP via the EWL to Abbot Point.

Rail capacity requirements from NSP to Port Hedland are proposed as 3 x 24,000 tonne payload steel trains per day. This will likely require further rail capacity augmentation of the existing Mt Newman Railroad with some additional duplication, but this would be expected to replace a similar number of iron ore trains from the BHP Billiton mines exporting via Port Hedland.

The NSP site is very large and relatively flat, and is currently used for cattle grazing.

Water is planned to be supplied via piping from de-watering of nearby mine pits (e.g., Mt Whaleback, Yandi, Hope Downs – assuming agreement with these mine operators) and from harvesting local groundwater in the upper Fortescue River aquifers.

Rail access from the mines and to Port Hedland is proposed as being via the Mt Newman Railroad, with short connections to link to the Hamersley Iron rail systems near Yandi and Mining Area C. A separate spur line to link to the FMG railroad and mines is proposed if steelmakers require FMG ores or access to other deposits in the Chichester Ranges area.

Newman is the local service centre (current permanent population is approximately 2,000). A major expansion of the town will be required to accommodate PIB. Significant fly-in/fly-out commuting of workers is also anticipated.

A major environmental issue associated with the location is the sourcing of sufficient water and its handling and treatment of stormwater run-off and used water to prevent local contamination. The NSP site is remote from any residential areas.

Options for disposing of solid wastes are local landfill or return to mine sites for incorporating in filling in mine pits.

The proposed location and concept layout for the Newman Smelter Park is as follows.

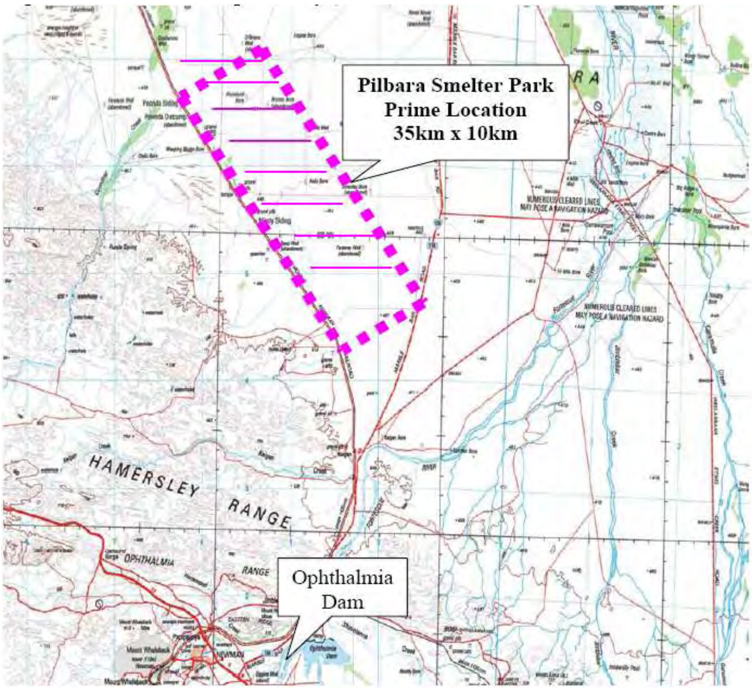


Figure 4.6 Proposed location of Newman Smelter Park

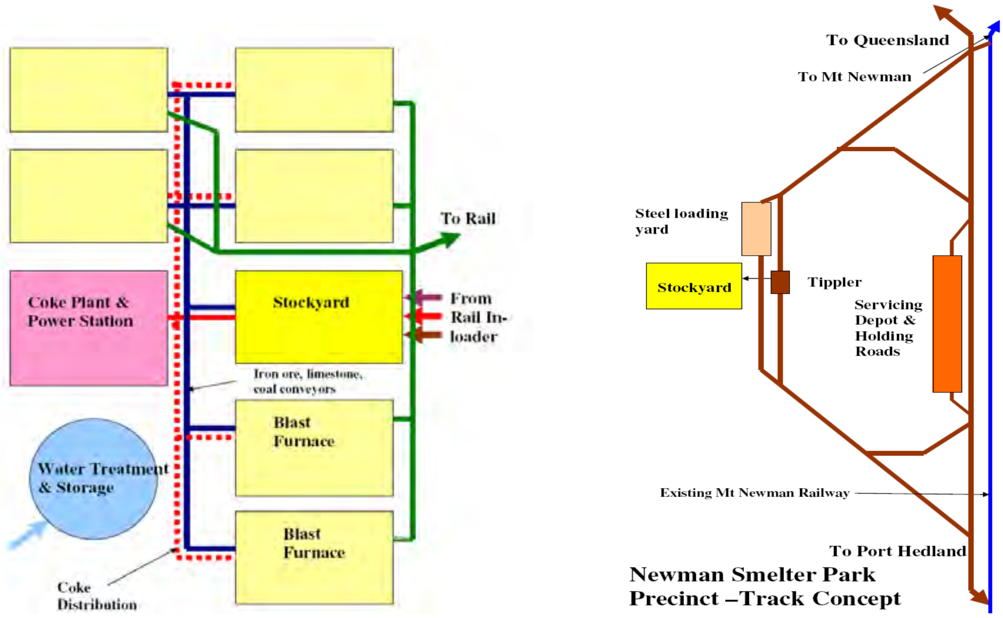


Figure 4.7 Newman Smelter Park – Concept Layouts

### 4.4 *Port Hedland Steel Handling*

The preliminary operational concept for Port Hedland for the handling of slab/billets provides for a separate short rail spur to a rail unloading and storage yard in the Boodarie area. Road transport will then be used to a dedicated wharf/berth in the Anderson Point area. The concept is notional only at this phase, with no involvement by the Port Hedland Port Authority or Government on the concept planning, or with any competing users for port capacity or land side facilities.

Panamax or Handymax size ships are assumed as adequately meeting shipping requirements for steel slab/billets, with a notional 60,000 tonnes per day throughput needed when all six steel smelters are operating.

Rail deliveries are proposed on 3,100 metre (refer to Appendix AP12) long trains with a payload of 24,000 tonnes (refer to Appendix AR2).

Diesel fuel deliveries to Newman Smelter Park will involve an estimated 2.5 million litres per week, and are proposed via tank wagons attached to a steel train. Diesel fuel storage tanks and rail tanker loading facilities are proposed in the vicinity of the steel handling yard.

An alternative to Port Hedland is the proposed port at Cape Preston, with options subject to a detailed feasibility study and the timing of any development at Cape Preston.

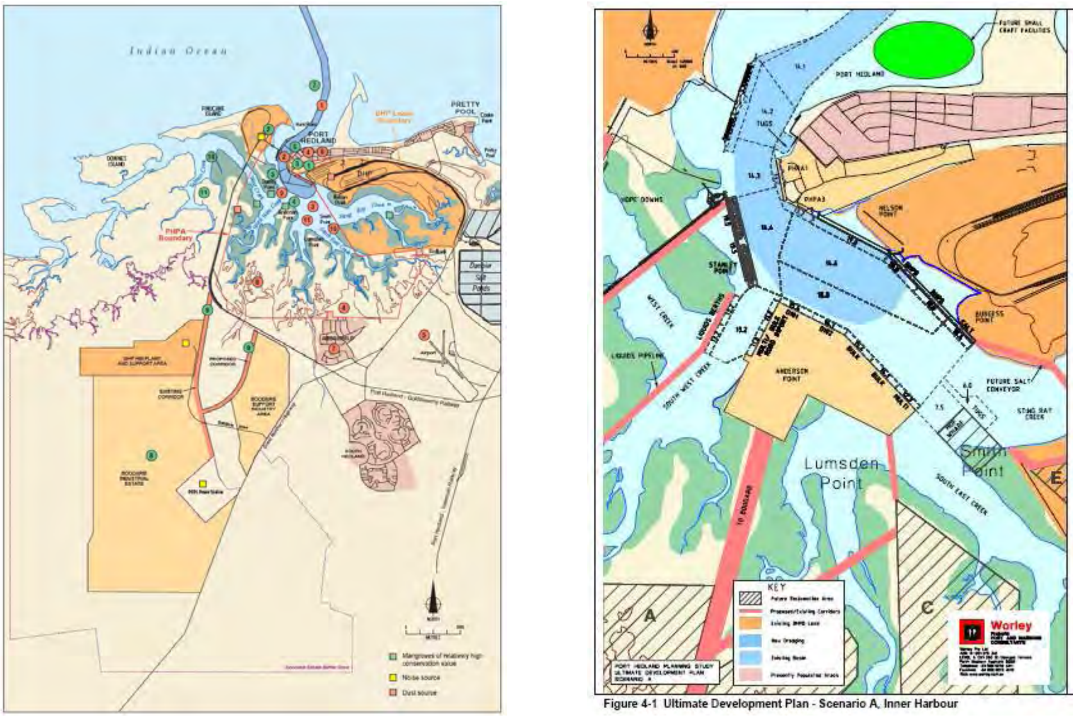


Figure 4.8 Port Hedland

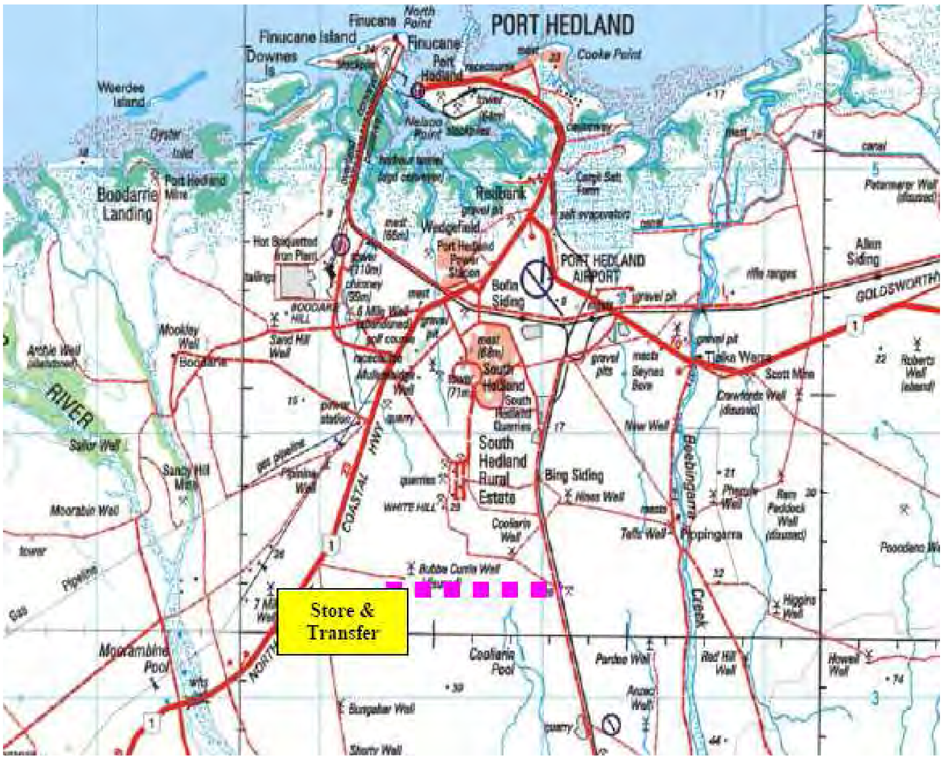


Figure 4.9 Port Hedland - Rail/Road Transfer and Storage Yard

# 5. Railroad

The East West Line linking the Pilbara iron ore mines with the Bowen Basin coking coal mines and the smelter parks is the fundamental element in the PIB concept and the major fixed cost element. The Pre-Feasibility Study has identified a viable railroad alignment suitable for heavy haul rail operations and developed a comprehensive operations and resourcing plan to meet the phased needs of the smelter parks. This relies on well established and proven railroad technologies and engineering practice in delivering a reliable, low risk logistics outcome for steelmakers. The following sections summarise the results of the detailed studies undertaken to date.

## *5.1 Rail Alignment*

### 5.1.1 Background and methodology

The target origin/destination for the East West Line is Abbot Point, via the existing narrow gauge Newlands Railroad corridor and its planned extension to near Riverside Mine, then connecting to the existing Mt Newman-Port Hedland Railroad near Poonda Siding, approximately 55km northwest of Newman.

Quantm Pty Ltd, a subsidiary of Trimble Corporation, was engaged to identify viable corridors to stringent heavy haul rail grading and alignment criteria and determine the most efficient corridor alignment. The technology utilised for this initial desk top investigation was Quantm's proprietary alignment design software package. This relies on using available 3-dimensional digital terrain data, topographical data, land use data and other relevant databases, to design viable alignments, compare relative construction costings, and determine the most appropriate alignment/s.

The key rail design criteria for the EWL are:

- maximum grading of 0.5% (one in 200); and
- minimum horizontal curve radius of 3,000 metres.

The overall route length from Riverside to Newman was dissected into 15 overlapping sections to cover the level of data processing and accuracy required, and the top 50 viable alignments were determined and ranked. The Quantm software generated full alignment designs to specified minimum standards, cross-sections, quantity take-offs, and costings for selected quantities and nominated unit rates.

**Selected preliminary alignment**

The outcome of the Quantm modelling was the determination of alignments that achieve the design criteria, and which are practical and efficient options in terms of overall route length, minimising land use impacts, construction costs, and rail operating costs.

The selected preliminary route option is as indicated on the map below. This route has a number of important features.

The route passes through sparsely populated areas with the predominant land use being for low intensity cattle grazing on very large pastoral properties.

It skirts the upper reaches of the drainage systems in western Queensland, and is located to the south of the normal monsoonal influence, reducing the size of drainage structures and irregular flooding impacts, and providing better foundations and gravel/ballast sources.

It passes close to the settlements of Kynuna in Western Queensland, and Ti Tree, approximately 170km north of Alice Springs on the Adelaide-Darwin Railroad. The towns are both on major highways. The locations are proposed to be utilised as important railroad infrastructure maintenance centres, crew change points, and Ti Tree would be the major intermediate locomotive re-fuelling depot.

Significant river crossings are limited to the Bogie, Broken, and Fortescue Rivers, and the upper reaches of the Diamantina, McKinlay, Hanson and Lander Rivers, and Wokingham Creek.

The bulk of the alignment in the Northern Territory ("NT") and WA traverses low rainfall regions, with poorly or non-defined surface drainage systems to cater for the sporadic major rainfall events. Design issues will be determining an appropriate under-track drainage system and adopting flood-proofing measures at locations where very infrequent track over-topping events may occur.

Virtually the entire route will be subject to Native Title, being predominantly pastoral leasehold or unallocated Crown land. Negotiations with the traditional owners for access will be necessary. The route also passes through Aboriginal Reserves in the NT and WA. Cultural heritage issues may impact on local design outcomes.

Approximately 500 km of the route in WA and the NT passes through arid desert terrain, comprising dunes and gibber plains. This will require particular consideration in respect of sub-ballast design, economical sourcing of suitable gravel base, and long-term track and dune stability.

Overall route length of the EWL from Abbot Point to Newman Smelter Park is approximately 3,370 km. Overall track length, inclusive of crossing loops, terminals, and maintenance sidings, is approximately 3,500 km.

A map showing major Indigenous and Environmental areas is below.

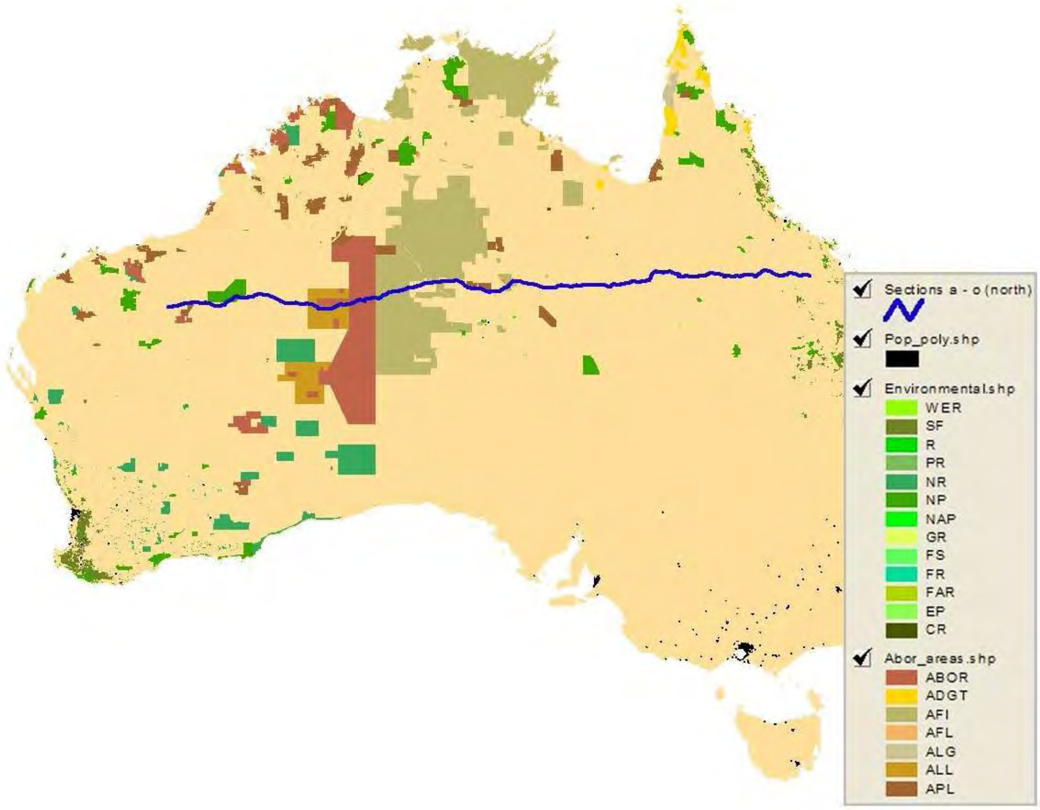


Figure 5.1 Major Indigenous and Environmental Areas

The Quantm report, which is the basis for the planned route, is included as an attachment to this Pre-Feasibility Report. Further, Quantm has produced a fly-over video of the route. This video CD is available as an attachment to this report. It allows close inspection of the full route and provides detailed information about the topography, ownership and use of all lands.

### 5.2 *Railroad Standards and Implementation*

Preliminary planning provides for the following design standards:

- axle load to 40 tonnes (TAL), but operation will be nominally at approx 34 TAL for iron ore traffic, and 23 TAL for coal (volume constrained);
- rail size 68 kg/m;
- pre-stressed concrete sleepers (at 600mm spacings);
- crushed rock ballast with 250mm depth below sleepers;
- design train is 4 locos (7,000hp AC traction) with 300 wagons; and
- crossing loops to be 3.5km long and each to also include a refuge loop.

Proposed construction methodology is working concurrently on four fronts:

- west from Abbot Point (rail shipped to Abbot Point);

- east from Ti Tree (rail delivered via the Adelaide-Darwin Railroad);
- west from Ti Tree (rail delivered via the Adelaide-Darwin Railroad); and
- east from Newman Smelter Park (rail shipped to Port Hedland and railed to Newman Smelter Park).

Sleeper manufacturing plants and rail welding plants are to be established at the three starting points. Major track materials (rail and concrete sleepers) will be fed by work trains from these starting points to each construction front. Ballast sources will be developed along the route (to minimise transport distances) and trucked to loading sidings for final delivery to track by rail.

Key railroad implementation issues will be:

- resources availability (skilled workers and equipment, particularly the specialist track construction equipment);
- provision and logistics of construction camps, and the quality of services provided in ensuring workforce morale and efficient deployment;
- effective management of local stakeholders and landowner issues and local construction impacts;
- sourcing gravel sub-ballast layer and ballast (to acceptable strength and durability quality standards) along the route (to minimise haulage distances and cost);
- sourcing water for construction;
- supply of rail and pre-stressed concrete sleepers to meet the tight track construction period;
- logistics of construction materials and support, particularly rail, sleepers and ballast, and pre-cast concrete materials;
- local sourcing for concrete in remote areas;
- dealing with flood plain crossings and potentially poor soil conditions;
- economic designing for rare flood events;
- desert crossings;
- remoteness issues (in managing human resources, location of construction camps, response to equipment failures);
- achieving economic production rates and having civil construction (earthworks and structures) keeping well ahead of the tracklaying front on each section;

- equipment reliability; and
- climatic conditions (extreme heat during summer).

Major track materials quantities are (refer to Appendix AR5):

| | |
|---|---|
| Rail | 473,000 tonnes |
| Concrete sleepers | 5,800,000 |
| Ballast | 7,660,000 cubic metres |
| Main line turnouts | 78 |
| Siding turnouts | 146 |

### *5.3 Terminals*

Concept layout for the Newman Smelter Park rail terminal is:

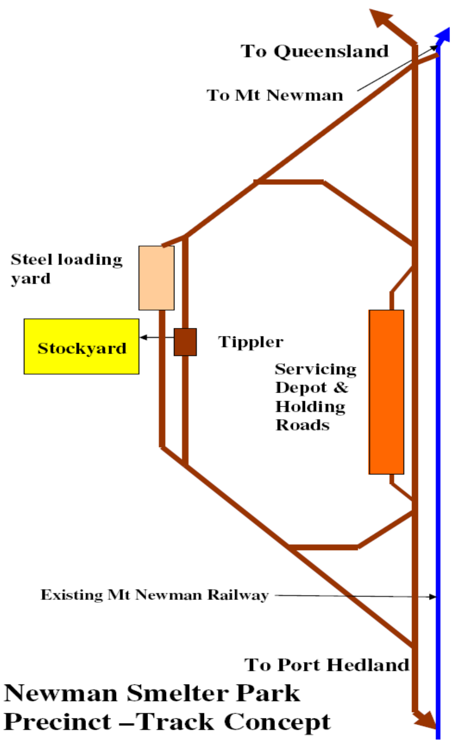


Figure 5.2 Newman Smelter Park Rail Terminal

Details of the concept for the Abbot Point rail balloon loops (separate EWL standard gauge loop and tippler, and the Queensland Rail ("QR") narrow gauge balloon loop and bottom-dump unload station), as well as locations for the EWL rolling stock depots, have yet to be developed. The decisions require the involvement of other stakeholders in the region and other potential industrial users of the area around Abbot Point.

The Moranbah Coal Hub comprises a short QR narrow gauge spur line and balloon loop (electrified) with bottom dump unloading station, feeding the coal stockyard via conveyor and coal stacker. The EWL comprises a single straight-through track with passing loop, with an overhead bin (fed from the stockyard by a reclaimer and conveyor) to load coal on west bound EWL trains.

The Port Hedland Steel Handling Yard is proposed as a 2 km long siding with run-around track, adjacent to a hardstand area for forklift or crane unloading of steel slab for stockpiling or direct loading to truck for delivery to wharf. An additional siding for loading of fuel tankers is also proposed.

## *5.4 Railroad Operations*

### 5.4.1 Planning assumptions

The key operational planning assumptions are as follows.

Locomotives are to proven heavy haul standard, designed for heavy duty, hot and arid conditions, similar to GM's SD70ACe diesel electric AC traction locomotive with extended fuel tank capacity.

Wagons for the main iron ore/coal traffic are low tare, stainless steel bodies, similar to the latest BHP Billiton design but with a 400mm higher wall to provide additional cubic capacity to better balance the coal-iron ore traffic balance.

Design train is 4 locomotives x 300 wagons with distributed power. Train payloads (and gross trailing mass) are:

| | **Iron ore** | **Coal** |
|---|---|---|
| Payload/wagon | 109 tonnes | 65 tonnes |
| Payload/train | 32,700 tonnes | 19,500 tonnes |
| Operating axle load | 33.3 tonnes | 22.4 tonnes |
| Gross trailing load | 40,050 tonnes | 26,850 tonnes |

The number of daily train services for the project case of six steel smelters each end is three trains/day each direction (based on 340 days/year operation).

Overall EWL train cycle time is estimated at 124 hours, which includes 16 hours to load and unload (iron ore and coal) and an average running speed of 75kph (excluding crossing delays, crew changes, locomotive provisioning and train inspections).

The steel train from Newman Smelter Park to Port Hedland is 3 locomotives x 200 wagons with a payload of 24,000 tonnes. Short haul delivery of iron ore to the Newman Smelter Park will be in smaller trains comprising two locomotives and 150 wagons.

Train operations provide for maximum 12 hour shifts, with the four shifts between Moranbah Coal Hub to Newman Smelter Park being two person crews (to overcome problems of shift length and remoteness), and the crew for shorter runs between Moranbah and Abbot Point, and Newman to the iron ore mines and Port Hedland being a single person. Crew depots and crew change points would be located at Abbot Point, Moranbah, Kynuna, Ti Tree, mid-point between Ti Tree and Newman, Newman Smelter Park, and Port Hedland.

Train control is based on satellite based voice and data communications from the locomotive (and on track machines) to central control, with computer based travel authority and validation protocols linked to GPS tracking to provide a basic Automatic Train Control system.

Crossing loops will initially be based on maximum three hour section running times (nominal spacing of 210 km) and be equipped with power operated points, remotely activated by the train driver on approach. Sixteen crossing loops are proposed initially to meet the operational flexibility of six steel smelters each end.

Rolling stock servicing depots (for locomotives and wagons) are located at Abbot Point (main depot) and Newman Smelter Park. Locomotive fuelling is undertaken at both terminals and at Ti Tree.

### 5.4.2 Rolling stock requirements

Train numbers and rolling stock requirements for the Project Case are assessed as (refer to Appendix AR3):

| | No. of trains | Locomotives | Tippler wagons | Other wagons |
|---|---|---|---|---|
| EWL trains | 15 | 69 (*) | 4,950 (*) | |
| Local IO trains | 3 | 6 | 450 | |
| Steel trains | 3 | 9 | | 630 (*) |
| Fuel trains | 1 | 1 | | 30 |
| Work trains | 2 | 2 | | 80 |
| Totals | | 87 | 5,400 | |

(*) Includes spares.

Rolling stock specifications will be developed with the major proven suppliers during the detailed feasibility, based on the latest proven technology. Consideration will include fitting all trains with electronic braking to assist train handling, in-cab fuel utilisation efficiency support tools, and on-wagon health monitoring and reporting diagnostics.



*Courtesy of EDI Rail & United Group*

### 5.4.3 Infrastructure maintenance

Infrastructure maintenance objectives and resourcing are focussed on maintaining the fixed infrastructure "fit for purpose with high performance reliability" by preventative maintenance and providing the ability to respond quickly to incidents to minimise operational disruptions. Key activities involve:

- condition monitoring (track alignment and rail condition);
- rail grinding;
- tamping and lining to maintain top and line;
- drainage maintenance and vegetation control;
- desert crossing maintenance; and
- maintenance of turnouts, point machines and other electrical/mechanical equipment.

Five infrastructure maintenance depots are proposed to provide geographic coverage along the EWL, plus two high production mobile resurfacing gangs and a separate rail grinding production gang.

### 5.4.4 Rolling stock servicing and maintenance

Maintenance depots for locomotives and the wagon fleet are proposed near Abbot Point (main depot) and at the Newman Smelter Park. These depots will cater for scheduled periodic inspections, component change-outs and minor repairs. This will include wheel and bogie change-outs, engine replacements, and an underfloor wheel lathe.

Wayside condition monitoring will include wheel bearings (acoustic and/or infra red heat sensors) and wheel flat spot detection, with all rolling stock equipped with electronic tag identification.

#### 5.4.5 Railroad manning levels

Preliminary EWL workforce resourcing requirements are (refer to Appendix AR2):

| **Function** | **Personnel** |
|---|---|
| Train crew | 165 |
| Rolling stock maintenance | 150 |
| Infrastructure maintenance | 274 |
| Operations and administration | 183 |
| **Total** | **772** |

#### 5.4.6 Diesel fuel

Diesel fuel is the greatest single rail operating expense. Total estimated consumption is 450ML per annum. Diesel fuel logistics are:

- re-fuel or top up locomotives at Abbot Point, Ti Tree and Newman with storage depots at each location;
- rail fuel to Newman from Port Hedland;
- rail fuel to Ti Tree via the Adelaide – Darwin Railroad from either Darwin or Adelaide, depending on source (or from Abbot Point); and
- ship fuel into Abbot Point and pipe to storage depot.

### *5.5 Connectivity to Coal and Iron Ore Mines*

#### 5.5.1 Coal mines

Coal deliveries to the Abbot Point Smelter Park and to the Moranbah Coal Hub will be on the QR narrow gauge network, providing access to all coal mines in the Bowen Basin. The EWL rail system will operate totally independently of the QR narrow gauge network.

### 5.5.2 Iron ore mines

Access to the Pilbara region iron ore mines will be by a combination of existing lines, short connections to link the existing rail networks (the BHP Billiton and Rio Tinto rail systems), and (potentially) short spur lines to connect with new railroads and iron ore mines (e.g., FMG's Christmas Creek mine and rail system).

The linkages from the Mt Newman system to the Rio Tinto rail system and mines at Yandicoogina, West Angelas, Marandoo and Hope Downs, can be achieved with short connections where they intersect or are nearby (from near Yandi and Area C). These connections will provide adequate train refuging for EWL trains and should not adversely impact rail capacity at the upper ends of the various iron ore rail systems.

An issue will be the different wheel rail profile between the two rail systems, and the impact this could have on wheel and rail life for large tonnages and high axle loads. The EWL is proposed to be configured with a similar wheel-rail profile to the BHP Billiton system, as it will be its predominant rail access system. It is considered that the relatively short hauls for the iron ore trains to access the Rio Tinto mines on that rail system, and the conservative axle load proposed (34 TAL), should be acceptable to all stakeholders. This should be confirmed during the Feasibility Study.

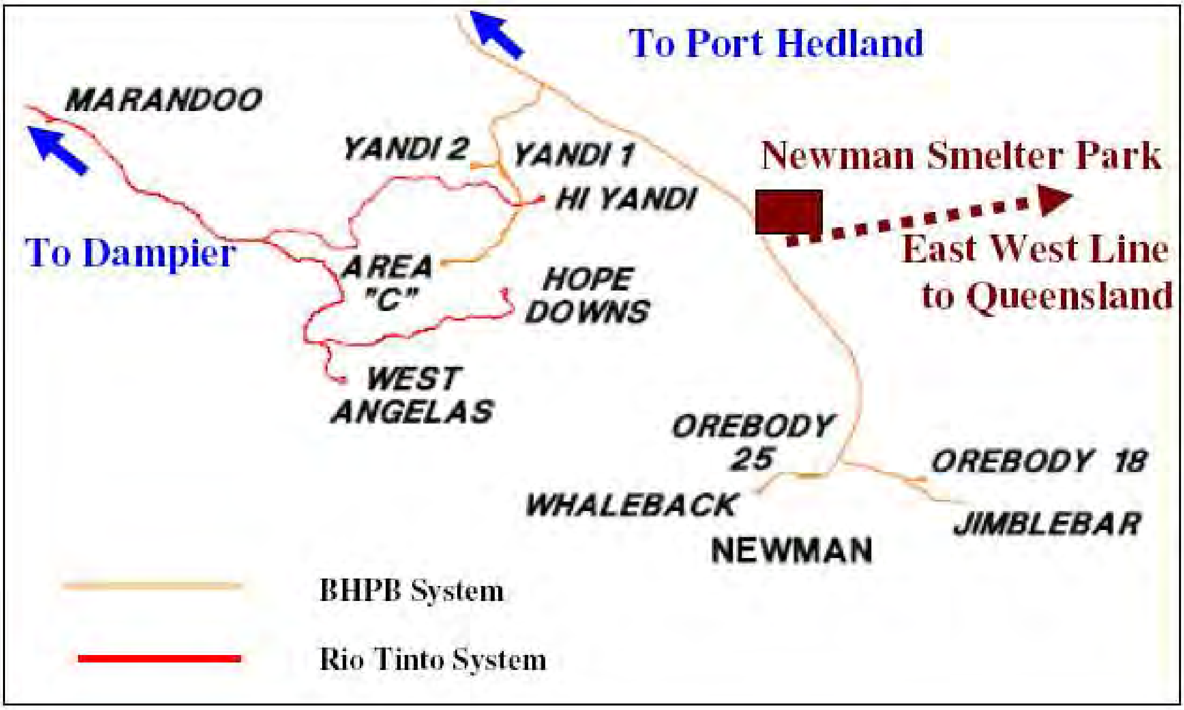


Figure 5.3 Newman Smelter Park Location

### 5.6 *Conclusions*

Key conclusions to be drawn from this section are as below.

The East West Line linking Abbot Point to Newman is technically feasible, with a very economic route and grading, and minimal impact on existing land uses or the environment.

A highly efficient railroad operation is planned, utilising proven technology and maximising back-loading principles.

The project case of six steel smelters at each end only entails running three EWL trains each way per day, and there is substantial reserve capacity to cheaply service additional steel smelters and lower overall prices for all users.

The rail design and construction is relatively straight forward with the major issue being securing the resources (materials, skilled workers and specialist equipment) to build it in an economical timeframe to suit the start-up of the initial steel smelters.

The railroad and PIB concept provides very good connectivity to the existing and future coal and iron ore mines in the Bowen Basin and Pilbara regions respectively, providing the opportunity for steelmakers to access a number of competitive suppliers of the major steelmaking inputs.

# 6. Financial Summary

This section reports on the financial analysis that has been conducted during the Pre-Feasibility Study. Summary information is reported on capital expenditure, operating expenditure, revenue requirement and the business outcomes of PIB. Detailed information is provided in the financial spreadsheets that are attachments to this report, including textual descriptions of the mechanics of the spreadsheets. Sensitivity analysis is reported on key assumptions. Then the railroad option is compared to using coastal shipping as the means to transport the raw materials to the smelter precincts. The section begins with a brief description of the analysis conducted.

The most important data for steelmakers evaluating the economics of PIB is the basic financial justification of the project compared to the base case of the existing logistics model of steelmakers importing major raw material inputs and other comparable estimates. This is reported in Section 7 and in many ways is the most important part of this report.

All of the financial analysis supports the economics of PIB as being compelling. Proceeding to the next step of conducting a Feasibility Study of PIB and EWLP is recommended.

### *6.1 Methodology of the Financial Analysis*

A detailed financial model has been developed covering the first 25 years of project implementation and servicing the operation of the Project Case of six 10,000 hot-metal tonnes/day steel smelters in each of the two initial smelter parks. The analysis is then extended to 50 years using the terminal value method. The amounts in the table are expressed in US dollars, as that will be the functional currency of the project, and as at the commencement of implementation.

The financial spreadsheet model (Appendix A) consists of eight worksheets. The main elements of the analysis are the capital expenditure ("capex") and operating expenditure ("opex") data. The analysis separates the railroad from the precincts for steel smelters. The railroad is further separated into above and below rail, as is conventional for railroads. The initial forecasts of capex and opex are largely in Australian dollars as that will be the most common currency of the capital and operating costs incurred. The Australian dollar amounts are then converted into US dollars at the forecasted US$ long-run average exchange rate. Working capital, primarily accounts receivable, inventory requirements and allowances for accounts payable and payroll, is built up in the final year of construction in quarterly increments. The investment in working capital is assumed to be consistent with the average working capital of publicly listed companies in the appropriate industries.

The implementation period is assumed to span four years for the construction of the railroad, completion of the precincts for the first four steel smelters (two at each end of the rail line), and the establishment of the rolling stock of the railroad sufficient to service the production of the first four steel smelters.

Additional rolling stock will be acquired to service the additional steel smelters as they come on line.

The precincts will be constructed in three phases, each involving the construction of two steel smelters at each end of the rail line. Construction of the steel smelters will be undertaken by the owner/operators. That is not a part of PIB or the analysis here. The precincts will be developed so that the steel smelters can also be built and be operational by the completion of the railroad. The second development phase for the precincts will see four additional steel smelters constructed over an 18-24 month period, and the third phase will be the last four steel smelters constructed over an additional 18-24 month period for a total of twelve steel smelters. Although it is considered likely that there will be further development of precincts and steel smelters, that is not included in the analysis here.

The analysis is conducted at the level of the firm rather than only the equity. Therefore, the cost of capital is the Weighted Average Cost of Capital ("WACC"), as is commonly used in practice. As with the currency of the forecasts, the WACC is expressed in US dollars. For purposes of this analysis and report, the firm is assumed to be funded equally with debt and equity. This is considered a conservative assumption as the achievable leverage is almost certainly higher. As the leverage is increased, within prudent limits, the cost of capital will reduce due to the tax deductibility of interest payments, making the project even more financially attractive than is presented here.

Advice has been taken on the forecasted interest rates. During construction, borrowing is expected to be at a premium over the rate on short term US Treasury bills that includes issuance costs. In making this assumption, it was noted that commitments for the funding of the construction project will be in place from the beginning, and its customer base will also be in place. The debt financing of the project after operations commence is assumed to be achievable at a premium over the rate on long-term US Treasury bonds. The rate assumes the use of syndicated loans appropriate for major infrastructure investments with a secure customer base and includes issuance costs.

The equity of the project will be higher risk during the implementation period and then reducing to low risk once operations begin. As with the discussion on the costs of debt capital above, the risks during the construction and operating periods are mitigated by the commitment to full funding and the established customer base. The cost of equity capital is estimated using the Capital Asset Pricing Model, as is accepted practice.

There are two principle outputs of the financial model. The prices that need to be achieved for the rail and precinct services and the value created by PIB for EWLP, which is the net present value of the full project. The financial model has been constructed with the capability to do sensitivity analysis on key input variables as required.

### 6.2 *Financial Analysis*

The EWLP financial analysis of the PIB case for the works and operations undertaken by EWLP includes the capex of the railroad, the smelter park precincts, the materials handling facilities at Moranbah and Port Hedland and the opex of these facilities. Significant investments will be undertaken by other service providers such as Queensland Rail, Ports Corporation Queensland in its Abbot Point port expansion, and iron ore miners in upgrading their respective rail networks in the Pilbara, and Sunwater in respect of construction of major water supply infrastructure to Abbot Point from the Burdekin Dam. The capex and opex of the associated infrastructure are excluded from the PIB capex and opex. However the project financial analysis does include the estimated service charges associated with these investments and operations by others.

| | |
|---|---|
| **Prices per tonne (US$):** | |
| Below rail | $15.00 |
| Above rail | $13.00 |
| Total rail (of railed tonnes on EWL) | $28.00 |
| Precincts (output/t steel) | $17.00 |
| **Investment (US$ millions):** | |
| Below rail | $ 7,041.1 |
| Above rail | $ 1,461.9 |
| Precincts | $ 3,801.0 |
| Working capital (at full production) | $ 40.3 |
| Total investment | $ 12,344.3 |
| **Value created in EWLP (US$millions):** | |
| Rail | $1,633.7 |
| Precincts | $1,174.4 |
| Total | $2,810.2 |
| **Assumptions (long run):** | |
| Cost of capital from commencement of operations (WACC based on 50% debt) | 7.5% |
| Inflation rate | 2.5% |
| Exchange rate | A$1.00 = US$0.75 |
| Diesel (per litre) Govt Tax Exempt | $0.56 |

Detail in support of the above data is provided in the spreadsheets included as Appendix A, specifically AF3, AF4, AF5, AF6 and AF7. The spreadsheet analysis allows for conducting sensitivity analysis of key factors, which is discussed in Section 6.6 below.

### *6.3 Capital Expenditures*

Capital expenditures are reported in detail in Appendix A, specifically AF1 and AF4, and are summarised as:

| **Capex Element** | **US$M** |
|---|---|
| EWL Railroad | 6,123 |
| Rolling stock | 1,271 |
| Moranbah Coal Hub | 159 |
| Abbot Point Smelter Park and associated servicing facilities | 1,441 |
| Newman Smelter Park and associated facilities plus Port Hedland steel handling | 1,705 |
| Contingency provision (15%) | 1,605 |
| **Total Capex** | **12,304** |

There will be considerable investment in addition to the direct expenditures by PIB. The capital expenditures for steel smelters, basic oxygen furnaces, coke plant and other supporting processing facilities to be built by steelmakers are expected to ultimately be in excess of US$30 billion. Total investment by state government entities will be of the order of $2 billion (refer to Appendix A for details).

Transport logistics in the Pilbara are fully costed within the above totals, with PIB proposing to own the rolling stock and paying an access fee to the relevant railroad owner where operating 3rd party product on its rail system. This principally applies to BHP Billiton with other parties' iron ore, steel and fuel being hauled on the Mt Newman railroad system.

Direct imported content for the PIB railroad and precinct works (excluding the steel smelters and associated works) is estimated at approximately US$3.1 billion (refer to Appendix AP10).

### *6.4 Operating Expenditure*

Total operating expenditures for PIB infrastructure, when all 12 steel smelters are operating, are currently estimated at US$766 million per annum. Major components are labour and energy (primarily diesel fuel). Operating expenditures (excluding capital charges and depreciation) are summarised as (refer to Appendix AF2):

| **Opex Element** | **US$M pa** |
|---|---|
| **EWL Railroad Operations** | |
| Labour (operations and maintenance) | 83 |
| Diesel fuel | 254 |
| Infrastructure maintenance (excluding labour) | 16 |
| Rolling stock maintenance (excluding labour) | 65 |
| Other | 49 |
| Track access charges and coal haulage by QR | 36 |
| **Railroad - Total** | **503** |
| **Precincts** | |
| Abbot Point Smelter Park (includes port charges for steel exports) | 97 |
| Moranbah Coal Hub | 14 |
| Newman Smelter Park | 113 |
| Port Hedland Steel Handling | 39 |
| **Precincts - Total** | **263** |
| **Total Opex** | **766** |

Excluded from the above costs are raw water charges delivered to Abbot Point (expected to total A$46m per annum) and any charge applicable for purchasing groundwater allocation for the Newman Smelter Park, and supply of any energy to the steelmakers.

### *6.5 Revenue Requirements*

PIB annual revenue requirements at the full operational phase of the project are currently assessed as:

| Revenue Element | US$M pa |
|---|---|
| Below-rail charges | 783 |
| Above-rail charges | 679 |
| Precinct services | 745 |
| **Total Revenue per annum** | **2,207** |

### *6.6 Sensitivity*

The main drivers that influence the financial performance of the project include:

- required return on assets for PIB;
- construction costs;
- debt servicing costs;
- fuel prices (higher fuel prices favour PIB due to its lower total fuel usage when compared to the current situation for steelmakers importing iron ore and coking coal); and
- shipping rates (particularly given the high volatility of charter rates based on supply and demand fundamentals).

From a steelmakers perspective other key issues include the capital cost differentials between building in Australia and other locations, and future operating costs of the steel smelters.

Items not included in the financial analysis here are any monetary benefits from carbon trading and the sale of surplus energy from the precincts. These advantages are discussed in Section 8.

We have conducted sensitivity analysis on the project case outlined in Section 6.1 above. The key variables in the financial analysis are:

- capex;
- opex;
- cost of capital (WACC);
- exchange rate (AUD – USD); and
- inflation.

The structure of the sensitivity testing is to hold the value created by the project constant and measure the impact of a change in a variable on the prices for rail and precincts. Rail prices include both above and below rail. The prices in the base case are $28.00 per tonne hauled on the EWL for rail and $17.00 per output tonne of steel for precincts. In practice, if these changes eventuated, it is likely that there would be adjustments to both the prices and the return to PIB. The main sensitivity results are shown in the following table.

| **Factor** | **Adjustment** | **Rail** | **Precinct** |
|---|---|---|---|
| Capex - rail | Increase 10% | $29.84 | |
| Capex - precincts | Increase 10% | | $17.81 |
| | | | |
| Opex – rail | Increase = 10% | $28.99 | |
| Opex - precincts | Increase = 10% | | $17.67 |
| | | | |
| WACC (base = 7.5%) | 7% | $26.99 | $16.39 |
| | 8% | $29.06 | $17.65 |
| | | | |
| Exchange rate (base = 0.75) | A$1 = US$0.80 | $29.66 | $18.01 |
| | A$1 = US$0.70 | $26.35 | $16.00 |
| | | | |
| Inflation (base = 2.5%) | 1.5% | $31.08 | $18.87 |
| | 3.5% | $25.15 | $15.27 |

In evaluating the sensitivities above, it is important to bear in mind that virtually any of these changes will have similar impacts on other cost structures within the steel industry, including transportation costs. Although we do not extend our analysis to the entire industry, we consider it likely that most of the factors that would lead to the changes modelled here would impact on alternative production and transportation alternatives, such that there may be little or no implications for comparison purposes. As an illustration, an increase in opex as a result of an increase in the price of diesel fuel is likely to enhance the value of PIB as it reduces the total use of diesel fuel relative to alternatives now in place. Also, a change in inflation is likely to have a similar impact on the cost of capital, and the two will tend to be offsetting.

### 6.7 *Comparison of Railway with Coastal Shipping*

The genesis of PIB was to provide a far more efficient transport logistics solution to the current trend of hauling very large volumes of raw materials from remote locations to the steelmaking facilities, generally located in the major consuming countries.

This relied on the principles of consolidation of steelmaking raw materials and back-loading in the transportation of these raw materials to maximise the transport intensity. PIB provides the opportunity for semi-finished steel production close to raw material inputs, the unique feature of maximum back-loading on the railway, and consolidation of the major raw inputs of iron ore and coking coal providing a 60% reduction in transport mass prior to the long shipping leg to consuming markets.

The economic advantages of clustering steel smelters in precincts to achieve efficiencies are clear, as are the environmental gains of locating first-stage steel production in Australia rather than bulk shipping coal and iron ore overseas. That leaves the question of whether it is more efficient to transport the commodities to the precincts by rail, as proposed by PIB, or by coastal shipping. At least in principle, it would be possible to develop the precincts and steel smelters as planned with PIB, but use coastal shipping rather than a new railway to transport the coal and iron ore for first-stage processing in Australia.

The coastal shipping alternative requires lower capital investment compared to the continental railway, but the operating costs are commensurately more highly variable. The comparative advantages of the two options are then a matter of economies of scale. The alternatives were assessed for different numbers of steel smelters. The coastal shipping alternative was viable for up to four steel smelters at each end but required an assumption of minimal congestion of rail and port links in Central Queensland and the Pilbara. This assumption is clearly not realistic. The coastal shipping alternative would put considerable additional stress on the both rail and port infrastructure, and substantial additional investment would be required to overcome capacity bottlenecks. In fact, an additional advantage of PIB is that it will reduce the expansion pressure on ports in Western Australia and Queensland. We have not attempted to estimate the additional cost that would be required to accommodate the increased shipping, but it would be significant. Thus, even at four steel smelters at each end, the railway alternative would likely be more economic.

The economics rapidly move in favour of the railway option for six steel smelters or more at each end. In addition, the coastal shipping option does not share the advantages of the railway of considerable spare capacity (exceeding 12 steel smelters each end), which is highly economic, and of being essentially insulated from the export bottlenecks.

The case for coastal shipping is weak at best.

### 6.8 *Summary*

The business case for PIB is based on:

- need for additional world steelmaking capacity;
- reduced logistics costs to the steelmakers;
- benefits of co-location and precinct economics, and efficiencies in managing energy inputs/outputs;
- environmental benefits of locating the major steelmaking processes in Australia, close to the major raw material inputs, and installing new capacity based on latest technology and processing efficiencies;
- availability, sustainability and quality of the major raw material inputs in Australia, and the competitiveness of the supply of these resources;
- the large sites available to accommodate the precincts; and
- the stability and low sovereign risks involved in major investments in Australia.

This section puts those advantages into financial terms.

PIB is based upon developing a railroad connecting the coal resources in Queensland with the iron ore resources in WA, precincts at each end of the railroad to accommodate six steel smelters at each end, each producing 10,000 tonnes per day of steel slab for export to hypothetical East Asia coastal rolling mills. The steel smelters are not included in PIB. They will be constructed and operated by steel companies that participate in the project.

The economics of PIB are compelling.

The spreadsheets included in Appendix A provide a range of preliminary evaluations associated with PIB. The analysis is all consistent with significant positive economic impact from PIB as anticipated in the study.

The pre-feasibility investigations indicate substantial advantages to steelmakers on a number of dimensions.

Building a railroad across northern Australia to bring together the coal and iron ore resources is highly efficient. It is far superior to the alternative of using coastal shipping for the transportation. More importantly, the PIB case delivers annual transport logistics saving of US$406 million (refer to Appendix AP4) compared to the current structure where the resources are shipped overseas for first-stage steel production. This is discussed and analysis presented in Section 7. PIB dominates the status quo and will provide substantial cost advantages to the steelmakers that participate.

Although it is not included in this financial analysis of PIB, precinct economics are another source of substantial savings. These savings are driven by achieving high asset utilisation of essential common user infrastructure. The average capital cost of each steel smelter and its share of supporting infrastructure for the PIB case of six steel smelters in each smelter park is estimated at only 60% of that of a "stand-alone" steel smelter (an estimated capital cost saving of US$1.15 billion for each). This is discussed and analysis presented in Section 7.

In addition, to the economic advantages to steelmakers, the environmental advantages are significant. These were mentioned earlier in Section 1. Further, there are a number of potentially substantial economies and advantages of PIB that are not included in the financial analysis here. These are discussed in Section 8.

The financial analysis reported in this section provides strong support for proceeding to the next step of conducting a Feasibility Study of PIB and EWLP.

# 7. Project Analysis

This section reports on further analysis that has been conducted during the Pre-Feasibility Study. The analysis covers:

- project logistics and break-even analysis of PIB with respect to the number of steel smelters;
- the advantages of scale in developing smelter parks, with common–user facilities and services shared by all steelmakers located in the precincts; and
- a comparison of the PIB Project Case to a Base Case of a coastal East Asia second-stage steel mill.

The economic support for PIB is very significant, as the analysis shows that the cost to deliver slab steel to a coastal East Asia steel mill is reduced by over 30% relative to the benchmark rate as of September 2007.

### *7.1 Project Logistics and Break-Even Analysis*

PIB's economic analysis of its logistics is detailed in Appendix A. The analysis covers only the major material logistics - iron ore, coal and steel slab. Lesser inputs, such as fluxes and other additives used in steelmaking, will have only a secondary impact on the analysis but will be covered in the detailed Feasibility Study.

As an extension of the analysis in Section 6 and Appendix A, the optimal number of steel smelters to locate in precincts was investigated. There are obvious economies of scale, but they are not without limit. The analysis also included sensitivity to the volatile shipping costs.

Key inputs into the analysis are:

*Shipping costs*. Recent history indicates that market rates are highly variable. A conservative assumption on shipping rates has been adopted.

*Rail and port infrastructure costs and prices*. Current prices (or costs) have been assessed and adopted. Future prices are expected to increase in real terms as more costly expansion projects are undertaken, existing assets are re-valued, and increasing tonnages lead to increasing congestion and more costly expansion paths.

*PIB service charges*. The charges applicable for the logistics services provided by PIB are as derived in the financial analysis for the project (refer to Section 6).

Conclusions are:

- Break-even from a cost perspective is between four and five steel smelters in each smelter park. The initially proposed six steel smelters in each smelter park generate substantial annual saving.

- The costs are sensitive to volume on the East West Line, with average rail costs reducing as the tonnages increase, hence increasing the overall logistics savings.

- Key considerations in future shipping rate volatility are basic supply/demand fundamentals, port congestion leading to a continuation of excessive ship queuing, bunker oil prices in a "peak oil" scenario, and the cost of ship building (driven partly by steel prices). A real increase in shipping rates has a significant impact on project viability. As shown in Section 6, higher fuel costs enhance the advantages of PIB.

- The East West Line has the capacity, with relatively minor enhancements, to support at least 24 steel smelters, and perhaps as many as 30.

- The optimal number of steel smelters is related to the number of steel smelters to be co-located in a precinct. The preliminary view is that six to eight steel smelters in a precinct is optimal. This warrants further investigation in the Feasibility Study.

- The cost advantages of expanding to eight steel smelters in a precinct, to a total of 16 smelters, are substantial.

- If the number of steel smelters in a precinct is not more than eight, but the full scope of PIB is to expand to a total of 24 smelters, then developing two precincts at each terminus is optimal. Further investigation of the optimal magnitude of PIB will be undertaken in the Feasibility Study.

- The cost advantages of expansion beyond the basic case of twelve steel smelters are substantial. Although EWLP bases its viability on twelve steel smelters, the potential of PIB is considerably greater.

### *7.2 Precinct Economics*

In addition to the supply-chain logistics benefits, Project Iron Boomerang provides substantial direct and indirect benefits associated with the concentration of steel smelters in purpose designed smelter parks, with a sharing of infrastructure and supporting services by all of the steelmakers in each smelter park.

These precinct benefits include:

- Sharing of input and output materials handling infrastructure outside the steel smelter gate, and the economies of achieving high asset utilisation for this shared infrastructure.

- Sharing of the support services provided in the smelter park, including water supply, water treatment (new and waste water), power supply and reticulation, and the economies of scale in initial capital costs and ongoing operating and maintenance costs.

- Economies of scale of building and operating the supporting industrial plant between each steel smelter, including the coke plant, oxygen plant, and sintering plant.

- Ability to optimise the inputs into the steel smelter to improve efficiency and consistency of slab steel quality, due to location, depth and quality of resources available.

- Maximising the efficiency of energy use in a purpose designed precinct, with co-generation from utilisation of waste heat and volatile gases from the coke making process producing substantial surplus electricity for sale, and potential carbon credits for efficient energy utilisation.

- Shared design and construction costs, including the anticipated commonality of designs and extensive use of modular construction techniques.

- Reduced inventory holding of major material inputs due to much shorter supply lines and potential sharing of inventory.

It can be noted that the precinct benefits are capable of being implemented elsewhere, where sufficient land and other resources may be available, but these would not attract the concurrent benefits of the supply chain inherent with the smelter parks being located adjacent to the major iron ore and coal resources in northern Australia.

### *7.3 Project Case - Base Case Description*

For the purposes of this Pre-Feasibility Study, a simplified analysis has been undertaken to demonstrate the financial benefits of PIB to steelmakers. The PIB case is compared to a representative case for the delivery of slab steel to a coastal East Asia steel mill.

**Project Case:** The Project Case provides for a total of twelve steel smelters located at the two smelter park precincts - Abbot Point and Newman. Each steel smelter produces 10,000 tonnes/day of steel slab, with the 43.8 million tonnes per annum of steel slab being shipped to the consuming markets in East Asia for finishing and sale. Details of the concept, the precincts and the transport arrangements are provided in earlier sections of this report. The Project Case adopts the assessed East West Line rail charges and the materials handling logistics costs of stockpiling and delivering the iron ore and coal in the precincts to the individual steel mill gate, and the costs of transporting steel slab from each mill to ship (as described in Section 6).

**Base Case:** The Base Case assumes that equivalent steel slab making capacity, producing a total 43.8 million tonnes per annum of steel slab, are located at various coastal locations in East Asia. The case assumes that these mills would be sourcing their 60% of their iron ore and all of their coal requirements from Australia in the direct comparison of supply chain costs. The remaining 40% of their iron ore is assumed to be sourced from Brazil. The Base Case assumes current transport costs (rail, port, shipping) will be applicable in transporting the design transport task of 65.8 million tonnes per annum of iron ore, and 39.6 million tonnes per annum of coking coal from mines in Australia to steel mills in East Asia. The Base Case likely understates the real future costs, as increasing congestion and resultant costs are likely to become more significant than any further productivity improvements in the supply chain.

Project Iron Boomerang is focussed on future supply chain arrangements and in best meeting the needs of new steelmaking capacity, where greater reliance will be placed by steelmakers on seaborne supply chains. This reliance will be essential as their local sources of iron ore and/or coal become increasingly exhausted, or become uneconomic and of diminishing quality. Locating new steel mills in near-coastal locations to minimise supply chain costs and reduce competition for major internal land transport capacity in major consuming countries, such as China and India, is also expected.

The earliest start-up for producing the first steel slab is in late 2014, given the planning and construction lead-times involved. The financial analysis in this report has been undertaken on "current costs" estimated in 2007 dollars. Future price movements (construction costs, oil, labour costs, shipping rates, exchange rates, etc) would be expected to impact on both the Project Case and the Base Case to varying degrees, and preliminary sensitivity to key inputs has been undertaken and reported in Section 6.

A preliminary quantification of these benefits of the Project Case over the Base Case for 12 steel smelters is provided in the table below.

| | Savings | Saving (US$m) | |
|---|---|---|---|
| | (US$ / t) | Per Smelter | 12 Smelters |
| **CAPEX Savings** | | | |
| Shared services | 8.30 | 450 | 5,400 |
| Smelters - prefabrication of modular construction | 5.60 | 300 | 3,600 |
| Smelters - standard order construction | 7.40 | 400 | 4,800 |
| Feasibility Study cost (for 12 smelters) | 0.70 | 40 | 480 |
| Total Slab tonne CAPEX Savings | 22.00 | 1,190 | 14,280 |
| **OPEX Savings** | | | |
| Steel smelter efficiency (iron ore quality blend) | 34.00 | 122.4 | 1,469 |
| Precinct shared services | 16.00 | 57.5 | 690 |

| | | | |
|---|---|---|---|
| Supply chain consolidation | 10.60 | 38.2 | 458 |
| Sales of surplus energy | 5.20 | 18.6 | 223 |
| Brazil vs Port Headland for shipping iron ore | 15.20 | 83.5 | 1,002 |
| Carbon credit trading benefit | 4.00 | 14.5 | 174 |
| Total Slab tonne OPEX Savings | 85.00 | 335 | 4,016 |
| **Total Slab tonne Savings** | **107.00** | **1,525** | **18,296** |

The analysis is based upon a number of assumptions including:

- Costs are based upon the fob cost to a second-stage steel mill in coastal East Asia.
- Base Case steel mill is assumed to import 40% of its iron ore from Brazil and the balance from Australia.
- Capex savings per tonne is annualised over the life of the project.
- $CO_2$ emission savings are 8.7m tonnes per year, and the $CO_2$ emission trading price is estimated at US$20/tonne of $CO_2$.
- Bulk supply and service discounts that can be achieved through precinct location have not yet been quantified.

The analysis indicates that PIB will reduce the fob production cost of slab steel for delivery to the representative second-stage steel mill by US$107 per tonne. Based on the September 2007 worl benchmark average for fob slab steel cost of production US$340/mt, the savings are in excess of 30%.

Each steelmaker, and each existing steel mill will have different mixes of current supply chain arrangements, including varying reliance on seaborne traded iron ore and coal, varying existing suppliers (and country/s of origin) of these two major inputs and other resource inputs (including possibly local suppliers), and with mills located at coastal or inland locations.

A detailed spreadsheet identifying these costs savings and the underlying assumptions is included in Appendix A. As an extension to this Pre-Feasibility Study Report, EWLP will provide steelmakers with a model that will permit the Base Case analysis to be altered for different situations. The EWLP project team will be available to assist individual steelmakers to customise this to their own circumstances in helping to better understand the advantages of PIB.

It should be noted that the evaluation has not included the cost of any re-heat of the steel slabs preparatory to further processing or rolling, where such re-heating might not now be required within an integrated steel mill facility.

### *7.4 Summary*

The business case for PIB is based on:

- the advantages of locating new efficient, steelmaking capacity in Australia, close to the major world class, price competitive, iron ore and coal resources;
- benefits of co-location and precinct economics, and efficiencies achievable in managing energy inputs/outputs; and
- indicative 30% reduced costs to the steelmakers.

This section puts those advantages into financial terms in comparing the Project Case of locating six steel smelters in each smelter park at Abbot Point and Newman, compared to a Base Case of providing similar production capacity at various East Asian coastal locations.

PIB provides a real supply-chain advantage, with the benefits of consolidation and maximising back-loading justifying the relatively high initial capital cost of a new transcontinental railroad linking the major ore bodies and the smelter parks in the Pilbara and the Bowen Basin. The economics of the railway are driven by volume, and the break-even point is about four steel smelters at each end. Additional steel smelters will reduce the overall transport costs for all users, and the rail link has substantial reserve capacity.

However the precinct economics provides a very compelling justification for the PIB concept. This arises from the advantages from utilising shared services, the economies of scale achieved in the smelter parks with six or more steel smelters, and the production efficiencies and sustainable quality inputs and outputs from locating the smelter parks near the quality major resource inputs.

The net benefit to steelmakers is estimated at approximately US$107/tonne of steel slab. This benefit will increase with additional steel smelters (and further economy of scale), but the actual quantum will vary for individual steelmakers depending on their own circumstances.

The reduction in initial capital cost for each steel smelter is estimated at over US$1 billion, compared to a stand-alone OECD location facility as a result of sharing on services, prefabrication and modular construction, and the economies of building twelve similar smelters. The proposed extensive use of standardised design, maximising the use of prefabricated and modular construction, and assembly line construction processes possible with the staged construction of the twelve steel smelters, should more than offset the additional construction labour rates in Australia compared to alternative sites, and the increased costs due to relative remoteness, particularly the Newman Smelter Park.

The Project analysis reported in this section provides strong support for proceeding to the next step of conducting a Feasibility Study of PIB and EWLP.

# 8. Additional Economic Advantages

Project Iron Boomerang has advantages beyond those that provide the basis for the financial analysis included in this Pre-Feasibility Study Report. These include the option of expanding the project beyond six steel smelters at each end of the railroad, environmental benefits and carbon credits and the ancillary infrastructure investments that will arise with the commencement of PIB.

### *8.1 Expansion of Precincts*

This report assumes six smelters at each end, each producing 10,000 tonnes per day of steel slab for export. There will also be supporting infrastructure in each smelter park. The scope and costings of PIB are based on this minimum scheme. In Section 7 the Project Case was compared to a Base Case of building new coastal steel mills in East Asia that rely on imported iron ore and coal. The comparison assumed the finishing rolling mills were located close to the consuming markets. This comparison shows that steelmakers producing in PIB will reduce the fob cost of slab steel by US$107/tonne compared to the Base Case of the current structure. With this level of advantage it is likely that there will be demand for expansion beyond the Project Case. Further development should provide lower prices to steelmakers, as well as the other major global environmental and resource sustainability benefits. Development of precincts beyond the Project Case is considered in this section.

The economics of the PIB concept and the major fixed infrastructure costs of the East West Line are driven by volume. The EWL has substantial reserve capacity, with only three loaded trains operating per day in each direction for the Project Case. The EWL capacity should be at least 24 steel smelters and perhaps 30 or more. Additional rail activity would be at low marginal costs. Further increases in scale of production only reinforce the overall financial benefits of the project, with lower unit costs of the supply chain.

All the opportunities below would add positively to the overall value proposition of PIB.

#### 8.1.1 More than six smelters per precinct

The two smelter parks could be expanded beyond six steel smelters each. This will substantially improve economies of scale of the precincts, supporting infrastructure and the railroad, but may be constrained by the environmental footprint of each precinct and possible water limitations at the Newman Smelter Park.

The transport savings for the Project Case of six steel smelters in each precinct was assessed as US$406 million per annum (refer to Appendix AP4). The additional transport savings of additional steel smelters in excess of the Project Case in each precinct, are estimated at US$600 million per annum (refer to Appendix AP4) for seven steel smelters in each precinct and US$830 million per annum (refer to Appendix AP4) for eight steel smelters in each precinct.

The analysis is based on conservative estimates of future shipping rates and fuel prices. An increase in shipping rates improves the overall project viability.

Note that this analysis of potential savings only includes transport savings. Further savings will be realised from reduced average costs of the precincts and steel smelters.

8.1.2 More than one precinct at each end

An expansion alternative is to develop additional precincts, which would likely be one at each end and potentially with six or more smelters per precinct. Second smelter parks at each end could be located near Moranbah in Queensland (utilising the EWL and Abbot Point for slab steel exports), and near Port Hedland or Cape Preston in WA (subject to the availability of sufficient water and ultimate port capacity at Port Hedland).

Additional smelters will provide even greater economies of scale than in the Project Case. As the expansion will require the development of new precincts, and the associated infrastructure, we conservatively assume no further savings at the precinct level on a cost per tonne basis. However, an expansion of the steel slab making capacity to 24 steel smelters will permit a substantial reduction in the overall rail charges.

The expansion will require additional rolling stock and some expansion of servicing depots, but the below-rail upgrade essentially involves construction of additional passing loops only, plus a more extensive track maintenance regime. Preliminary estimates indicate a reduction in the rail costs for all users by approximately 30%, or an US$8.00/tonne reduction for a collective project additional continental freight saving of US$848 or US$35m p/a for each PIB steel mill (refer to Appendix AP4). This will be evaluated more fully during the Feasibility Study.

Further more, with the expected additional generated commercial freight demands stemming from the expected developments of many inland mines, the above additional freight savings are expected to duplicate and further reduce PIB rail operating and service costs and enhance the PIB investor net returns.

### *8.2 Related developments within precincts*

The precincts are very large industrial parks with the basic infrastructure in place. Power, water and roads will be developed as part of the precinct development. This creates opportunities for complementary industries to locate in the smelter parks.

A key consideration in the precinct planning is to maximise the energy efficiency of the steelmaking process. A large power co-generation plant is proposed as an integral element of the coke production process, using surplus heat and burning the released volatiles to produce electricity for internal precinct use, and for export to external users. Refer to the attached report from

Hill Michael Associates Consulting "Pre-Feasibility Evaluation and Strategic Comment – Energy" in respect of energy related aspects of each precinct. Opportunities exist within both Queensland and WA to value-add from efficient utilisation of surplus heat and volatile gases for sale of electricity for base load use, and to replace existing high cost gas or diesel fired electricity generation in the Pilbara.

A particular attraction in the Pilbara will be providing base load power for the production and beneficiation of iron ores. Other industries that are high energy users may be attracted to the precincts to take advantage of surplus energy generation. An immediate related major industry prospect is with the production of cement from the steel mill slag waste and with the related co-gen use of the precincts heats offering energy and $CO_2$ savings of over 50% against standard operating process plants.

The expansion of the precincts to accommodate such businesses would have low marginal cost and would generate additional revenue to the precincts. This would reduce the charges to the steel smelter operators.

### *8.3 Environment and Carbon Credits*

In addition to the economic advantages to steelmakers, the environmental advantages are significant. These were discussed in Section 1. There is an economic perspective on these advantages.

Global warming has become a major international issue with scientific, economic and political dimensions. The United Nations Intergovernmental Panel on Climate Change ("IPCC") has issued a series of reports on global warming and climate change. The Kyoto Protocol was established in 1997 and has now ratified by over 170 countries including Australia in 2008. The objective of the protocol is to reduce the greenhouse gas emissions that are believed to cause climate change.

Carbon credits are a part of an international emissions trading scheme; a way of moving the control of greenhouse gases into markets. The credits provide a way to reduce greenhouse effect emissions by having the market for carbon credits determine a price for trading on an industrial scale. Credits can be exchanged between businesses or bought and sold in international markets at the price set by the market. The credits can be used to finance carbon reduction arrangements between trading partners.

At this point, we are not able to evaluate the impact of carbon credits on EWLP, but it is clearly an issue to be investigated during the Feasibility Study. We believe it has the potential to enhance the interest in the project as well as to possibly provide another revenue source for EWLP.

## 8.4 *Infrastructure Support Investments*

A feature of PIB is the substantial investment that will be required in supporting infrastructure. This includes power, water and other services. These developments are not incorporated within PIB. We assume that they will be provided by independent companies who will then charge PIB and the steel smelter operators for their services. The charges that we expect to be imposed upon PIB are included in our analysis. Charges for these services that are imposed directly on the steel smelter operators are not included in our analysis.

We have discussed these infrastructure projects with people in the related industries as well as with engineering and finance companies. We understand that the projects are not unique or complex. Construction should be relatively conventional, particularly when compared to the construction of the railroad across the continent.

We expect there will be considerable interest in funding these investments. Infrastructure investments attract interest internationally. These investments will have distinct advantages over most infrastructure investments as the customer base is clear and demand is predictable. These will be relatively low risk investments.

We consider it important for EWLP to maintain control of these ancillary developments. Steelmakers will be the owners of PIB and the users of the services from the infrastructure. We anticipate EWLP being very involved in the awarding of contracts with respect to the whole range of infrastructure investments. It is likely that EWLP will realise income from the developments, but that possibility is not included in the financial analysis reported in Section 6.

## 8.5 *Enhancement of Iron Ore and Coal Reserves*

The railroad will pass close by many known resource deposits that have not previously been economical to mine. We expect that there will be mines open once the access through PIB is established. It will also provide the opportunity to effectively use cheaper lower grade iron ore reserves without the added transport penalty involved in exporting these ores to overseas smelters. Indicative known resource deposits are identified at Appendix F.

We anticipate there will also be additional traffic on the railroad linked to feed stocks into the smelters (e.g., from limestone quarries and a manganese mine) or from other non-PIB related mineral deposits or resource industries along the route. Any additional rail traffic generated on the EWL will contribute to improving the overall financial outcomes for EWLP or to reduced charges to the steelmakers.

Linking the iron ore railroads in the Pilbara (Hamersley, Newman and the FMG railroads) is another interesting concept that would deliver opportunity and alternatives to the owners of these railroads and their current customer base, as well as the large customer base represented by steelmakers involved in PIB. For purposes of the Pre-Feasibility Study, we have assumed direct linkage to the Newman rail systems (and use of this system on a third party rail operator basis) and connections to the Hammersley rail system and mines, it is important to note that the use of any of these rail systems is not essential for the success of PIB.

### *8.6 Summary*

In the previous sections, we show that PIB is expected to reduce the cost of a metric tonne of slab steel by US$107 for the average case of delivering the slab to an East Asia steel mill for second-stage processing. In this section, we discuss a number of additional economic and environmental advantages of PIB.

The Project Case for PIB is for six steel smelters in a precinct at each end of the railroad. However, the capacity of the railroad will be considerably in excess of what is required to deliver the iron ore and coal to the 12 steel smelters. The capacity is sufficient to service at least 24 steel smelters, and perhaps 30 or more. We provide estimates of the impact of expanding the number of steel smelters.

If the number of steel smelters is increased on each of the two precincts from six to eight, the transport logistics savings more than doubles from US$406 million per annum to US$830 million per annum (refer to Appendix AP4). This results from economies of scale in transport logistics. Additional economies of scale savings would be expected for the steelmakers within the precincts.

An alternative for expansion is to develop a new precinct at each end of the railroad, with six steel smelters in each. Although there are likely to be savings realised in establishing the precincts and in the above rail capex and opex, we focus on the additional savings that could result from the below rail. The capex and opex would be low for below rail. Our preliminary estimates indicate a reduction in the rail costs for all users of US$8.00/tonne (refer to Appendix AP4).

The development of the railroad and precincts creates opportunities for complementary industries to locate in the smelter parks. In planning the precinct, a key consideration is to maximise the energy efficiency of the steelmaking process. There appears to be opportunity for substantial savings through utilisation and sale of surplus co-gen related secondary and tertiary heats. The expansion of the precincts to accommodate synergistic businesses would have low marginal cost and would generate additional revenue to the precincts. This would reduce the charges to the steel smelter operators.

There are significant environmental advantages to PIB, which were discussed in Section 1. There is also an economic perspective on the advantages through carbon credit trading. This will be explored further in the Feasibility Study.

Substantial investment will be required in the supporting infrastructure for PIB such as power, water and other services. These capex developments are not incorporated within PIB but will be provided by independent companies who will then charge for their services. EWLP intends to maintain control of these infrastructure developments and considers it likely that that it will realise income from them.

A spin-off consequence of establishing EWL is that it will provide access to numerous deposits of iron ore and coal that have not previously been cost efficient to mine. This will provide windfall benefit to the miners and additional traffic on the railroad. The additional rail traffic generated will improve the overall financial outcomes for PIB and/or reduce rail charges to the steelmakers.

There are many dimensions to PIB, and this section has discussed a few of the more significant ones that are not included in the financial analysis presented in Section 6. The magnitude of these considerations is expected to provide further advantages to the steelmakers that participate in PIB.

# 9. Government Regulatory Approvals, Environmental Approvals and Land Acquisition

This section provides an overview of the environmental challenges faced by the project and the approach that will be followed during the Feasibility Study to address these issues. It also addresses the rail corridor and smelter park land acquisition process, and the other requisite Governmental regulatory approvals and policy settings needed to bring the project to fruition.

Key government related issues involved with the project include:

- planning and environmental approvals;
- land acquisition;
- project business environment; and
- government support services.

There are four Australian governments involved (Commonwealth, Queensland, WA and the Northern Territory) as well as numerous Local Authorities, Statutory Agencies, and Aboriginal Land Councils. In addition, the very large scale and global nature of the project will involve other national Governments in terms of trade matters, investment and global environmental outcomes.

PIB entails major capital investments in the railroad and steel smelters by foreign owned companies, as well as in the long-term operation of these industrial plants, primarily as value-adding to basic major resource exports. Critical to attracting this investment and to the project proceeding are the obtaining of the various government approvals and having in place the appropriate business policy settings to provide maximum certainty over the project life cycle.

Facilitation of regulatory approvals will be coordinated by obtaining:

- approved Major Project Facilitation ("MPF") status from the Prime Minister's Department and the Commonwealth Minister for Infrastructure, Transport, Regional Development and Local Government;
- approved 'significant project' status from the Queensland Coordinator General; and
- approved 'major project' status from the WA and Northern Territory Ministers for Industry and Resources.

PIB will promote the establishment of a Steering Group comprising senior representation from each of the four governments to facilitate overall planning, environmental and other approvals, and interfacing with PIB and the individual steelmakers and associated entities involved.

### *9.1 Globally Responsible Approach to the Environment*

Actions in governance, planning and managing PIB and its impact on the environment, will be guided by its values of building community and engaging in best environmental practices as core aspects of bringing benefit to its local, national and global stakeholders. PIB will conduct itself and report its actions in a manner prescribed by the Global Compact Sustainability Reporting Guidelines of the Global Reporting Initiative (GRI). These guidelines include:

- Assessing sustainability performance with respect to laws, norms, codes, performance standards, and voluntary initiatives. Environmental laws will be regarded as the minimum standard, with international best practice standards used as a guideline to continually improve our performance and set new national and global standards for environmental outcomes;

- Creating a continuous platform for dialogue with stakeholders concerning expectations for responsibility and performance;

- Understanding the impacts (positive and negative) that the project can have on sustainable development; and

- Comparing our performance against industry norms and those of our partnering organisations over time to inform our decisions.

### *9.2 Project Planning and Environmental Approvals*

Preliminary planning has identified the key smelter park sites near Newman and at Abbot Point as best meeting the range of criteria covering matters such as environmental outcomes, site availability, water availability and logistics outcomes; however the sheer scale of the industrial activity proposed demands far more extensive evaluation of impacts and amelioration measures.

The rail corridor preliminary planning by PIB and Quantm has involved an initial desk top evaluation of land-use and environmental impacts to determine the most viable corridors meeting rail design criteria. The initial study has identified a rail corridor that will avoid known protected areas and minimise unwanted environmental, social and cultural impacts. These will be confirmed in the Feasibility Study.

PIB will trigger consideration and require planning approvals under an extensive range of Commonwealth, State and Territory legislation covering environmental protection, land use, resources use and sustainability, transport, cultural heritage and Native Title.

An Environmental Impact Statement ("EIS") is mandatory, responding to an approved Terms of Reference, which will be subject to prior consultation with advisory agencies. The EIS will address the impacts and proposed management and amelioration measures on the natural environment, existing land uses, infrastructure, and communities, cultural heritage, and social and economic impacts. This EIS is proposed to address the impact of the proposed railroad and the smelter parks, including industrial developments in the smelter parks.

The Governments involved will be requested to follow similar procedures used to establish the environmental impact for the implementation of the Darwin - Alice Springs rail line. This precedent included:

- Establishing an overall Framework Agreement with Governments and Land councils;
- Sacred site clearance and long-term railroad corridor leases were negotiated within this framework with all affected parties including Aboriginal Land Trusts and Communities;
- Access rights were negotiated by Governments involved (Northern Territory, South Australia, and Commonwealth);
- Upon completed negotiations, conditional access rights were handed over to the consortium that owned and operated the line; and
- Environmental issues were identified and resolved.

9.2.1 Environmental approvals

Environmental approvals will include consideration under the Commonwealth Environment Protection and Biodiversity Act, 1999 ("EPBC Act") and various state legislation and regulations relating to the natural environment, wildlife conservation, water, air and land conservation. Major local environmental considerations anticipated include the following.

**Smelter park precincts and adjoining areas**

- Water availability, water treatment, handling process water (collection, treatment and re-use), and managing stormwater flows. The Abbot Point site is particularly sensitive, given its proximity to the Caley Valley Wetlands and the Great Barrier Reef waters. Total retention of all water used and stormwater runoff is proposed in response to these particular issues.
- Clean air provisions (note that both initial smelter park locations are remote from existing residential areas).
- Dealing with solid process wastes.
- Local transport management issues (road, rail, port).
- Housing and community infrastructure for the substantial construction workforces and permanent workforces.

**East West Line Railroad**

- Implementation activities, including sourcing of water for construction, construction access to the railroad on local roads, and impacts of the transitory construction camps.

- There is a need to minimise any impacts on waterways, natural vegetation, fragile semi-arid areas and existing National Parks or conservation areas (given the possible proximity to implementation activities).

- On-going operational issues include noise, responding to spillage (from derailments, diesel fuelling), pollution control at the rail depots, and corridor land management practices (vegetation control, waterway management).

- There is extensive practical experience in constructing and managing similar heavy haul railroads in Australia to satisfy environmental concerns.

Other associated infrastructure and environmental concerns include the following.

- **Northern Missing Rail Link** (by Queensland Rail) – EIS has been completed (2006) and conditions of approval notified. Land is currently being acquired (by negotiated agreement with existing landowners). QR is awaiting commercial decision and commitment by coal miners to use the link, to proceed to construction.

- **Abbot Point Port Works** (by Queensland Ports Corporation) – will require EIS and environmental approvals. Issues are considered manageable with some impact likely on existing sea grasses.

- **Burdekin Dam Raising and "Water for Bowen" Channel** (by Sunwater) – will require EIS and environmental approvals. Limited issues are anticipated.

- **Moranbah Coal Hub** (by EWLP) and spur line by QR – expect minimal issues with activity similar to existing coal mine supporting infrastructure in the region.

- **Port Hedland Steel Handling Yard and Wharf** (by EWLP) – to include in overall project EIS. Concept is compatible with current Port Hedland Port Authority strategic planning.

### 9.2.2 Approvals process

The EIS approvals process is shown in Figure 9.1 below.

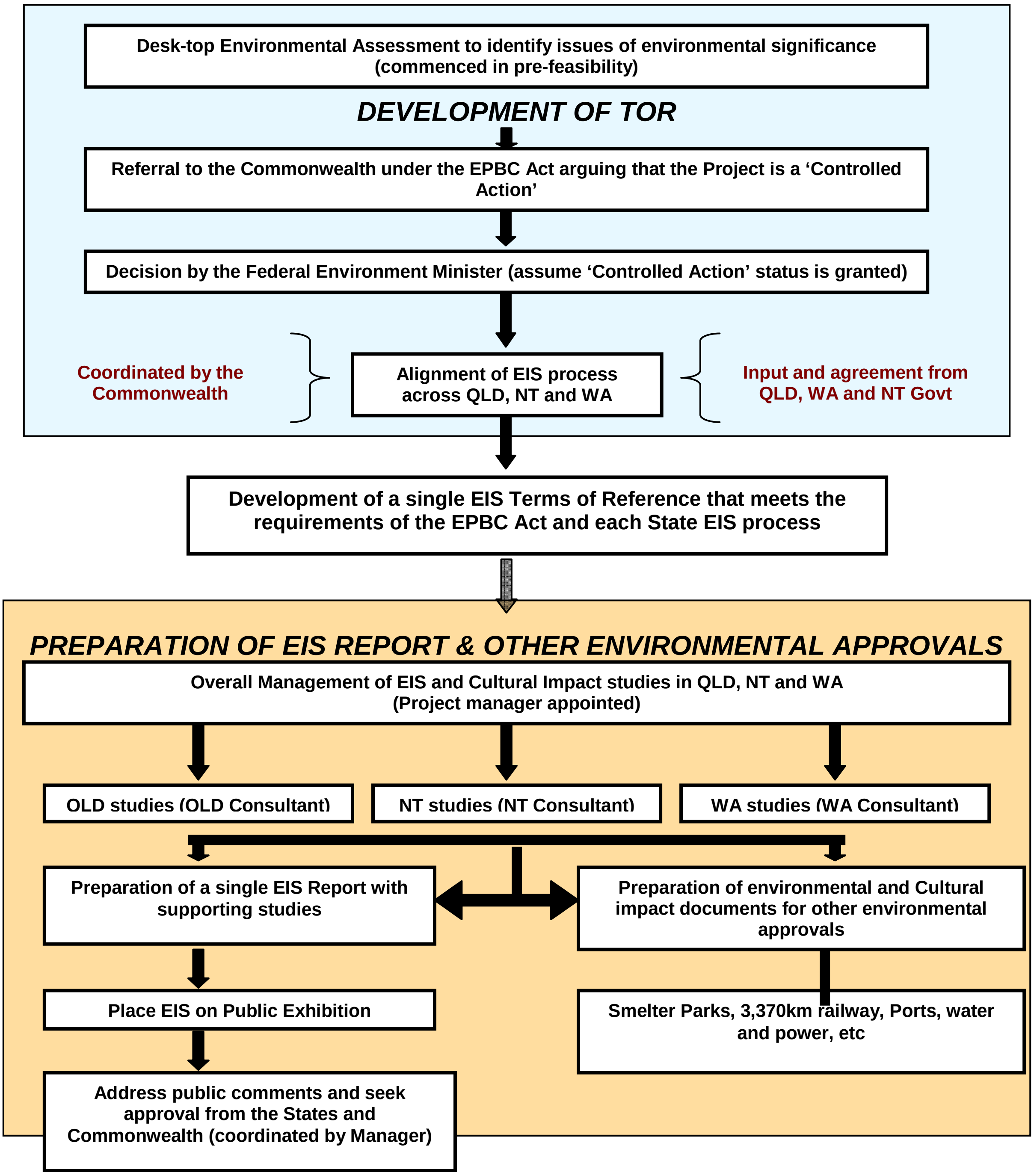


Figure 9.1 EIS Approval Process

(Courtesy of AustralAsian Resource Consultants)

## *9.3 Land Acquisition*

### 9.3.1 Smelter park precincts

The land tenure and acquisition process for the smelter park precincts will be subject to negotiation and agreement with the Queensland, Northern Territory and WA Governments. A long-term lease (99 year plus), or freehold title in favour of PIB as the smelter park owner and operator of common-user facilities, is planned. The Queensland Government has recently acquired a large site at Abbot Point and designated it as a State Development Area (refer to Appendix G). We will request from Western Australian Government that the Newman Smelter Park Precinct be accommodated in a similar area.

9.3.2 Rail corridor and associated facilities.

Land acquisition for the rail corridor will be subject to negotiation with the Queensland, WA, and Northern Territory Governments, as part of the EIS and planning approval process, with all Governments exercising their compulsory acquisition powers to secure the corridor land. We expect that the rail corridor would then be leased to PIB as the nominated rail manager under existing legislative provisions. Long-term leases (99 years plus) are proposed.

9.3.3 Native title and cultural heritage

The bulk of the rail corridor land and the Newman Smelter Park Precinct are existing lease hold, vacant crown land, or Aboriginal reserve, and subject to native title considerations under the Native Title Act 1993 and relevant state legislation.

A fully inclusive process of consultation and negotiation with the traditional owners of the land, assisted by each of the Governments, is proposed to facilitate agreement on the rail corridor and precinct lands. Recent major mining and infrastructure projects in northern Australia have been able to progress more quickly when the key stakeholders are included in the negotiations from the beginning, and their historical traditions and roots are recognised. In order to minimise delays, negotiations with traditional land owners and others on land access rights will commence in parallel with environmental assessments.

The aims of these negotiations with traditional owners will be to create long-term benefits that will positively impact on current and future generations. Extensive opportunities will be provided to local indigenous communities, including training, to maximise employment opportunities during the implementation phase and importantly in the long-term operations phase.

### *9.4 Other Regulatory and Policy Settings*

9.4.1 Competition regulation

The railroad and smelter park precincts are essentially private sector commercial business entities, with the fundamental business model preventing monopoly control or abuse of market power. PIB requires that the railroad not be "declared" under National Competition Policy and the Trade Practices Act and not be subject to 3rd party operators having access rights.

Whilst the business will not be regulated, PIB is keen to generate additional rail business where commercially viable and where it does not compromise the valid business (and safety) interests of PIB. This particularly applies to further mining developments that may utilise the EWL, and opportunities will be actively pursued on a fully commercial basis.

**Foreign investment**

The project and business model involves major investment by foreign owned steelmakers in the PIB and in their own smelters and supporting industry. Foreign Investment Review Board approval of this investment is required for the project to proceed. Such individual (steel mills etc.) approvals while supported by PIB within the master project will need to be sought individually by each foreign owned company participating in the project.

**Tariff concessions**

*In Australia*

The project will involve major procurement of equipment and processing plant that cannot be supplied by Australian suppliers (due to scale and technology). The biggest single threat to the project viability is the much higher construction and fabrication costs in Australia, compared to Asian and South American competitors in particular. This will be coupled with the skilled labour limitations in Australia due to the current resources boom, and the relative remoteness of the major construction sites at Abbot Point and Newman.

Maximum tariff concessions and/or enhanced By-Law Scheme covering the imported materials, equipment and prefabricated pre-assembly modules is essential to minimise any competitive disadvantage.

*In Home Countries*

A key element of the project is the capturing of the value–add in processing of major steelmaking raw materials in Australia by the world's major steelmakers, and for their importing of this semi-finished material into their home countries (or elsewhere) for further processing and consumption. The removal of any discriminatory import duties or tariffs on these imports that may detract from the project's viability would be important and a subject for negotiation between the Australian and respective home countries' governments.

**Sponsored migration and temporary workers schemes**

The project requires large construction workforces for an extended duration of up to eight years, with an estimated 8,000 – 10,000 direct workers at both Bowen and Newman, plus approximately 4,000 transitory workers to build the railroad, and smaller workforces to build infrastructure near Moranbah and at Port Hedland. Following current policy and practices, five-year working visas will be sought for needed skilled workers from overseas.

On-going operation of the steel smelters will involve a permanent workforce of 2,000 – 3,000 workers, requiring specialist skills based on the parent companies' steelmaking skills, to be located in both Bowen and Newman. A flexible arrangement as to manning by the steelmakers is proposed, involving rotation from their parent workforces.

**Community Infrastructure and Government Trading Corporation Services**

The project will require significant community infrastructure in regional centres, particularly at Bowen and Newman, with lesser requirements at a number of other support centres, to support the large construction workforce and permanent employees. Major investment by Government Owned Trading Corporations will also be required to meet the requirements of the project.

Support from Government in the timely provision of essential services to support the local communities and Local Authorities is required. This includes availability of developed sites for housing, water supply and sewage, roads, power, telecommunications, schools, and so on.

Whilst the arrangements with the Government Owned Trading Corporations are proposed on a fully commercial basis, support from government stakeholders in approving the timely provision of this essential supporting infrastructure is required.

### *9.5 Conclusions*

Whilst the project is extremely large and challenging, similar project elements including railroads, ports, major industrial developments and minerals processing plants, have been approved and built in WA, Queensland and the Northern Territory, and the established regulatory approvals processes, including inter-jurisdictional cooperation, are proven.

Potentially major environmental impacts will be associated with the smelter parks, and the concentration of industrial activity in these areas. Key concerns will be on water consumption and on effective management of process water quality and emissions.

Land acquisition will rely on the compulsory acquisition powers of the respective Governments. Early full inclusion of traditional land owners in the process, and the maximising of opportunities for indigenous communities to derive long-term sustainable employment opportunities in the project, will facilitate the land acquisition process.

The project credentials for positive global environmental outcomes and major investment and regional job creation, should ensure strong bi-partisan support for the project from all levels of government in Australia.

# 10. Project Implementation

EWLP has been set-up to develop and imp1ement Project Iron Boomerang. EWLP proposes to progress the project in five phases in accordance with the timelines and budgets used in the financial forecasts. It has developed a functional organizational structure which provides the corporate governance, strategies and global network to lead a team of organizations and professionals across Australia to deliver the project. It is an organization which can grow and change as the project develops through the phases.

The five phases of Project Iron Boomerang development are:

- **Pre-Feasibility**: establishment of project concepts and operational requirements, financial models and major steelmakers and/or investor commitment to the Feasibility Study;

- **Feasibility Stage**: proof of concept and definition of project operational requirements, detailed project scoping, preliminary engineering environmental impact assessment, cost estimates, market viability, planning and other regulatory approvals, risks assessments and develop risk management and allocation strategies, resulting in confirmation of the business case and a "bankable" Feasibility Study;

- **Commitment and Financial Closing**: development of investment agreements and briefing requirements to gain commitments from steelmakers to build smelters within the precincts, prepare concession/franchise agreements with governments, and develop major procurement contracts and call tenders for EPCM and/or DCM contracts; completion of due diligence processes by investors, and suppliers;

- **Implementation**: land purchase by government for lease to EWLP, engagement of project managers, detailed engineering and environment management plans, procurement of design and construction, procurement of rolling stock and precinct plant and equipment; and

- **Operations:** commissioning and commencement of operations.

This section of the Pre-Feasibility Report outlines key issues to be addressed in each phase, significant project risks, organizational structure, team capability, and budgets. As EWLP will follow an emergent strategy in developing the project, this section places the greatest emphasis on the next phase, the Feasibility Study and the opportunities to be realised and uncertainties to be reduced.

### *10.1 East West Line Park and PIB Project Functional Structure*

EWLP has conceived a three tier functional structure to deliver to Project Iron Boomerang the global steelmakers. The three tiers are the EWLP business and its investors and stakeholders, the PIB global project, and the Australian program of works. The project's functional structure is shown in Section 2

The genesis of this structure is that it models how EWLP has developed the Pre-Feasibility Study through high level volunteers with specific professional skills in various facets of the project, staff who have been multi-tasked to provide support services, and supporting companies to market knowledge, and specific services. Throughout the Pre-Feasibility Study regular teleconferences and meetings of the global team have been held to discuss and lead all elements of the project. The three tier approach works as follows;

- Tier 1 is the EWLP business and its close relationship with its clients, steelmakers, investors and major stakeholders, supply chain providers and governments. EWLP will set the overall project strategy, risk allocation matrix, corporate governance structure and engage staff, consultants, contractors and suppliers. EWLP will set up a Steering Committee made up of EWLP leaders, steelmaking representatives, and senior consultants to guide the PIB project to which the PIB Global Project Director will report.

- Tier 2 is the PIB global project. A key factor to the success of PIB will be an alliance of steelmakers to gain the knowledge of material handling and support infrastructure needed to set the technical requirements and brief for the precincts and shared facilities therein.

  The PIB project has significant positive global environmental impacts, these must be assessed and the valve thereof returned to EWLP and its wider stakeholders to justify the project on environmental terms. A team of analysts will be engaged to assess these impacts across different countries.

  The PIB project has complex operational requirements which will be developed in further detail so that operational costs can be established with detail and certainty and so that plant and equipment such as rolling stock, and precinct material handling can be finalised and procured.

  Throughout the Feasibility Study the market analysis, capital and operational costs will be regularly updated to ensure project contingencies are properly assessed and not over stated and to ensure PIB retains it competitive advantage.

- Tier 3 is a program of local projects to study separately the detailed engineering, local environmental and community aspects of each major infrastructure element, the smelter precincts, the railroad, the rail hub and other infrastructure.

  Separate teams will assess the construction costs and time program, maintain the risk register and quality assurance system and prepare procurement contracts.

  Program support services, such as its network, and a central collaborative document control system, will be established.

A network of local community engagement officers will be established and provided with information, hot lines and internet, etc. to ensure all levels of the community and stakeholders, both local and national, are part of the project.

## *10.2 Implementation Timeline*

- The timeline for the project implementation is given in Figure 10.1 below. It demonstrates the interaction between the different phases.

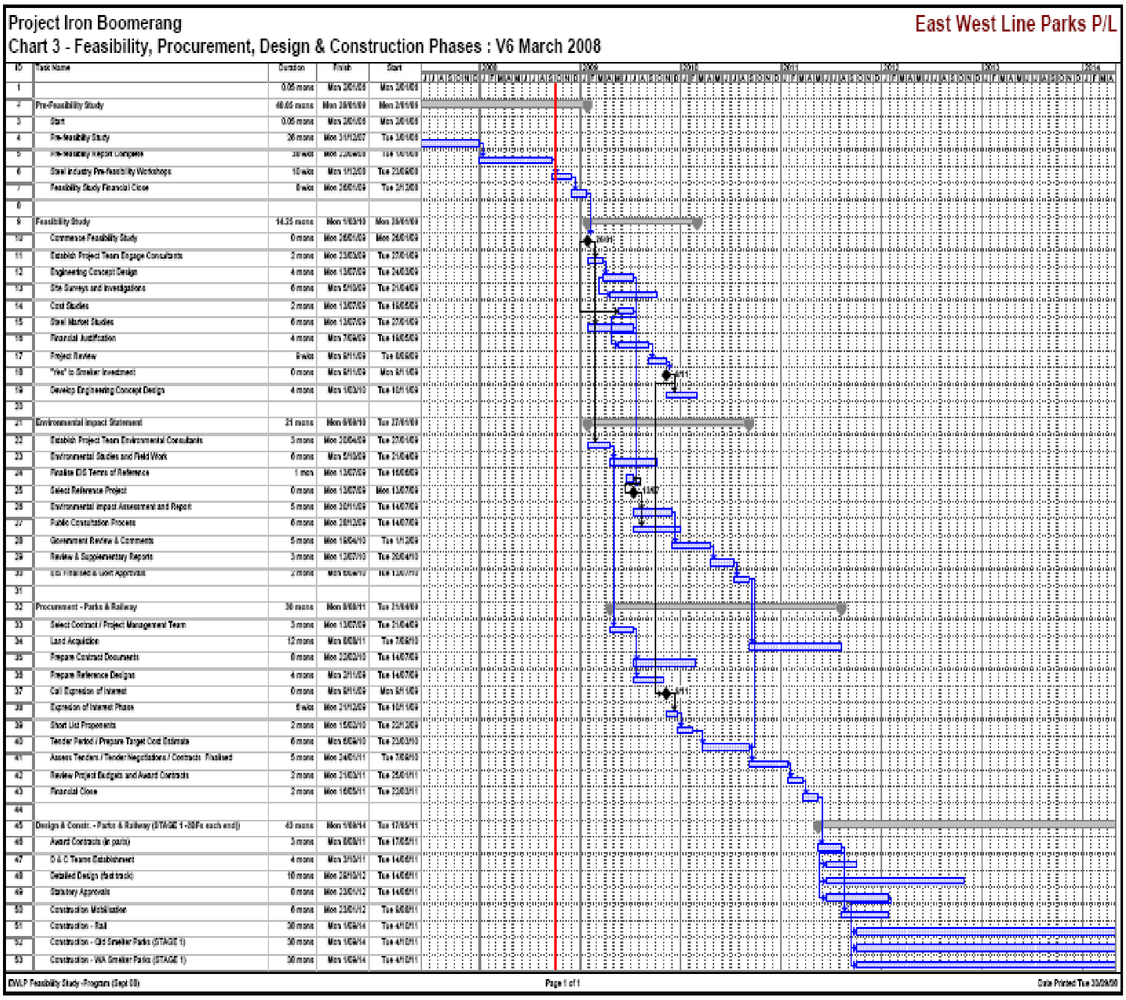


Figure 10.1 Feasibility, Procurement, Design and Construct Phases

Key milestones within the program are:

- An approval in principal by the investing steelmakers to the project and their commitment to build the smelters;

- The commitment by the steelmakers will also enable the government to complete its reviews and to complete the environmental and planning approvals;

- With steelmakers and governments fully engaged and committed, suppliers and contractors can competitively tender the works so that construction, capital costs and operating cost can be confirmed and risks reduced; and

- Once the above three milestones are achieved financial closure can be finalised along with agreements and land purchases.

### *10.3 Feasibility Study*

The primary objective of the Feasibility Study is to prove the feasibility of the Project Iron Boomerang to steelmakers and governments. This requires the study of the following key outcomes:

- Fully developed Scope of Works and Project Plan (for the railroad and smelter parks and industrial plants);
- Environmental and Planning Approvals for the overall project;
- Finalising of the rail corridor, smelter park locations and agreement in respect of land acquisition (inclusive of sufficient engineering to support the Environmental Impact Study and cost estimates);
- Detailed capital and operating cost estimates and developed Business Case;
- Detailed analysis of the project time frames, and procurement packages, to ensure key milestones can be achieved,
- Government approvals in respect of the regulatory and policy settings required to support the project;
- Preliminary procurement activities to support the Business Case and a fast track project implementation phase;
- Finalising the detailed business framework for the project; and
- Finalising agreements with other key service providers in commitment to their associated project works.

The Project Plan will integrate project scope and performance requirements, quality, safety and environmental control systems, time program of works, cost estimates and budget controls, procurement plan, human and other resource plans, communication plan, quality and safety plans.

Key inputs into the Feasibility Study will be the specific requirements of the steelmakers in their proposed developments in the smelter parks, including:

- Technical: scale, technologies, layouts, environmental impacts;
- Market: knowledge of steel industry, major risks and opportunities as perceived by the steelmakers;

- Commercial: how precincts will function with respect to the "common user" facilities, timing of developments, procurement practices and construction resourcing arrangements; and

- Expertise: substantial in-kind commitment of the steelmakers' individual expertise will be required.

Other key project participants will also contribute their specific expertise "in-kind" to the Feasibility Study, particularly in design and constructability issues.

Key planned milestones are:

- Commitment to Feasibility Study – December 2008;

- Finalise EIS Terms of Reference – July 2009;

- Preliminary "Approval in Principle" by steelmakers – October 2009;

- Obtain planning and environmental approvals – April 2009; and

- Construction to commence – April 2011.

Feasibility Study risks are:

- Resourcing of Feasibility Study to meet time/cost/quality requirements;

- Obtaining and maintaining a critical mass of commitment by steelmakers to Feasibility Study;

- Obtaining political support for the project;

- Obtaining planning and environmental approvals, particularly in respect of smelter parks and managing local environmental impacts and water issues (availability in WA and managing waste water and runoff at both sites);

- Gaining agreement on Native Title in respect of land to be used and satisfying Cultural Heritage requirements;

- Obtaining reliable cost estimates and construction and implementation programs; and

- Governments requiring additional or extended studies with critical impacts to project approvals, the Feasibility Study costs and implementation program.

EWLP recognises these risks and has developed a functional structure to provide resources to control or mitigate these risks.

### *10.4 Commitment and Financial Close*

An early "in-principle" commitment to proceed to a definitive number of steel smelters and the supporting industrial infrastructure will be critical to providing some certainty to the scope of the project, the concept design layouts, and the essential inputs into the Environmental Impact Study and detailed planning and pre-procurement activities by all associated parties, including key potential suppliers. The key milestone for the approval in principal is April 2009 if the current implementation program is to be met.

Financial close will be subject to obtaining the key planning and environmental approvals, and confirmation on other key business settings. Financial close will trigger awarding of critical supply and construction contracts to ensure long lead time items and activities can meet program.

*Commitment and financial close risks*

- Timely completion of commercial arrangements and commitments with equity partners and lenders;
- Extended government approval processes and the need for additional studies to address unforeseen environmental impacts and/ or community concerns;
- Gaining sufficient interest from key suppliers and contractors to ensure bankable competitive cost estimates from them are provided to firm up project construction and operational costings within the financial modeling;
- Fully assessing project contingencies to avoid double counting and threatening the overall project viability;
- Securing government commitment to purchases land and grant EWLP leases; and
- The complexity of taxation laws involved with major global investors can diminish overall project returns.

### *10.5 Implementation*

Concept planning based on anticipated commitments and approvals provides for the following key milestones.

- Project planning approvals (April 2009)
- Financial close (December 2010)
- Award major contracts (March 2011)
- Complete land procurement (September 2010 – February 2011)

- Railroad construction (commence April 2011– complete June 2014)
- Precinct construction (commence April 2011)
- Smelter construction (commence June 2011 – complete June 2014)
- Commissioning (July 2014 – December 2014)
- First steel production (December 2014)

Key program related issues include:

- Complexity of the project and number of separate stakeholders, competing steelmakers, investors and decision-makers involved at the planning and approval phases;
- Number of "approving entities" involved;
- Competition for resources (skilled personnel, equipment, materials);
- Ability to mobilise resources (particularly at both Smelter Park precincts with accommodation and supporting infrastructure);
- Logistics management for the railroad construction;
- Managing environmental impacts;
- Assessing the time and cost impacts of the very diverse geographic, geological and climatic conditions which prevail of the length of the project; and
- Managing interfaces within the project and with associated service providers.

Project procurement will likely comprise a range of proven delivery mechanisms covering the wide range of activities. These include having a desire to reduce overall construction time, appropriate risk allocation outcomes, maximise economies of scale whilst recognising the sheer scale of the overall project (scope, geographic extent and construction costs), and best manage the interfaces. Early major contractor and supplier involvement will be essential to maximise their experience in constructability issues and logistics management at the early design phase in particular.

*Implementation phase (design, procurement, construction) risks*

- Skilled resource availability (design, construction) and timely provision of on-site accommodation and services;
- Staging, timing and co-ordination to the transcontinental rail construction to ensure all sections are completed to program;

- Equipment and materials availability;
- Contractor/supplier performance;
- Interface and coordination management;
- Meeting construction environmental conditions, particularly sediment control, fragile arid environments and impacts on native vegetation;
- Economic technical solution to the desert crossings, and extent of poor ground conditions;
- Extensive bridge crossing needed and raised track aligned to protect the facilities from flooding;
- Proximity of suitable gravel, ballast and water for railroad construction (cost, time impacts);
- Major adverse weather impacts (cyclones);
- Transport of imported plant, equipment, materials, and the large prefabricated assembly modules; and
- Construction safety performance.

### *10.6 Operations*

The operating period will begin at the commissioning of the railroad and the first four steel smelters. As the construction of the next eight steel smelters will be on-going, there will be an overlapping of the implementation and operating phases of PIB.

When the initial operations commence, there will be a number of additional activities to be managed. Foremost will be the completion of the remaining steel smelters. Consideration of additional precincts and steel smelters beyond that incorporated within the scope of PIB here will become important.

*Operational phase risks*

- Railroad and precinct common user facilities' reliability and availability, including availability and responsiveness of support base;
- High asset utilization of rolling stock (high kms/year usage);
- Major adverse weather impacts (and supply chain reliability and recovery);
- Meeting environmental performance standards;
- Port/rail congestion from other users;

- Retaining skilled resources in remote areas;
- Maintenance of facilities; and
- Ongoing supplier contracts.

### *10.7 Further Developments*

Refer to Section 8, Additional Economic Opportunities for a full description of some the ongoing development potential of the project. EWLP will explore these opportunities at all phases to ensure to use of assets will be maximised.

### *10.8 Risk Management*

The management of risk is an important issue with any project and particularly with one as large and complex as Project Iron Boomerang. EWLP will adopt structured processes, methodologies and techniques to identify and communicate risk information. We intend to conform to the joint *Australian/New Zealand Standard, AS/NZS 4360:2004, Risk management*. Consistent with this Standard, a preliminary identification of risks covering the project life cycle has been undertaken and included in the above phases.

All levels of EWLP will be empowered to examine project risks as part of developing the project. Strategies include avoiding the risk, transferring the risk to another party, reducing the negative effect of the risk, and accepting some or all of the consequences of a particular risk.

#### 10.8.1 Risk management techniques

Traditional risk management focuses on risks stemming from physical or legal causes (e.g. natural disasters or fires, accidents, death, and lawsuits) and uses insurance. Financial risk management focuses on risks that can be managed using traded financial instruments. Strategic risk management encompasses the broad range of operational actions available to management.

Hedging risks with financial instruments is an alternative that will be considered. The two areas where this is common are foreign exchange rates and interest rates. The use will depend upon the phase of development of the project and the issue.

It is likely that the functional currency for the railroad and precincts once operations commence will be the US dollar. The intent is that revenue will be generated almost entirely in US dollars. However, an appreciable portion of costs will be incurred in Australian dollars. The currency hedging policies for EWLP will be developed during the Feasibility Study as part of the risk allocation matrix. The Feasibility Study is different in that the time period is substantially shorter and a significant portion of costs will be incurred in Australian dollars, perhaps as much as three-quarters. We intend to engage in currency hedging to the extent that our currency exposure relative to our funds available for the Feasibility Study is significant and could potentially impinge on EWLP's ability to complete the Feasibility Study on time and on budget.

At this stage, we do not anticipate engaging in hedging of interest rate risk. Rather, where interest rate volatility or uncertainty is a concern, we expect to use floating rate debt.

EWLP will use insurance to mitigate a range of standard risks. There will be a number of risk areas that are re-occurring and not catastrophic, particularly after implementation has commenced. During the Feasibility Stage, analysis will be conducted to determine where it is financially prudent for EWLP to self-insure in these aspects. As a principle, EWLP expects to procure insurance coverage for risks that have the potential to impact appreciably on the financial viability of PIB, when such insurance is commercially available.

### 10.8.2 Risk registers

A major tool for ensuring that risks are addressed appropriately is the use of a Risk Register. PIB will utilise Risk Registers to list all the risks identified at the beginning and during the life of the project. The initial Risk Register will be maintained to account and control risks during the Feasibility Study. Risk Registers are also prepared for the Construction phase; partitioned into General, Railroad and Precincts. Each risk is grading in terms of likelihood of occurring and the consequences to the project in terms of time and costs. Control strategies are then developed and residual risks are assessed, again in terms of likelihood and consequences. For each risk, management responsibility is assigned to a specific person.

### 10.8.3 Commercial risks and contingencies (all phases)

- Sovereign risks (changing ground rules)
- Cost escalation (fuel, labour, materials, services)
- Market demand (steel, by-products)
- EWLP governance and ownership issues

Generally the above risks are not readily addressed with insurance or financial instruments and encompass a broad range of areas. These will be addressed with risk management strategies that are appropriate for the issues. We will impose structure, discipline, process, and a level of conformance on PIB to ensure that risks are approached systematically and are continually reviewed.

### 10.8.4 Risk allocation matrix

EWLP will develop a risk allocation matrix which it will use a network of Deed Agreements risks between major parties. These risk allocation matrixes will be the basis for negotiations with steelmakers, investors, major suppliers and contractors.

### *10.9 East West Line Parks Team for the Feasibility Study*

EWLP has successfully assembled a high caliber team of professional people with global experience in developing, planning, analyzing and delivering major infrastructure projects to the steel industry and railroads such as PIB in Australia and other countries. This knowledge and experience coupled with the knowledge of the investors; steelmakers, consultants (Quantum, Engenium, Ranbury, Monash Rail), miners (Xstrata) and contractors (Leighton) gives EWLP all the range of skills necessary to lead the project Feasibility Study and procure the additional services of contractors, consultants and suppliers to deliver the project.

Profiles of the management group and their capabilities are included in Appendix E.

### *10.10 Feasibility Study Budget*

The proposed Feasibility Study Budget is A$150 million as detailed below. The expenditures during the Feasibility Study will predominately be incurred in Australian dollars, so the budget is in that currency.

| | A$millions |
|---|---|
| Preliminary engineering and surveys | 50.0 |
| Environmental Impact Study | 48.0 |
| Consultants - engineering | 7.5 |
| Consultants - environmental, economic, legal, tax | 8.0 |
| Project management, administration and overheads | 11.5 |
| Contingencies (20%) | 25.0 |
| Total | 150.0 |

This budget excludes direct in-kind contributions from the project participants.

### *10.11 Summary and Conclusions*

The following key conclusions arise with respect to the implementation of PIB.

A commitment to project implementation will be challenging, given the range of stakeholders involved and the need to fully align the various interests from a program perspective.

The preliminary program is ambitious and challenging but for good reason, and implementation will occur in a period of uncertain competing demands for resources.

An early decision by steelmakers and commitment to proceed with a common configuration of steel smelters and the supporting infrastructure will be critical to the timing of the project.

The time line for PIB is realistic but will require continuous communication and coordination between EWLP and the steelmakers concerning their respective construction projects.

Risk management is a practice of systematically selecting cost effective approaches for minimising the effect of threats to an organisation. All of the risks facing a company cannot be fully avoided or mitigated. There are too many complexities as well as financial and practical limitations. PIB will have to accept a level of residual risks. Risk management will be facilitated in at least three ways:

- Using proven technology, and reputable contractors and suppliers in the design, procurement and construction phases, and in supporting the operating phase;

- Utilising the technical and operational expertise of the steelmakers and other proposed major investors in EWLP and participants of PIB with respect to their respective areas; and

- Development of a comprehensive Risk Management Plan.

The project program and budget projection provide for appropriate provision of contingency funds to cover unforeseen scope and normal risk events during the feasibility phase. Preliminary evaluation of the above risks suggests that they will be manageable in the context of current planning and actual experience on similar railroad projects and major individual industrial projects in North Queensland, the Pilbara in WA, and in the Northern Territory.

# 11. Conclusion and Invitation to Participate

### 11.1 *Project Iron Boomerang and Its Advantages*

Project Iron Boomerang is based upon developing first-stage steel production facilities in smelting precincts adjacent to existing resource locations in Queensland and Western Australia. Australia has an estimated 40% of the world's seaborne high grade iron ore and 65% of the world's seaborne coking coal. These resources have been estimated to have the capacity to meet demand for a hundred years. The precincts will be connected by a railway enabling cost effective transport of input resources to the appropriate smelter precinct.

This Pre-Feasibility Study outlines a convincing preliminary case for steel manufacturers and others to join together to commence the full Feasibility Study of PIB. The study provides evidence that the construction of first-stage smelter precincts offers many cost effective savings and that a dedicated railroad with all supporting infrastructure is feasible and economically favourable for steelmakers. The project will also deliver major global environmental benefits from improved transport efficiencies, modern first-stage steel production techniques and efficient energy utilisation. The Feasibility Study will test these early findings in depth, and further establish the validity of the business case.

The pre-feasibility financial assessment is based on six steel smelters in each precinct and assumes the production of steel slabs for export to second-stage production locations. The decision on output will ultimately be made by the steelmakers. The project also encompasses the transportation of the output of the steel smelters to the ports in Australia from which they will be shipped. The project does not include the construction of the steel smelters or their operation. This will be the responsibility of the steelmakers that participate in the project.

If steelmakers choose standard modular construction of the smelters, there is an estimated savings of about US$700 million each. Also, there are substantial direct and indirect benefits associated with the concentration of steel smelters in purpose designed smelter parks. Capital expenditure savings in the shared services is estimated at US$450 million for each smelter.

The potential savings for steelmakers are significant. For a representative steel mill in East Asia, the cost of delivered steel slab is estimated to be reduced by US$107 per tonne. The savings projected as compared to current practices are based on conservative estimates and do not include the likely and continuing increase in transportation costs under the existing practices of shipping ores and coal to smelters in other international locations.

### 11.2 *Financing and Administration of the Feasibility Study*

A full Feasibility Study is necessary to confirm the highly favourable results of this Pre-Feasibility Study before the commencement of construction of PIB. The projected cost of the study is A$150 million.

Steelmakers, the ultimate beneficiaries of PIB, are being asked to be the principal funders of this study. Other companies that have an interest in the project may also participate through investor positions. The project encompasses the staged construction of twelve steel smelters. To secure a right to a steel smelter position, a steelmaker will contribute a proportionate share of the costs of the Feasibility Study; that is A$10 million. The contribution will entitle the company to have a seat on the Management Advisory Committee, which will advise the East West Line Parks Board of Directors and management during the study and subsequently during construction. This will be the means by which the steelmakers and other key participants will provide information to EWLP and receive information on the development of PIB. The contribution will not acquire an equity interest but will acquire the right to an equity participation in EWLP as described above.

A key benefit to steelmaker contributors to the Feasibility Study, and an incentive for early commitment, will be the selection of positions in the precincts. The construction of six steel smelters at each of the two precincts will be staged, with two steel smelters at each end being constructed during each stage. Steelmaker participants will select a precinct and a construction sequence at that precinct on a first-come, first-served basis. For example, the first contributor may choose to construct the third steel smelter at the Queensland precinct. The second contributor would then choose from the remaining eleven positions.

In addition to securing a position in the proposed smelter parks, participation in the Feasibility Study will bring additional benefits including early identification of opportunities for increased investment and control of coal and iron ore resources in central Australia. There appear to be many resources that are uneconomical until an east-west railway line is built. PIB will make many of these resources economic for mining, thereby increasing security of supply for existing steelmaking facilities, and providing a platform for further expansion and investment in Australia.

### *11.3 Invitation to Participate*

Companies interested in participating in PIB are invited to contact EWLP. As a recipient of this Pre-Feasibility Study Report, you have signed a Confidentiality Agreement. To progress your participation in the Feasibility Study, please contact:

Shane Condon, Project Founder and Managing Director
East West Line Parks Pty Ltd
Level 15, 344 Queen Street
Brisbane, Queensland 4000
Australia

Tel: +61 7 32216966
Fax: +61 7 32112913

Please Note:

i) This preliminary survey was conducted on 2006.

The figures emanating from this report have since been adjusted to September 2007 to take into account inflation and cost escalation to the PFS Report Spreadsheets

ii) The trans-Australia continental rail crossing flyover should be viewed together with this report

This report has been prepared and submitted to East West Line Parks Pty Ltd by:

QUANTM

A TRIMBLE COMPANY

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Submitted to: 30 March 2007

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Brisbane, Australia

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# 1.0 EXECUTIVE SUMMARY

The Iron Boomerang Project is East-West Line Parks P/L (EWLP) vision for a trans-continental railway linking the Central Queensland coal fields with the Pilbara iron ore region in Western Australia. Iron ore smelting plants at both ends of the railway will provide pig iron and/or steel for export from Queensland and Western Australia.

The objective of this pre-feasibility investigation into the rail line is to conduct a wide area search for potential corridors and to identify macro level land use constraints and opportunities. In assessing alternative feasible corridors, comparative construction cost estimates were also made.

The investigation was carried out using the Quantm corridor identification and alignment optimisation system. The use of this sophisticated technology allowed a much higher level of information to be generated at this pre-feasibility stage than would have been possible if a conventional approach had been adopted.

The project database was assembled from publicly available digital terrain models, land use and topographic information. EWLP provided unit construction costs and the operational requirements of the rail line, including maximum grade limits and minimum horizontal and vertical curve values.

EWLP stipulated that the Queensland end of the railway (start point) be located near Moranbah, with EWLP to use the existing Newlands system and proposed extension of this line to North Goonyella (the Northern Missing Link). In Western Australia the railway was to end (finish point) adjacent to Poonda Siding, located approximately 50km north of Newman on the existing Mt Newman – Port Hedland railway.

Significant waypoints for the corridors were also identified and included proposed crew change depot locations near Kynuna in Central Queensland, and near Ti Tree in the Northern Territory. An intermediate crew change depot in Western Australia was likely to be remote from any established settlement.

Based on this set of data, the Quantm system was utilised to generate up to 50 alignments in each 200km section of the study area between the start and finish points of the rail line. Sorting the alignments in order of construction cost identified the generally lower cost corridors. The topographical maps overlaid on the corridors and terrain facilitated the identification of potential issues that will need to be investigated in more detail in subsequent studies. Features of note within the identified corridors included:

- several major non-perennial river crossings,
- proximity to National Parks and mining leases,
- the need to secure access for the corridor to cross several areas that are under Aboriginal ownership/control, and
- located the approximate position of crossing points on existing rail and road infrastructure, and location relative to existing settlements.

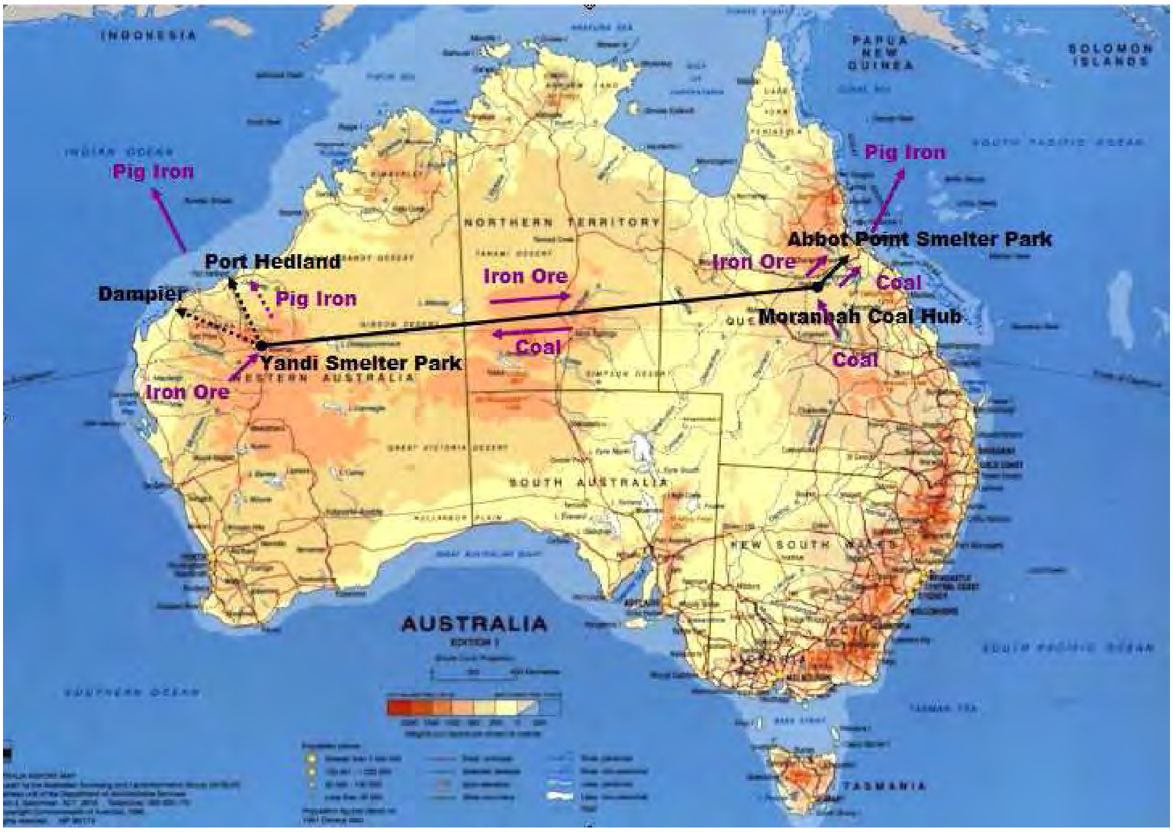
The investigation showed that the straight line distance between the East and West start/finish points was some 2,900km. With the initially targeted maximum gradient restricted to 0.5%, the lowest cost corridor that complied with this limit was 3,120 kms at an overall construction cost at 2006 prices of approximately $6.5 billion AUD.

The information in this report forms the foundation for subsequent, more detailed studies that would assess further the relative merits of the alternative corridors, develop optimum alignments within those corridors and to provide a higher level of certainty of cost outcomes.

## 2.0 BACKGROUND

The Project Iron Boomerang (PIB) concept is to construct and operate a heavy haul railway from coast to coast across the Australia continent near the Tropic of Capricorn. The line will travel from the North Queensland port of Abbot Point, through the coalfields of Central Queensland and extend to the iron ore region in the Pilbara, Western Australia where it will link into the existing iron ore railways to the Western Australia port of Port Hedland.

The East West Line railway (EWL) will be standard gauge, built to contemporary Pilbara iron ore railway standards, and linking to the existing and planned rail lines and iron ore mines in the Pilbara, and to proposed steel smelter parks at each end of the line. The EWL will link with the existing narrow gauge coal network in the Bowen Basin, accessing the existing and future coal mines in that region, via a transhipping facility near Riverside Mine (the Moranbah Coal Hub). The EWL will also be connected to the Adelaide to Darwin railway.




*(Fig 2.a) Proposed Project Route, Smelter Parks and Movements of Mine Haul Materials.*

The EWL will carry iron ore or coal in either direction to iron ore smelting plants located near Newman in Western Australia, and at Abbot Point. The coal hub near Moranbah will transfer coal from the narrow gauge network in Central Queensland for back-loading on trains heading to the west. Smelters will be located near the mine sites or ports, and will produce pig iron or steel, primarily for export. The EWL trains, running predominantly loaded in both directions, underpins a dramatic improvement in transport efficiency and environmental

performance compared with current practices of shipping raw materials offshore for processing.
EWLP Pty Ltd has retained Quantm Pty Ltd to carry out the initial corridor identification and alignment development using Quantm's specialised software, which is an innovative and unique system for transport infrastructure optimisation. This Report describes the outcomes of this initial study and will form the basis for undertaking subsequent detailed feasibility work.

## 3.0 OBJECTIVES

The primary objective of this work is to demonstrate that a comprehensive search for favourable corridors has been made and to provide confirmation that there are a range of corridors where alignments are compatible with macro land use constraints and railway operational and engineering requirements.

Identified corridors will highlight the main land use considerations and flag potential opportunities and issues that will be addressed at subsequent, more detailed stages. The potential corridors should also be compatible with the geometric requirements of the rail line, i.e. be within maximum gradient and minimum curvature requirements for a heavy haul rail line.

Strategic construction cost comparisons between alternative corridors will also be made to identify least cost corridors that maintain compliance with land use, rail operational and engineering requirements.

It is recognised that at this pre-feasibility desk top study stage that many unknowns have been left out, particularly in regards to detailed topography, site specific geology, hydrology and flood impacts and localised land use. So as not to unduly skew the study results to one alignment or another on assumed data, the cost impacts of these items will be considered in the comparative cost, and an allowance made in the general contingencies for railway capital costs. This method is to give confidence that a railway which meets the required heavy haul gauge horizontal and vertical alignment criteria can be achieved within the overall route.

# 4.0 PROJECT AND RAIL OPERATIONAL CRITERIA

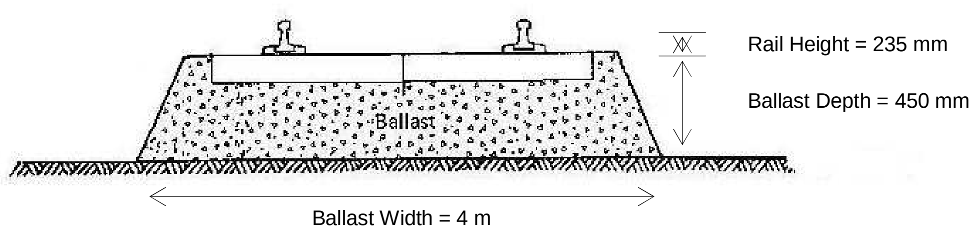
## 4.1 Specific Rail Requirements

### 4.1.1 Grades

Rail operational criteria used within the Quantm analysis was to account for the heaviest of haul requirements, this being the movement of iron ore eastwards from the Pilbara to the smelter parks in Queensland. Although slightly steeper grades heading westwards for coal / coke loading could be accommodated due to the different product density and volumes needed, EWLP decided that a maximum design grade of 1 in 200 (i.e. 0.5%) would account sufficiently for fully loaded diesel-electric locomotives moving in either directions for this initial stage evaluation.

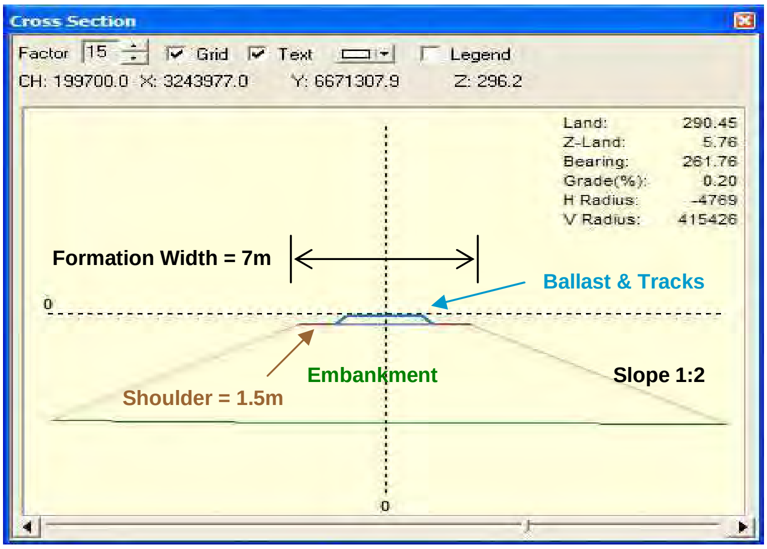
### 4.1.2 Standard Heavy Gauge & Cross Section

Rail alignment design was based on the standard heavy gauge system (1,435 mm). Ballast depth was specified as 450mm from top of sleeper, with a total depth of rail structure to sub-ballast of 685mm.




*(Fig 4.a) Rail & Ballast Specifications.*

The formation width of the rail corridor was 7m in both cut and fill, which included a 4m width for ballast and 1.5m shoulders. Although not included in the determination of alignments for this analysis, an overall corridor width of 50metres to include for an access track along the corridor was assumed.




*(Fig 4.b) Rail Corridor Cross Section.*

## 4.2 General Project Requirements

### 4.2.1 Start / Finish Points

EWLP stipulated the following start, finish and way points for the rail corridor.

**Start Point**: Immediately West of the Goonyalla Riverside Mine, which is located approximately 30km north of Moranbah and 180km west of Mackay in Central Queensland.

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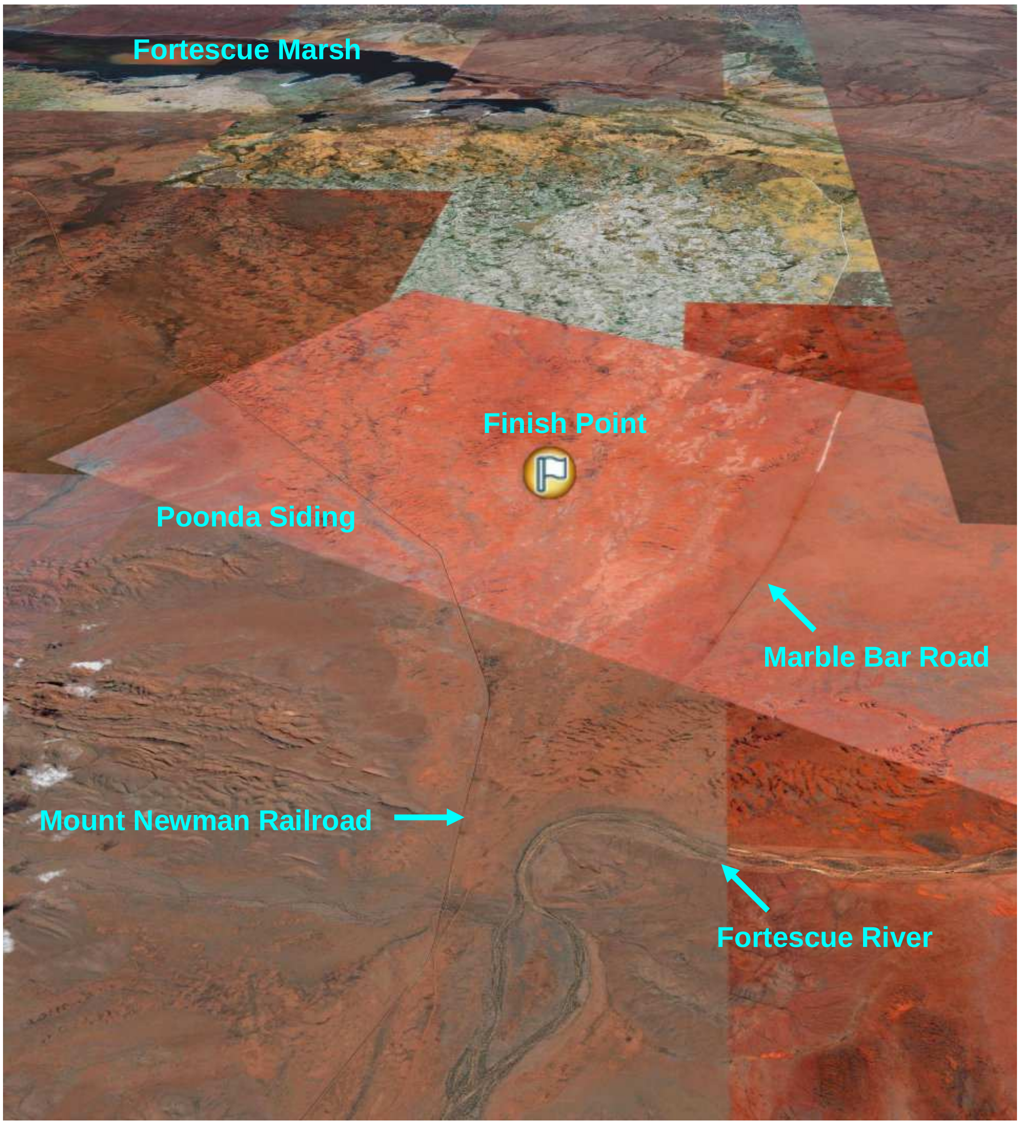
*(Fig 4.c) Rail Corridor Start Point: West of Goonyalla Riverside Mine, Qld.*

**Finish Point:** East of Poonda Siding located at the 334km point on the existing Mt Newman Railway, approximately 50km north of Newman, in the Fortescue River Valley, Pilbara, Western Australia.




*(Fig 4.d) Rail Corridor Finish Point: East of Poonda Siding, Pilbara, WA.*

### 4.2.2 Tie in Points with Existing Mine Haul Infrastructure

At the Queensland end, the Initial Smelter Park is proposed to be located adjacent to the existing export coal terminal at Abbot Point (near Bowen). The EWL is proposed to be co-located with the existing narrow gauge Newlands Line and along the proposed extension of this line to North Goonyella (the Northern Missing Link), which will be owned and operated by Queensland Rail (QR). The feasibility of constructing this section of railway has been carefully studied and established by Queensland Rail. This existing rail corridor will require selective widening to accommodate the EWL and future narrow gauge upgrades, and limited deviations to satisfy EWL grading requirements. For this level of analysis, no Quantm work was required on this section.

A narrow gauge electrified spur-line will be built to connect the existing QR Goonyella network near Riverside, to a transfer facility (the Moranbah Hub) for the transhipping of coal onto EWL trains for delivery to the WA smelters. Coal for the smelters at Abbot Point will be delivered via the QR narrow gauge network.

Similarly, at the Western Australian end the proposal for a smelter park east of the Poonda siding on the existing Mount Newman railway line will facilitate a means of rail connections with the Hammersley and Mt Newman systems (and possibly other new systems) to allow the transportation of the product to an export port (currently Port Hedland). It is believed that BHP Billiton will share the use of their existing Newman line with EWLP as the PIB will complement the marketing of iron ore from their existing mines.

#### 4.2.3 Waypoints

EWLP require a number of waypoints along the rail corridor to serve as refuelling stations, maintenance depots, crew change over points, etc. If possible, these waypoints should be within close proximity to existing settlements where EWLP workers will reside and integrate into these communities, but far enough away that any adverse impact on the nearby community such as rail operating noise would be minimised.

Possible way-points suggested by EWLP included; Winton and Kynuna in Queensland, Ti-Tree in the Northern Territory, which is located approximately 185km North of Alice Springs, and a third location halfway between Ti-Tree and the Pilbara.

# 5.0 METHODOLOGY

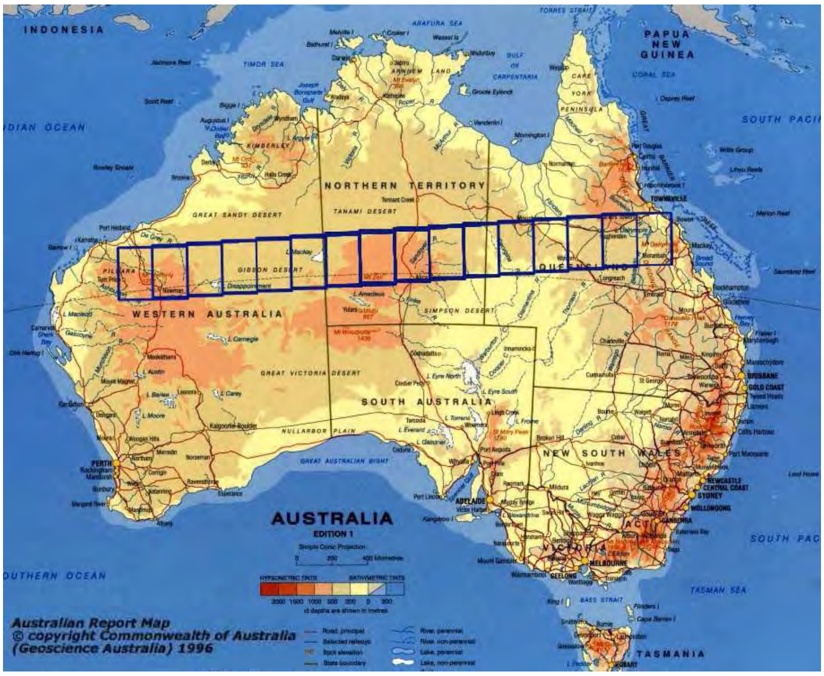
## 5.1 Quantm System

The Quantm system for corridor identification and alignment optimisation was the technology utilised to generate the results. This system identifies viable corridors and optimises alignments for rail carriageways. The system can take into consideration the land use constraints, unit construction costs [eg rails, sleepers, ballast, earthworks and structures], design geometry for the rail, existing linear features [eg roads, rail lines and rivers], and generates sets of alignments that comply with the criteria and are of lowest cost. The system is very fast at generating alignments compared to conventional methods, which allows a comprehensive search for corridor opportunities to be made and facilitates rapid sensitivity analysis of key parameters.

Quickly re-optimising alignments as new constraints emerge during investigations, stakeholder consultations or geotechnical studies can also significantly reduce planning times. The Quantm system is a great tool within the community consultation process in that it provides a transparent alignment selection methodology and an electronic audit trail of alignment development decisions. The Quantm System also provides a high level of confidence that an alignment which meets the engineering criteria can be achieved over the entire length.

## 5.2 Methodology Description

Total length of the rail line is in the order of 3,000km and to obtain the level of accuracy and detail required to meet the objectives, the rail study area was broken into 15 sections.  Each of approximately 400km, made up of a 200km section plus a 100km overlap with each adjacent section as shown in the diagram below:




*(Fig 5.a) Rail Corridor Study Area.*

In order to ensure the set of lowest cost overall corridors are identified, the methodology utilised a floating start and finishing points for each section of the overall line. The cheapest corridors were then used as a basis for determining the transfer points between sections. The corridor and sub-corridor alternatives were then spliced together to form composite corridor options for the full 3,000km line.

The sequential steps in this methodology are summarised as follows:

**Step 1:** Data acquisition: Digital terrain data, existing roads and rail, water features, mining leases, ownership maps, topographic maps.

**Step 2:** Compile the geographic information into a single data base using a common projection system.

**Step 3:** Break the study area into 15 x 400 km sections.

**Step 4:** Utilising the Quantm system, generate sets of 50 alignments in the first section to identify corridor options.

**Step 5:** On the adjacent section, generate sets of 50 alignments from each of the corridor end points of the previous section to identify corridor options in the section.

**Step 6:** Continue process until all 15 sections have been processed.

**Step 7:** Compile a composite map of the corridor options across the full length of the rail line.

**Step 8:** Assess each of the corridors and sub-corridors for opportunities and issues relating to land use constraints and surface features.

**Step 9:** Prepare report on results.

**Note:** EWLP provided the engineering requirements, operational requirements, unit construction costs and the definition of constraints that were used in the Quantm system to generate the corridor options and identified the initially preferred corridor options from the Quantm generated alignments.

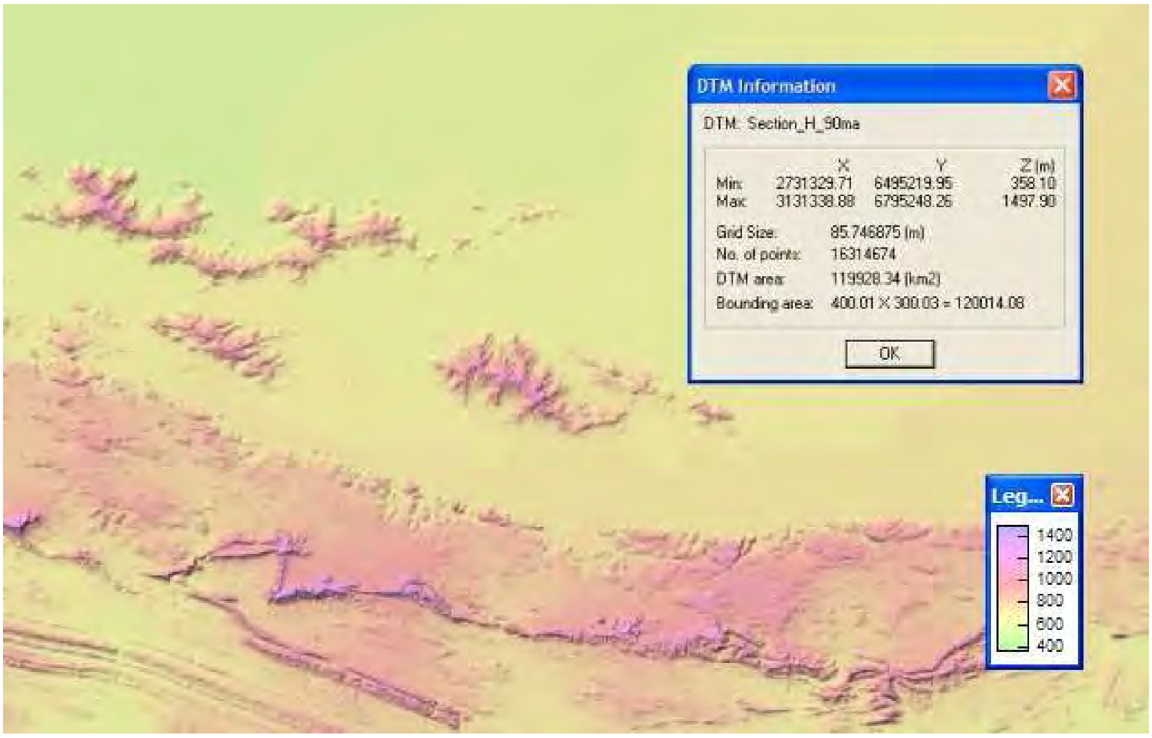
# 6.0 DATA ACQUISITION AND APPLICATION

## 6.1 Projection System

The Quantm system operates using Cartesian (X, Y, Z) co-ordinates and therefore requires a projection system to convert spherical (i.e. latitude, longitude) co-ordinates into Quantm compatible Cartesian co-ordinates. Due to the extreme scale of this project, a custom projection system was created to reduce the distorting effects of the earth's curvature. Since the project is primarily East-West oriented a Mercator projection with origin latitude -22°30'00" and central meridian 134°00'00" was deeme d most appropriate. The standard WGS84 spheroid was used along with a 3,000,000m false Easting and 9,000,000m false Northing.

## 6.2 Terrain Data

Digital terrain data was acquired from the U.S. Geological Survey EROS Data Centre. This 3 arc second SRTM (Shuttle Radar Topography Mission) data was projected then converted into Quantm format. Once projected the final Quantm DTM (Digital Terrain Model) had a resolution of approximately 86m.



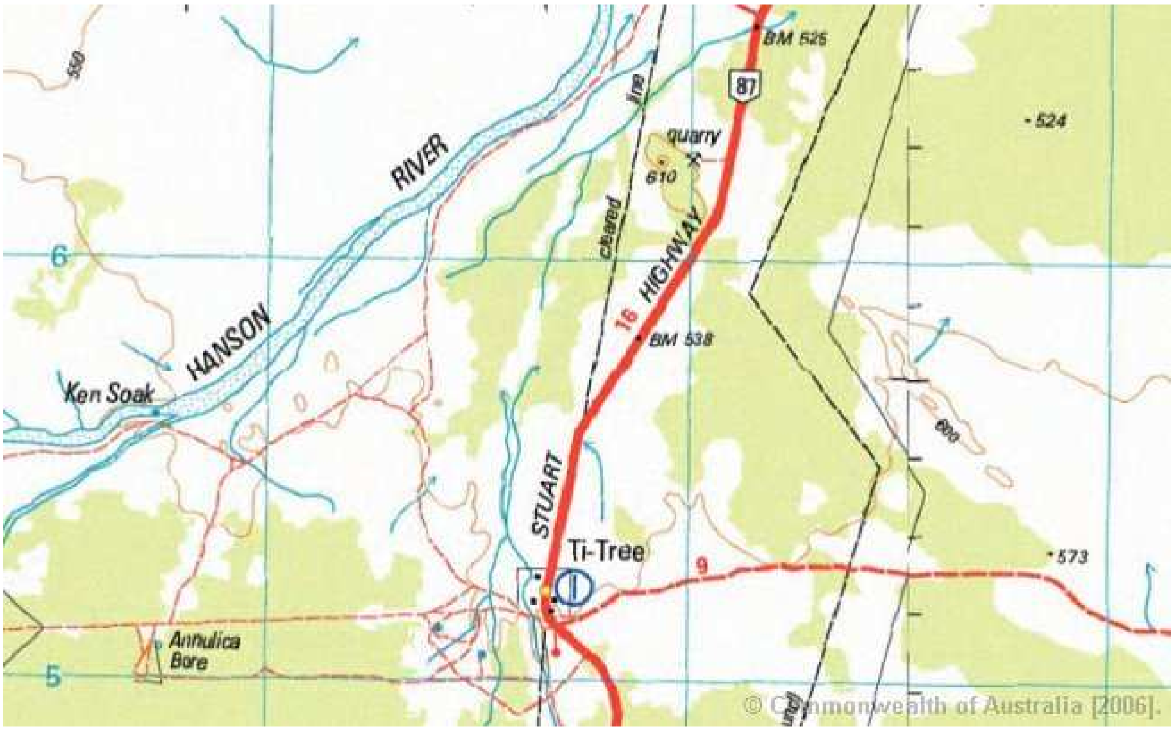

*(Fig 6.a) Sample Image of Quantm 3D Digital Terrain Model.*

## 6.3 Topographic Data

Topological maps obtained from the Australian Government's Geoscience Australia Website were used within Quantm to provide a seamless coverage of digital topological data across the entire study area. The maps form part of the GEODATA TOPO 250k 3rd Series and exist at a 1:250,000 scale resolution - i.e. 1cm on a map represents 2.5 km on the ground.

The series of maps were acquired in Enhanced Compressed Wavelet (ECW) format and then projected into the project coordinate system to align them within the project database. The drawings provide a vector representation of features on the earths surface and include natural and constructed features such as, but not limited to; existing road and rail infrastructure, land use areas, hydrography, vegetation, terrain, elevation, utilities and environmental boundaries.

The information gained by loading these maps within Quantm Integrator as a background image enabled more informed decisions on the appropriateness of corridor options, whilst ensuring their potential impact on communities and critical infrastructure would be noted and included in future analysis.

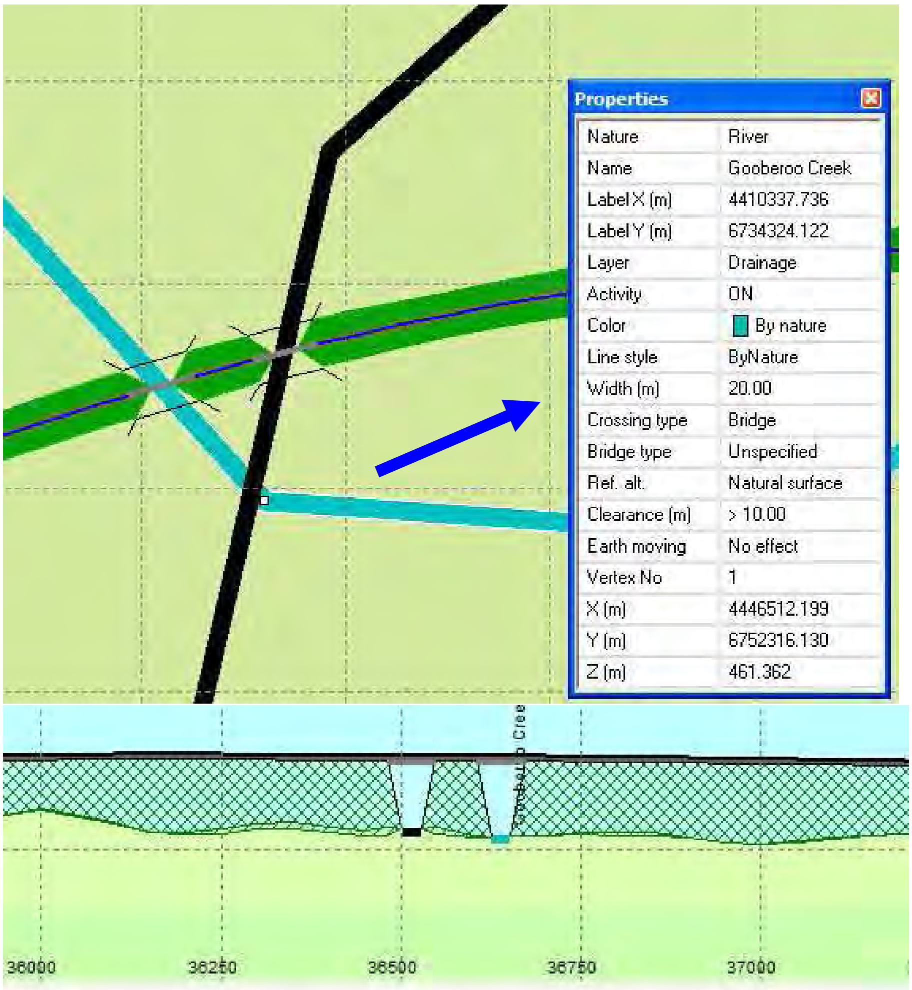



*(Fig 6.b) Sample Image of Topological Map.*

## 6.4 Roads, Rail, Water Courses

Existing road and rail infrastructure, together with water management areas, lakes and perennial/non-perennial drainage basins were acquired in digital format from Geoscience Australia. Although these were not included within this first stage of Quantm analysis and therefore did not actively influence the location of corridors, their influence on possible corridor options and the required structure crossings was noted for future consideration.

At this stage no hydrology studies have been carried out, nor have the necessary alignment adjustments and extra culvert or bridge structures across flood plains been considered. A key study requirement for the feasibility stage will be the determination of the required heights for crossing these flood plains.

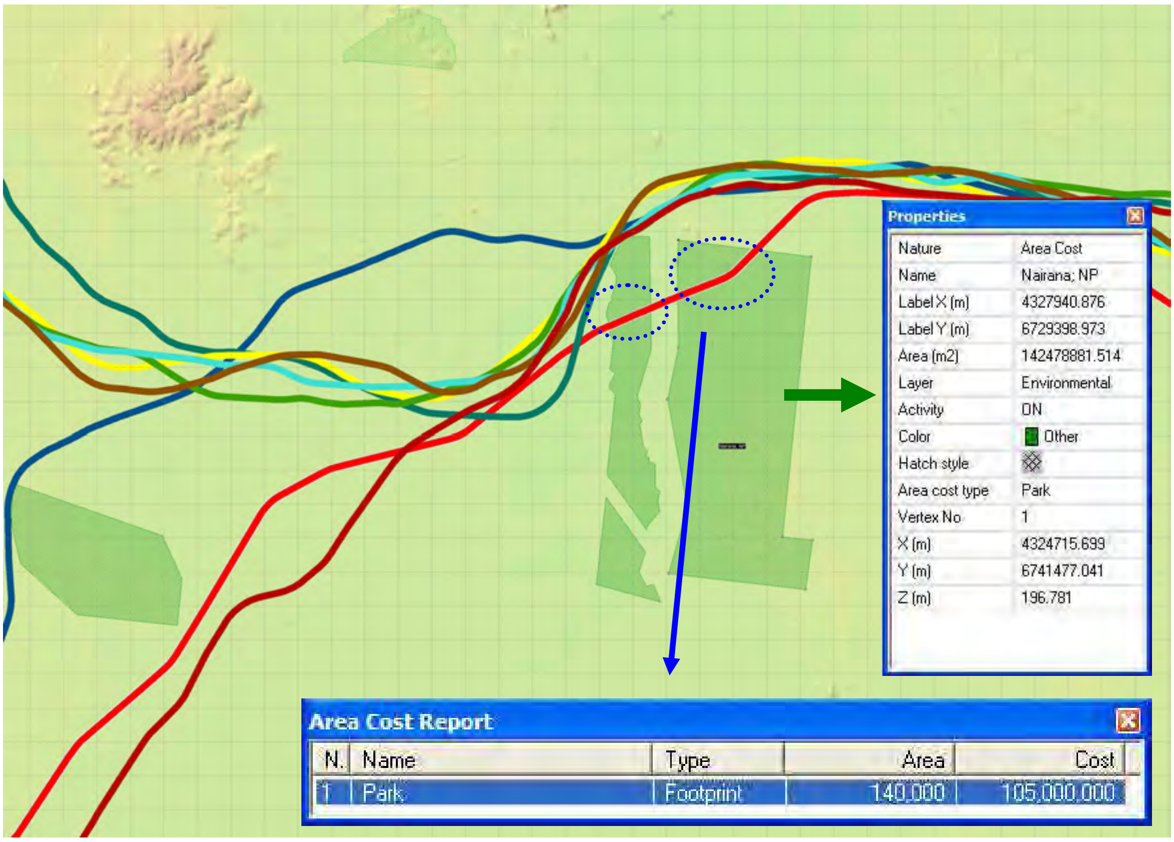



*(Fig 6.c) Using Quantm to Constrain River & Highway features with Structure Crossings.*

## 6.5 Land Usage / Environmental

Land-use and environmental data was assembled from Geoscience Australia and other state agencies which included populated places, utilities, national and state parks, crown lands and indigenous reserves. These constraints were not included within the system at this stage of the analysis. However, their influence on possible corridor options and the required structure crossings was noted for future consideration.

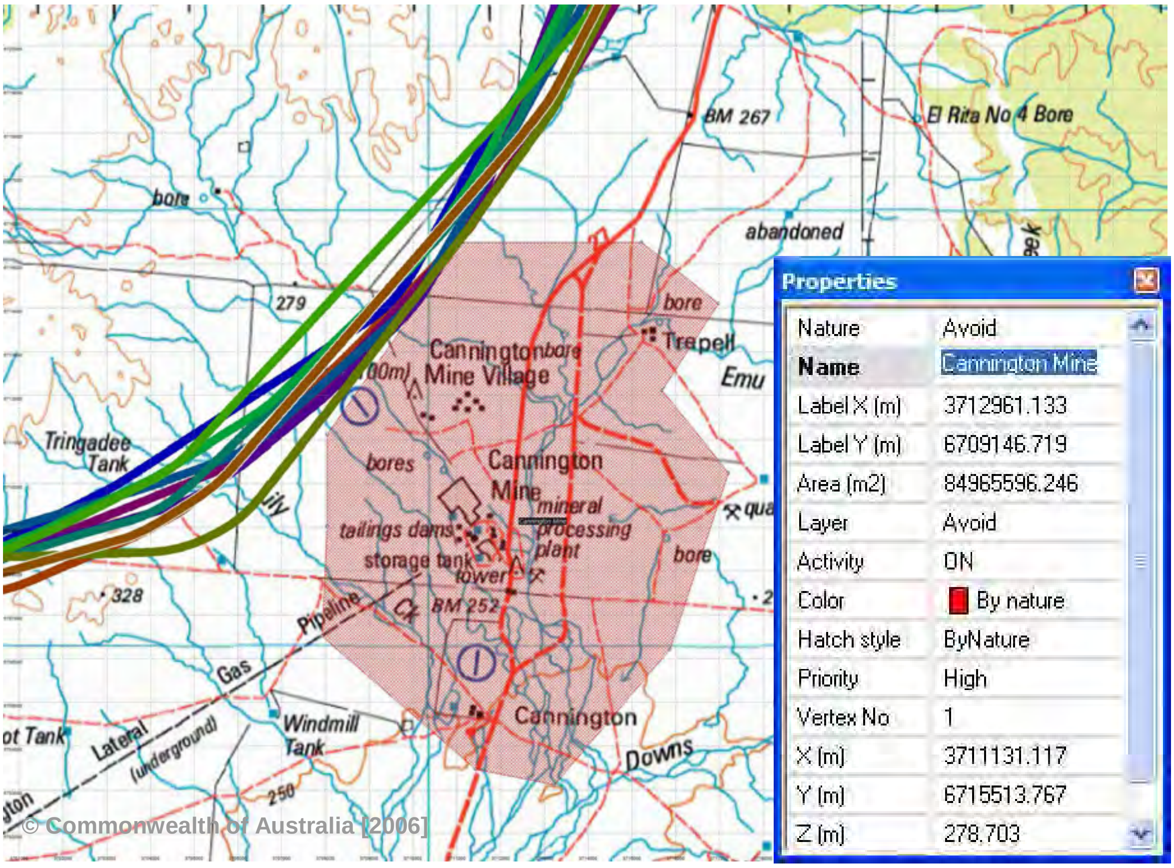
The following is an example that illustrates how these constraints could be included in future Quantm analysis to minimise their impact on sensitive environmental and land-use areas. The alignment marked in RED passes through the Nariana National Park. To minimise the impact on the National Park, but retain the low costs associated with this alignment, the alignment was “seeded” back into the Quantm system with the National Park attributed with a land acquisition cost. The resultant refined alignment options [shown in other colours] complied with this new constraint at a minimal or no extra cost.




*(Fig 6.d) Using Quantm to define Areas of Land Acquisition such as Nairana National Park, Queensland.*

## 6.6 Mineral Exploration Leases

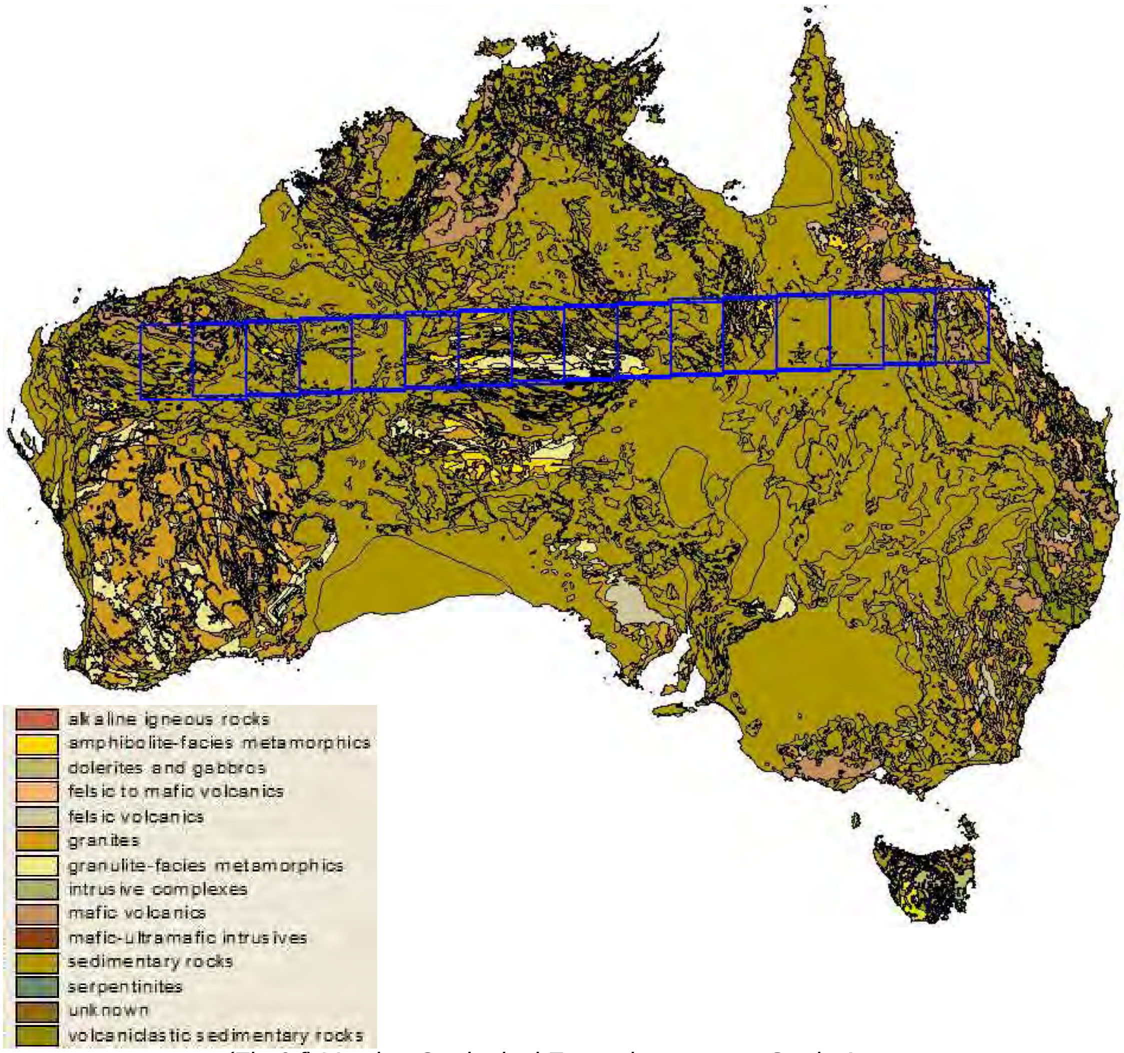
Current and proposed mining leases, exploration permits and licenses were sourced from the Queensland Government Department of Mines and Energy; Northern Territory Department of Primary Industry, Fisheries and Mines; and Western Australian Department of Industry and Resources. The datasets consisting of spatial information featuring boundary and attributes for the mining areas, where not constrained within Quantm and instead used to isolate areas that required further consideration in future studies.




*(Fig 6.e) Defining existing Mining leases such as Cannington Mine, Queensland to avoidance will result in the system generating all alignments around these sensitive areas.*

## 6.7 Geology

Data defining various geological regions was sourced, however due to the preliminary nature of this study was not utilized. It was noted that the real geological cost influence on the rail alignment would be site specific, and for this stage the geology could only be used to determine major obstacles as opposed to actual costs influences. Further fieldwork will be necessary to determine the relative properties of these different geological formations. For the purposes of this study a single default geology was used across the entire study area.




*(Fig 6.f) Varying Geological Formations across Study Area.*

## 6.8 Data Application

During this Pre-feasibility work, the primary data set that was used to generate corridor alternatives was the digital terrain model, rail geometric requirements and unit construction costs. The data sets pertaining to land use land ownership, roads, water courses, geology and mining leases etc were not used to influence the location of the corridors during this stage of the investigation. At this stage, these data sets were however used to note and highlight specific issues, opportunities and constraints that will be addressed in subsequent work.

# 7.0 MAJOR ASSUMPTIONS AND UNCERTAINTIES

## 7.1 Cost Estimates

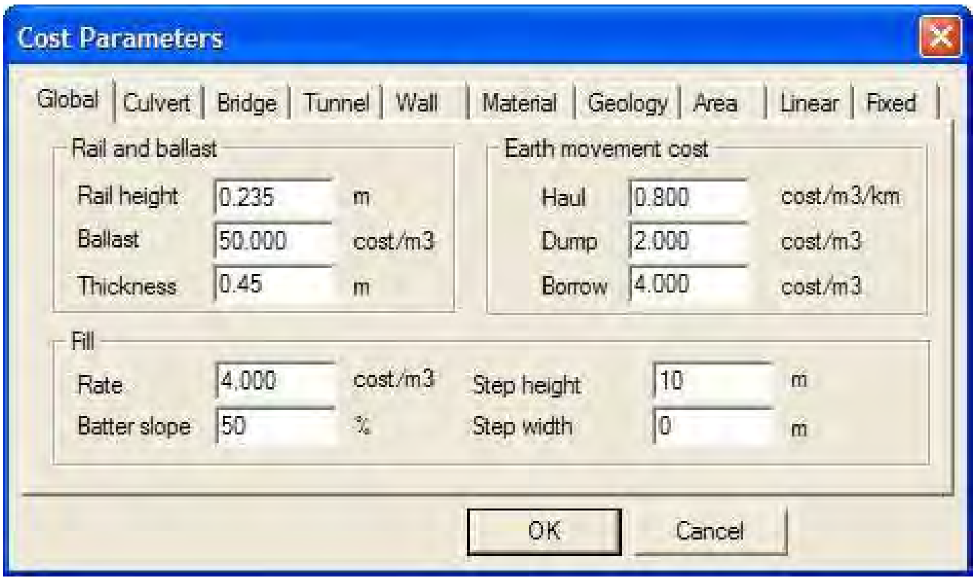
### 7.1.1 Global costs

Global costs are those that are applied over the entire study area and do not vary locally. A linear cost of $750/m was used throughout the study to cover track materials supply and track laying costs.

Other global cost rates include:

- Fill placement: $4.00/m$^3$
- Borrow material (import): $4.00/m$^3$
- Dump material (export): $2.00/m$^3$
- Haulage: $0.80/m$^3$/km
- Ballast supply & placement: $50.00/m$^3$

For the purpose of this study, and for comparative purposes in alignment selection, it was assumed that unit costs were independent of any variability in materials transport logistics, such as availability of suitable gravel for sub-ballast layer, crushed stone ballast, water for construction and pre-cast materials, which may vary significantly over the corridor length. Any extra costs for construction in remote areas will be accounted for in overheads and special costs at a later stage. All rates are in 2006 dollars and are based on recent historical data only.



*(Fig 7.a) Global costs as utilised within the Quantm system.*

### 7.1.2 Structure costs

The Quantm system required these rates to decide where it was more economical to place a structure rather than constructing very high embankments or generate deep cuttings. Viaduct, tunnel and retaining wall rates were estimated at the following values:

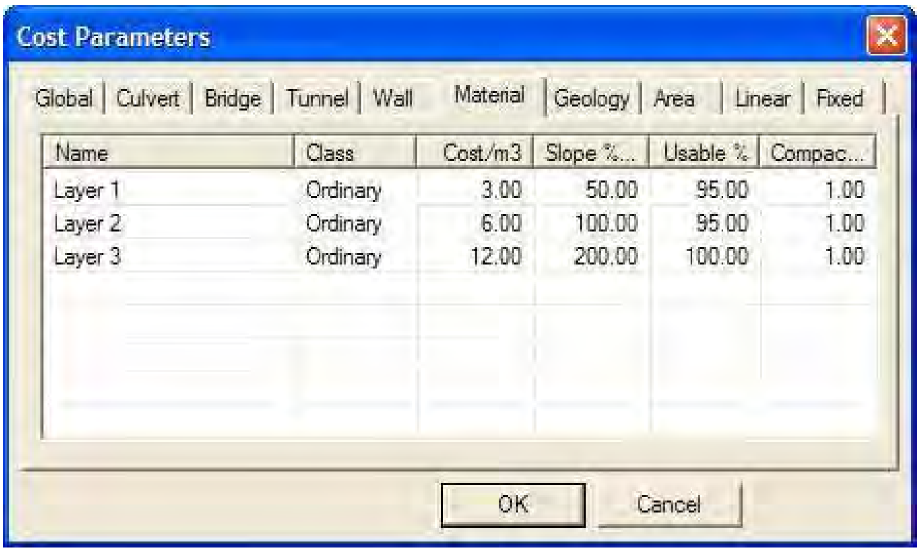
- Bridge (based on plan area): $3,000/m²
- Tunnel (linear cost): $1,000,000/m
- Retaining wall (surface area): $1,500/m²

## 7.2 Geotechnical Requirements

While digital data for geology had been acquired by Quantm, for this level of analysis the structure and properties of geological formations as these may impact on railway design and construction costs, were assumed to be consistent across the entire study area with respect to the global cost rates used to cost the overall capital costs.

It was noted that to a large extent, the study area was across flat terrain with isolated areas of semi-rough and sandy formations that would require further consideration in future studies.

Three separate layers of material were defined with associated excavation rates, batter slopes, compaction rates, the fraction of usable material that could be used for fill, and the unusable part to be hauled away and discarded as dump. The material costs entered into the system for each material reflected the depth of excavation and material hardness, with an easily worked surface material, overlying harder, more costly material.




*(Fig 7.b) Material structure & properties used within the Quantm system.*

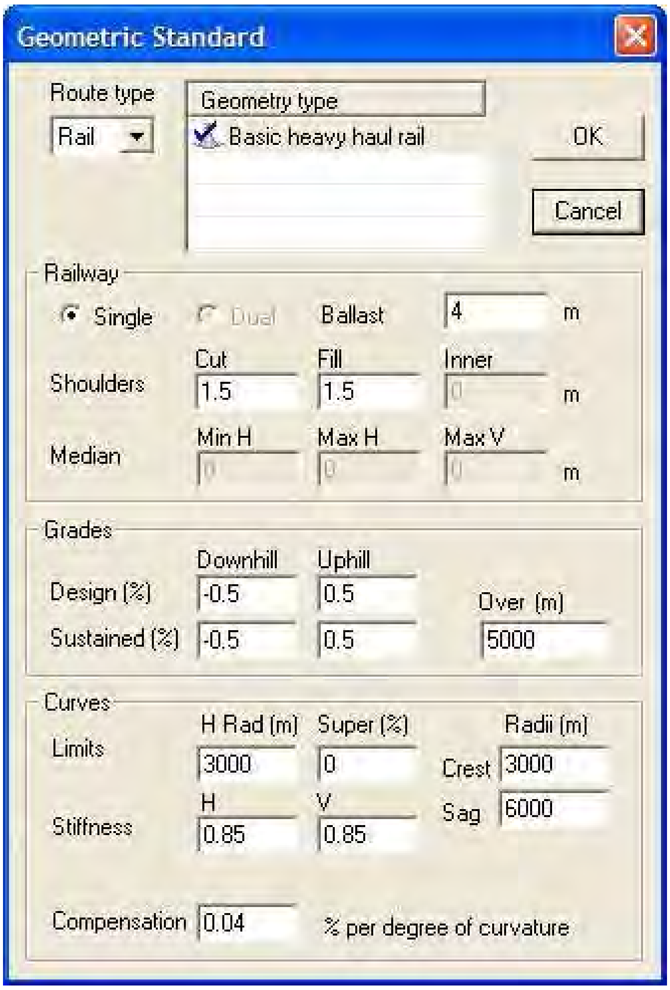
The default geology was based on three horizontal stratums, with the first starting at the natural surface and travelling down to a depth of 3m, second a further 5m deep, and the final stratum being of infinite thickness. Rail corridor cross section would requiring benching every 5m and be stepped 2m across.


*(Fig 7.c) Geology used within the Quantm system.*

## 7.3 Geometric Criteria

Preliminary estimates of rail engineering parameters for curvature and compensation were selected based on similar heavy haul rail projects. These values were reviewed and confirmed by EWLP in an email to Quantm on 15/12/06. EWLP advised that these criteria are suitable for the heavy haul standard gauge trains to operate at a design speed of 80km/hr.

- Min Horizontal Radius: 3000m
- Min Vertical Radius for Crest: 3000m
- Min Vertical Radius for Sag: 6000m
- Gradient: 0.5%
- Curve Compensation: 0.04%




*(Fig 7.d) Geometric standards used within the Quantm system.*

## 7.4 Earthwork Limits & Mass Haul Considerations

Earthwork limits restricting the maximum height of embankments and maximum depth of cut were not deemed necessary for this first stage of work. This was based on the assumption that the small sections of terrain that were not flat would not generate high/deep escarpments across the landscape and therefore would not effect corridor location on a macro scale.

With the Rail Line broken up into 200km sections it was also assumed that mass haul would be balanced at the end of each section. It was noted however that mass haulage over this distance may be too excessive and a more practical mass haul balance would require the identification of possible natural spots for mass haul barriers, sources of fill or dump sites for spoil.

## 7.5 Sandy Desert Crossings Requirements

There is some uncertainty associated with crossing through Western Australia where the rail corridor will need to negotiate desert crossings through sandy areas such as The Gibson Desert, Great Sandy Deserts and the Little Sandy Desert. This may involve several hundred kilometres of track through or parallel to sand ridges of varying density, reaching heights of 15-20m in some locations.

Such crossings although not given any special attention within this stage of the analysis, will require consideration due to the effects of dune instability, soil erosion and acceleration of wheel and rail wear from drifting sands, if applicable. Mitigation of these effects in future studies using Quantm may come in the form of paralleling ridges, following an existing track where possible (e.g. Talawana Track), employing a flatter more stable cross section, using a wider formation to allow for fabrication and vegetation banks, and minimising the lengths of tracks crossing these desert areas, and further detailed engineering assessment of these areas will be required during the Detailed Feasibility stage.

## 7.6 Dry Creeks and Floodplains

There are numerous perennial/non-perennial river systems, wetlands and lakes located throughout the study area and at this stage their impact on rail corridor location and costs is uncertain. Some of the more major drainage systems that may have some level of impact on the rail corridor include; Wokingham Creek, the upper reaches of the Diamantina, Burke and Georgina Rivers in North West Queensland, together with Lake Mackay, Napperby Creek, Hanson River, Lander and Fortescue Rivers in Western Australia.

Catchment features, water levels, channel and flow patterns, discharge distribution and flood frequency could all have a bearing on the crossing type and clearance required over these systems. Crossing clearance will need to be at levels that ensure the track remains operational during the infrequent but possibly extended periods of inundation. Some may necessitate an expensive bridge made lengthy by the requirement to reach a certain clearance at a fairly low gradient. Others such as dry lakes and floodplains may only require the use of regularly spaced culverts to allow sheet flow to pass underneath, or raising the railroad onto an embankment to meet a minimum height above expected flood levels. There may also be the need to minimize the environmental impact of crossing over the sensitive ecosystems.

## 7.7 Indigenous & Environmental Areas

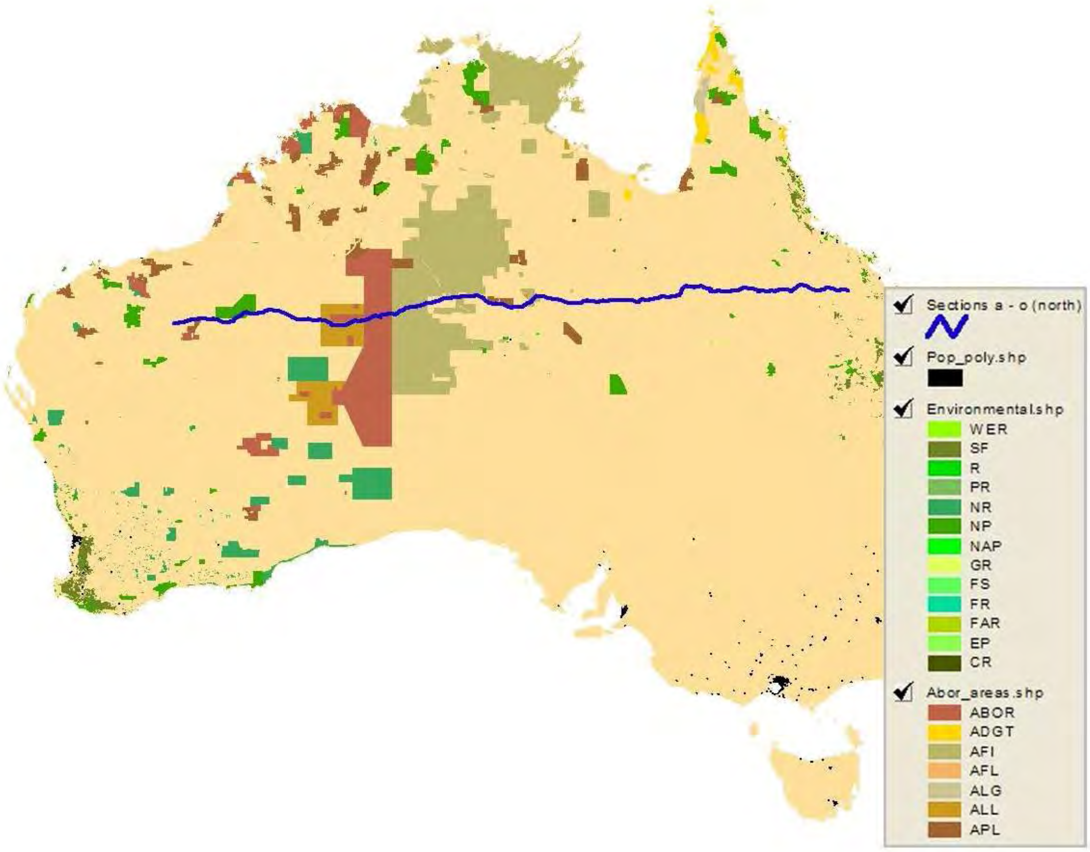
Visualisation of the GIS datasets identified various regions of land which may be affected by the proposed rail route. The two major types of regions, Indigenous and Environmental, will likely require avoidance or land access permitting in order for the railway to pass through them.

Whilst the entire corridor will be subject to need to identify and manage cultural heritage issues, and potentially be subject to Native Title claims from the traditional owners, the rail corridor will need to traverse current Aboriginal controlled lands, such as the Central Australia Aboriginal Reserve and Kiwirrkurra Aboriginal Reserve, both of which lie in Western Australia. There are also a small number of national and state reserves located across the study area including The Rudall River National Park in Western Australia and

Nairana and Bladensburg National Parks in Queensland. The impact of these social / environmental areas on the rail corridor is somewhat uncertain, and will be subject to further investigation, consultation and agreement with the various stakeholders.

There was no data included within this analysis to represent the boundaries of these sensitive constraints, however for future investigations various socially / environmentally sensitive areas can be defined as mitigation costs areas, and then changed to avoidance criteria to determine the engineering cost to protect these sensitive sites. The system can then demonstrate compliance with these criteria, and therefore demonstrate environmental consideration and avoidance to ensure a better public and environmental outcome.

The map below shows at a macro scale, where indigenous and environmental areas are located in relation to the favoured corridor. These are primarily Aboriginal controlled lands in the Northern Territory and Western Australia.




*(Fig 8.b) Map showing major Indigenous and Environmental areas.*

## 7.8 Cost Relativities

The raw corridor costs generated in this initial round of processing are based on assumed unit cost, terrain and alignment geometric requirements, for selected items used in comparative assessment of the various corridor options. They are a good guide as to the relative construction costs in 2006 dollars of the alternative corridors within the sections evaluated, but do not indicate full rail project costs such as contingences, overheads and profits, nor the impacts of remote areas and differential costs along the extended corridor.

The unit rates exclude the variable impacts of yet-to-be-determined sources of supply and the associated haul distances for major construction inputs such as water, gravel sub-ballast layers and track materials. In addition costs such as project management, detailed design, land acquisition and associated costs, train control, signaling and communications systems, and contingency provisions etc have are not included in the raw construction costs being calculated in Quantm for each of the corridors/alignments generated.

At this stage of the project development, an allowance for the total capital cost of the rail line will be the Quantm raw cost plus approximately 10% construction contingency, $500 million for bridges allowances and 65% for overheads and profit (percentages provided by EWLP). The anticipated capital costs hence total $6.4b. Note that the Quantm model and costing does not include the section from the Riverside stating point to Abbot Point.

During the next more detailed stage of alignment development factors such as:

- Drainage structures
- River crossings (culverts/bridges)
- Minor linear costs (fencing, etc.)
- Grade separated crossings of major highways/railways
- More accurate and detailed geological information and likely sources of ballast and gravel
- Design standards for crossing desert sections
- Avoidance or land mitigation of environmental areas
- Avoidance or land mitigation of other incompatible land-use areas

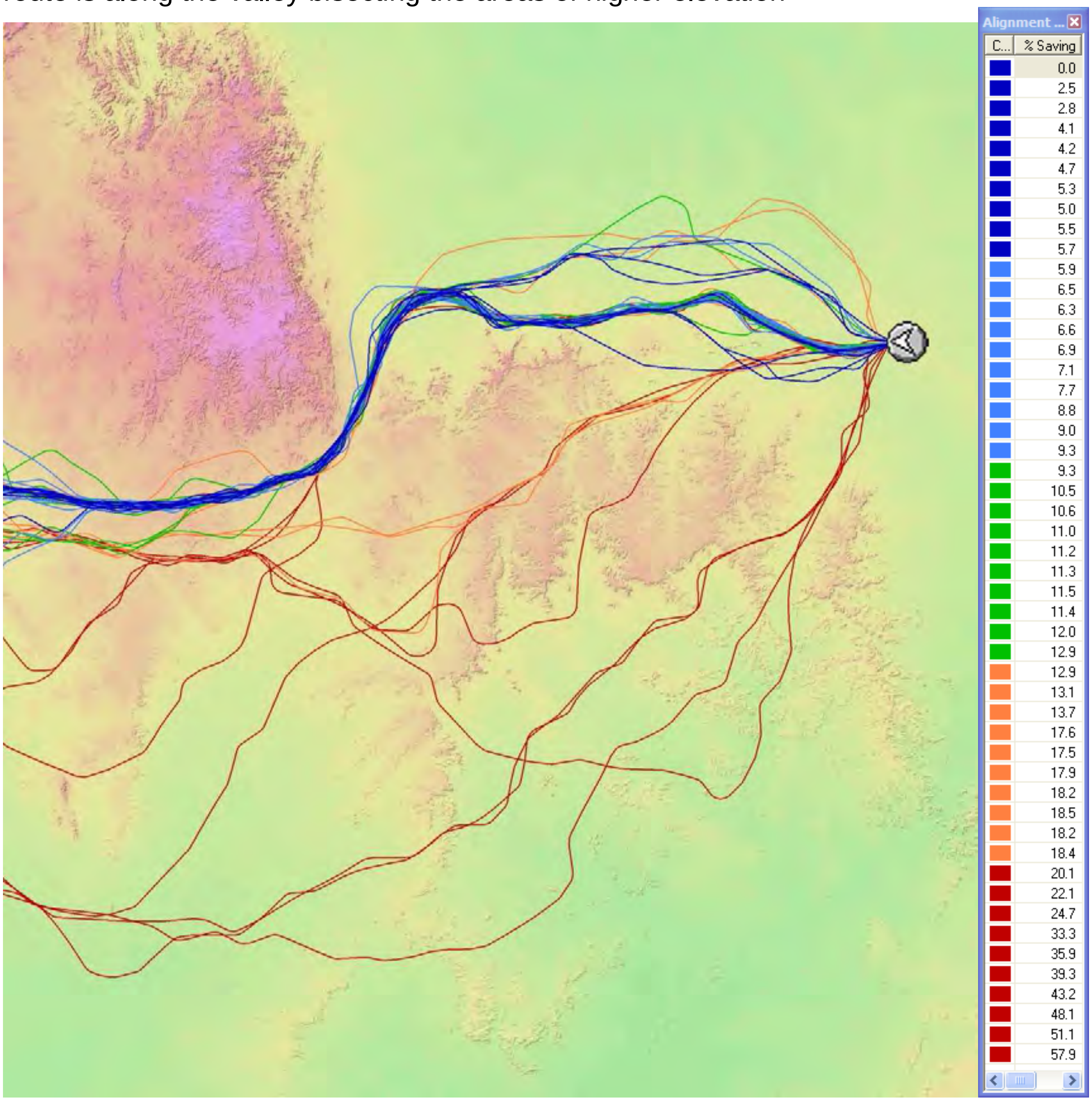
will be assessed individually as to their cost impact, which will increase the certainty and reduce the contingency factor.

# 8.0 CORRIDOR SEARCH

## 8.1 Corridor Search - Full Area

Quantm was used to perform free-to-roam searches across each of the fifteen sections comprising the study area. In free-to-roam mode, the Quantm system searches the whole terrain for low cost alternatives. The output is a range of up to fifty rail alignments spreading across the terrain model. Clumping of alignments indicates a favourable corridor. Colour coding the alignments in order of cost, highlights the lowers cost corridor. Using this functional capability of the Quantm system, provides evidence that the whole of the available area has been searched for viable corridors.

In the example below, which shows a set for results generated in Section D1, the lowest cost corridor is shown by the clumping of blue alignments. It can be seen that the cheapest route is along the valley bisecting the areas of higher elevation




*(Fig 8.a) Example results set from Section D1 of 50 alignments coloured by cost.*

## 8.2 Corridor Descriptions

Analysis of these results showed the key driver of corridor location to be grade related. The overall trend in the results is that the low cost corridors tended to favour the most direct route from section to section. Deviations from a straight line were forced by the very low maximum grade which resulted in to the corridors deviating to avoid any rough or mountainous terrain.

After the initial low cost corridors that met the geometric and grade constraints were identified, a collaborative review was carried out between Quantm and EWLP. The purpose of this was to identify any macro level features of importance which could impact the more favoured corridor alternatives. Each of these significant features will require special attention at the next level of investigation to modify the corridor in those specific areas to address each issue. These features have been summarised in the following table.

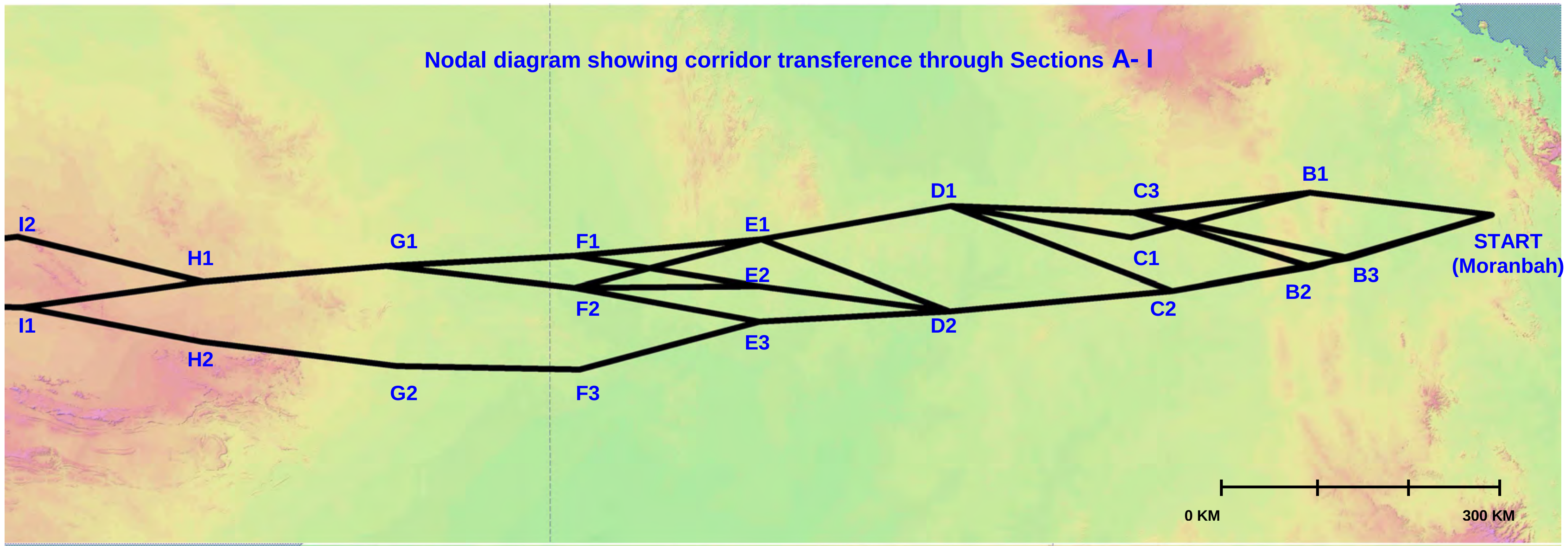
*Table 8.a: Summary of Length, Cost and Significant features for Corridor Sections.*

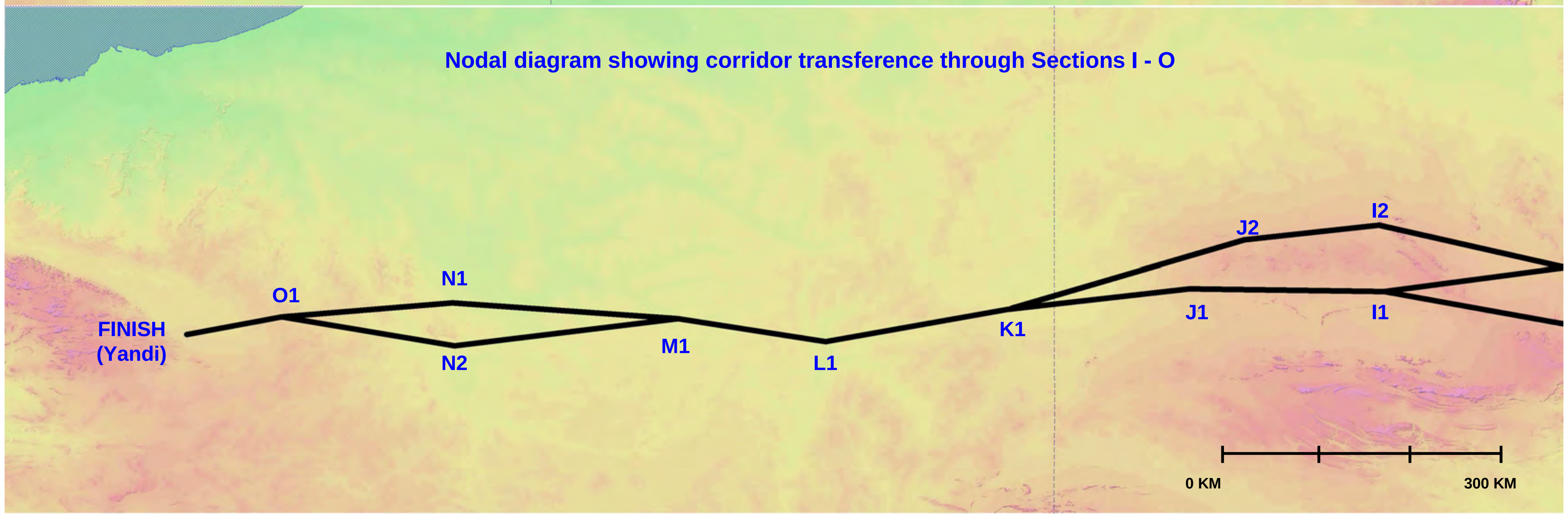
| Corridor Section | Distance (km) | Raw Cost* ($) | Significant Features |
|---|---|---|---|
| A – B1 | 216.2 | $238M. | Consideration to existing Mining leases, Gregory Developmental Road, Nairana National Park |
| A – B2 | 212.7 | $232M. | Gregory Development Road, Twin Hills |
| A – B3 | 169.9 | $179M. | Gregory Development Road, Twin Hills |
| B1 – C1 | 218.5 | $215M | Small Dry Lakes, Lake Buchanan, Landsborough Creek |
| B1 – C3 | 224.9 | $217M | Landsborough Creek |
| B2 – C2 | 172.6 | $164M | Towerhill Creek, Lake Galilee, Lake Barcoorah |
| B2 – C3 | 228.9 | $225M | |
| B3 – C2 | 217.4 | $220M | |
| B3 – C3 | 264.4 | $268M | |
| C1 - D1 | 222.4 | $218M | Winton Highway, Winton Branch Railway, Wokingham Creek Landsborough Highway, Diamantina Creek, Winton Township |
| C2 – D1 | 273.7 | $282M. | |
| C2 – D2 | 267.4 | $282M. | Winton, Western River, Bladensburg National Park, Diamantina River |
| C3 – D1 | 221.0 | $219M. | Kynuna |
| D1 – E1 | 246.6 | $235M. | Diamantina River, Landsborough Highway, Mckinly River System, Cannington Mine (BHP), Chatsworth, Phosphate Hill Mine |
| D2 – E1 | 239.7 | $236M. | |
| D2 – E2 | 231.7 | $232M. | |
| D2 – E3 | 235.6 | $238M. | |

| | | | |
|---|---|---|---|
| E1 – F1 | 223.4 | $221M. | Phosphate Hill Mine, Diamantina Development Road, Georgina River |
| E1 – F2 | 227.0 | $230M. | |
| E2 – F1 | 226.2 | $236M. | |
| E2 – F2 | 213.8 | $232M. | |
| E3 – F2 | 225.9 | $225M. | |
| E3 – F3 | 226.8 | $254M. | |
| F1 – G1 | 210.4 | $198 | Some Small Sand Dunes |
| F2 – G1 | 213.1 | $207M. | |
| F3 – G2 | 223.0 | $222M. | |
| G1 – H1 | 227.4 | $217M. | Ooratippra Creek System, Sand Ridges, Bundey Creek, Sandover Highway, Sandover River |
| G2 – H2 | 225.0 | $227M. | |
| H1 – I1 | 226.6 | $211M. | Ti-Tree, Hanson River, Lander River |
| H1 – I2 | 223.8 | $219M. | Stuart Highway, Alice Springs Darwin Railway, Darwin Gas Pipeline |
| H2 – I1 | 213.7 | $199M. | |
| I1 – J1 | 216.7 | $202M. | |
| I2 – J2 | 147.2 | $139M. | Cockatoo Creek, Tanami Road, Yaloogarie Creek |
| J1 – K1 | 208.5 | $203M. | |
| J2 – K1 | 279.6 | $265M. | Sand Dunes, Lake MacKay, Central Australia Aboriginal Reserve |
| K1 – L1 | 219.0 | $226M. | Kiwirrkurra Aboriginal Reserve , Sand Ridges through Gibson Desert |
| L1 – M1 | 170.9 | $186M. | Patchy Sand Dunes |
| M1 – N1 | 274.2 | $276M. | Rudall River National Park |
| M1 – N2 | 271.1 | $293M. | Corridor not reviewed |
| N1 – O1 | 232.4 | $238M. | Talawana Track, Little Sandy Desert |
| N2 – O1 | 228.3 | $230M. | |
| O1 - Finish | 105.0 | $92.4M. | Fortescue River |

[*] *Raw costs do not include contingencies, overheads, distance impacts, overheads or profits.*

In each of the following corridor drawings, the corridor marked as BLUE is the initial preferred corridor due primarily to its shorter length and lower raw cost.

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east west line parks pty ltd

**East West Line Parks Pty Ltd**
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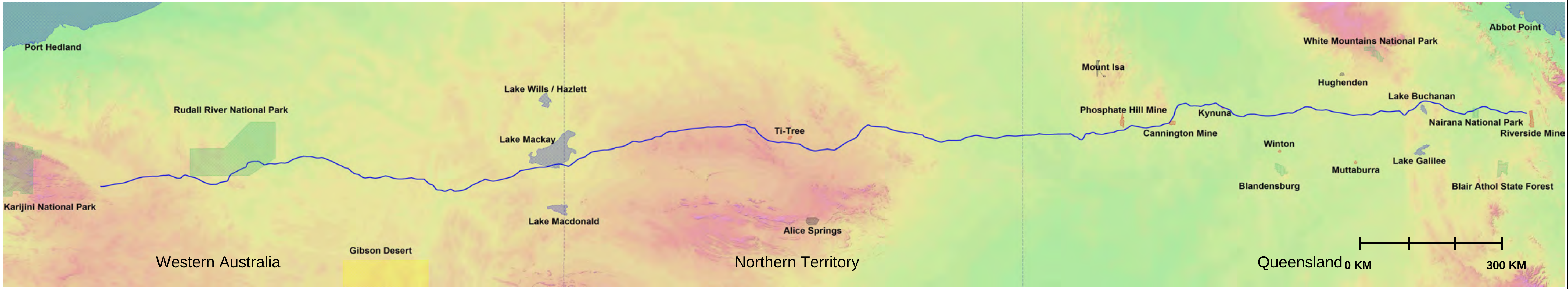
Date 5/2/2007
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Nodal**




*(Figure 8.b) – Illustration showing the Preferred Northern Corridor Route.*

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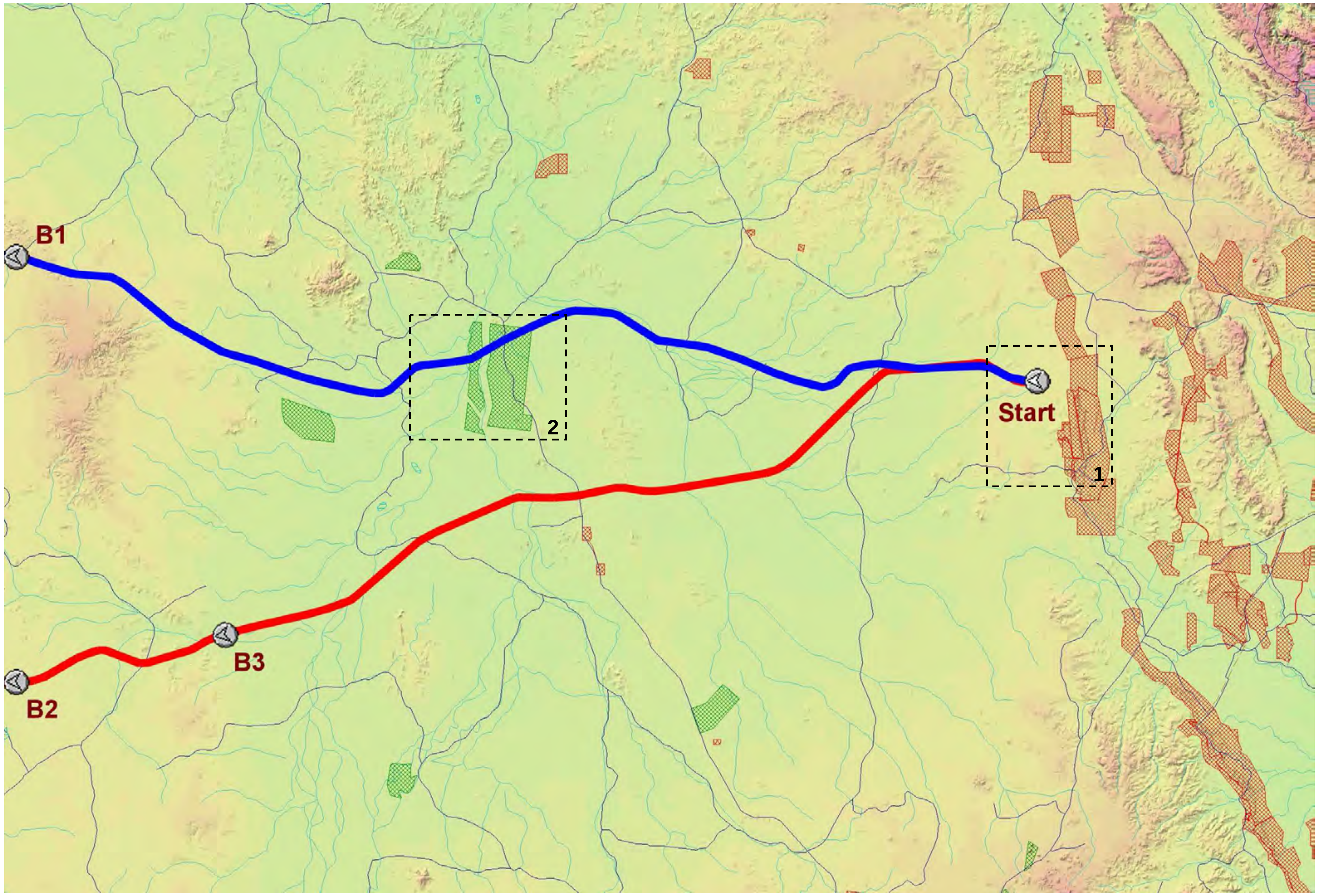
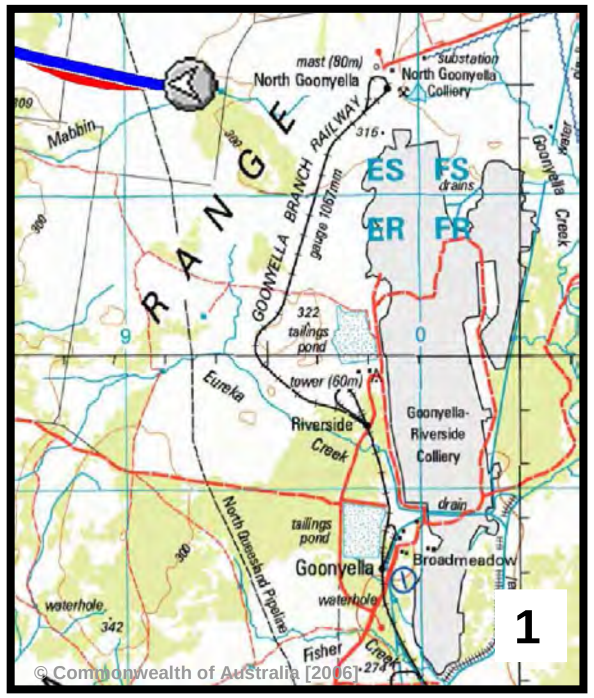
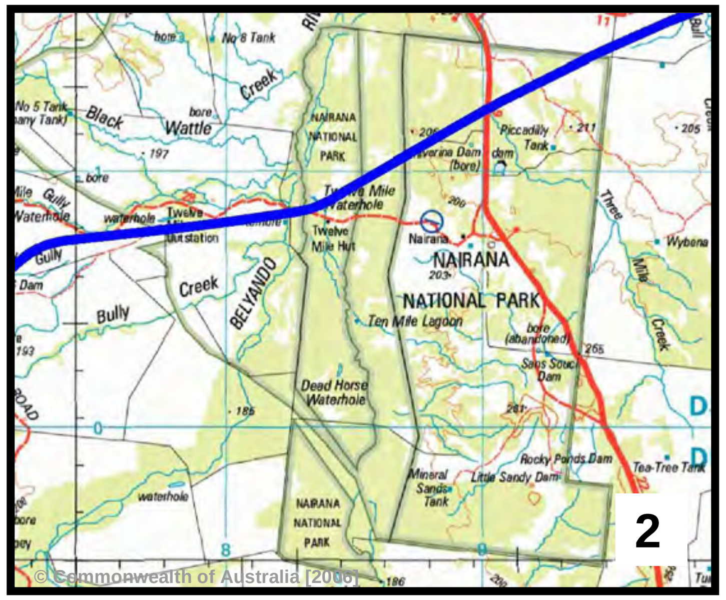



*Goonyella-Riverside Mine*




*Nairana National Park*

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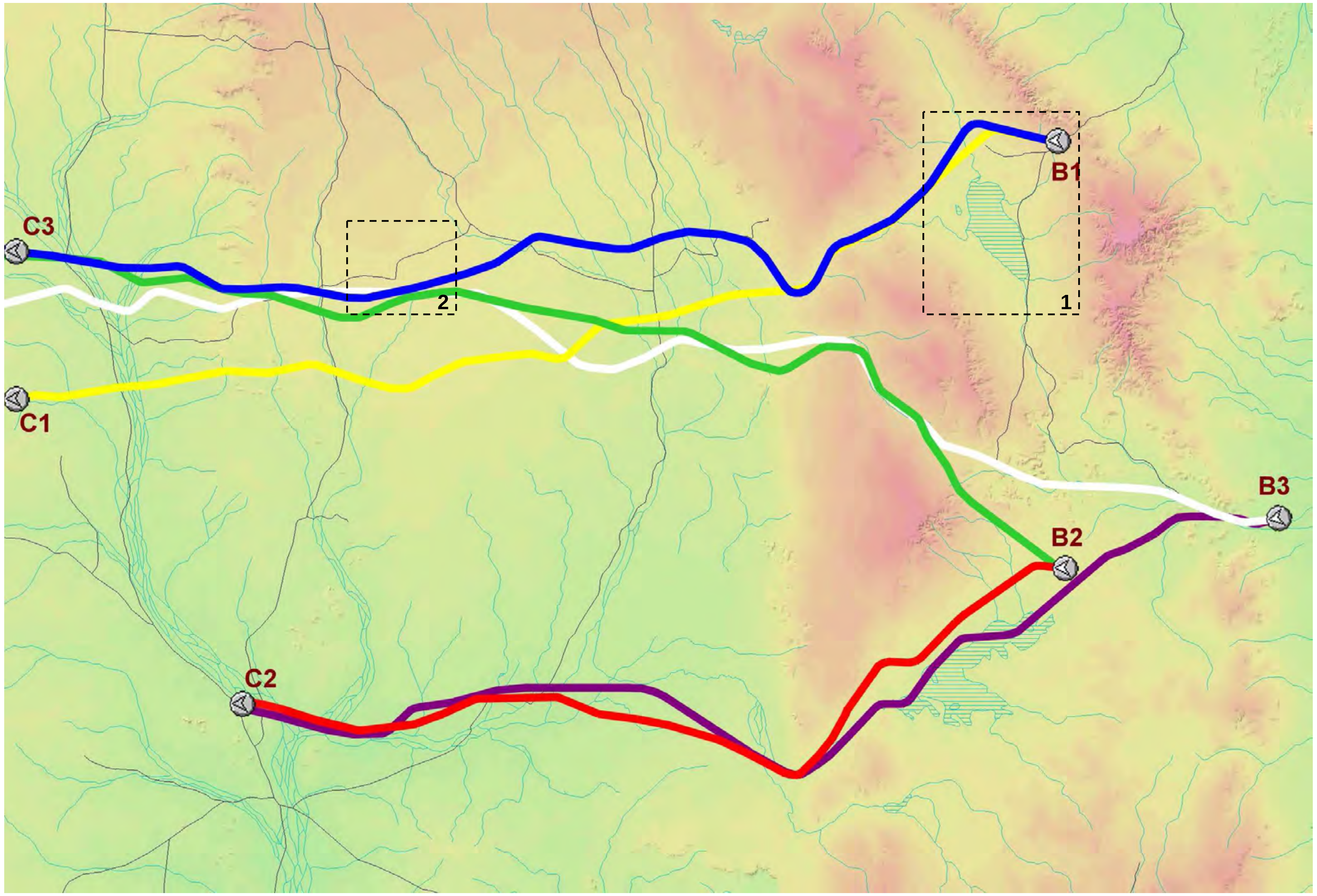
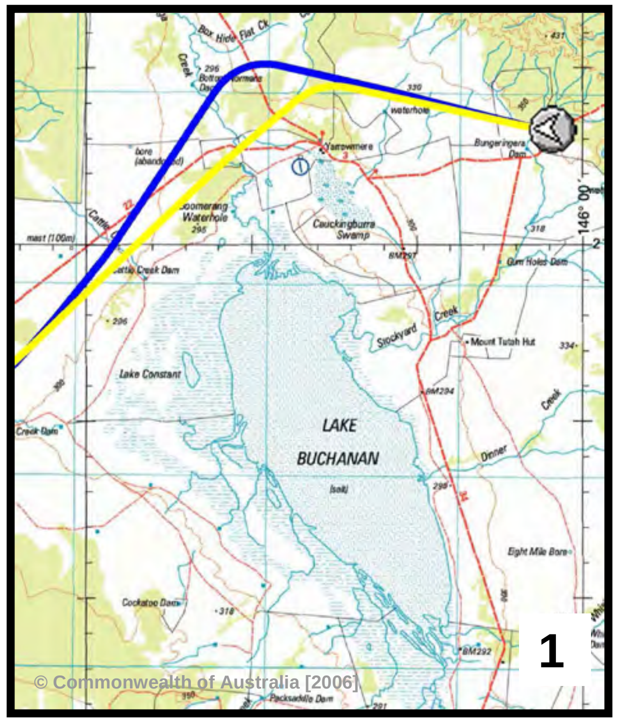
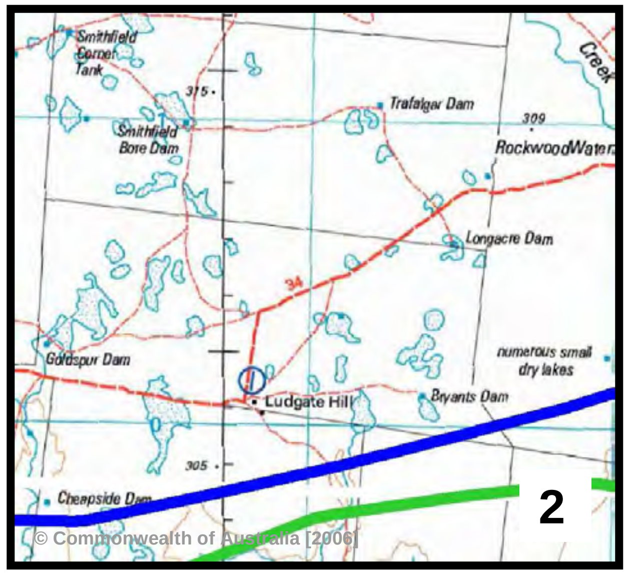
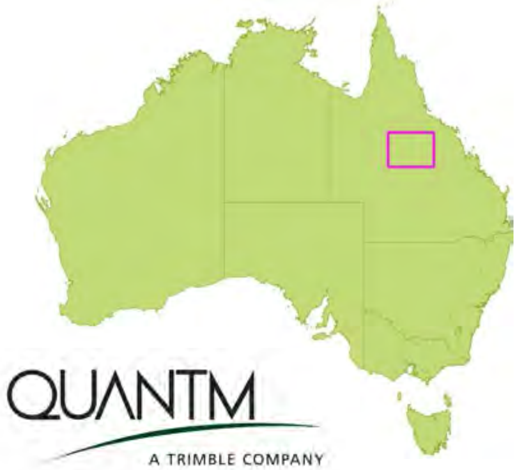



*Lake Buchanan*




*Numerous small dry lakes*



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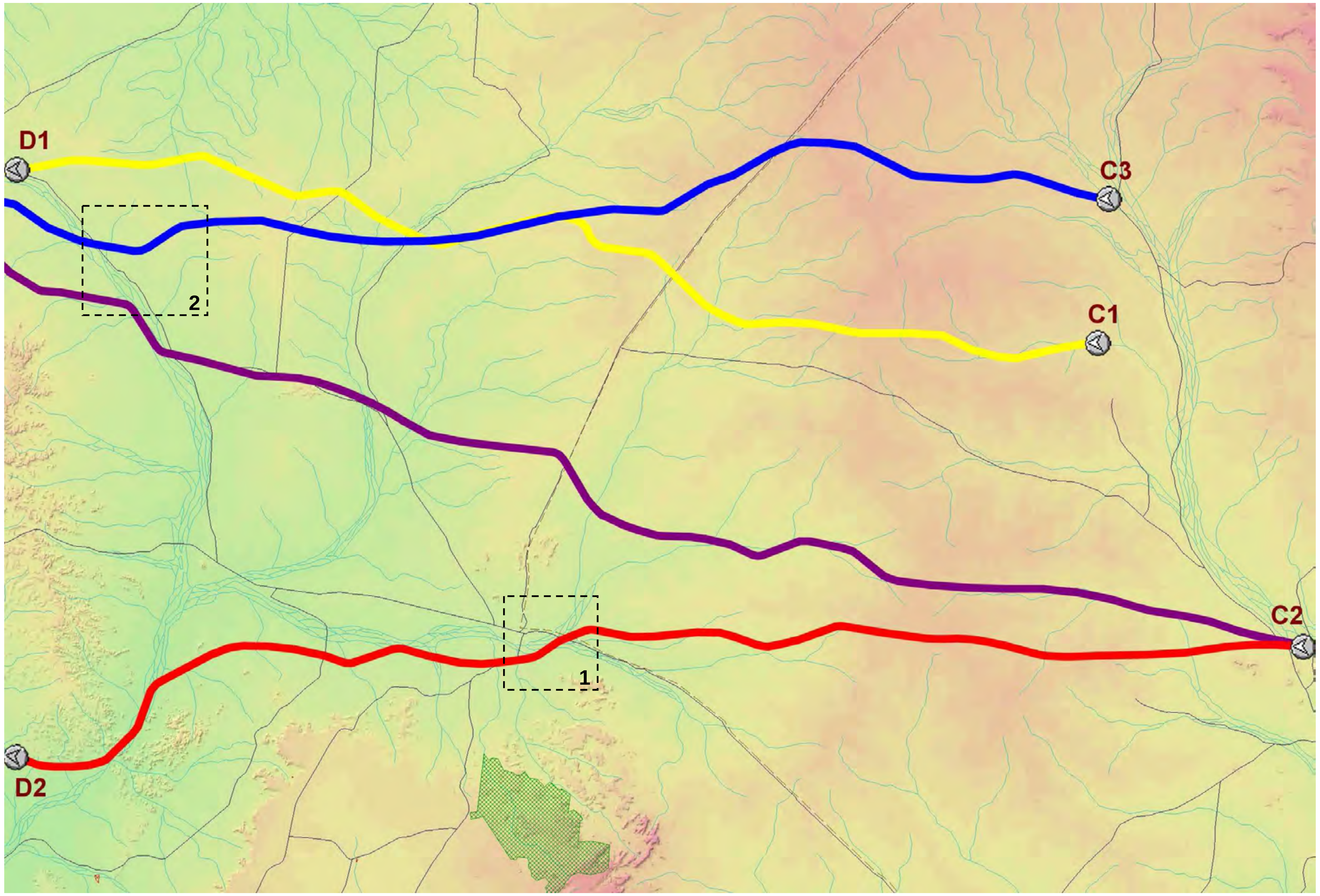
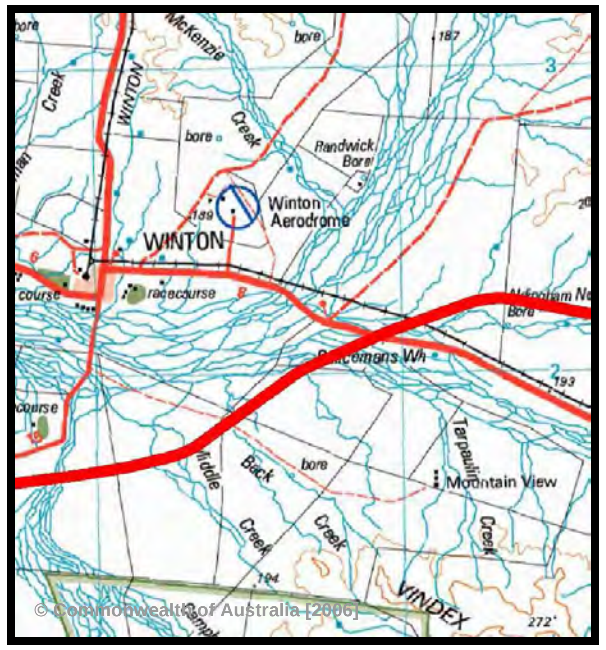
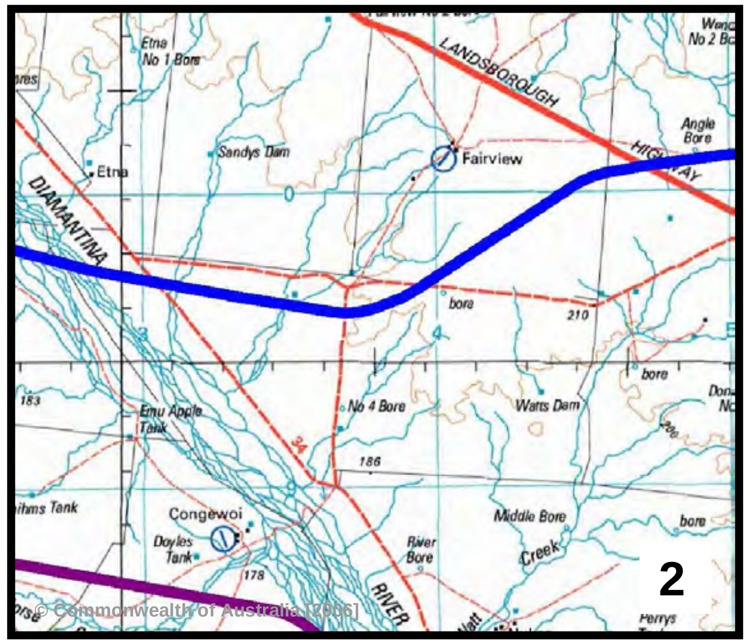



*Winton Township*




*Diamantina River*

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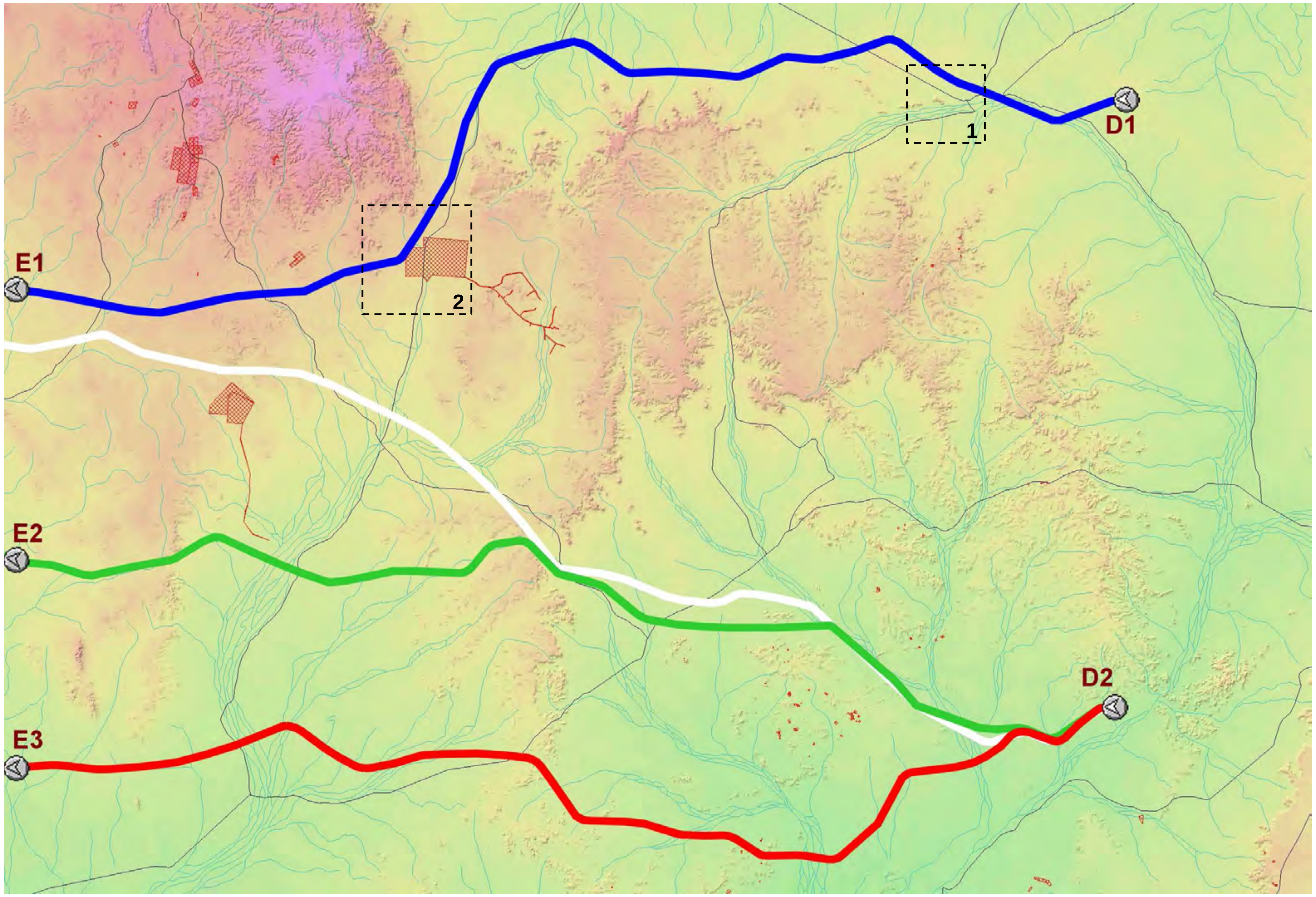
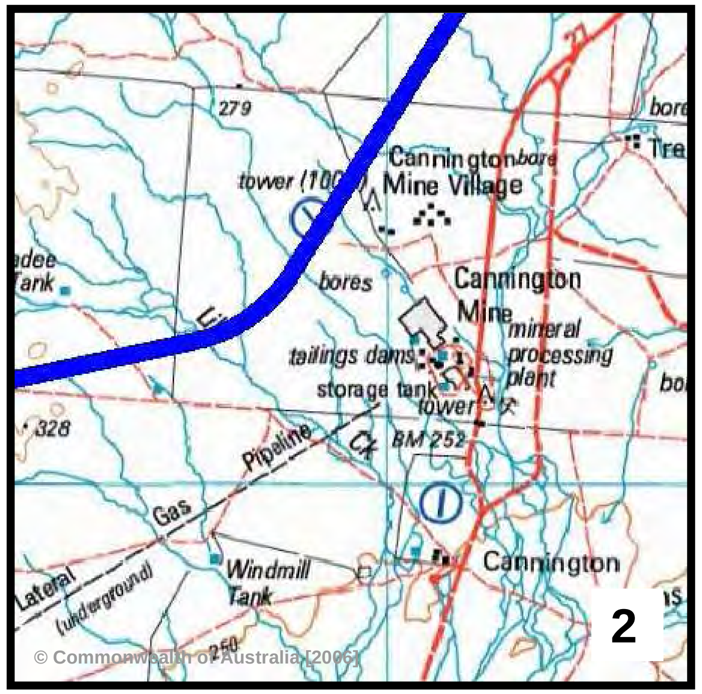




*Kynuna Township*




*Cannington Mine*

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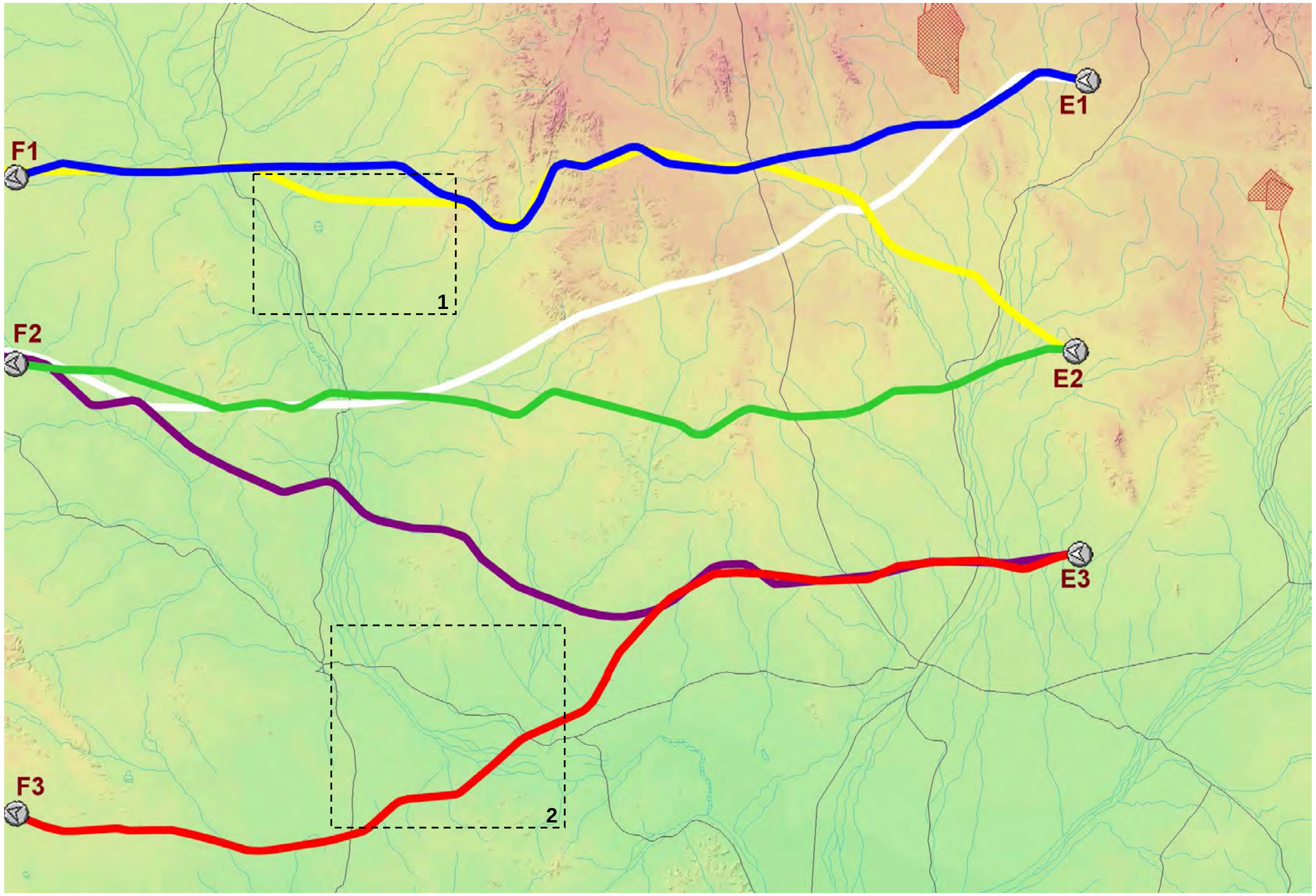
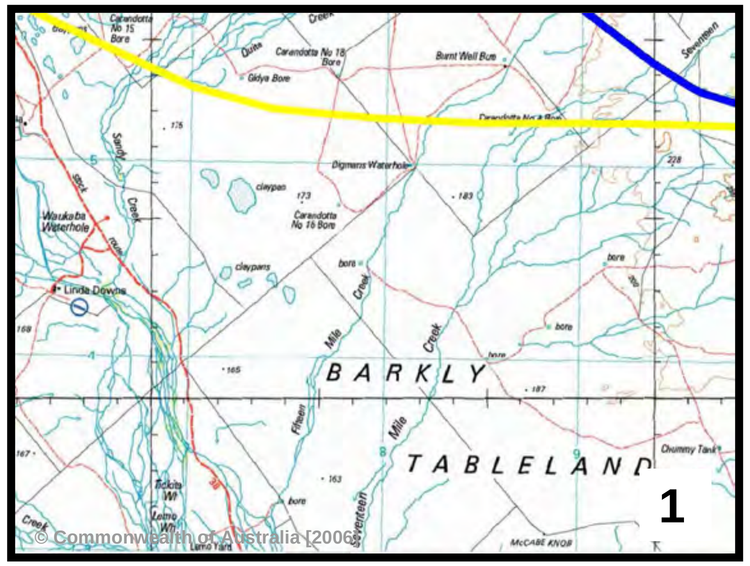
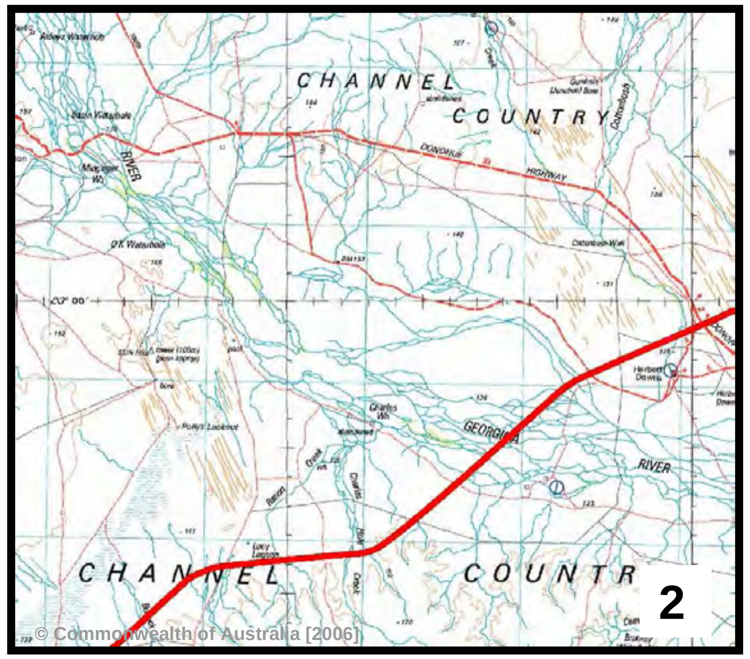
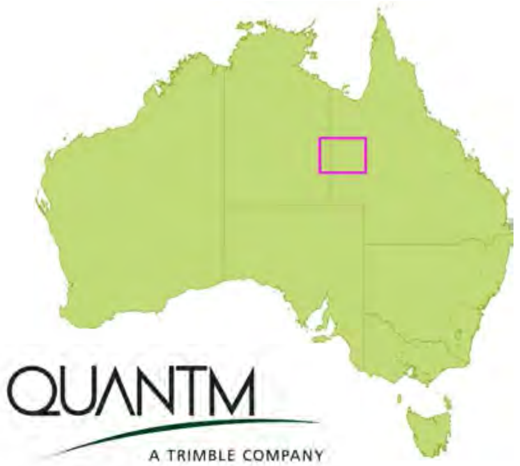



*Barkly Tableland*




*Channel Country*



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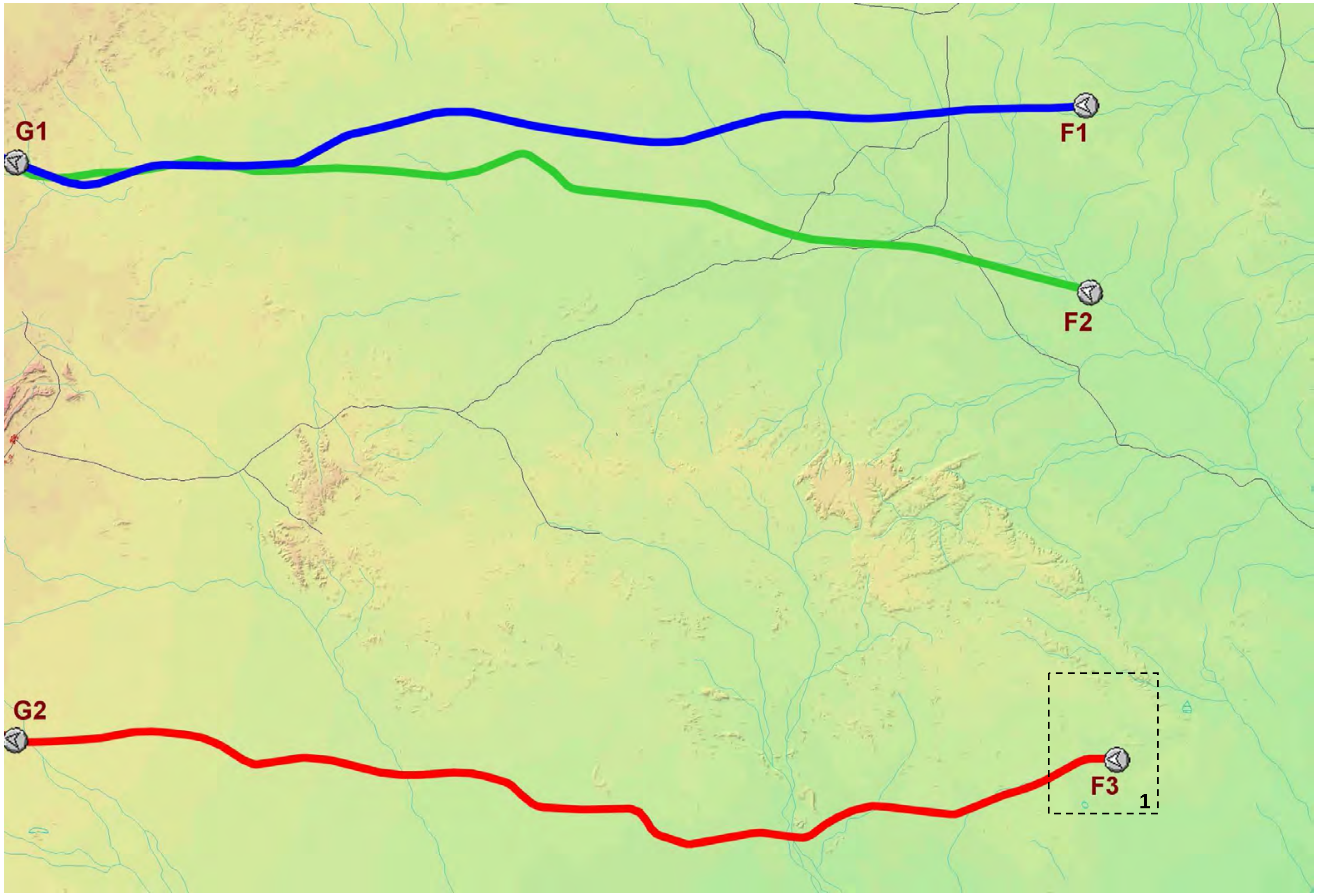


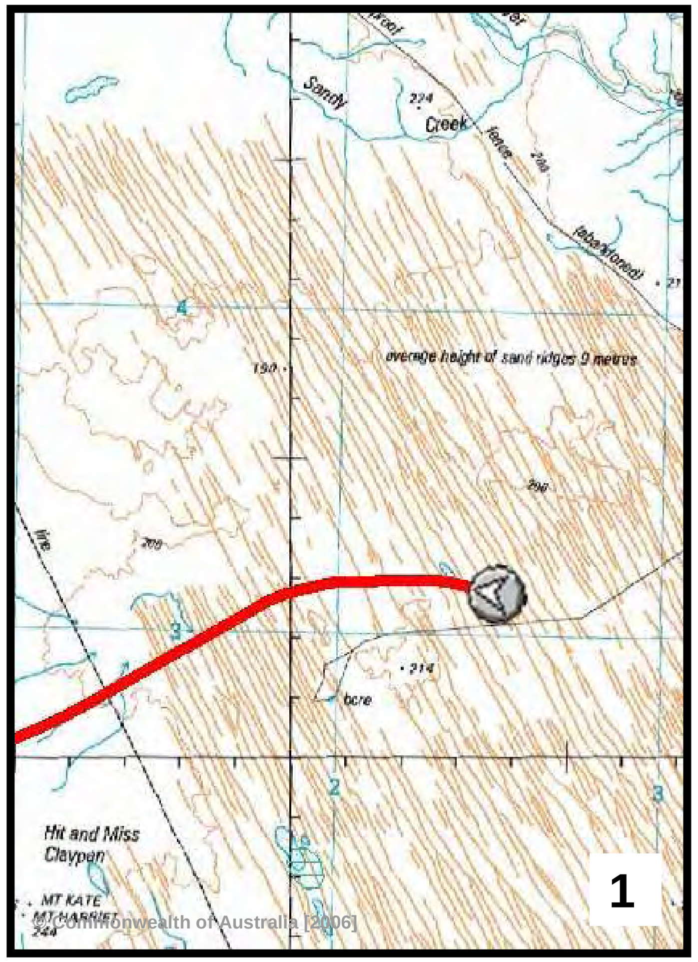


*Simpson Desert*

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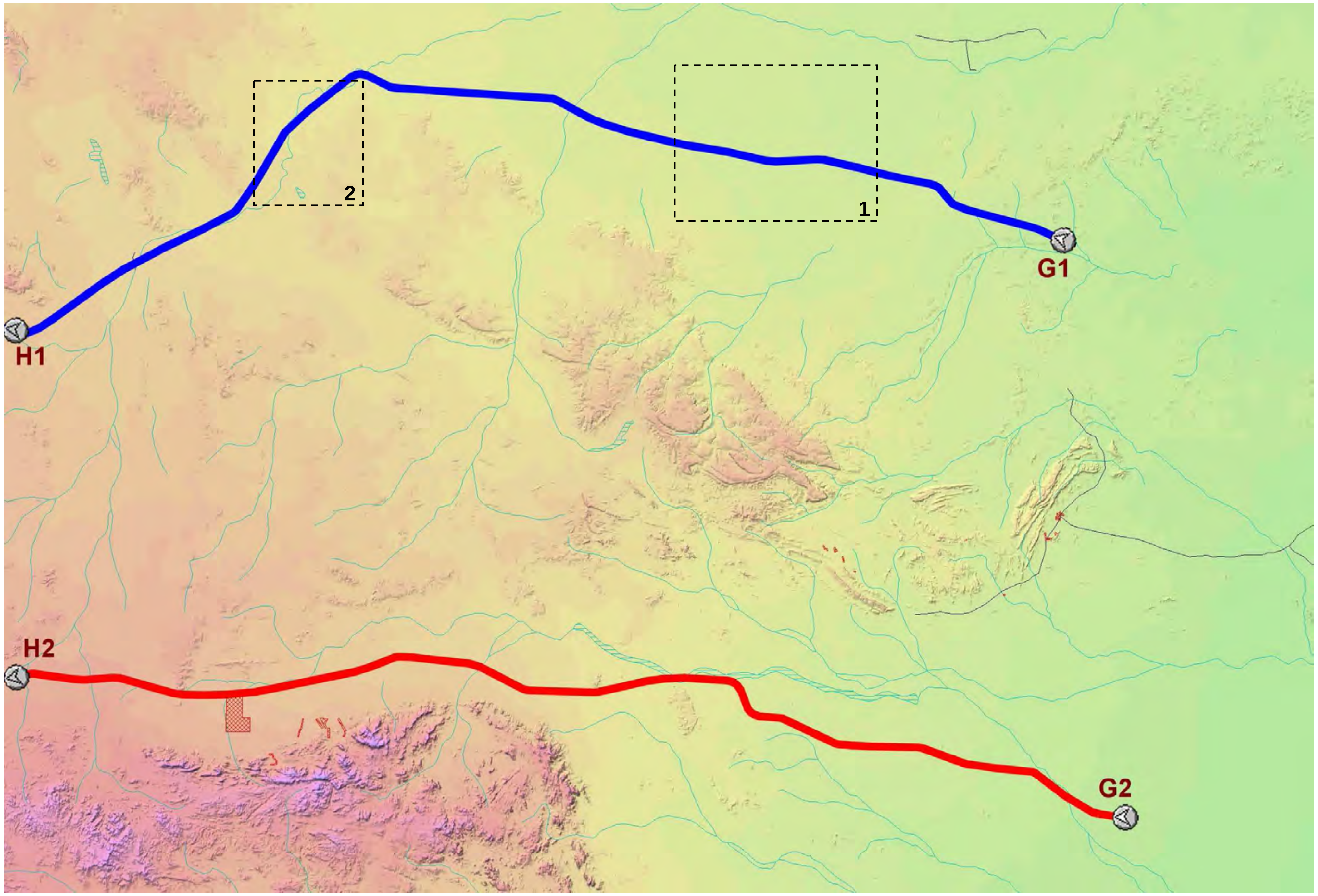
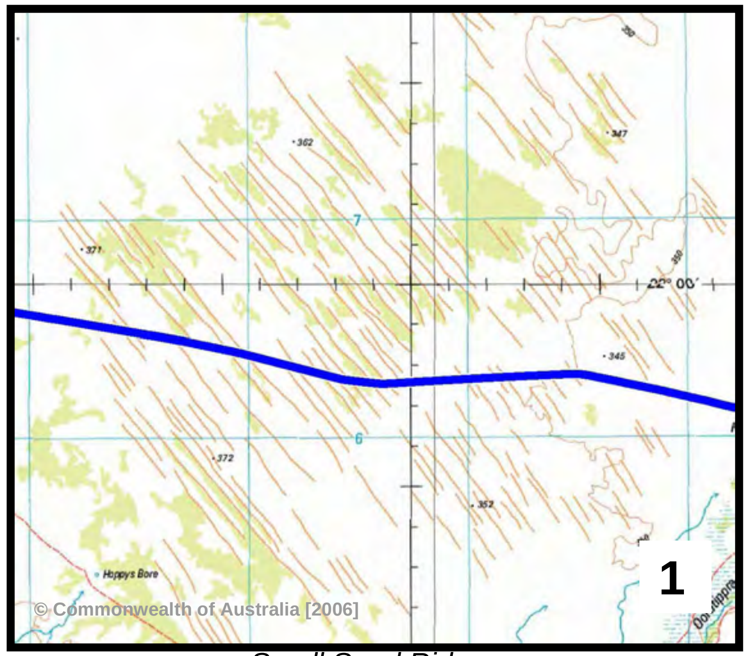
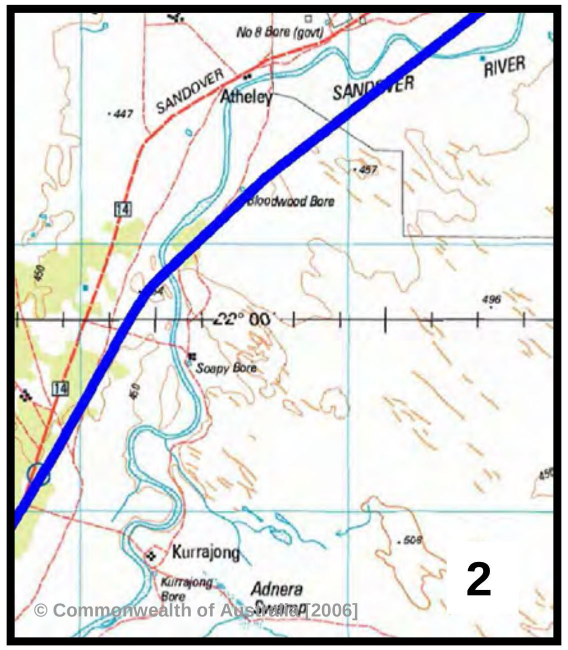
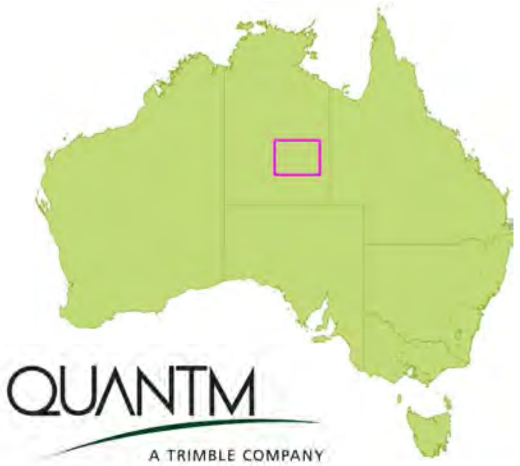



*Small Sand Ridges*




*Sandover River*



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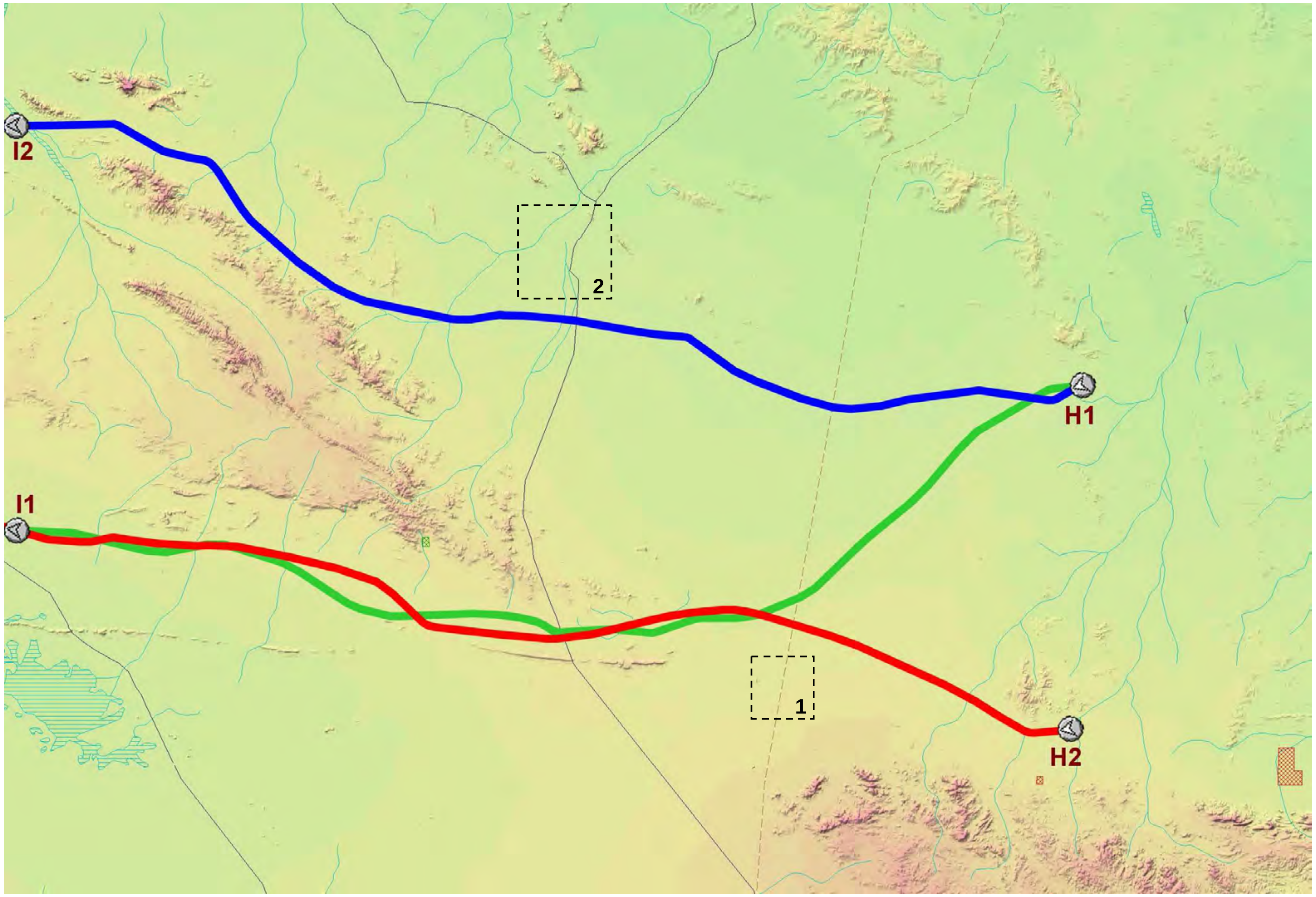
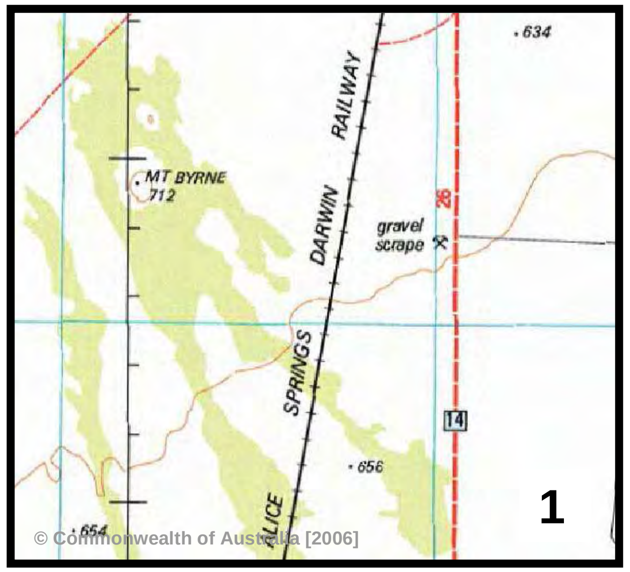
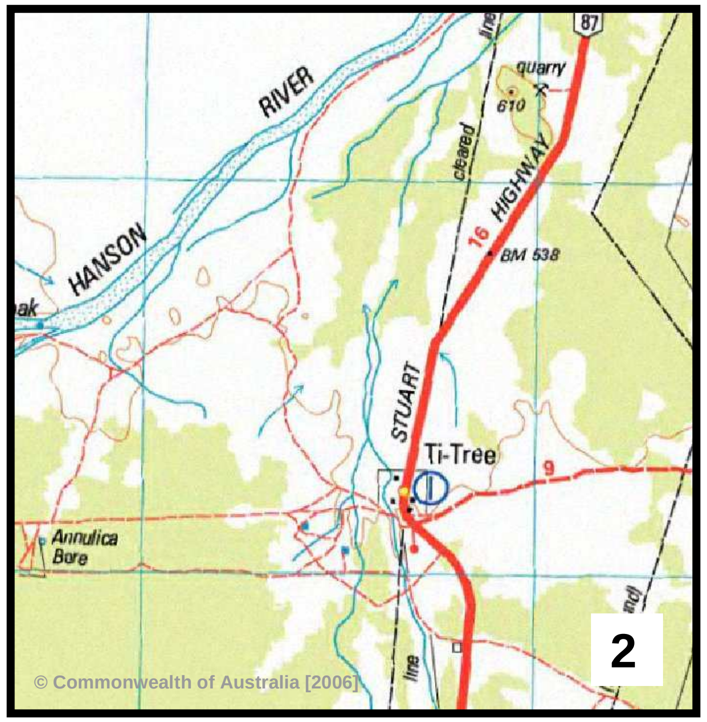
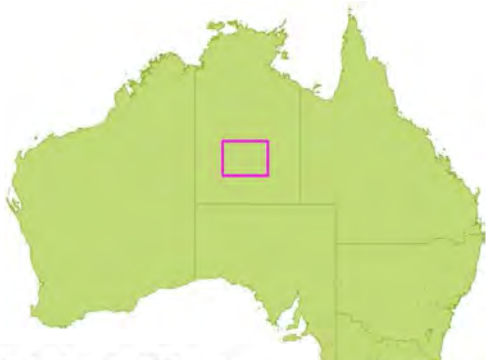



*The Ghan*




*Ti-Tree Township*



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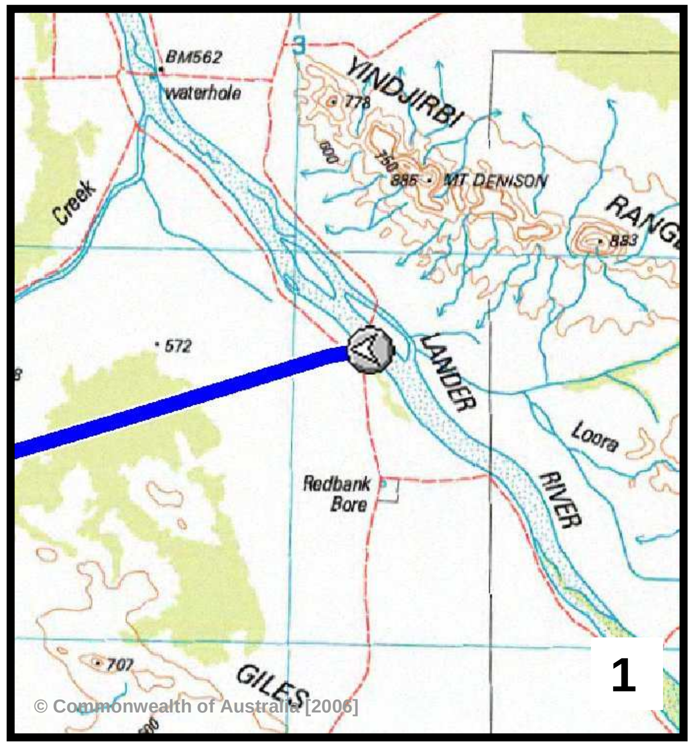
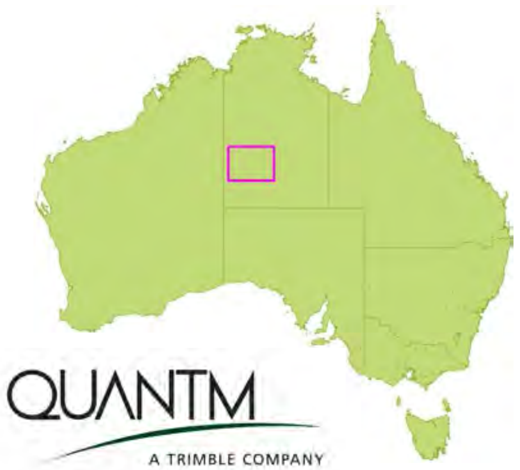



*Lander River*



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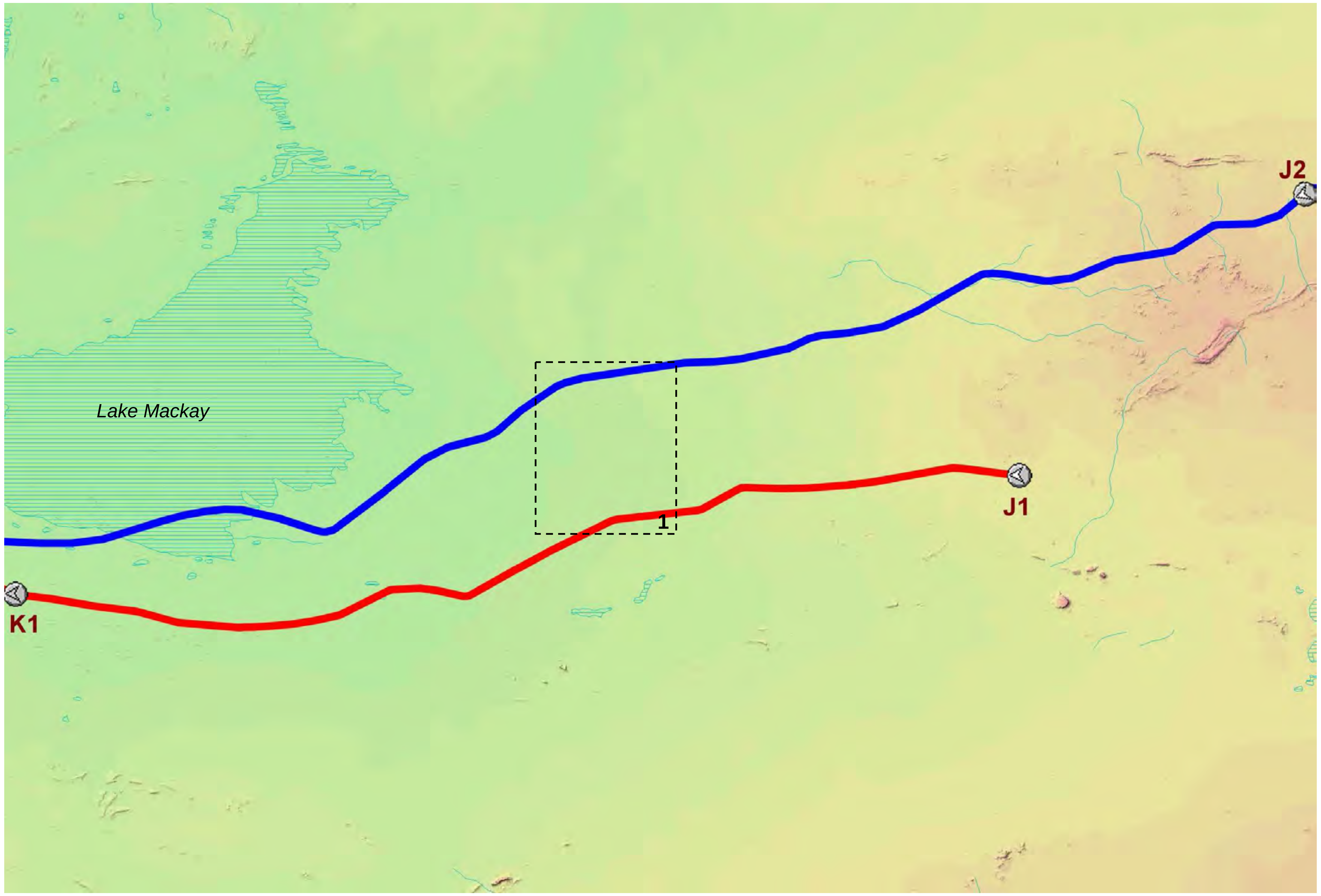


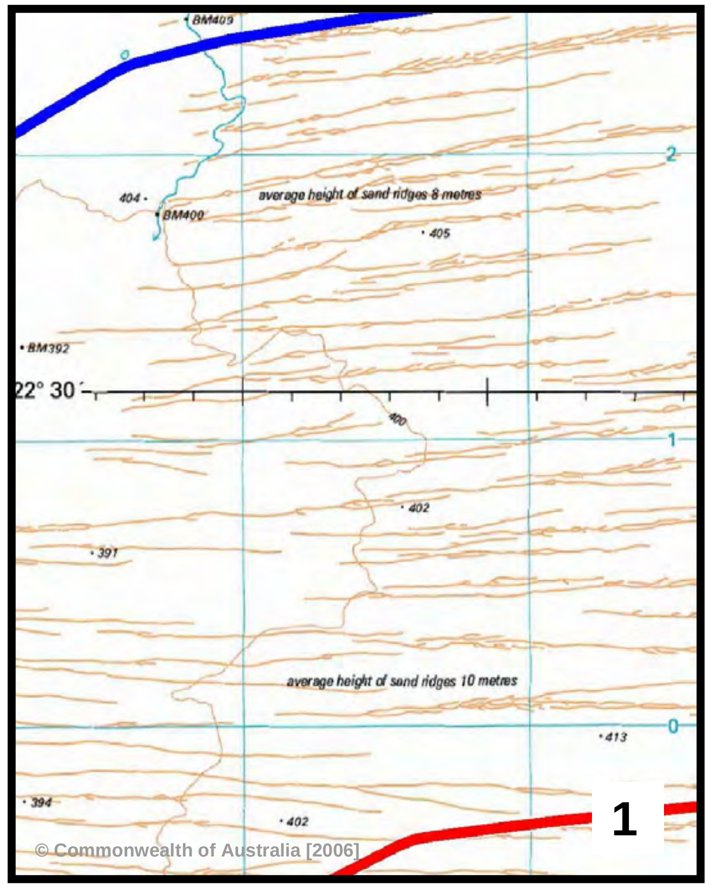


Sand Ridges

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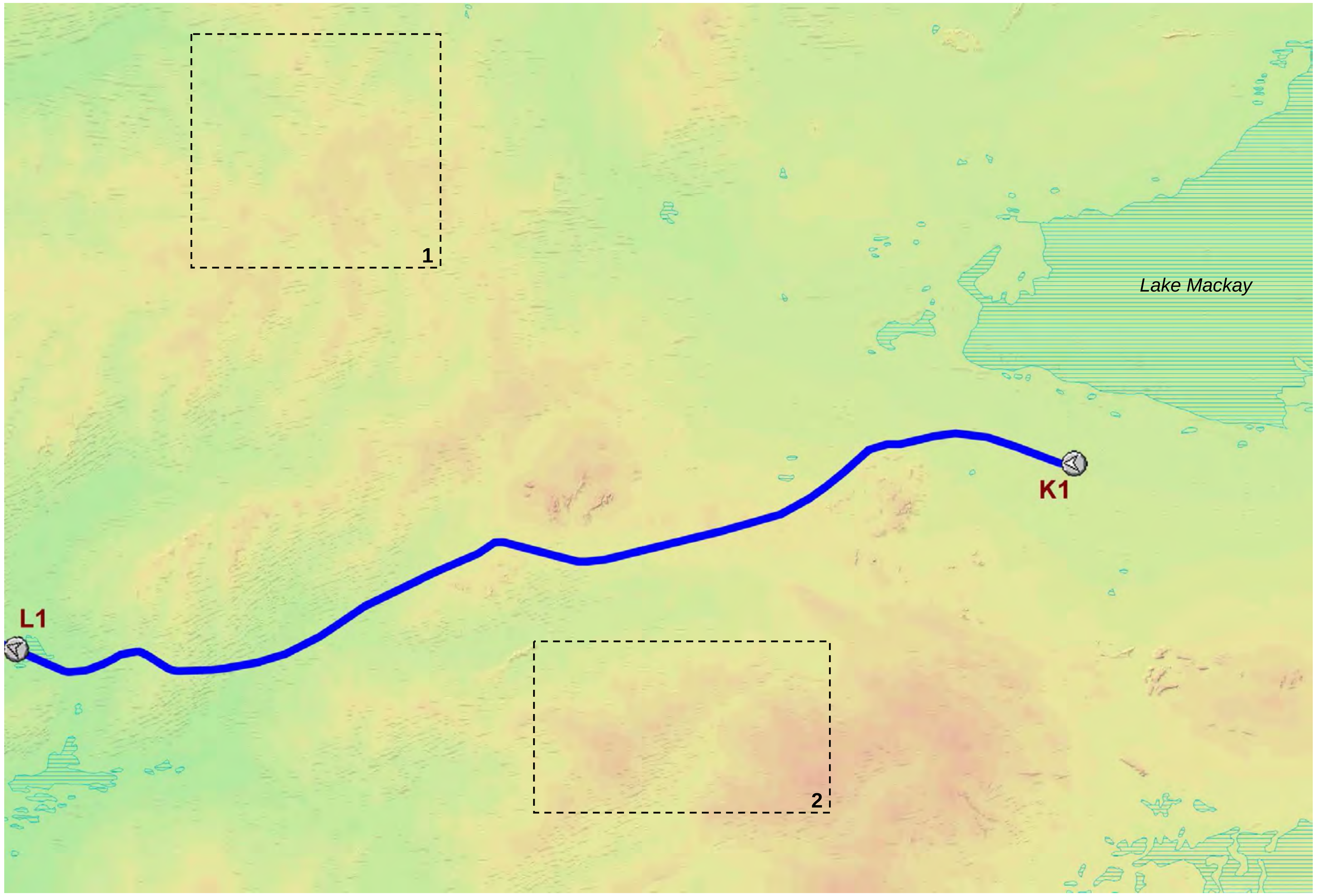
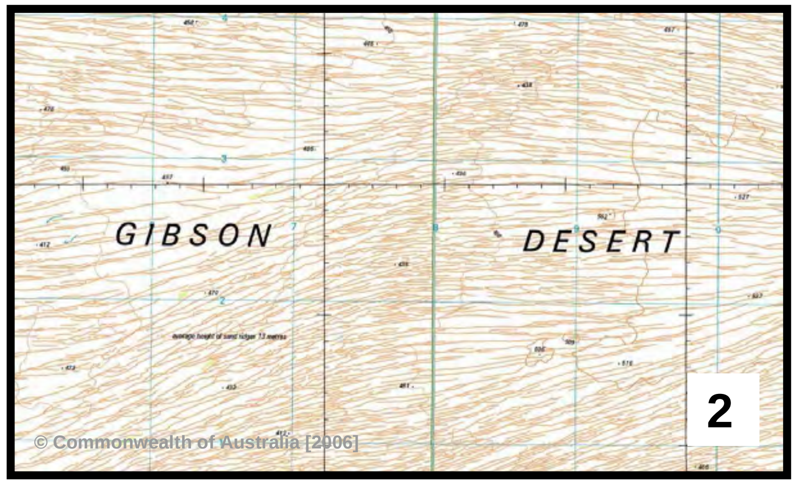




Great Sandy Desert




Gibson Desert

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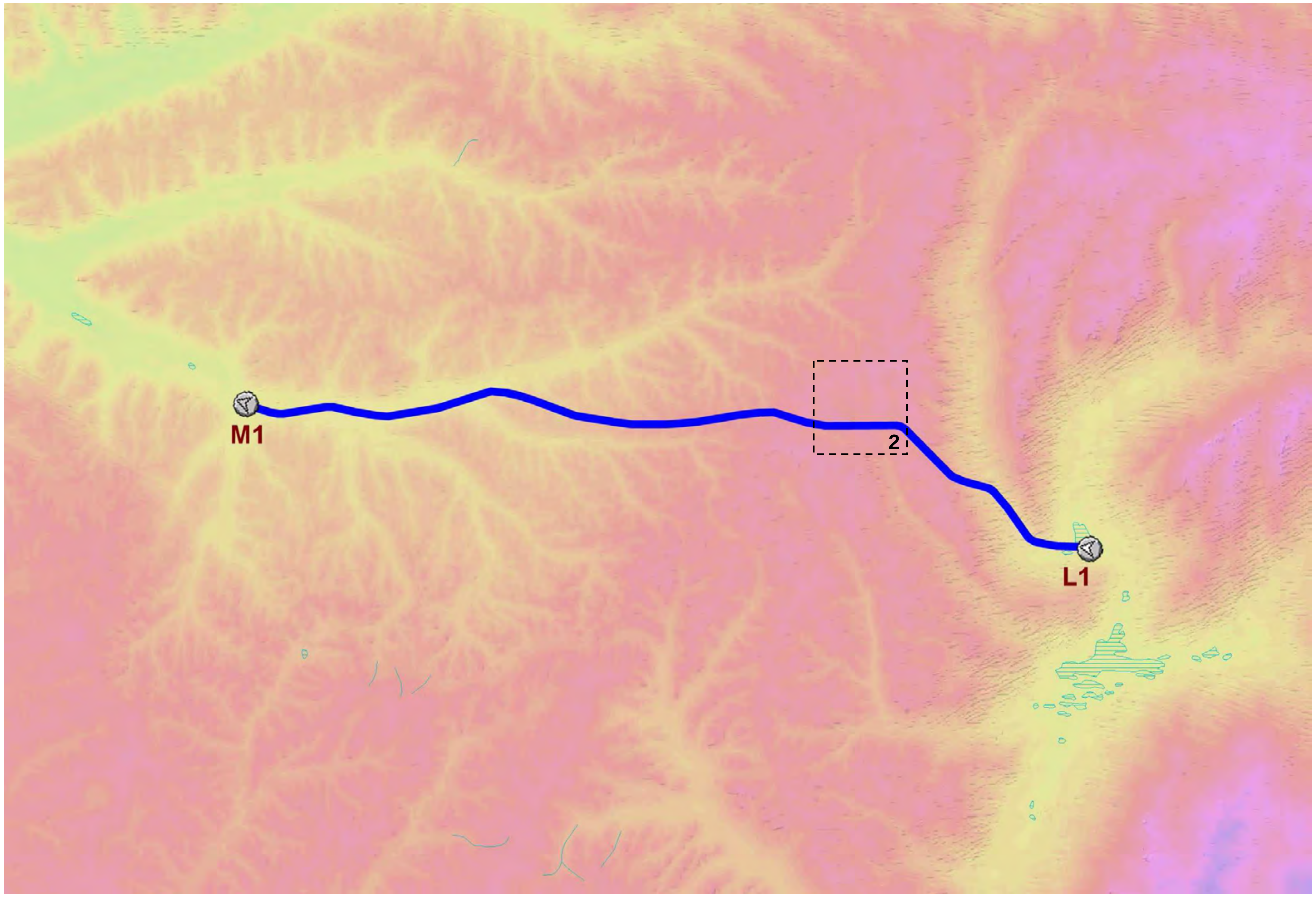


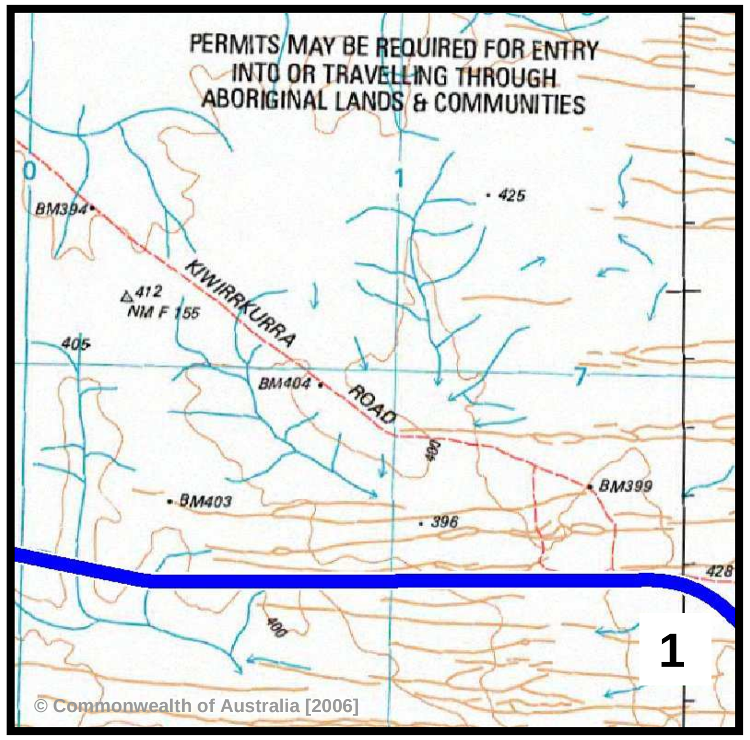


*Kiwirrkurra Road*

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Date 5/2/2007
Scale: NTS
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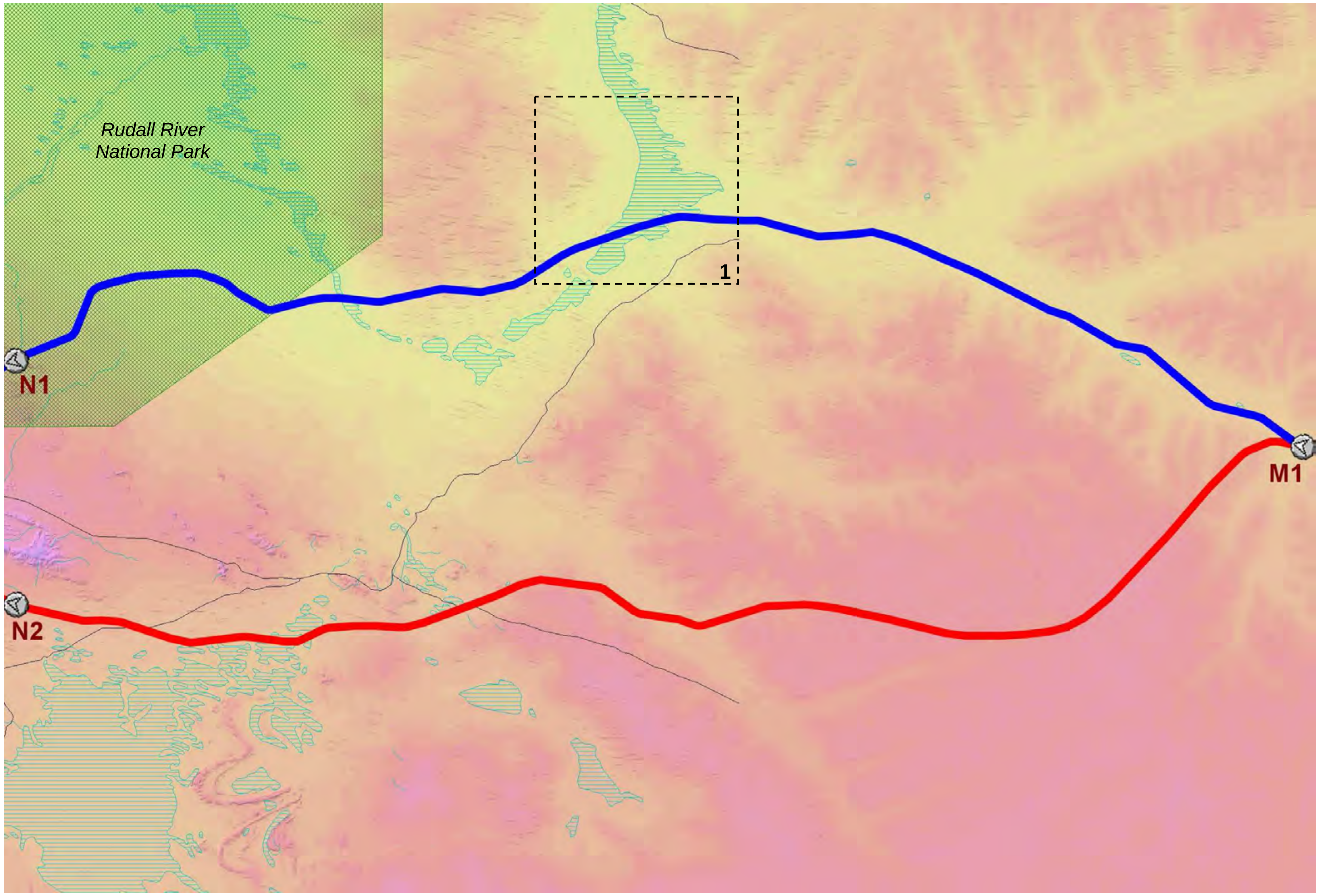
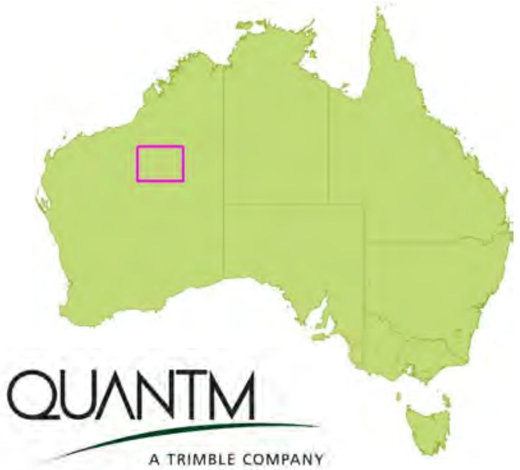




Lake Auld



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Scale: NTS
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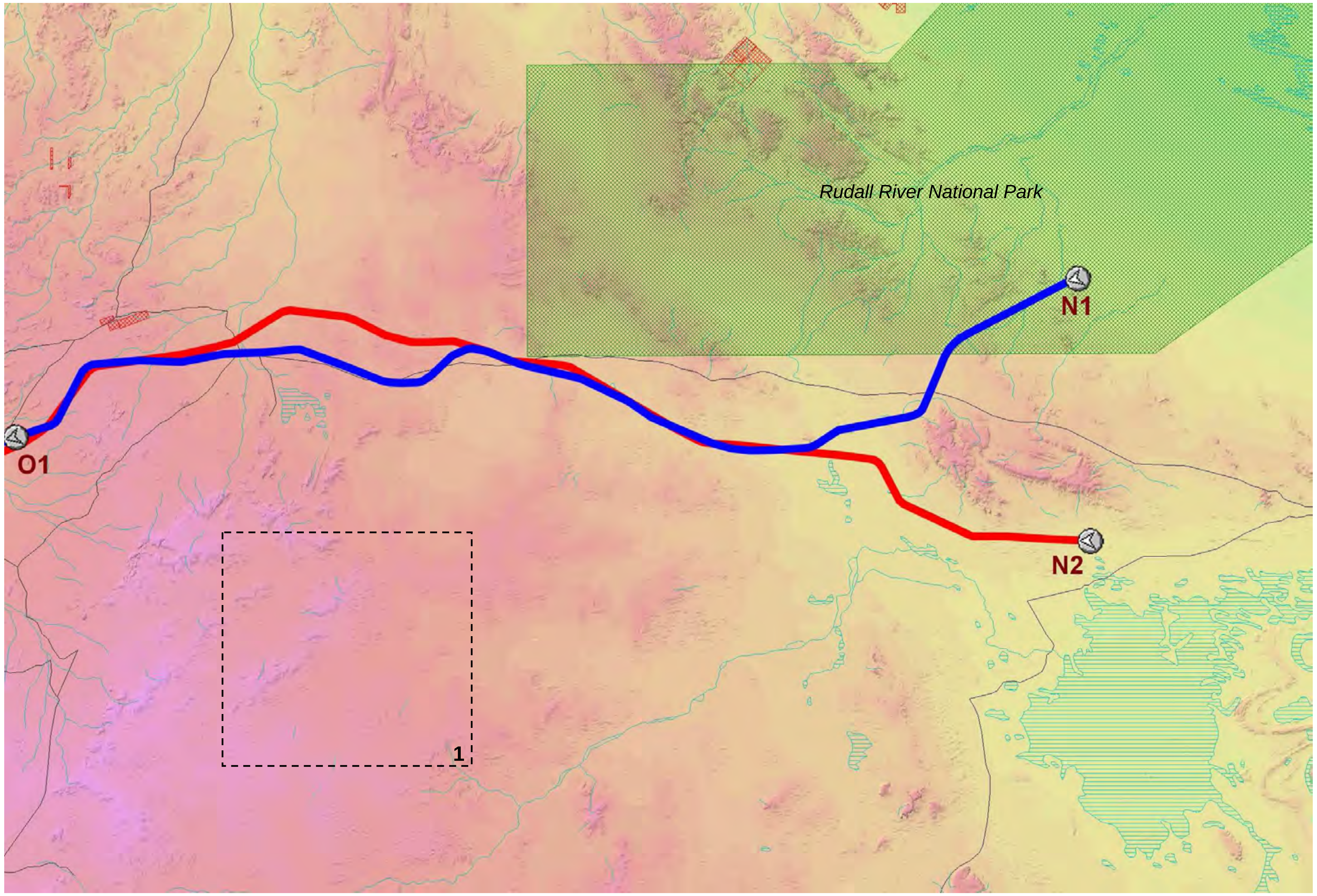


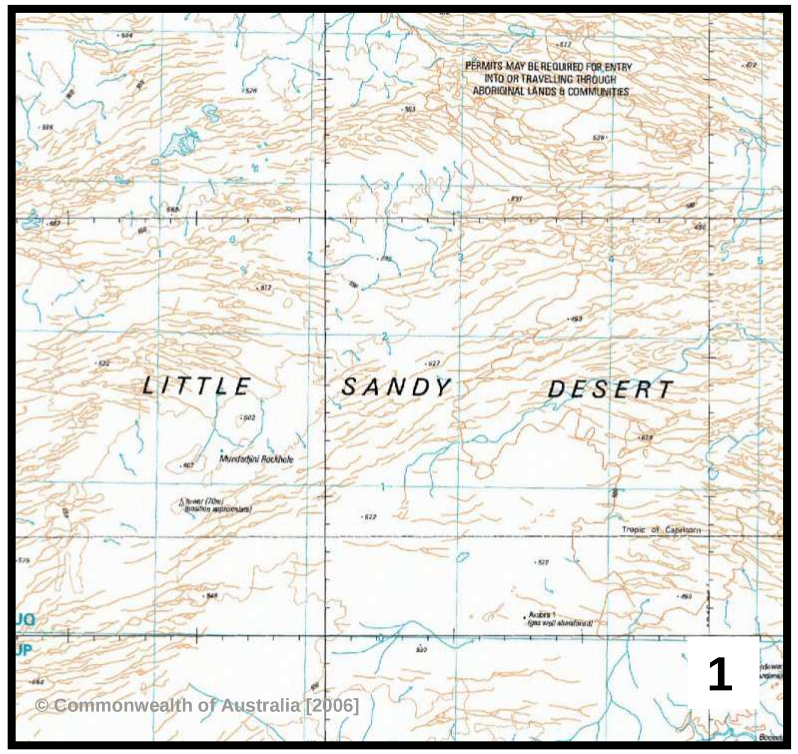


*Little Sandy Desert*

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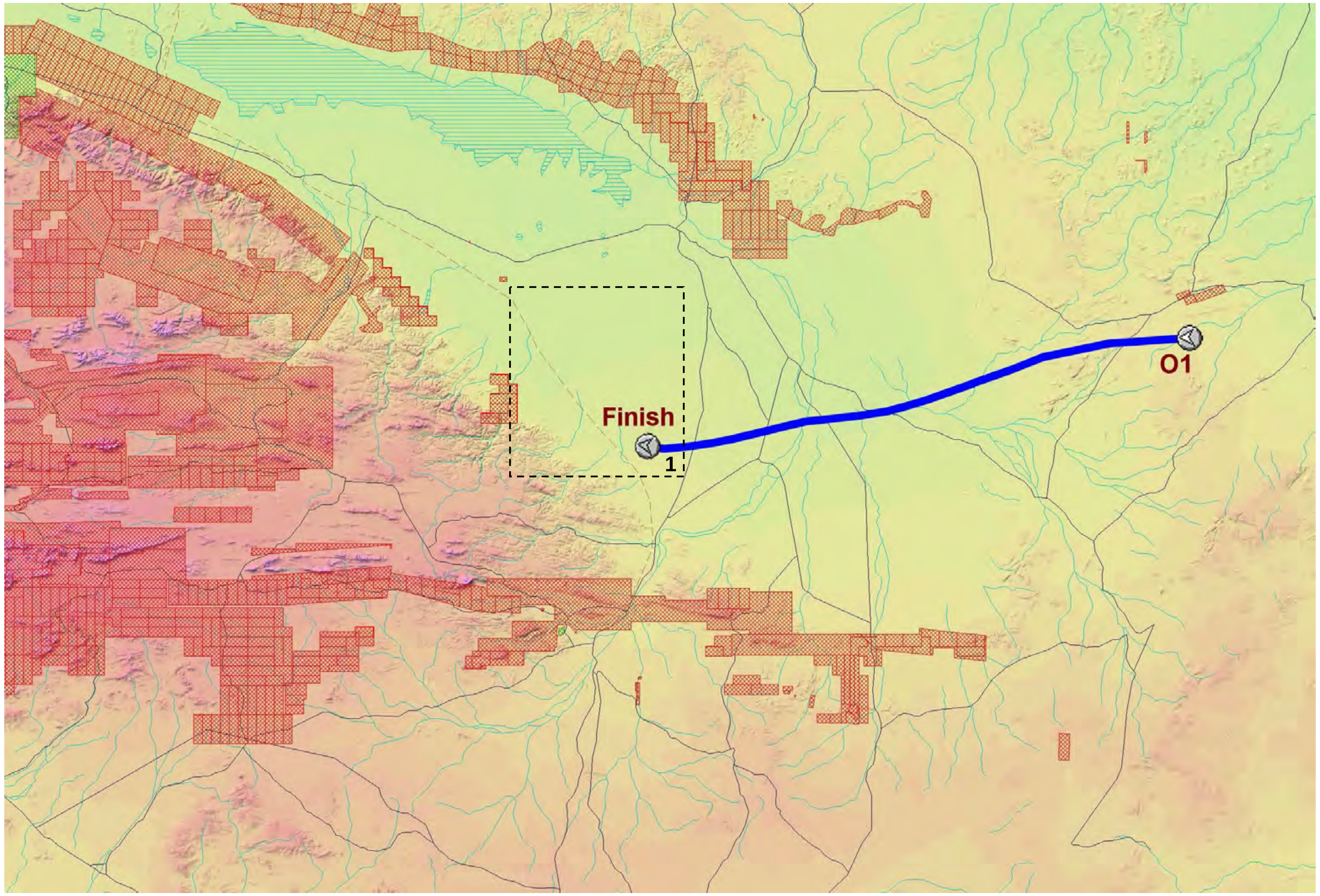
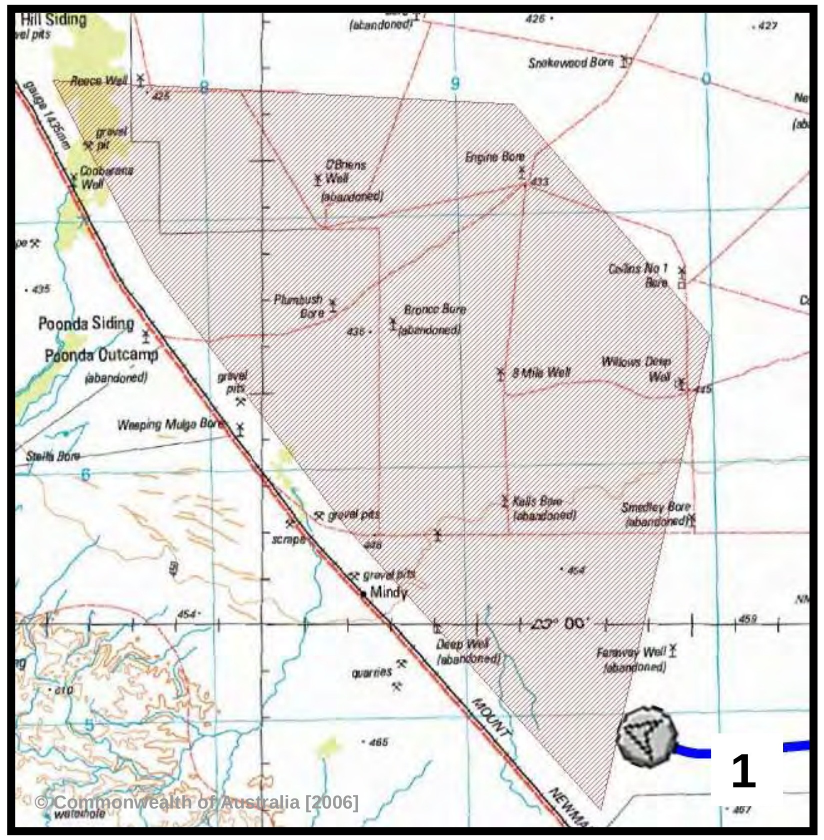
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Section N**




*Proposed location of Newman Smelter Park*

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PROJECT IRON BOOMERANG
east west line parks pty ltd

**East West Line Parks Pty Ltd**
**Project Iron Boomerang:**
Rail Corridor Identification Pre-feasibility Study

Date 5/2/2007
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Section O**

# 9.0 TYPICAL ALIGNMENT CHARACTERISTICS

## 9.1 Preferred Corridor

During the session held between Quantm and EWLP on the 23/01/2007, the results and outcomes for each corridor section were presented to the team. This revealed that a comprehensive search of the terrain model had already identified a number of favourable corridors. Alternatives were individually reviewed and critiqued within the Quantm software. Strategic construction cost comparisons were made on each, while their localised impact on macro scale environmental and land-use constraints were investigated by viewing the options super-imposed over topological maps. This led to the selection of the northern corridor route being preferred over others, mainly due to it meeting more of the project requirements and criteria for an early stage rail corridor route. The alignments shown in blue in the sectional drawings represent the EWLP preferred corridor (*refer to Section 8.3*).

The northern route was chosen for the following reasons:

- Exhibited minimal impacts on river systems, national parks, townships and existing mining leases. Those that were impacted could be easily constrained and avoided in further more detailed studies.

- More suitable site for the railway crew change, maintenance and refuelling depots along the route, in the vicinity of existing settlements (for example near Ti Tree in the Northern Territory and Kynuna in NW Queensland).

- Achieved the economic objective of minimising construction costs, with the 3120 km route having an approximate total raw construction cost of $3.3 billion AUD.

- In comparison to some of the other corridor options, the preferred route exhibited less intrusion across the sensitive deserts of Western Australia.

- Preferred route commenced immediately east of the Riverside Mine and finished near Poonda Siding on the Mt Newman rail system, within the proposed smelter park precinct. The EWL will utilise the existing Queensland Rail corridor from near the Riverside initiation point to access Abbot Point (via the Newlands Railway and the approved Northern Missing Link from North Goonyella to Newlands). This section was not evaluated by the Quantm model as it follows the existing rail corridor.

- Showed compatibility with the engineering requirements of heavy haul rail, such as maximum gradient and minimum horizontal and vertical curvature. At this early stage the key geometric requirement from an operational viewpoint is maintaining a 1:200 gradient (0.5%) in both directions. The Quantm generated route achieved this, with the majority of the route being under 0.2% grade.

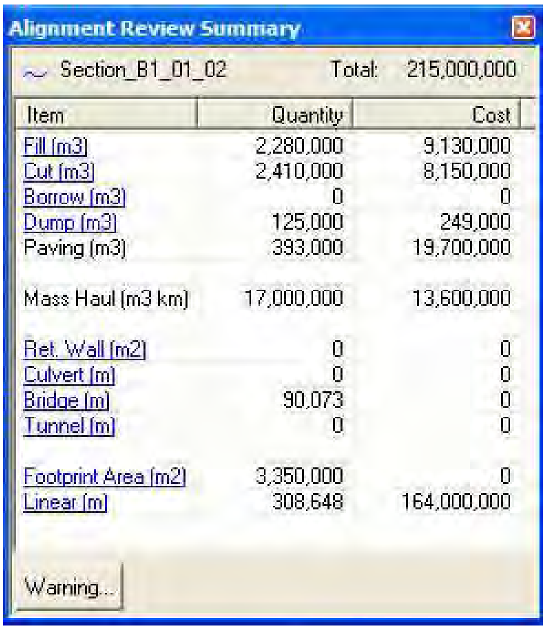
*(Table 9.a) Break down of Gradient for Preferred Northern Route.*

| Category | Grade (%)* | Distance (km) |
|---|---|---|
| I | 0.500 to 0.201 | 480 |
| II | 0.200 to 0.051 | 885 |
| III | 0.050 to -0.050 | 520 |
| IV | -0.051 to -0.200 | 720 |
| V | -0.201 to -0.500 | 500 |
| | Total | **3120** |

## 9.2 Civil works raw cost summary & reports

The Quantm system provides a much improved ability to analyse corridors and alternatives. To investigate rail corridors at a more detailed scale the Alignment Review Summary was used as a cost estimation tool to review the breakdown of construction quantities and costs. A number of consistent observations along the route where noted:

- Cut and Fill quantities provided a close balance within most sections.
- Mass Haul was not extensive in the context of the total comparative construction cost, indicating the system had minimised where possible excess cut and deficits of fill.
- There were very few, if any structures (bridge, tunnel and retaining wall) generated along the route, however this will change significantly when the impact of flooding is considered.
- Typically 70%-75% of construction cost was attributed to the linear cost which is the rail, sleepers and ballast. Due to this high cost penalty, the system tended to straighten out alignments where possible to minimise the route distance, which is also a desirable outcome for trip duration, crew shift considerations and fuel consumption.



Alignment Review Summary

Section_B1_01_02 Total: 215,000,000

| Item | Quantity | Cost |
|---|---|---|
| Fill (m3) | 2,280,000 | 9,130,000 |
| Cut (m3) | 2,410,000 | 8,150,000 |
| Borrow (m3) | 0 | 0 |
| Dump (m3) | 125,000 | 249,000 |
| Paving (m3) | 393,000 | 19,700,000 |
| Mass Haul (m3 km) | 17,000,000 | 13,600,000 |
| Ret. Wall (m2) | 0 | 0 |
| Culvert (m) | 0 | 0 |
| Bridge (m) | 90,073 | 0 |
| Tunnel (m) | 0 | 0 |
| Footprint Area (m2) | 3,350,000 | 0 |
| Linear (m) | 308,648 | 164,000,000 |

Warning...

*(Fig 9. a) Alignment Review Summary Window.*

In addition to the summary window, the system also has comprehensive reporting capabilities detailing location, geometrics, quantities and costs within user-defined intervals. In this study these were used to analyse the gradient along the route. The reporting functionality was also used to create a seamless composite route of the northern preferred corridor from each of the individual corridor sections.

Quantm Alignment Customised Report
Date: 02/07/07 17:55:50

Project: East-West Coal Line
Project ID: 941
Scenario: Section_B1_01
Alignment: Section_B1_01_02

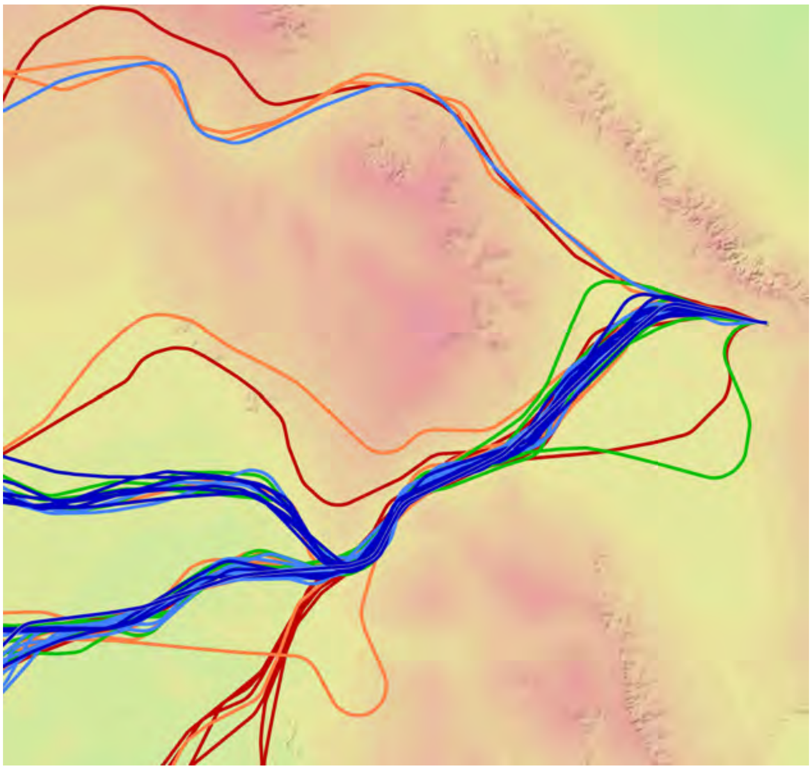
| | | | | | | | | | | Local quantities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dist 2D (m) | Dist 3D (m) | X (m) | Y (m) | R.E. (m) | Land (m) | R.E-Land (m) | Bearing (degrees | Grade (%) | H Radius (m) | V Radius (m) | Fill (m3) | Cut (m3) | Pavement (m3) | Mass Haul (m3 km) | Area (m2) | Wall (m2) | Culvert (m) | Bridge (m) |
| 0 | 0 | 4232560 | 6754646 | 352.2 | 344.115 | 8.085 | 275 | -0.31 | -14365 | 581889 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 100 | 100 | 4232460 | 6754655 | 351.8984 | 344.075 | 7.824 | 275.3 | -0.297 | -14365 | 581889 | 15649 | 0 | 180 | 6820 | 3606 | 0 | 0 | 0 |
| 200 | 200 | 4232361 | 6754665 | 351.614 | 344.196 | 7.418 | 275.7 | -0.28 | -14365 | 581889 | 14518 | 0 | 180 | 8303 | 3477 | 0 | 0 | 0 |
| 300 | 300 | 4232261 | 6754675 | 351.3467 | 344.391 | 6.956 | 276.1 | -0.263 | -14365 | 581889 | 12954 | 0 | 180 | 9639 | 3292 | 0 | 0 | 0 |
| 400 | 400 | 4232162 | 6754686 | 351.0967 | 344.41 | 6.687 | 276.5 | -0.246 | -14365 | 581889 | 11813 | 0 | 180 | 10844 | 3152 | 0 | 0 | 0 |
| 500 | 500 | 4232063 | 6754698 | 350.8638 | 343.684 | 7.18 | 276.9 | -0.229 | -14365 | 581889 | 11915 | 0 | 180 | 12018 | 3169 | 0 | 0 | 0 |
| 600 | 600 | 4231963 | 6754711 | 350.6481 | 343.883 | 6.765 | 277.3 | -0.211 | -14365 | 581889 | 12525 | 0 | 180 | 13274 | 3241 | 0 | 0 | 0 |
| 700 | 700 | 4231864 | 6754724 | 350.4472 | 343.707 | 6.741 | 278 | -0.198 | -6624 | 837706 | 11583 | 0 | 180 | 14447 | 3124 | 0 | 0 | 0 |
| 800 | 800 | 4231765 | 6754739 | 350.2583 | 343.625 | 6.633 | 278.9 | -0.186 | -6624 | 837706 | 11623 | 0 | 180 | 15610 | 3128 | 0 | 0 | 0 |
| 900 | 900 | 4231667 | 6754756 | 350.0813 | 344.6 | 5.481 | 279.7 | -0.174 | -6624 | 837706 | 9659 | 0 | 180 | 16644 | 2864 | 0 | 0 | 0 |
| 1000 | 1000 | 4231568 | 6754774 | 349.9163 | 345.35 | 4.566 | 280.6 | -0.162 | -6624 | 837706 | 6444 | 0 | 180 | 17362 | 2387 | 0 | 0 | 0 |

*(Fig 9. b) Alignment Report generated at 100m intervals.*

## 9.3 Alignment sections: Plan, profile and cross sections

The Quantm system has an extensive reviewing capability that allows the operator to display the optimised rail alignment in plan, profile and dynamically in cross section. In this macro-level study these were predominantly used to identify low cost areas of the terrain and other patterns of alignments which can reveal much about potential corridors and the need to stick to certain locations and the freedom to deviate.

For example the figure below shows the rail alternatives clumping into two distinct corridors as they pass through the Great Dividing Range in Queensland. This strongly suggests that, from this particular start point, there are only two narrow passes available to negotiate the range at reasonable costs, however west of this there is more scope to deviate.

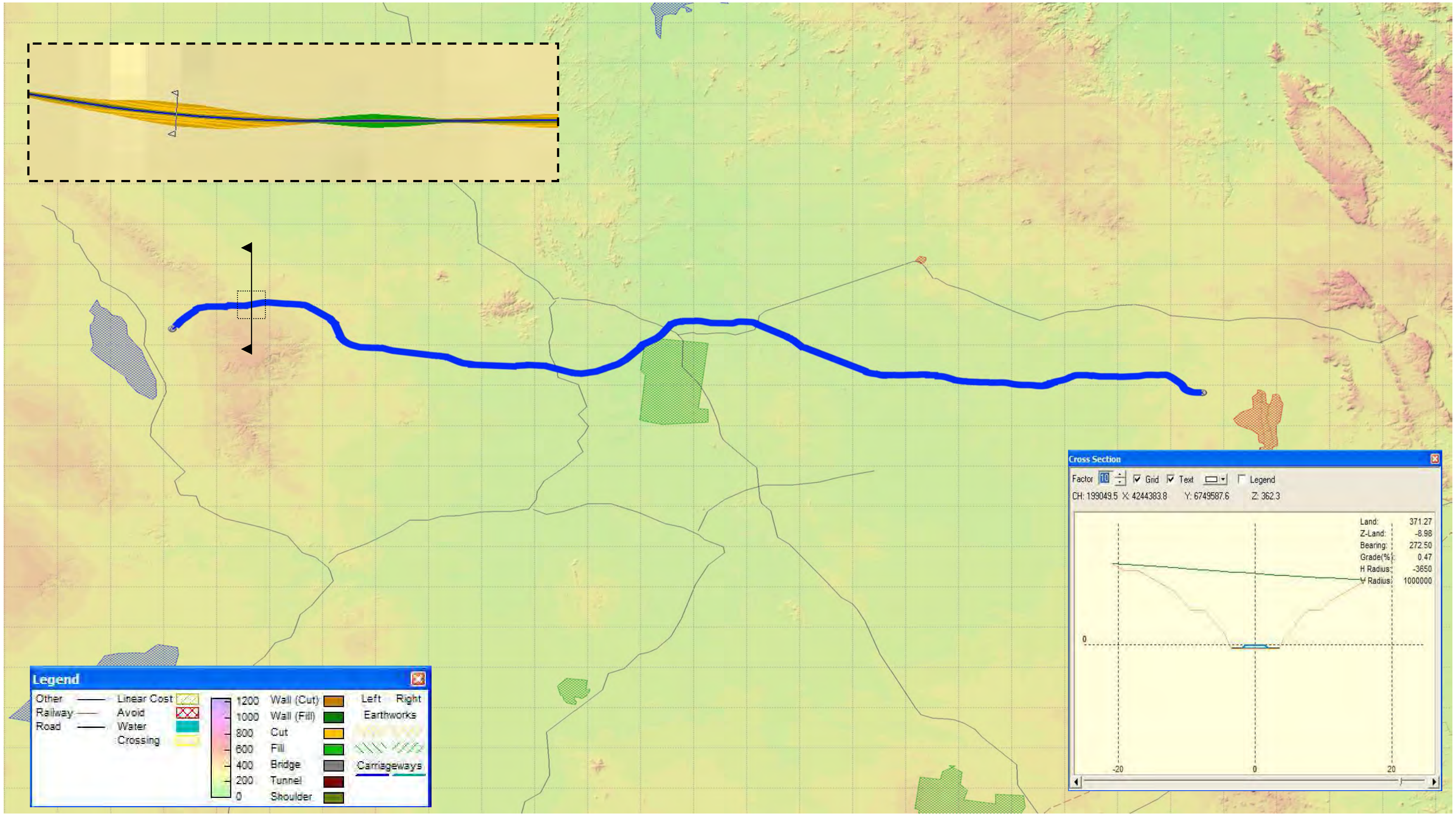


*(Fig 9. c) Two corridors traversing different valleys in Section B.*

In general rail routes converging into a narrow corridor indicates its importance in containing costs, whereas where routes fan out (such as across the deserts areas in Western Australia) indicates that cost is not an important driver in the alignment in plan and therefore provides more flexibility to satisfy other criteria with minimal impacts to costs.

Rail corridor cross sections were studied along the route using the Dynamic Cross Section tool. This allowed the altitude of the centreline to be viewed in relation to the natural surface and provided values of bearing, gradient, radius and horizontal curvature at any chainage along the route. During this study this information was mainly used to gain insight into where rail alternatives were approaching the maximum gradient when traversing difficult terrain, or tight corridor where the minimum radius was being approached.

Mass haul diagrams can also be generated within the Quantm System for each rail alternative showing the magnitude and direction of mass haul. This allows the rail engineer to gain insight into the dispersion of material throughout the alignment and determine where the balance points are.  Figure 10.c shows a typically mass haul diagram generated from an alignment representing the northern corridor in section B. This could be used in future work to identify areas of surplus material or deficit of fill and therefore be used to designate areas for borrow and dump pits.




*(Fig 10.d) Section A of the northern preferred corridor showing alignment in plan and dynamically in cross section.*

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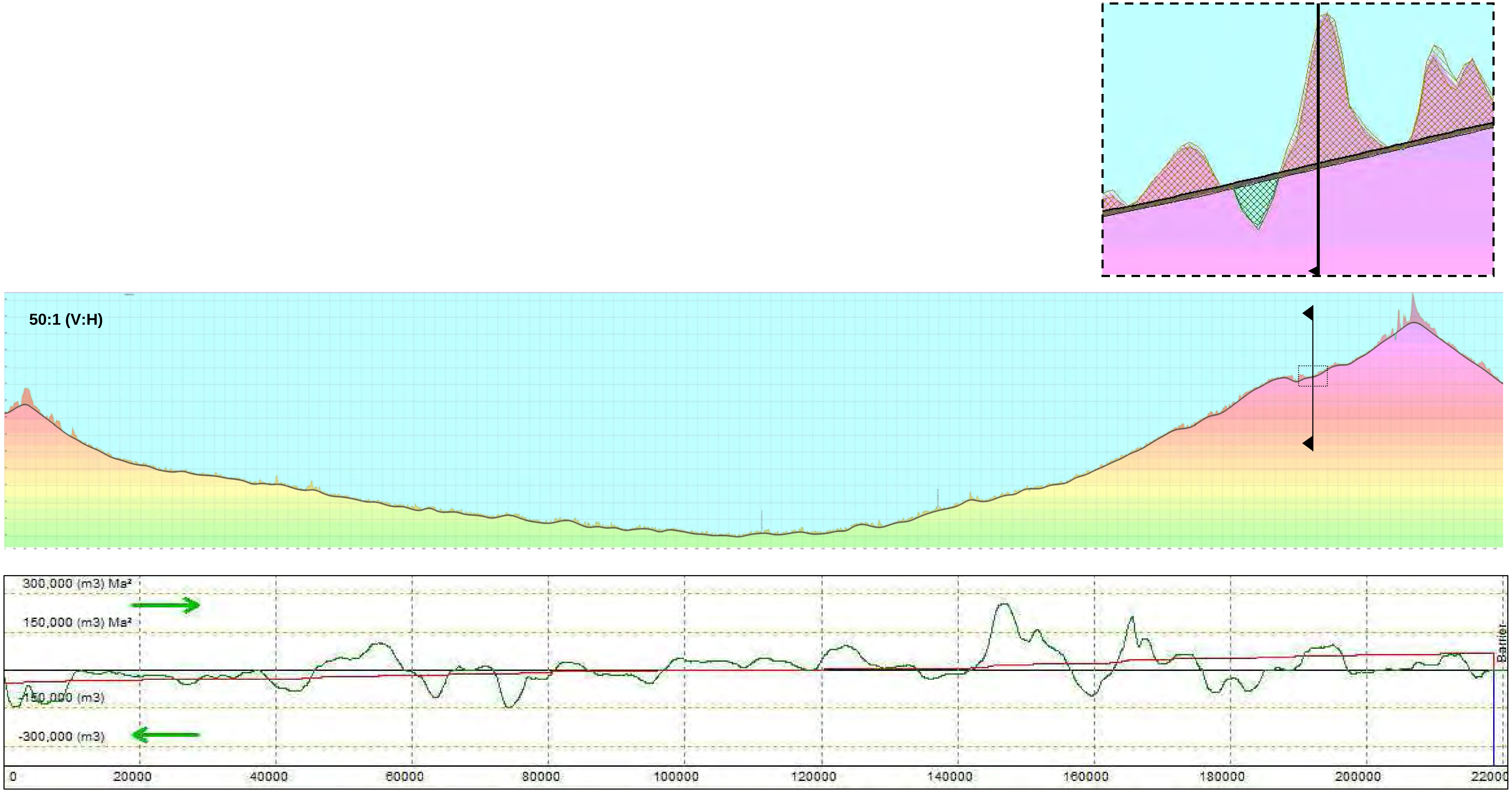
**Project Iron Boomerang:**
Rail Corridor Identification Pre-feasibility Study

Date 5/2/2007
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Plan**




*(Fig 10.e) Section B of the northern preferred corridor showing alignment in profile and mass haul movement underneath*

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**Project Iron Boomerang:**
Rail Corridor Identification Pre-feasibility Study

Date 5/2/2007
Scale: NTS
**Drawing No PIB-RCI-01 Rev 0 – Profile**

# 10.0 Conclusion

## 10.1 General Conclusions

The Quantm system has been used to demonstrate the engineering feasibility of the PIB rail project and had identified key to environmental, geological, mining and land-use constraints. The PIB provides for 3,120km of heavy standard gauge railway from Moranbah in Queensland to near Newman in Western Australia, at a maximum grade of 1:200 and a design speed of 80 km/hr.

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Monday, 10 March 2008

Report to:

PROJECT IRON BOOMERANG
east west line parks pty ltd

# Pre-Feasibility Evaluation and Strategic Comment – Energy

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| **Author:** | John G. O'Brien |
| **Project Manager:** | John G. O'Brien |
| **Name of Document:** | Pre-feasibility report. |
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# Executive Summary

Hill Michael has offered its services to East West Line Parks Pty Ltd in support of Project Iron Boomerang (PIB) to undertake an initial pre-feasibility investigation into the energy requirements, associated infrastructure and strategic considerations of energy inputs and outputs.

This report has been prepared based on Hill Michael's knowledge of the energy industry in Australia and the energy infrastructure in each region.

The aim of the report is to provide validation of the fundamental feasibility and natural advantages of the PIB proposal. The report does not provide recommendations on the optimum energy configuration, or other detailed solutions, but does provide investigative support to the PIB concept, and illustrate the feasibility and high conceptual value of the project.

The energy equation for the PIB development is driven by the relative availability of coal for coking and thermal purposes in Queensland and the availability of gas in Western Australia (WA).

The relatively small size of the connected demand for electricity in WA, and the large market available from the National Electricity Market (NEM) in Queensland encourages the development of coking plant and heat recovery generation in Queensland rather than WA.

The sale of electricity in WA is likely to yield a higher price. The larger sales in Queensland will require intelligent selling arrangements to manage the price and volume risks associated with the national market pool and the relatively short term contracts market.

The cost of electricity network infrastructure required to connect the quantity of electricity likely to be produced will be significantly less in Queensland because of the close proximity of the smelter park to a major transmission network node at Strathmore. In WA, the economics of displacing relatively small quantities of isolated load will determine the quantity of electricity that can be sold into that market.

This study concludes that the coking plants, based on capability to dispatch electricity generated, should be considered for Queensland and the blast furnaces should be shared between Queensland and WA. This will result in some imbalance in the material flows between WA and Queensland and therefore the overall PIB system will require optimisation.

Electrical Infrastructure and demand for electricity is unlikely to be a constraint in Queensland for export and sale of electricity. The detailed economics of connecting isolated electrical loads will be important to establish the optimum energy balance in WA.

## Table of Contents

# 1 Introduction

Hill Michael has offered its services to East West Line Parks Pty Ltd in support of Project Iron Boomerang (PIB) to undertake an initial pre-feasibility investigation into the energy requirements, associated infrastructure and strategic considerations of energy inputs and outputs.

This report has been prepared based on Hill Michael's knowledge of the energy industry in Australia as well as the energy infrastructure in each region. The aim of the report is to provide validation of the fundamental feasibility and natural advantages of the PIB proposal. The report will not provide recommendation on the optimum energy configuration, or other detailed solutions, but will provide investigative support to the PIB concept, and illustrate the feasibility and conceptual value of the project.

Hill Michael is a specialist electrical networks consulting business, focused on developing strategies to manage the connection of large-load and generation projects to the electricity supply network. Hill Michael also has considerable expertise in energy market and fuel sectors and provides strategic advice for the feasibility evaluation of generation and heavy industry projects.

# 2 Scope

The overall Scope of this report is to undertake high-level evaluation as a Stage 1 review of the energy requirements, balance (inputs and outputs) and infrastructure investment requirements. This investigation will provide a basis for commenting on the core energy issues and characteristics of PIB.

More specifically, the Scope will include:

- A summary of the energy balance (inputs and outputs) for the key energy-related components.
- Comment on the energy infrastructure requirements.
- Initial design and development of a fundamental structure for a whole-of-project energy model to enable detailed energy and financial modelling (this does not involve actual development of this model at this stage).
- Comment on the key energy procurement requirements.
- Comment on the key energy sale opportunities and relevant markets.
- Suggested progression options and proposed 'next steps'.
- Comment on regulatory implications for the energy procurement and sale from PIB.

It should be noted that at present a number of plant configuration and geographical options are being considered for PIB; as such this investigation has not focused on any single solution or attempted to identify optimum solutions. The Scope of this report is focused on providing validation of the fundamental energy-related feasibility of the PIB concept for reference by the project team, investors and other stakeholders.

# 3 Pre-Feasibility Analysis & Outcomes

## 3.1 General

Hill Michael has focused investigation of the feasibility of PIB based on 3 core energy drivers:

1. Energy Inputs (All types of fuel/inputs).
2. Energy Outputs (Primarily energy which must be dispersed).
3. Infrastructure Requirements.

For each of these drivers, critical technical commercial and regulatory issues have been considered.

While variation in Capital Costs (CAPEX), energy efficiency, regulatory approvals and environmental approvals is inevitable and dependant on various project configuration options, Hill Michael find no energy-related fatal flaws in the PIB concept. There are many energy benefits and market opportunities for the project, in electricity, carbon/emissions and input/fuel acquisition.

One fundamental constraint is the ability to sell / export the electricity generated from waste-heat in the Iron manufacture process. The differing nature of electricity network infrastructure and markets between Queensland and Western Australia makes Queensland the preferable location for high-volume electricity generation. The Queensland network has a maximum demand of over 8,000MW and is growing significantly. Connection in Queensland also provides access to the National Electricity Market (NEM) with an additional opportunity to sell around 1,100MW across the inter-connectors into New South Wales (NSW). Connection to the National Grid and therefore the NEM, can be achieved for around $220M via connection to the Powerlink Queensland (Powerlink) 275kV substation at Strathmore.

The physical size of the WA market into which PIB can sell its electricity output is currently limited to approximately 850MW including isolated mining loads, which is expected to grow to 1,000MW in the medium term. Growth in this region is hard to evaluate given the influence of large project-related loads which increase the load in significant increments depending on the success or otherwise of major project investment.

The introduction of major new loads in either market – such as an aluminium smelter or LNG plant – would have a beneficial impact on the prospects of PIB however the benefits should not be over emphasised. Such a load would increase the market size in Western Australia and be of significant benefit to PIB. Such a load in Queensland would absorb some of the existing and planned cheap base load generation. In both cases the price that highly energy intensive loads (such as aluminium smelters) can afford to pay for electricity makes them unattractive as direct customers of PIB.

At present PIB are considering a number of configurations for the precincts in both Queensland and Western Australia. To provide PIB and stakeholders with an advanced understanding of the energy-related feasibility of the project, while acknowledging various configuration options are still being considered, Hill Michael structured its investigation to focus on external factors influencing each of the three feasibility drivers defined above, within the bounds of reasonably likely project inputs and outputs.

The primary variables considered are determined by the 'mix' of the primarily plant component options, the project 'Building Blocks', being:

1. Coking Plant
2. Blast Furnace

The environmental variables (specifically carbon emissions) have not been considered in this report.

## *3.2 Energy Inputs*

### 3.2.1 General Plant Options and Resultant Input Requirements

Hill Michael has developed a spreadsheet model to readily identify project inputs (coal, coke, gas, electricity and water) required at the smelter parks for combinations of "raw" steel (or pig iron) production elements termed Building Blocks. The spreadsheet will also provide an estimate of the outputs of the Smelter Parks (pig iron, electricity, and coke).

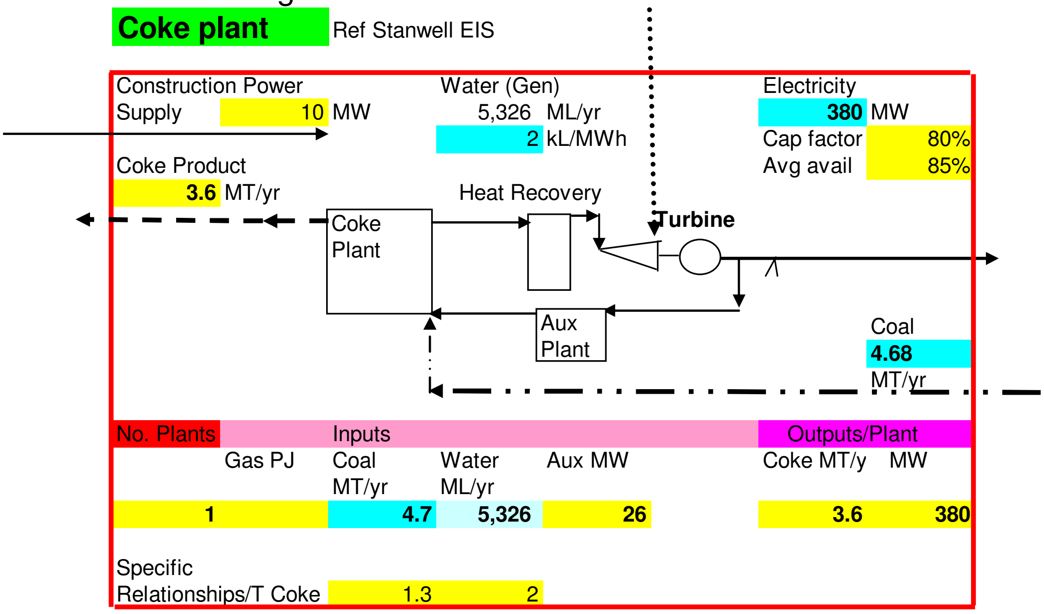
Initially it will be used to give the project team an idea of the effects of using the different technologies and how different combinations fit into the perceived "constraints" of each area.

Potentially, it could be used as part of the optimisation process once resource, product, production and transport costs and availability are known.

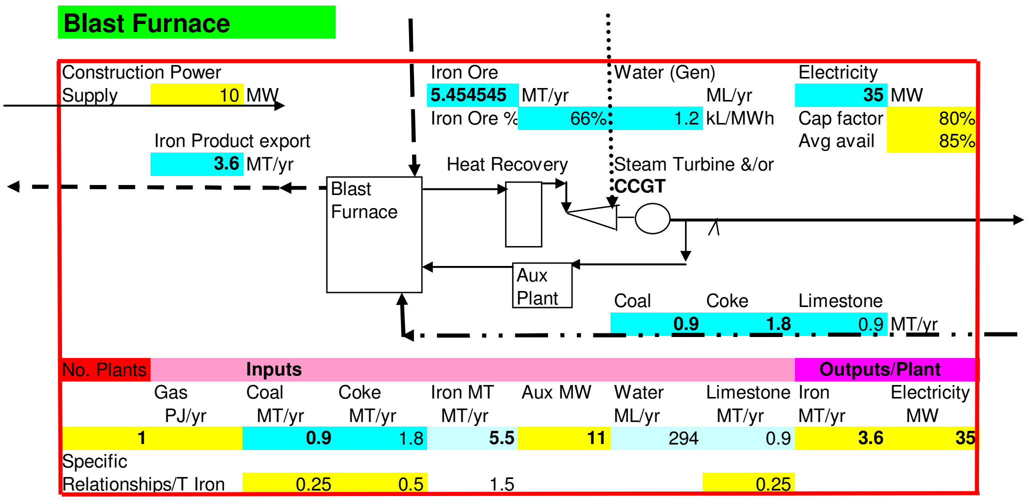
Production 'Building Blocks', as noted above, are discussed in more detail below. At this stage of the project it is necessary to use some assumed relationships between inputs and outputs as these will vary with manufacturer, process and resource economics and value of outputs. Also, there may be applicable environmental/planning/regulatory constraints to consider.

An assumed base-case for each Building Block is given below.

1. Coking Plant




2. Blast Furnace




The base case configuration involves six blast furnaces and six coke plants at Bowen and six blast furnaces in Western Australia. The arguments supporting this base configuration are developed below.

### 3.2.2 Fuel Availability & Cost – Queensland

**Coal**

Queensland has vast resources of steaming and coking coal and can be assumed to be in “limitless” supply at world competitive prices.

**Gas**

The Bowen region gas is potentially available from either the coal seam gas fields around Moranbah or via the proposed pipeline from the Bowen Basin to Gladstone. The PNG gas pipeline project was an alternative in the initial stages of the Iron Boomerang Project but the PNG pipeline project has been abandoned. The Moranbah field currently produces approximately 18 PJ/yr (refer RLMS map) which is delivered to Townsville for power generation (predominantly) and metal processing.

With each blast furnace potentially requiring up to 5 PJ/yr, this demand would require further exploration and drilling. The current field has a large potential and an extra 20 + PJ/yr is seen as possible. The potential price of gas is in the order of $3.70 - $4.20 /GJ delivered at Bowen, whether it is sourced from Moranbah or the wider Queensland gas network. In general, the availability of gas in Queensland is considered acceptable as evidenced by the four LNG Project currently under investigation in Queensland.

In the assumptions provided by PIB (spreadsheet A Input-Output Qtys 20Jul 06) up to 5.8 PJ per year (1 PJ = 1,000,000 GJ) can be used as a heat source in a 1.6 MT/yr blast furnace in lieu of coal. Assuming gas could be delivered at $3.50/GJ the cost of gas per blast furnace would be $20.3 M/yr.

Steaming coal landed at Bowen should be available for about $2 – 2.5 /GJ depending on rail costs. The cost of coal per blast furnace (for the same heat input i.e. 5.8 PJ/yr) at $2/GJ would be around $11.6M/yr.

The use of coal will normally incur higher capital and operating costs (excluding the fuel itself). Much of the materials handling infrastructure should already exist for the coking coal being delivered. Whether it can be effectively used will depend on how separate or simultaneous the handling operations have to be.

The use of coal will usually involve higher plant maintenance (wear) and possibly higher manning levels. Additionally, steaming coal typically contains 15 - 25 % ash which will need to be disposed of (either stored or recycled or both) and will require additional flue gas cleaning equipment to filter out the "fly" ash.

The decision to use gas or coal will be complex and affected by fuel cost, environmental (potential Carbon Trading) costs and gas availability. Initial research indicates that only a few countries seem to use gas to add extra heat, possibly due to cost. The value PIB could add to the project and the decision making processes of the iron makers (where it rests) is by either themselves, or encouraging a pipeline developer, to scope out and possibly "permit" a connecting pipeline into Bowen. This then gives real fuel choices with added certainty.

In summary the optimised use of coal and gas for fuel will be a balance between transport economics of coal, environmental impacts and costs and product quality.

### 3.2.3 Fuel Availability & Cost – Western Australia

**Coal**

It is assumed all coal would be railed from Queensland although some coal deposits exist in Western Australia. Therefore, apart from the tonnage that could benefit from backhaul freight rates it is assumed that coal is better utilised in Queensland.

**Gas**

Natural gas is plentiful in North-West Western Australia. Existing research conducted by members of PIB with expertise in the Western Australian gas industry supports the economic availability of natural gas, and Hill Michael support this view. The WA Smelter Park is less than 100km from the Goldfields Pipeline.

### 3.2.4 Water Requirements

Hill Michael has focused primarily on the water requirements for electricity generation. The water requirements of other plant is not within the scope of this report. The water pre-feasibility investigation suggests consumption will be in the order of:

- Steam turbine plant
  - Wet cooled i.e. cooling towers – 2 KL/MWh
  - Dry Cooled i.e. radiators – 0.2 KL/MWh (with a 3-5% efficiency impost and up to 20% capacity impost in summer)
- Combined Cycle Gas Turbine
  - Wet cooled i.e. cooling towers – 1.2 KL/MWh
  - Dry Cooled i.e. radiators – 0.1 KL/MWh (with a 2-5% efficiency impost and up to 20% capacity impost in summer)

In general, while water supplies are theoretically high in both regions (artesian water in WA and via the Burdekin Dam in Queensland), Hill Michael do note the high scrutiny placed on water consumption in Australia at present, and suggest it would be important to manage the regulatory expectations and water efficiency aspects of the project closely.

Recent debate about water in eastern Australia has highlighted the significant amount of water available in tropical north Queensland. It is likely that there will be considerable investment in water harvesting and transport in the north and hence the availability of water for major industrial developments should increase.

## 3.3 Energy Outputs – Export Capacity and Market Value

Hill Michael has developed a spreadsheet model using the "building blocks" referred to earlier. Below is a discussion on electricity output that is based on iron ore production at each smelter park of approximately 20 MT per year (Scenario 2 in the model), which is in line with the PIB briefing material. .The base case configuration is based on 6 blast furnaces in both WA and Bowen and 6 coke plants in Bowen serving both sets of blast furnaces. It should be noted that the material balance (eg: the relative haulage tonnages) has not been considered here nor has any optimisation. Scenario 1 (utilising Corex plants) in the model produces a closer east – west material balance in terms of tonnages.

The cost of generation will be similar in both Queensland and Western Australian locations. If it is assumed that the steam is available from the iron production process at zero cost then the three major components of the "cost of sales" for electricity will be the cost of the capital used to fund the generating plant development, the connection costs to the point of sale and operations and maintenance costs.

Costs of capital should be similar for both Queensland and Western Australian locations. The project will carry the CAPEX for steam turbines, generators and associated EHV equipment. This assumes minimal steam conditioning plant prior to steam delivery to the turbines. No supplementary fuels are assumed.

Costs to connect to the point of sale will vary between Western Australia and Queensland and these variations are dealt with below.

Operations and maintenance costs should be relatively small because there is no fuel used in the power station end – no coal handling or gas combustion.

For the purposes of the pre-feasibility study and based on the assumption that the steam is available to the generation plant at zero cost then the cost of electricity production is in the order of $20/MWh.

Connection to the national or regional network and NEM participation costs are additional to this.

### 3.3.1 Queensland

#### Export Capacity and Maximum Demand

In this scenario the Bowen Smelter Park would consist of six blast furnaces (3.6 MT/yr each) and six coke plants (also 3.6 MT/yr each). Three coke plants are required to support the blast furnaces in Queensland and three would "export" coke to the WA Smelter Park.

The electricity export from the Bowen Smelter Park could be up to 2500 MW.

The Bowen Smelter Park generating plant would export electricity to the Australian NEM, via connection at Powerlink's Strathmore 275kV substation in north Queensland. Refer Section 3.4.1 on infrastructure requirements to connect to the National Electricity Grid.

Queensland electricity demand and energy consumption is predicted to grow strongly over the years between 2006 and 2015, in the order of 350 – 400 MW per year. This will have a positive impact on the ability to dispatch the generation, although some network constraints will exist these are not considered to change the fundamental feasibility of the generation proposal.

Based on this load projection the total output of the Park would take 6 to 8 years of forecast growth to absorb. The PIB development is likely to stimulate increased demand in north Queensland and hence the output would be absorbed sooner. Other generation projects will continue to be developed and the older existing generators (particularly coal plant in Central Queensland) will be retired. The Queensland system will be able to absorb the PIB output to an extent that makes the project feasible.

The forecast Queensland electricity demand and energy growth is shown in the Powerlink graphs 3.7 and 3.8 below (Powerlink Queensland, Statement of Opportunities, 2006).

The average economic growth in Queensland for the High, Medium and Low Growth Scenarios developed by NIEIR over the period 2006/07 to 2016/17 are:

**Economic Growth**

| | HIGH | MEDIUM | LOW |
|---|---|---|---|
| Australian Gross Domestic Product (average growth p.a.) | 4.0% | 3.0% | 2.1% |
| Queensland Gross State Product (average growth p.a.) | 5.0% | 3.9% | 2.9% |

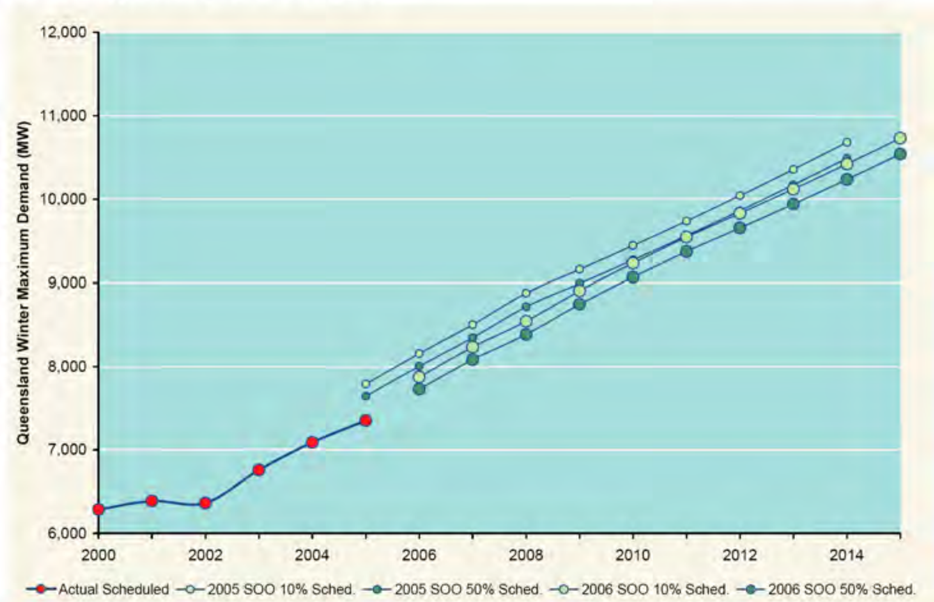
For Queensland these updated growth rates are slightly higher for the high growth scenario, un-changed for the medium growth scenario and slightly lower for the low growth scenario compared to the NIEIR prediction outlined in the Powerlink 2006 Annual Planning Report (APR).

Powerlink Queensland provided the maximum demand projections and supporting information for the Queensland region.

The winter maximum demand (Powerlink Fig 3.7) for Queensland is projected to increase over the forecast period (commencing in 2006) by an average of:

- 3.5% each year under the medium-growth scenario; and
- 5.7% and 1.8% under the high and low-growth scenarios, respectively.

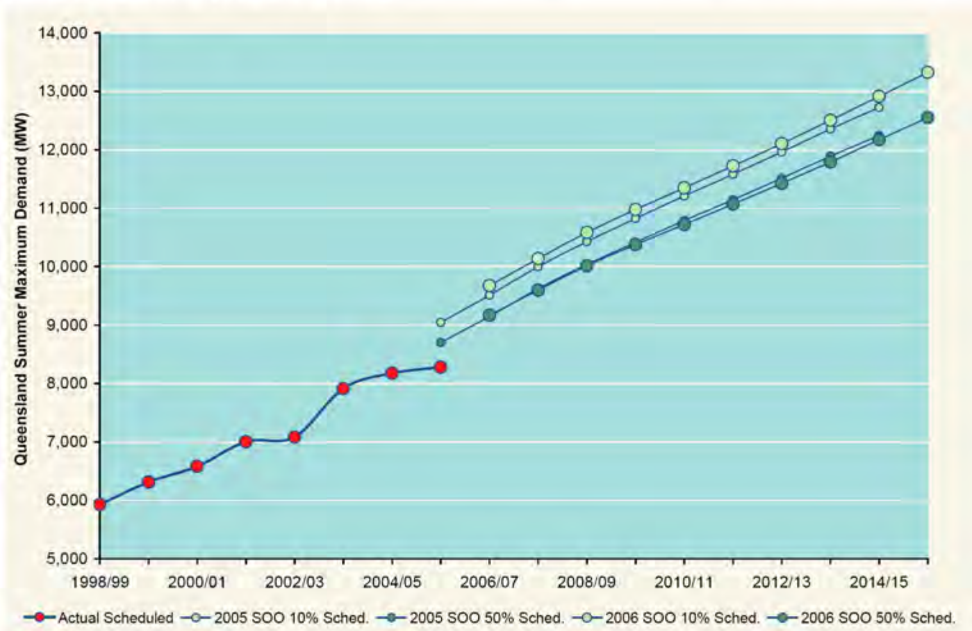
**Figure 3.7 Comparison of Actual Queensland Winter Scheduled MD with the Previous and Current Projections (Medium Growth)**



The summer maximum demand (Powerlink Fig 3.8) for Queensland is projected to increase over the forecast period (commencing in 2006/07) by an average of:

- 3.6% each year under the medium-growth scenario; and
- 5.6% and 2.4% under the high and low-growth scenarios, respectively.

**Figure 3.8 Comparison of Actual Queensland Summer Scheduled MD with the Previous and Current Projections (Medium Growth)**




### Value of Electricity in Queensland

In the Queensland market the value of electrical energy is largely determined by the National Electricity Market. This is encouraging for the PIB because the market must deliver a return on generation investment over the long term. On this basis the value of base load electricity in Queensland can be conservatively forecast to be set by the cost of cheap coal plant. Extracting additional value is largely dependant on the strategy employed for sale. The NEM in eastern Australia provides some flexibility in contracting arrangements unlike in Western Australia where arrangements are generally bilateral contracts.

The short term (daily/monthly) value of wholesale electricity sold in the Queensland market depends on the short term supply / demand balance at the time. The physical electricity market has a complementary derivatives market which allows participants to effectively manage the price risk associated with short and medium term supply / demand imbalance – either over or under-supply

There are alternative sale strategies to accommodate the appetite for risk and these are briefly discussed below.

1. *Pool Sales Strategy:* Electricity can be sold directly into the NEM Pool resulting in all electricity being consumed, with no obligation to supply any fixed volume. The annual revenue received would be the average Queensland Regional Reference Node (RRN) NEM Pool price, weighted for volume. The Queensland RRN price to date (2007-08 financial year to 7 March 2008) is $59.85/MWh. The full year average is expected to be around $50/MWh. Based on a maximum export of 2,500MW, total annual revenue would be in the order of $876M (assumes 80% capacity factor[1]). Pool based revenue could vary between $438M/yr and $1000M/yr from historic averages between 2005 and 2007.

2. *Longer-term Contracting through the derivatives market:* Revenue can be received through long-term contracting for electricity. Along with a fixed revenue stream at an increased price per unit, this arrangement also comes with the volume risk of having to deliver electricity, or incur a liability associated with the cost of not producing electricity. At present a long-term (5 to 15 years) contract price would be in the order of $38-$40/MWh without allowance for carbon costs. Based on a maximum export of 2,500MW, total revenue would be in the order of $680M (assumes 80% capacity factor[2]).

3. *Inter regional trading*: Inter-Regional Settlement Residue is the difference between the value of energy in one region and the value of that energy once it has been transferred to another region. This difference in value is primarily due to the price difference between regions. The price differences can be due to the applications of inter-regional transmission constraints or (to a lesser extent) the marginal loss factors that apply between regions. The Settlement Residue Auctions are intended to improve the efficiency of the NEM by promoting inter-regional trade. By making the settlements residue available to the market place, the risks of trading between regions can

[1] Capacity Factor refers to the proportion of time the power station is generating and exporting electricity.
[2] Capacity Factor refers to the proportion of time the power station is generating and exporting electricity.

be better managed. Along with a revenue stream, this arrangement also comes with the price risk that may impact the bottom line of the business. A generator portfolio of 2,500MW in Queensland would be likely to participate in the Residue auction to manage Queensland price risk.

4. *Revenue Optimisation:* Through a combination of long-term contracting, short-term contracting and derivative trading, revenue from the sale of electricity can be optimised to match the risk profile of the project proponents.

In the Queensland region of the NEM there are adequate opportunities to find power station developers and operators when the project is at an advanced stage. Existing generators in Queensland will have a vested interest in containing the level of new generation and hence are not logical partners at the feasibility stage. Once past feasibility these organisations can vie for a role in the trading and operation of the new capacity to manage the impact on their current portfolios.

For the Queensland electricity sales the key issue in the feasibility process is not who the generator is but understanding the market value. Contracts with major users for a portion of the output may add value from a financing perspective. The very recent sale of the government controlled retail sector to Origin Energy and AGL means that they become the largest off-takers in the state. There are a small number of large customers who are also potential counterparties.

The electricity sector has seen the emergence of the 'gen-tailer', significant companies bullish in their development of the retailer + generation business, who would be very enthusiastic about the potential acquisition of this generation capability, and who would provide a risk management mechanism for PIB. These players are best introduced when the project has certainty so that PIB extracts most value from a competitive energy market in Queensland.

### Strategy to Generation Development

The Queensland generation market is dominated by four Queensland government owned enterprises (GOC). Each GOC has particular strengths. The main issue for each of these generators is that the state government is reluctant to invest more government money into generation and is encouraging private sector participation.

The generator GOC's and the major private sector generators all have a vested interest in restricting further capacity development because it will put downward price pressure and reduce returns on their existing assets.

There are large amounts of capital available for generation development and there will be no shortage of potential constructors / operators. The key issue is for PIB to develop its trading strategy to optimise electricity based revenues. This process will also identify the potential partners required to implement the strategy.

**Regulatory Constraints for Electricity Sale**

It is reasonable to assume that no significant regulatory hurdles would prevent the development of a power station in conjunction with PIB. Whatever entity developed the electricity generation capability would need to satisfy NEMMCO generation registration performance standards, and also obtain an electricity retail license. Hill Michael could see no reason why these registrations would not be obtained via the typical process.

There are also similar regulatory approvals required by the Queensland Government, however these are typically closely related to the NEMMCO requirements and for this purpose can be assumed to be satisfied if the project can satisfy NEMMCO requirements.

## 3.3.2 Western Australia

**Export Capacity and Maximum Demand**

In conjunction with Resource and Land Management Services (RLMS) and the information supplied by PIB the capacity of the Western Australia electricity market that can be readily reached by the project is estimated and allocated in 2 distinct groups:

- Connected Loads - North Western Interconnected System (NWIS).
- Isolated loads.

**Table 1**

| Asset Name | Owner/ Developer | Comm Date | Capacity (MW) | Plant Type | Fuel Type |
|---|---|---|---|---|---|
| Port Hedland | Alinta Limited | 1996/98 | 180 | Gas Turbine | Natural Gas |
| Cape Lambert | Robe River Iron | n/a | 105 | Steam Turbine | Natural Gas |
| Mt Newman (BHP) | Alinta Limited | 1996 | 108 | Gas Turbine | Natural Gas |
| Dampier - Woodside | Woodside Petroleum | n/a | 120 | Gas Turbine | Natural Gas |
| Dampier 'C' - Hamersley | Hammersley Iron | n/a | 120 | Steam Turbine | Natural Gas |
| Paraburdoo | Hammersley Iron | n/a | 20 | Gas Turbine | Natural Gas |
| Telfer Gold Mine | Newcrest Mining | n/a | 135 | Gas Turbine | Natural Gas |
| Plutonic | Plutonic Resources | 1997 | 16 | Reciprocating | Natural Gas |
| Broome | Horizon Power | n/a | 19 | Reciprocating | Oil / Distillate |
| Carnarvon | Horizon Power | 1981 | 15 | Reciprocating | Natural Gas / Distillate |

| | | | | | |
|---|---|---|---|---|---|
| Onslow | Modra Electric | 1999 | 3.6 | Reciprocating | Natural Gas |
| DESTEC Energy | DESTEC Energy | n/a | 660 | Gas Turbine | Natural Gas |
| Exmouth Advanced | Verve Energy | 2002 | 7.04 | Wind Turbine / Diesel | Wind / Distillate |
| Broome | Horizon Power | 2007 | 0 | Gas Turbine | Natural Gas |
| Wodgina | Sons of Gwalia | 2001 | 8.82 | Reciprocating | Natural Gas |

Pending detailed analysis of the economics of connecting loads to the WA smelter park it would appear that a potential load of approximately 850 MW exists, of which about 500 MW is connected to the NW Interconnected System (NWIS).
Other potential loads such as pipeline compressors may increase the total load available to approximately 1,000 MW.

### Value of Electricity in Western Australia

In Western Australia, as an isolated system, there are limited trading opportunities for the electricity produced in the Western Australian smelter park precinct. The contracting arrangements will most likely be bilateral contracts with off-takers. These off-takers may be local retail entities in the NWIS or individual loads.

The likely value of the electricity in NWIS, and the surrounding areas can be assumed to be the cost of the existing generation that would be displaced. For the purposed of initial analysis it will be assumed that the heat rate of existing diesel or gas fired plant is 10 GJ/MWh. Gas price will vary from between an estimated $3/GJ on the coast to $4.50/GJ at the mines. Diesel is estimated at $15 /GJ. The amortised capital cost of gas/diesel engines or simple cycle gas turbines will vary between $10 – $20 /MWh.
O&M for gas and diesel generation is estimated at $10-$15 /MWh.

This puts the cost of efficient grid connected gas fired generation at $50 – 60 /MWh and remote gas fired generation at up to $80 /MWh. This compares to between $170 – 200 /MWh for diesel generation depending on diesel price.

The output from PIB is extremely attractive even after the connection costs are added. Capturing 100% of an existing market is very difficult because there will be other influences on buying decisions. Some loads may have long term contracts for gas / or electricity which may not be abandoned easily. Also the incumbent generators may respond to competition with prices that discount their capital because the plant already exists.

In Scenario 2 with only blast furnaces in the WA smelter park approximately 200 MW would be available for export. If sold at an average of $70/MWh it would produce revenue of approximately $100M (at 85% capacity factor).

**Regulatory Constraints for Electricity Sale**

The regulatory framework in Western Australia is slightly different to that applied in Queensland as Western Australia is not part of the NEM. The Western Australian Electricity Market (WAEM), and associated regulatory bodies and structures are of similar nature to the NEM, and for the purpose of this investigation be can be assumed that our conclusion that electricity generated by PIB would satisfy the Western Australian regulatory tests given that it will satisfy the tests applied in the NEM.

### 3.3.3 Strategies for Optimising Export Capacity & Market Value

**General**

Hill Michael has undertaken a high-level review of the export electricity opportunities from PIB in both geographical markets to identify where to increase export capacity and market value may exist.

**Western Australia**

Unlike Queensland, the export capacity of any power station in Western Australia can only be influenced by two events; Interconnection of the NWIS and other Shared Networks in the region, and/or; new connection of individual significant loads.

The presently known loads are shown in Table 1 and total about 340MW. In the next phase of the project Hill Michael will undertake a cost/benefit analysis for these local isolated loads to extend the NWIS, in conjunction with PIB and the load users.

The economics of connecting the other loads would require detailed analysis, and is dependant on the loads' willingness to contribute and the extent to which they value reliability. Most mines would be connected at 66 kV at a cost of approximately $300,000/km.

The market value of electricity for isolated loads in the Pilbara region of Western Australia is not easy to determine without being privy to actual generation costs, however they would be expected to be in the order of $90-$110/MWh. The value of electricity in the NWIS is likely to be in the order of $70-$90/MWh. Given this high electricity cost, and the need for PIB to displace these loads to ensure off-take demand, it is unlikely the value of electricity can be increased from this high price level.

**Queensland**

Export capacity in Queensland is essentially "unlimited" due to the ability to bid low into the NEM and have generation dispatched to meet the demand in Queensland. However, the practical limit may be in the order of 1,500 to 2,500 MW due to market growth, other generators coming online and possible transmission line constraints discussed below. Hill Michael suggest there is no requirement to consider strategies to minimise or maximise the export capacity of the power station within this range.

As discussed above, there is a great deal of scope for the optimisation and maximisation of revenue from electricity generation. The NEM is very efficient and it will be difficult to achieve any arbitrage or abnormal returns from electricity sales. Important for PIB will be optimising the revenue from electricity, balancing the important drivers of pricing risk in the Pool and volume risk in the contracts market .

## *3.4 Energy Infrastructure Requirements*

### 3.4.1 Electricity Transmission & Connection Assets

**Western Australia**

For PIB, the most essential electrical infrastructure required in Western Australia is connection of PIB to the NWIS. This will be done via a 200 km (approximately) 220 kV double circuit line, at an estimated cost of $100M to $150M. A double circuit 220 kV line would have a capacity of about 600 MW. This would be sufficient to supply all existing loads on the NWIS.

As noted above, subject to economics and the willingness of other loads in the region to take supply via PIB generation, further infrastructure would be required. This infrastructure could be customer specific or create small shared networks in the region.

**Queensland**

A connection of this size (1,500 to 2,500 MW) directly into the transmission network will be significant.

As noted above, the most appropriate connection point for large quantities of generation (ie > 100 MW) is Strathmore substation near Collinsville, about 80km from Bowen.

In Powerlink's Annual Planning Report 2007, it identified that the combined capability of the CQ-NQ transmission network and local North Queensland generators will be fully utilised by summer 2007/08. Further augmentation is required by this time to ensure customers continue to receive a reliable electricity supply consistent with Powerlink's mandated reliability obligations.

In late 2005, Powerlink finalised regulatory processes for the following new large network assets to ensure supply reliability is maintained:

- Stage 1 - Construction of a 275kV transmission line between Broadsound and Nebo Substations, and 275kV static VAr compensator at Strathmore Substation by summer 2007/08;
- Stage 2 - Construction of a 275kV transmission line between Nebo and Strathmore Substations by summer 2008/09; and
- Stage 3 - Construction of a 275kV transmission line between Strathmore and Ross Substations by summer 2010/11 (now timed for summer 2009/10).

The higher forecast demand includes specific load developments at the coal handling facility at Dalrymple Bay, new and expanding coal mines and increases to industrial plant in Townsville. These development will strengthen the grid and improve the ability of the grid to absorb new generation.

With the current strengthening of the North Queensland transmission system by Powerlink Queensland as noted above, it could be possible to inject up to 2000 MW into Strathmore. Detailed technical analysis is required to model any potential grid constraints in either directions (north or south) as there are some stability limit across CQ to NQ corridor as well as further south. It may be the location of this generation near Strathmore will alleviate some of these limits but this needs to be investigated. This can be carried out by Hill Michael in conjunction with Powerlink, Queensland's transmission entity.

PIB would require connection to Strathmore by one double circuit 275 kV line, for each 700 MW and a cost of approximately $0.5 to 1 M/km. Therefore, for 2,500 MW three or four 275 kV double circuit lines would be required at a total cost of approximately $240 M. At the full 2,500 MW export capacity Powerlink may also need to strengthen the Grid north and/or south of Strathmore. This may add to the overall cost.

### 3.4.2 Gas Transmission & Connection Assets

**Western Australia**

The proposed location for the PIB smelter park in Western Australia is east-south-east of Yandi. Hill Michael estimate the precinct is less than 100km from the primarily Goldfields Pipeline (350, 400mm Natural Gas).

**Queensland**

Gas delivery to Bowen would require an approximately 100 km long pipeline connecting to the North Queensland Gas Pipeline (NQGP) at an estimated cost of approximately $50M. The NQGP has an estimated capacity of 20+ PJ/yr in its present configuration which may be able to be augmented with in-line compression.

# 4 Methodology

Below is set out the primary methodology characteristics employed in this report:

- Investigation has been based on industry standards and accepted and validated publicly available research.
- Modelling has been based on establishing feasible energy solutions for the developments in Bowen and Western Australia. There has been no attempt to optimise the solution for energy, transport and process efficiency.
- No energy market simulations or forecasts have been undertaken which assume PIB is operating.
- All estimates are provided in today's dollars.

# 5 Conclusions, Findings & Recommendations

- Electricity – Fundamental Drivers
  - Volume – The Queensland market and growing load will accommodate large electrical capacity associated with COREX and coking plants.
  - Price – Electricity sales will probably be more highly priced per unit in WA. The limitation in WA will be the volume of the market for electricity.

- Fundamental Infrastructure
  - Infrastructure - The amount of infrastructure required for the quantity of electricity produced will be less in Queensland. In WA, the economics of displacing relatively small quantities of isolated load will determine the quantity of electricity that can be sold into that market.

- Conclusions
  - COREX and coking plants should be considered for Queensland
  - Blast furnaces should be considered for WA
  - Electrical Infrastructure and load is unlikely to be a constraint in Queensland.
  - The detailed economics of connecting isolated electrical loads will be important in WA.

# 6 Next Steps

Progression of the feasibility investigation for PIB relies heavily on the effectiveness of integrating energy investigation, modelling and optimisation with the other key parameters of the project. Hill Michael would suggest the development of a single PIB energy model is fundamental to the effective determination of project feasibility. The PIB energy model can then provide the defining variables for expert review of such issues as carbon balance/benefit, fuel economics (electricity/gas/water) and infrastructure requirements.

End.

**Project Iron Boomerang**
**Briefing Paper**
**Modularisation of Smelters and Smelter Park Shared Utilities**

## 1.0 INTRODUCTION

Project Iron Boomerang (Iron Boomerang) is planning to develop an east-west railroad across Australia to link the world-scale coal deposits in the Bowen Basin of Queensland with the similarly massive iron ore deposits in the Pilbara Region of Western Australia.

At each end of the railroad, it is proposed to develop a smelter park to accommodate iron smelters owned by international steelmakers. East West Line Parks Pty Ltd, the promoter of Iron Boomerang, intends to procure, construct and operate a suite of shared services for the smelter parks, e.g. power, water, car dumpers, stockpiles.

The proposed location of the Pilbara Smelter Park is approximately 55km north of Newman which is more than 400km inland. The proposed location for the Queensland Smelter Park is a few kilometres from the existing port at Abbot Point. These are two fundamentally different locations that will exhibit different logistics, environmental, quality and safety issues that will impact the project execution and cost. In previous projects of a similar size and nature, cost and schedule parameters have been considerably improved by reducing the amount of "stick-build" construction and adopting a modular approach to construction.

A critical life cycle cost for Iron Boomerang is the capital expenditure necessary to design, procure, install and commission the railroads, smelters services and smelters. The constructability life cycle costs are specifically tied to the choice between modular construction versus stick-build facilities. Operability and maintainability are also important issues which will be addressed in deriving an optimum development solution.

When modularising major industrial plant, there are two general types of modules, viz. offshore modules and onshore modules. Offshore modules are generally linked to the offshore hydrocarbons industry. These modules are generally heavier than onshore modules and lifted or floated over the intended final destination.

Refer to Table 1 (Offshore and Onshore Modules) for a brief explanation of modules.

Most major industrial projects can derive substantial cost and schedule benefits through a modularisation approach when the plant is in a remote area, close to the sea and/or where limited support infrastructure exists. Modularisation also limits land disturbance and/or environmental damage caused by stick build construction activities.

For smelter parks' services and multiple smelter units, it is proposed that modularisation be examined very early in the Feasibility Study phase of the project. The design will be Front End Loaded (FEL) to identify benefits early and avoid rework at a later point in the project schedule. An important issue will be the use of off-site (overseas) pre-assembly and modularisation. The emphasis will be on modules and pre-assembled units (PAU) that may be taken by sea to a suitable module offloading facility (MOF) for subsequent land transportation using self-propelled motorised transporters (SPMT). Where possible, onshore heavy lifting equipment will be minimised to capture the benefits of modularisation and pre-assembly.

**Table 1 Offshore and Onshore Modules**

| OFFSHORE MODULES | ONSHORE MODULES |
| --- | --- |
| • Weights and sizes are usually determined by the lifting capacity of the derrick barges (northern hemisphere only) which install the modules at the offshore locations. Due to the notable absence of derrick barges in the southern hemisphere a more sophisticated approach known as a "float over" is sometimes used.<br><br>• Weights are usually in the range of 500 - 11,000 tonnes. However, there have been many smaller and larger modules built. Large modules are often considered to be "integrated decks". These may vary in size, e.g. 25m x 10m x 8m to 100m x 40m x 35m.<br><br>• There is no definitive upper limit on the size of offshore modules since the onshore transport route is usually very short, e.g. less than 500m from the construction foundations onto the transportation barge and most fabrication yards have a well prepared (and short) transport route to skid modules to a suitable quay.<br><br>Photo1 (overleaf) shows an examples of large North Sea modularised decks for oil production. This type of module is too large, heavy and wide for road transportation to the smelter parks. These modules need more sophisticated delivery systems than are available in Australia. | • Onshore modules have historically been used for petrochemical plants or mining developments located in remote areas with limited labour or construction facilities. Smelter services, power plant and iron smelters may be considered to be in this category.<br><br>• Onshore modules are usually jacked onto pre-prepared foundations.<br><br>• Onshore modules typically may weigh between 30 tonnes and 2,500 tonnes. They are often limited by the size and shape of the ship transporters. However, larger modules for onshore application have been shipped by motorised or dumb barges.<br><br>• The transport route (and carrier) is generally the governing factor for module weight and physical dimensions. Some large modules have been transported overland for more than 100km.<br><br>• The use of large modules for the Pilbara Smelter Park is likely to be a world first for distance (in the Pilbara) and difficulty.<br><br>Photo 2 (overleaf) shows examples of modules constructed onshore for delivery by sea to a remote location and subsequent road transportation to the final destination. These are the type of long, high and narrow modules which may used to construct smelters and associated services. |

**Project Iron Boomerang**
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**Photo 1 Offshore Integrated Deck - Large and Complex**[1]

**Photo 2 Onshore modules - delivered by sea for road transportation to site**


Transportable[2] biodiesel plant (420 tonne module) constructed by AGC at Henderson WA (2006) for sea transportation to Darwin and delivery using SPMTs.

Portion[3] of an LNG plant arriving in Sakhalin for delivery to its onshore final destination by road.

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[1] Source: www.oilrig-photos.com - The Captain Platform 68km north-east of Aberdeen. Photographed by Garve Scott-Lodge on 8th November 2006.

[2] Source: www.landcorp.com.au - LandCorp is the owner of the construction facility near Perth, WA.

[3] Source: www.sakhalinenergy.com via Google Images - Sakhalin is located in Eastern Siberia.

## 2.0 DEFINITIONS

Some special words and acronyms are used to describe the activities and elements of a project that uses a modularised approach to construction. The definitions below are offered as a guide:

**Module**

This is usually the largest transportable unit or component of a facility and is the result of a series of remote assembly operations. A module is a volume fitted with all the structural elements, finished, and process components which are designed to occupy that space. It may contain elements of different distributed systems, be designed for multiple functions and be constructed by multiple crafts. Modules may contain prefabricated components or pre-assemblies, and are generally constructed away from the job site.

***Short-form*** The result of a complex prefabrication and pre-assembly effort assembled remote from its final destination.

**Prefabrication**

This is a manufacturing process which generally takes place at a specialised facility and entails joining various materials to form a component part of the final installation. Prefabricated components often involve the work of a single craft.

**Pre-assembly**

This process joins together various materials, prefabricated components and/or equipment items at a remote location for subsequent installation as a unit. Completion of the pre-assembled unit (PAU) may involve additional work operations at the site away from the final point of installation. Pre-assembly often involves decoupling of sequential activities into parallel activities. Pre-assemblies typically contain portions of systems and require work by multiple crafts.

**Block Construction**

This comprises construction of separate elements at ground level adjacent to the site for stacking into the final plant configuration. It allows simultaneous work at several locations and decreases the risk of accidents.

**Pre-assembled Unit (PAU)**

A PAU is a section of a process unit complete with items such as process equipment, piping, pipe supports, valves, steelwork, instruments, electrical, lighting, paint, tracing, insulating material and fireproofing.

The Engineering Contractor generally carries out the full design and supplies drawings and materials to the Fabrication Contractor in accordance with the agreed modularisation strategy. Assembly and testing is at the Fabrication Contractor's yard. The Fabrication Contractor generally prepares steelwork working drawing (although this often an automated part of the design process) and supplies piping test materials.

Precommissioning is maximised at the Fabrication Yard.

**Pre-assembled Rack (PAR)**
A PAR is a section of plant complete with items such as piping, pipe supports, valves, steelwork, instruments, lighting, paint, tracing, insulating material and fireproofing.

The Engineering Contractor generally carries out the full design and supplies drawings and materials to the Fabrication Contractor in accordance with the agreed modularisation strategy. Assembly and testing is at the Fabrication Contractor's yard. The Fabrication Contractor generally prepares steelwork working drawing (although this often an automated part of the design process) and supplies piping test materials.

Precommissioning is maximised at the Fabrication Yard.

**Vendor Assembled Unit (VAU)**
A VAU is an item of equipment where the Vendor's normal scope is extended to include items such as piping, pipe supports, valves, steelwork, instruments, lighting, paint, tracing, insulating material and fireproofing.

The Engineering Contractor carries out the full design and supplies drawings to the Vendor. Material may either be purchased by the Vendor or supplied by the Engineering Contractor.

An example of a VAU may be a fully dressed tower in the oxygen plant feeding the smelter complete with all its platforms, piping, insulating material, instruments and lighting.

**Vendor Packaged Unit (VPU)**
A VPU is an item of equipment where the Vendor designs a module, supplies all materials and fully assembles and tests it in a working condition.

The Vendor or manufacturer groups all of their components into a single plant unit. This assigns single responsibility for the process function, testing in the Vendor's shop and limits installation effort to making the external connections.

Examples of VPUs are skid mounted compressors and metering skids.

**Pre-assembled Steelwork (PAS)**
A PAS is a section of steelwork designed by the Engineering Contractor and assembled in the Fabrication Yard.

**Skid Mounted**
Skid mounting is mounting of several components (or a complete system) on a common base frame. This is common when assigning responsibility for the complete system to a Vendor or responsibility for several vendor-supplied items of equipment. Costs saving are achieved by the use of standard designs, shop fabrication, alignment and testing prior to the delivery date.

Examples of skid mounted plant include water treatment systems, lube oil systems, pumps, compressors and specialised process systems.

**Transport and Heavy Lift Contractor (THLC)**
The THLC is a contractor which specialises in transporting, shipping and lifting heavy and large loads.

**Barge Mounted**
This means construction of a complete plant on a barge for towing to the final seaboard location. Installation is limited to grounding or anchoring the barge and making connections.

This type of plant is unlikely to be included in Iron Boomerang. However, it could be considered as a preliminary offshore wharf arrangement for transfer of slab offshore as the final part of the export system.

**Battery Limits**
Battery Limits are boundaries which identifies the design "break" between the main industrial plant and external site services. The location known as Inside Battery Limits (IBL) normally contains the main process plant and is able to be isolated from the external site services, firewater, utilities, ancillaries and control locations. Most modularised plant would lie within the IBL.

The steelmaking companies would consider the smelting activities to be IBL and the support services and related activities of East West Line Parks Pty Ltd to be Outside Battery Limits (OBL).

## 3.0 MODULARISATION

There are three basic reasons to consider modularisation:

a) Improve, protect and accelerate the schedule.

b) Reduce capital expenditure.

c) Reduce peak site construction labour force.

***Schedule***
Modularisation protects or can improve the schedule because:

- Civil and mechanical works can be carried out in parallel;
- Many workfaces are available at hook-up commencement;
- Commissioning time at site can be shortened;
- Weather conditions have less impact on construction works.

**Capital Expenditure**
Modularisation entails both cost increases and cost decreases. It is the extent to which modularisation is employed that is the key to ensuring the overall costs are reduced by the construction and delivery methodologies.

Refer to Table 2 (Modularisation - Costs/Benefits/Labour) for more detail.

**Peak Site Construction Labour Force**
Modularisation removes workscope from the plant site. This reduces the total hours and peak workforce deployed at the construction site.

**Additional Benefits**
Prudently applied modularisation will also deliver general project benefits in:

- Safety;
- Quality;
- Project environmental impact;
- Benefits through the application of newer and higher technology.

The extent to which the additional benefits are delivered is incremental across many activities of a modularised project.

Table 3 provides a general view of the cost impacts on the project budget caused by modularisation.

Table 4 provides an overview of the general project advantage of modularisation.

Table 5 provides an overview of the general project disadvantages of modularisation.

## 4.0 CONCLUSION

Modularisation and pre-assembly will deliver substantial savings inside and outside the smelter parks. For the steelmakers and East West Line Parks Pty Ltd, there will be considerable cost and schedule benefits through front end loading the design of smelters and smelter utilities. Not all parts of the project may be modularised, e.g. the civil engineering component may comprise 23-35% of the overall project cost.

Modularisation of smelters and shared smelter utilities is considered relatively novel but a highly valuable component of Iron Boomerang. A Scoping Study will be the initial front end loading component of the design since it will identify:

- Elements of the project suited to modularisation and pre-assembly;
- Capital cost benefits that may be delivered through avoidance of stick-building;
- Life cycle costs that may be delivered through innovative design and construction;
- Environmental benefits of avoidance of stick-building;
- Social benefits derived through the use of less fly-in fly-out (FIFO) labour.

Modularisation and pre-assembly can dramatically reduce project schedule. Inevitably, this will accelerate delivery of initial slab production and front end revenue for all project participants.

**Table 2 Modularisation - Costs/Benefit/Labour**

| COSTS | BENEFITS | PEAK SITE LABOUR |
|---|---|---|
| Significant areas of extra cost associated with modularisation are:<br><br>• Increases engineering hours;<br>• Increases steelwork material and offsite fabrication;<br>• Increases handling costs. | Cost benefits are delivered in many ways. These can be significantly greater than the extra costs involved in engineering and offsite fabrication. Principal benefits are:<br><br>• Better conditions in the fabrication shop;<br>• Improves productivity;<br>• Better QA leading to less rework;<br>• Less QA/QC required on site;<br>• More stable workforce;<br>• Offsite labour is cheaper than site labour;<br>• More familiarity with work procedures;<br>• Improves safety;<br>• Reduces temporary weather protection at site location;<br>• Reduces weather downtime;<br>• Reduces site installation scaffolding costs;<br>• Reduces potential for industrial disputes. | Reducing the peak labour force on site delivers the following benefits:<br><br>• Reduces camp and temporary construction facilities leading to reduced site costs and reduced land disturbance;<br>• Reduces site supervision and consequently indirect overheads;<br>• Improves safety through reduced site congestion;<br>• Reduces scaffolding requirements;<br>• Reduces camp population which reduces environmental impact on locality;<br>• Reduces stress on local community and health services;<br>• Reduces travel and other costs associated with fly-in fly-out (FIFO) construction operations;<br>• Reduces exposure to skills shortage at site location. |

**Table 3 General Costs Effects of Modularisation**

| ACTIVITIES | ISSUES | IMPACT |
|---|---|---|
| Engineering | Increases detail. | **UP** |
| Civils | Access roads, labour and materials. | **UP** |
| Concrete | Slight decrease due to smaller footprint | **DOWN** |
| Structural steel | Approximately 2.5 times extra | **UP** |
| Buildings | Less required | **DOWN** |
| Machinery and equipment | Slight increase due to shipping costs | **UP** |
| Piping | Decrease (maybe 15%) | **DOWN** |
| Electrical | Slight decrease | **DOWN** |
| Instruments | Slight decrease | **DOWN** |
| Coating and scaffolding | Better labour efficiency | **DOWN** |
| Insulation | Slight decrease | **DOWN** |
| Testing and Precommissioning | Better managed in shop environment | **DOWN** |
| International expenses | Slight reduction | **DOWN** |
| Temporary construction facilities | Marked decrease in all site facilities | **DOWN** |
| Transportation | Significantly higher costs | **UP** |
| Construction (services and supplies) | Marked reduction in all field activities | **DOWN** |
| Field staff (subsistence and expense) | Reduction but not linear | **DOWN** |
| Payroll (bed and board) | Substantial reduction | **DOWN** |
| Construction equipment | Less required at field location | **DOWN** |

**Table 4 General Project Advantages of Modularisation**

| ADVANTAGE | IMPACT |
|---|---|
| Reduces schedule<br>Improves productivity | Work is done in an offsite location that will allow other activities on site to proceed. |
| Reduces labour congestion | Concurrent work being done in different locations. |
| Increases craft productivity | Work can be done in an environment more suited to the work and/or a controlled environment resulting in better quality and higher safety outcomes. |
| Reduces labour rates | Work can be done in a location where the market is more competitive and lower labour rates. This may include construction in countries with lower hourly rates. |
| Reduce impact on local culture | Less impact on local community, e.g. less dependent on local suppliers, less traffic movements, less stress on local social infrastructure. |
| Reduces site risk | Workshop environment mitigates possible impacts of issues related to weather, labour and materials. |
| More ground level work | Increased ground level work improves safety outcomes. |
| Reduces site construction | Reduced infrastructure required on site. |
| Lowers overall costs | For Iron Boomerang, it is the combination of the above that will deliver lower overall project costs. |

**Table 5 General Project Disadvantages of Modularisation**

| DISADVANTAGE | IMPACT |
|---|---|
| Increases engineering and home office costs | More detailed engineering is required at front end of project to accelerate procurement and construction. |
| Increases structural material requirements | Modules require to be robust for transportation and setting. |
| Requires early fix on process, basic data and work scope | Schedule is dependent on early design freeze for all discipline interfaces. |
| Requires early "no change policy" in engineering | Late changes have serious cost and schedule implications for a modularised project. |
| Requires an early fix on plot plan and equipment arrangement plans | Detailed engineering for plant and module sizes IS dependent on known plant site parameters. |
| Requires tight control of schedule activities | Activities become more crucial with little room for slippage due to interdependencies between modules. |
| Number of participants increases | More and varied roles become part of the project's critical path. In addition, more site teams for module fabrication yards. |
| Fewer fabrications yards | The choice of fabrication yards may be limited within reasonable distance of the job site. Australia is a long way from Asia. |
| Increases cranage | Requirements and cost of cranage is increased particularly for heavy loads. |
| Increases transportation | Land and sea transportation are increased with inherent risk of losses. |
| Increases management focus | Module design and construction requires a constant focus of design and construction teams to police progress. |

## Shane Condon:
## Project Founder and Team Leader

**Work Qualifications & Experience Brief.**

- **Contract Food Industry Management Consultancy-Australia and Asia/South Pacific: 20-years**
- **Leadership, Strategic Planning and Implementation Management Responsibilities:**
  - New and Existing Business; Project Development Efficiency/Expansion-Critical Process/Supply Chains-Recovery & Turnarounds.

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- **New and Established Business Development and Growth:**
  Operations-Marketing-Product Development-Process/Quality & Product Improvement/Development-Efficiency-Analysis-Reports-Strategic Business and Operational Budget Financial Planning-Investigation-Project Management & Implementations. Agro and Fisheries Economic Development Programmes Asia/South Pacific "Government and Private Sectors".
- **Founded N- Australia Export/Domestic Seafood & Meat Business:**
  - **Award "Marketing & Business Excellence", Confederation of Industry and Government.**
  - Harvesting- Processing- Operations- Domestic and Export Processing, Marketing-Trading Business.
  - 120-staff and direct dependent contractors. $6 Mil internal + $5 Mil contract Marketing =$11 Mil pa.
- **Three successful Food Industry Turnaround Consultancies:** "Crisis Management & Leadership".
- **10 years USDA Registered Export Meat and seafood Industry Management Experience:**
  - Progressive early management career base experience from trainee-cadet to management of all key operations divisions. Boning Room-80 staff; Slaughter Floor-40 Staff; Export Cold Storage & Shipping; 5-Retail & Wholesale Butcher Shops; Large Pasture Farm (10,000 acre)-Grain Cropping, Intensive Piggery & Cattle Stud-up to 25 staff; Establishment of New Prawn Processing Factory & Prawn Trawler Fleet, Operations + Induction Training.
  - Export Market Research/Development/Implementations - Japan, USA, South America and SE Asia.
    - Reports to Executive Management and Board of Directors.
- **Aquaculture**: **Pioneered Australia's First Prawn Farm**, Port Roper NT. *Private project!*
- **International Packaging Awards** nominated "original" design concept as Australia's entry**.**
- **Establishment of "Leading" Worlds Best Practice Food Industry Product Standards:** "Quality/Price" for continuous leading benchmark product, process & operational standards.
- **Education Philanthropy Project Establishment – Pre-School, Fiji.** A Condon family philanthropy project to initiate, organise co-sponsor and jointly seed finance, with the Australian Embassy-Foreign Aide, to establish run and operate a much needed education gap facility - Church multiracial pre-school, accommodating over 80 Preschool Children in two daily sessions. Still operating.

**Education:**

- **2006: MBA, University of Queensland (near completion)**

  **Three High Distinction major report marks to date!**
- **2002: P-Grad Cert Degree. "Management" University of Queensland**

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## Gordon Thomson:
## Deputy Project Leader and Western Australia Team Leader

**BSc (Hons), MBA, F Fin**

**Engineer & Business Developer:**
**Process Engineering, Facilities Design, Project Management, Marketing, Business Development and Technical Authoring.**

**Career:**
Commenced engineering career with Shell International in 1974 with a three-year posting to the offshore oil/gas production operations in Qatar.

- **30 years as an Engineer and Business Developer** in UK North Sea, Norway, Brunei Darussalam and Australia.
- **Last 17 years to Present**: Operated a family-owned Perth & WA based private consultancy company as an independent contractor/consultant.

**Clients:**
Fluor-Daniel, Government of Western Australia, Technip France, Technip-Coflexip, Kimberley Oil, Amira International, UK Government, Water Corporation of Western Australia, BHPB Billiton Iron Ore and BHP Billiton Petroleum and Monadelphous Engineering.

**Academic:**
**1974** Batchelor of Science (Hons) in Mechanical Engineering
University of Strathclyde, Glasgow, Scotland.

**1989** Master of Business Administration
South Australian Institute of Technology, Adelaide, Australia.

**2000** Graduate Diploma in Applied Finance and Investment
Securities Institute of Australia, Perth, Australia.

**Memberships:**
Fellow of the Financial Services Institute of Australasia
Member of the Petroleum Club of Western Australia

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## Saul Eslake:
**Leader, Economics Marketing & Business, Media and Political**

**Chief Economist ANZ "Australia and New Zealand Banking Group"** from Aug 1995**.**

- Member – Group Asset & Liability Committee: Mgt of ANZ's Bal/Sheet.
- Chairman of ANZ Cover – Internal Crime, Fraud & Prof/Indemnity Insur/Cover.
- Member – Corp. & Institutional Bank's Sustainability Steering Committee: Environmental & Social Issues.

**Previous Positions**:
1991-95: **Chief Economist** (Int) National Mutual Funds Management (now AXA Insur Group)
1981-86: **Chief Economist** Stockbroking Firm Mc Intosh Securities Ltd. (now Merrill Lynch)
< 1981: **Economist** Australian Government, including 2 years with Treasury.

**Education**: Hons Economics; Dip Applied Finance and Investment; 2003 Senior Executive Programme at Columbia Graduate School of Business, USA.

**Current Fellowships & Memberships**:
**The Australian Government**: Foreign Affairs Council / Trade Policy Advisory Council / World Trade Org Advisory Group / Tourism Forecasting Committee.
**Other:** Non-Exec Dir Aust Housing & Urban Research Institute; Dir University of Tasmania Foundation; Securities Institute of Australia; Assoc Aust/Institute of Management; Aust/Institute of Company Directors; USA National Association of Business Economists; The Australian Representative on the Int/Conference of Commercial Bank Economists.

**Services to Australian / State Governments & Institutions:**
CEO Victorian Gov. (Vic) Commission of Audit; Director Gascor – (Vic/Gov-Gas & Hospitals);
Invited & Accepted March 2005 – To Chair the Independent Project Management Committee for the City of Launceston, Tasmania. -To develop a vision for the community for the year 2020!

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## David Graham Russell RFD QC:
## Corporate Legal Business Facilitation Advisor

Called to the Bar in 1977, having been admitted as a solicitor in 1974.

Admitted to practise in New South Wales, Queensland, Victoria, the Northern Territory, the Australian Capital Territory and Papua New Guinea, David took silk in 1986 and holds that office in all the above jurisdictions, except Papua New Guinea.

He has served as a Judge Advocate and is a Wing Commander in the RAAF Legal Reserve.

David's principal area of practice is Revenue Law, which requires an understanding of commercial and administrative law. He has acted for Commonwealth and State Governments as well as individuals and corporations. David's other areas of expertise include: **Constitutional Law - Corporate Law - Equity**

David was President of the **Taxation Institute of Australia** (1993-5), and of the **Asia Oceania Tax Consultants' Association** (1996-2000). David served as Chairman of the National Education (1991-3) and International Relations (1995-2001) Committees of the Institute, is a member of its National Technical Committee and the **Law Council of Australia Business Law Section** Taxation Committee. He has been appointed an Honorary Adviser of the Asia Oceania Tax Consultants' Association. He served as a member of the Ministerial Consultative Committee for the Tax Law Improvement Project from 1994 to 1997 and as a member of the Steering Committee for the National Review of Standards for the Tax Profession in 1993 and 1994. From 1991 to 1995 he was a member of the National Tax Liaison Group.

David is the author of many published **articles and conference papers**, both inside and outside Australia, and is a member of the Advisory Editorial Board of **Australian Tax Practice.** He also lectures at the University of Queensland for the Master of Laws course, is an Adjunct Professor of the **Faculty of Business, Economics and Law** of the University of Queensland and is a member of the Industry Advisory Board of that University's **Australian Centre for Commerce and Taxation**. He is also an Advisory Board Member for Griffith University's **Key Centre for Ethics, Law, Justice and Government**.

He has been a member of the Management Committee **Australia - Japan Society, Queensland** since 1994, its Vice President in 1995-6 and President from 1996-2001. He was President of the **National Federation of Australia Japan Societies** from 2001 to 2005 and is a member of the Executive Committee for the **2006 Australia Japan Year of Exchange**.

David is actively involved in the operations of his family's business, Russell Pastoral Company. He is the third generation of his family to do so. **Russell Pastoral Company** carries on business at Dalby, Cunnamulla and Blackall. Its flagship property, **Jimbour**, is one of Queensland's oldest stations, dating back to 1841. In addition to pursuing the Company's interests in the cattle, wool, grain, wine and tourism industries, David has served as a director of the **Queensland Wine Industry Association**, the peak wine industry body for the state, and from 2002 served as its President. In 2003 he became a Committee member of the **Australian Regional Winemakers Forum**, and in 2004 was elected its Vice President and one of the members of the Council of the **Winemakers Federation of Australia**.

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## Prof Robert G (Jerry) Bowman, PhD, CPA:
## Chief Financial Officer

**PhD, Stanford University.**

**Emeritus Professor of Finance at The University of Auckland.**
- **Bank of New Zealand Professor of Finance**
- **Certified Public Accountant** (California, inactive).
- **University of Oregon, 1974-1987.**
- **Visiting Academic Positions**: Australian Graduate School of Management, University of Queensland, Southern Methodist University, National University of Singapore and Hong Kong Polytechnic University.
- **Published** numerous articles in international journals in Finance, Accounting and Economics.

**Presentations and Awards**:
- Invited guest presenter at numerous universities and international conferences.
- Awards for teaching and research.
- Executive education presentations for major corporations.

**Appointments and Positions:**
**Head of Department and Head of Finance for most of academic career.**
- Chair in Finance at the University of Auckland, 1987 to present.
- Head of Finance at the University of Auckland - 12 years;
  - Developed finance from no dedicated staff or curriculum into one of the top finance groups in Australasia.
- Head of the Department of Accounting and Finance - 3 years.
- Head of the Department of Accounting at the University of Oregon while on that faculty.

**Substantial commercial consulting and management experience.**
**Prior to Academic Career**
- **Audit manager** with Arthur Young & Company, USA
- **Treasurer and Chief Financial Officer** of Cohu, Inc., USA, diversified high technology company, then listed on the American Stock Exchange.

**Subsequent to Beginning of Academic Career**
- **Consultant and expert witness** for major companies in New Zealand, Australia, Fiji, Italy, Singapore and the United States.
- **Consulting engagements** primarily for regulated businesses and in three areas: Cost of Capital; Valuation; and Mergers and Acquisitions.
- **Advisor** to the National Competition Council (Australia); Ministry of Economic Development (New Zealand); Office of the Rail Access Regulator (Australia); Research work for the New Zealand Treasury.
- **Major Engagements** with Australian rail firms (Railways, Freightways, Northern Territories Rail, Queensland Rail, Rail Access Corporation and Western Australia Rail)

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## Professor Art Shulman:
## Leader, Best Practice, Project Editorial and Education Development Facilitation

**Professor of Business Griffiths University:** Art is a leading researcher, teacher and consultant in Knowledge Management, Innovation and Commercialisation Alliances (policy and practices).
**Duties Griffith University:** Administrative responsibilities within the Pro Vice Chancellor (Business and Law) office for ensuring that all facets of the School meet or exceed International best practice standards.
**Academic:** 39 PhDs supervised to completion, authored or co-authored over 100 publications.

**Research Tasks:** Focuses on improving public sector- private sector alliances.

Recent Work Grants

- **Australian Research Council grants**, LWRRDC and GRDC grants and competitive contracts from Government organisations including IPPA (Qld), HIC, PHARM, Murray Darling Basin Commission, QDPI, RTA-NSW, NSW Treasury,
- **Private sector consultancies** with Merck, Telstra, National Mutual, and Suncorp Metway.

**Business Advisor and Reviewer:**

- Research programs, corporate strategies, stakeholder communication practices and policy
- Commonwealth and State government agencies and collaborative research Centres in Australia and elsewhere. Scholarship recognised internationally.

**Awards**

- Fellowship status by the American Psychological Society for work in research methodology and fellowship status by the Board of Governors of the Communication Institute of Australia

**Honours**:

- Inaugural Ashworth Fellow- University of Melbourne, where he led a team of researchers in research with Telecom Australia developing methodologies for evaluating the social and economic impact of new telecommunication systems.
- Visiting Fellow appointments at the University of London, AGSM-UNSW, MIT best
- Published research paper awards.

**Presentations:** World Congress on Total Quality, at three National R&D Forums, the National Agricultural Systems Purchasers Forum, and for the Malaysian Ministry of Health sponsored WHO meetings on improving Medicine policies and practices.

**Previous:**

- Associate Professor of Management at the University of Queensland,
- Principal Research Fellow of the Communication Research Institute of Australia,
- Director of PHD programs in Organisational Behaviour and Social Psychology, Washington University, St Louis, Mo.USA.

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## Stephen Kennedy:
## Leader, Business Development Marketing/Planning Pre-and Feasibility Studies

**Senior Consultant – Investment and Business Planning**

- Experience of market and strategic studies within the non-ferrous and ferrous metals industries and financial modelling experience of process industry projects.
- Currently working with financial institutions, commodity traders and facility owners on corporate assessments from London, covering Europe, Russia & CIS, Africa, USA and the Middle East.
- Over 15 years experience on complex multi-disciplined energy, metals, minerals and infrastructure projects. Project roles have developed a strong capability in project management systems, contract management, cost engineering and scheduling. Strong foundation in the planning and design of mine infrastructure, major roadwork's and railways from various civil engineering roles.

**Key Skills:**

- Technical due diligence / reviews
- Pre-feasibility and feasibility studies
- Competent person's report
- Market studies
- Strategy development
- Financial modelling
- Valuations
- Project management
- Contract administration
- Cost engineering
- Planning and scheduling
- Mine infrastructure planning and design
- Major road infrastructure planning and design
- Railway planning and design

**Previous Positions**:
2002-03: **Consultant – Investment & Business Planning** Hatch Associates Limited (London)
2000-01: **Senior Project Engineer** Hatch Associates Limited
1998-99: **Senior Project Engineer** BHP Engineering Limited (now Hatch)
1996-97: **Civil Engineer** BHP Engineering Limited
1986-95: **Civil Engineering Technical Officer** – various roles with leading consulting engineering firms

**Education**:
Master of Business Administration - University of Queensland (2001)
Bachelor of Engineering (Civil) with Honours - Queensland University of Technology (1996)
Associate Diploma Civil Engineering - Queensland Institute of Technology (1987)

**Current Fellowships & Memberships**:
Member of the Institution of Engineers, Australia – Civil

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**Clem Tisdell:**
**Environmental & Economics, Editorial Support**

**Professor Emeritus, School of Economics**
**The University of Queensland**

**Previous Positions:**

1989-2004 Professor of Economics
The University of Queensland

1972-1989 Professor of Economics
The University of Newcastle, NSW

1964-1972 Reader in Economics,
Australian National University.
Plus other positions in Economics

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**Education:**
B. Com with 1st Class Hons in Economics and University Medal, UNSW
PhD (ANU)

**Fellowships etc:**

- Fellow of the Academy of Social Sciences in Australia (FASSA)
- Honorary Professor, People's University of China

**Publications, Consultancies etc:**
Author of more than 60 books and over 700 articles, many dealing with environmental economics. Wide range of consultancies completed for Australian and international clients.

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## Anton Michielsen:
## Leader, Rail Line Planning & Construction

**Leighton Contractors Pty Ltd,**
**Design Director, Gateway Upgrade Project, Leigthon Abigroup Joint Venture**
Member of the Executive Management Team for LAJV's $1.88 billion Gateway Motorway and Bridge Upgrade Project (GUP) for the Queensland Motorways Ltd. As Design Director he led the projects strategic direction with respect to value engineering, design and construction delivery and project risk assessments. He engaged and directed a team of LAJV Design Managers and consultants, with over 250 people involved, in the preparation designs for tender, detailed design and construction plans. This combined inputs of from construction cost estimators, builders and consultants to develop innovative competitive tenders to client's specifications. The project is under construction and due for completion mid 2010.

Within Leighton Contractors (LCLP) the projects he has been involved in include;
- Gateway Upgrade Project D&C, $1880 mil, 20km motorway and 1700m long bridge in the Brisbane CBD
- Adviser to BLJV North-South Bypass Tunnel BOOT Project tender, $3000mil for Brisbane City Council
- Adviser to LCPL Airport Link Tunnel BOOT Project tender, for Qld Gov.

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**Previous Positions**:

**Feb 2005 till July 2005 MetTRIP Network Program Manager, Queensland Rail**
SEQIPP*Rail* (formerly MetTRIP) is a recent Qld Department of Transport program of major infrastructure capacity enhancements of the Brisbane Metropolitan Rail System. As Program Manager he was a member of the MetTRIP Steering Committees and he devised and promoted the program of project alliance agreements which were adopted for the delivery of QR's major metropolitan rail program.

**1987 to 2005 Maunsell-AECOM , ANZAME region– Director from 1997, Engineer from 1987**
Industry Director, Major Projects for Maunsell–AECOM, a US publicly listed engineering and professional services company with a turn over US$ 4000mil. He participated at a senior level in major transport projects in Australia and throughout Asia, including Singapore, Hong Kong, Philippines and Delhi, India. He was accountable and responsible for the project management and technical aspects of many complex multi-disciplinary transport facilities, motorways, transits, metro's, railways, freight stations . Major projects include;
- Delhi Metro MC1a D&C in India, 4 km underground metro in the northern sector of Dehli, US $500mil
- Urban Motorways and tunnels in Australia, Mitcham-Frankston Tollway, Pacific Motorway, Brisbane Inner City by-pass which won the national engineering excellence award in 2002.

**1983 to 1987 Hughes Trueman Ludlow Pty Ltd – Engineer**
Engineering design and contract administration of civil works, roads, sub-divisions and buildings

**Education**:
MBA at University of Queensland, 2005
B.E Civil Engineering (Hons), University of Adelaide. 1982
Engineering Contract Management, Bruce TAFE, ACT. 1985

**Affiliations:**
Member Engineers Australia, NPER No. 183898
Registered Professional Engineer of QLD RPEQ 6016

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## Ross Hunter:
## Leader, Precincts & Infrastructure Developments & Government Support Services

**Senior Consultant – Project Management: Rail Infrastructure**

- Extensive experience (30 years plus) major rail projects planning and delivery - new railways - major rollingstock acquisition projects.
- Registered Project Director (PMRC)
- Ten years as capital works program director for Queensland Rail, overseeing A$6 billion expenditure on infrastructure and rollingstock projects. Project Director/Manager major individual projects - Gold Coast Railway, Mainline Upgrade, Inner City Quadruplication, Cairns Tilt Train and Coal Rollingstock Projects.
- Four years overseeing engineering resources of Queensland Rail, comprising 500 engineering and technical staff covering all rail-engineering disciplines.
- Currently Senior Coal Transport Advisor to the Queensland Government, covering planning and integration of a major expansion of rail and port transport capacity within the Queensland coal supply chain.

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**Key Skills**

- Rail transport planning; Project Director/Project Manager; Feasibility studies; Investment evaluation
- Capital works program management.

**Previous Positions**

- 2003-6**: Senior Consultant** – Coal Transport Advisor to Queensland Government;

  **: Director - Ranbury Management Group** (project management specialist consultancy group)
- 1999 – 2003: Group General Manager Technical Services, Queensland Rail
- 1990 – 1999: General Manager Projects, Queensland Rail
- 1972 – 1990: Various engineering and management positions, Queensland Rail, focussed on major project planning and delivery

**Education:**

- Bachelor of Civil Engineering (Honours)– University of Queensland (1972)
- Various post-grad subjects and courses

**Current Professional Affiliations**:

- Member Australian Institute of Project Management; Member Railway Technical Society of Australia
- Registered Professional Engineer of Queensland.

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## David Belham
**Executive General Manager & Project Member**

**Membership Duties:**
International Investor Facilitation - Management & Co-ordination – Communications Including Media Project Spokesperson - Logistics' - Administration & Marketing.

## Career:

- **Appointed by the Premier of Queensland to establish and open the Queensland Government Trade and Investment Office – India.**
- **2004 – 2007, Commissioner, Queensland Government Trade and Investment Office – India**, responsible to represent State of Queensland and for all Queensland Government activities in India.
- **Director, Information Management, Queensland Government 1998 - 2004**.
- Responsible for planning and implementation of economic and aid development projects throughout the South West Pacific and South East Asia 1992 -1998 for Federal Government.
- Senior officer in the United Nations Transition Authority in Cambodia during 1993.
- Extensive experience in the military, government and international affairs, including 25 years as a Department of Defence international communications specialist.

## Education:

- Graduate, Army Command and Staff College 1991
- Graduate Diploma Management Studies, Canberra ACT 1994
- Bachelor of Professional Studies (Major Asian Studies) University of New England, Armidale NSW 1995

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## Daniel Dezentje

**Associate Member:** Infrastructure Planning Management and Surveying.

**Current work position:**
Director, Intercontinental Project Management

15 years of construction / development experience in Projects up to $3 Billion including refineries, railways, infrastructure, buildings, utilities and services.

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**Career:**

- 2005-2008 Contracts / Project Manager and Principles Representative - Rio Tinto Alcan.
- 2004-2005 Consultant – Gold Coast City Council.
- 2003-2004 Construction / Project Manager – Ardmore Construction
- 2001-2003 Project Manager – Thiess Infraco.
- 2000 Project Manager – Coby Constructions
- 1993-1999 Various Construction / Development positions in Australia - BHP, Rio Tinto Coal (Coal & Allied), Queensland University of Technology, Tweed Shire Council – and in the United Kingdom - Christiani & Neilson / May Gurney JV, Davies Middleton & Davies, Interserve Project Services (ex - Tilbury Douglas), McNicholas Plc, etc.

**Key Strengths**

- Project Management.
- Commercial Management.
- Contract Management
- Engineering Management.
- Procurement Management
- Construction Management.
- Principles Representative
- Management of external agencies, contractors, suppliers and consultants in project development, execution and commissioning, etc.
- Management of multiple operations both on/off Site.
- Risk Analysis & Feasibility Studies.
- Financial propositions for Project development.

**Education**

- Grad. Dip. of Project Management - Queensland University of Technology, Australia
- Bach. of Surveying - Queensland University of Technology, Australia
- Cert. of Engineering/Construction - Yeronga College of TAFE, Australia
- Cert. of Computer Aided Drafting - Yeronga College of TAFE, Australia

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**Matthew Magin**
**Central Queensland Business Coordination and Development**

**Current work position:** Regional Relationship Manager Abbot Point (Contract position with Ports Corporation of Queensland)

**Career:**

- 12 years Federal & State Govt experience both political &bureaucratic
- 5 years CEO of a regional economic development organisation
- 10 years self employed in business I started from scratch
- 20 years senior management experience in retail industry

**Career Highlights/Achievements**

- Ongoing investment Attraction-CHALCO Aluminum Smelter ($2-3b)
- Sino- Australia Coal Summit
- Regional Housing Summits
- $5M grant for Mining Simulator Training and R&D Centre for Mackay region
- $28M grant for Mackay Water Re-use scheme
- $2M grant for new library @ CQU Mackay campus
- $4M grant Mackay Aquatic Centre
- Development of Bowen Economic Development Strategy
- Aquaculture Industry development in the Mackay region
- Formation of International Education & Mining Services Industry Clusters
- Conduct overseas trade missions & facilitate inbound trade missions
- Manage > $2.5 M in State Development grants since 1998
- Development of the Mackay Regional Water Resource Strategy
- Attraction and retention of Queensland Mining Exhibition for Mackay region

**Key Strengths**

- Networking/ Establish & maintain internal & external relationships
- Strategic leadership skills
- Organisation, co-ordination & facilitation skills
- Senior and general management

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## Haruhiko (Haru) Kinase:
**Japan/Asia Business Officer**
**& Precinct Engineering & Environmental Planning Services.**

**Education:**
- **Master of Business Administration:** Anaheim University, USA, 2004.
- **Master of Engineering:** Chiba University, Japan, 1996.
- **Bachelor of Engineering:** Chiba University, Japan, 1994.

**Career:**

- **1996 to 2007: Mechanical Engineer with Asahi Shimbun, Tokyo – 11 years;**

  A Japanese newspaper company with a circulation of over 8 mil newspapers per day and with more than 5,500 employees in Japan. Haru's main role was in operating, repairing and maintaining the printing presses and other printing equipment.

  - **2004 - 2007: Positioned as a key member of the project team to renew and upgrade the existing printing press and other printing equipment**; the project costs more than A$20million.
  - **2004 - 2007: Member/Director of the Environmental Management System (ISO 14001) project at Asahi Shimbun.** As the Director of ISO14001, Haru managed and oversaw 20 project team members. The purpose of the project was to increase energy and resource saving as well as reduce waste. The project successfully set up and carried out PDCA (Plan- Do-Check-Action) cycle and ensured the continued ISO 14001 certification for the company.
  - **2006 - 2007: Member - Japanese Newspaper Association** which edited and published over 5,000 copies of "Newspaper Printing handbook" for distribution amongst the Japanese Newspaper Association to raise the level of technical skill and knowledge.

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## "Nick" Fei Meng:
## Project Officer (China Asia-Pacific Trade Economist and Marketing)

**Education**: BEc, MBA

- **Master of Business Administration,**
  Business School, The University of Queensland, Australia.
- **Advanced English,**
  Edinburgh's Telford College, UK;
  International student representative.
- **Bachelor of Economics in Foreign Trade,**
  Business School, Dalian University, China;
  Editor of "Campus Monthly"

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**Nick Fei MENG** completed his MBA in 2005 with a part-time position as Assistant Marketing Manager, Anti Wave International, 2003-2004, with responsibility for expanding business into the Chinese market, ensuring collaboration between the company and its Chinese subsidiary company, and building and managing relationships with Chinese customers, including the China 2008 Olympic Committee. Nick has honed his skills in marketing, import and export, customer service and management through his varied and international experiences.

**Previous Positions**:
1998-2002: China -Business Branch Manager of Korean Mega Trading Limited.
1996-98: China-Commercial Representative MINMETALS (Liaoning) Import & Export Ltd.

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## Yi-Ling Chan:
## Project Officer, Project Administrator & Co-ordinator

**Education**:

- Master of Business Administration,
  University of Queenland, Australia.

- Bachelor of Arts (Geography and Psychology majors),
  National University of Singapore, Singapore

**Previous Positions:**

2001 – 2006: Joined **American International Group Pte Ltd, Singapore** in August 2001 and rose to the position of Head of Customer Service Centre in June 2003. Responsible for recruiting, training and managing graduate customer service executives; evaluating the change process and providing feedback to Management on the progress in addressing project objectives and managing customer complaints in relation to product liability. Spearheaded the design, development, re-location and successful launch of a new customer service centre with a double capacity volume and increased performance targets by 30% by re-engineering work processes to improve productivity. Job rotation in February 2005 to Compliance Department to understudy corporate audit procedures and regulatory requirements.

2000 – 2001: appointed Assistant Customer Service Manager with **JTC Corporation, Singapore** a quasi Singapore government land-lease organization.

1991 – 1997: Fund-raiser at **National University of Singapore, Singapore.**

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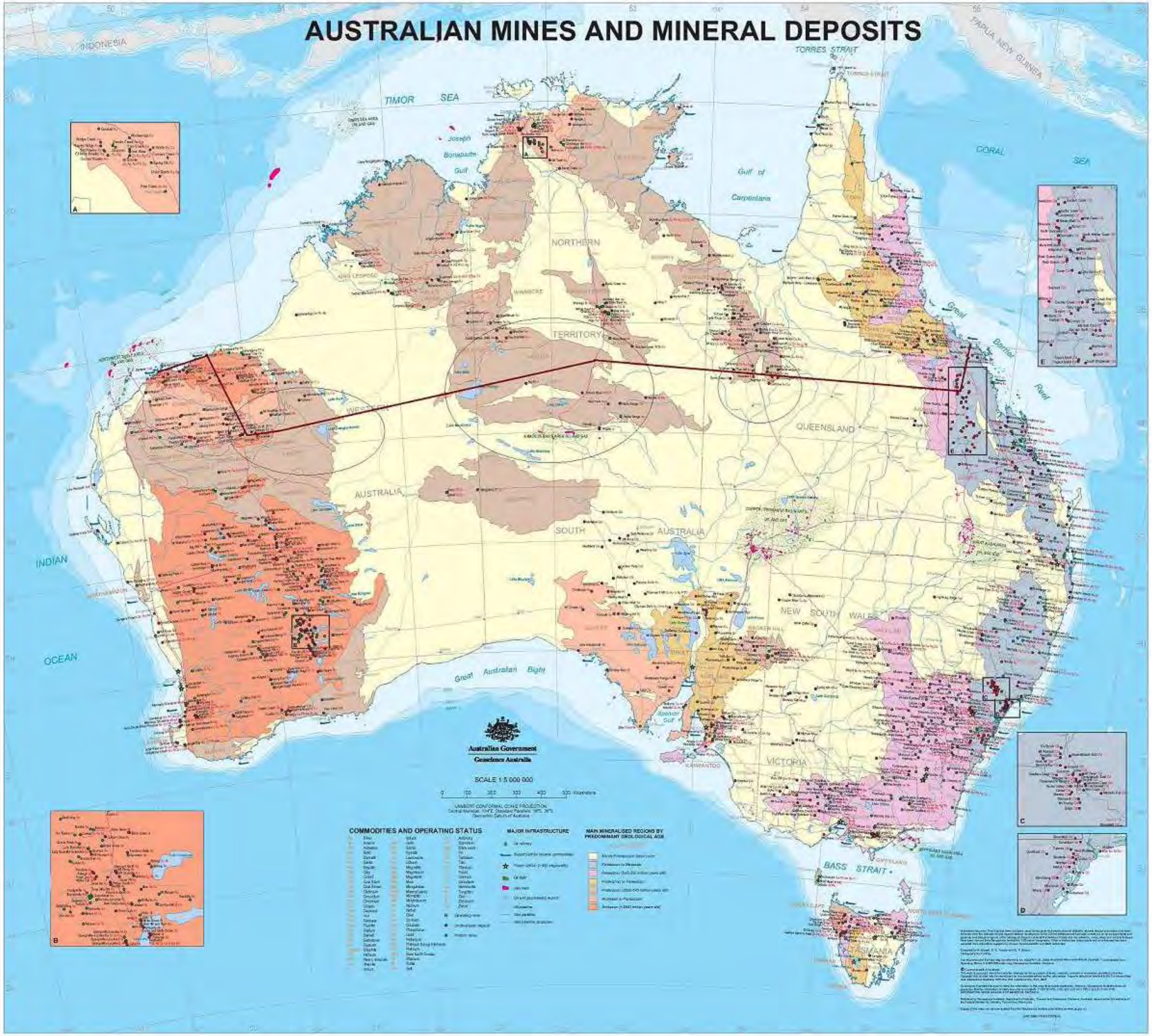
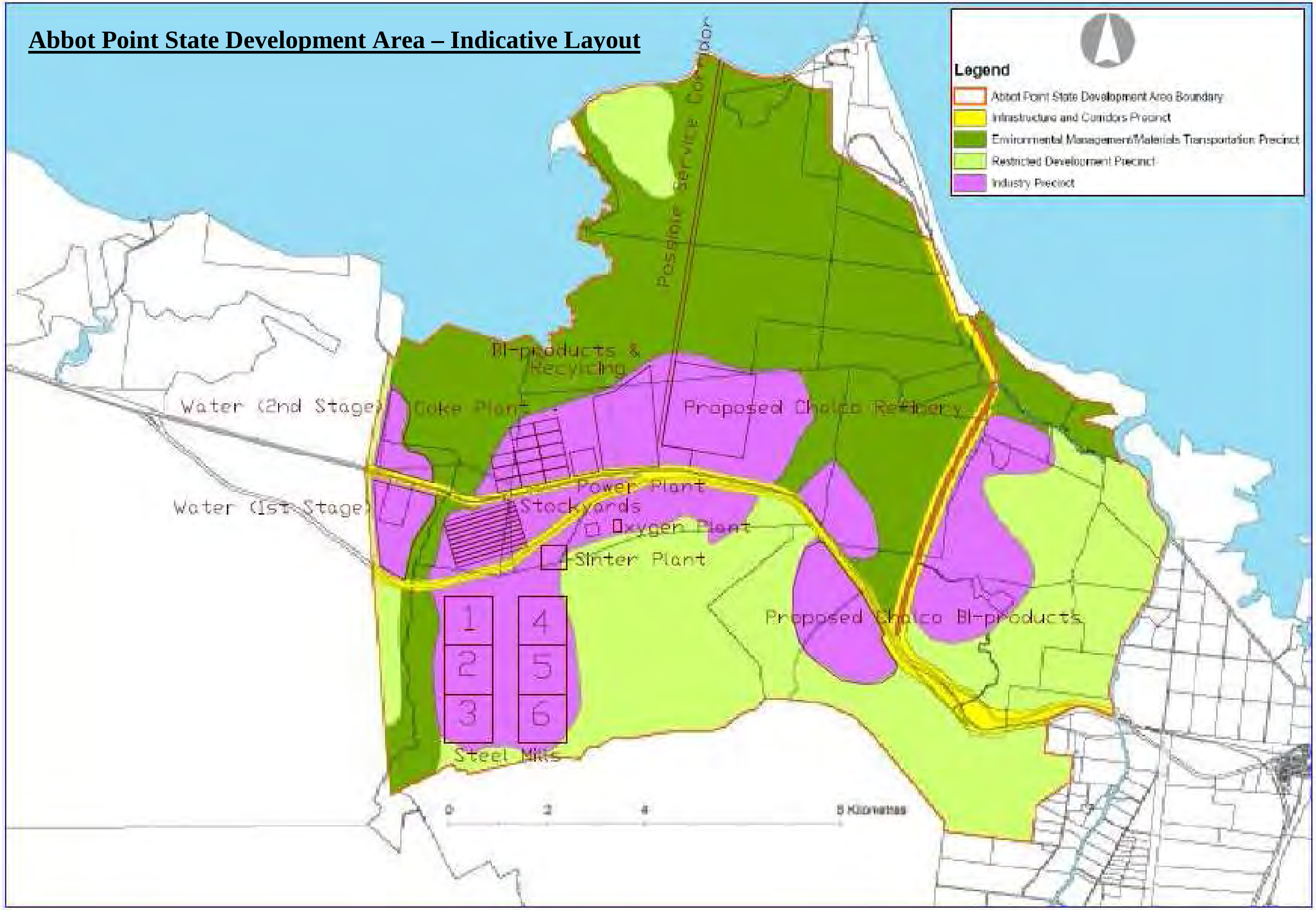
# Project Iron Boomerang Trans Continental Line Crossing New Mines and Mineral Deposits






Note: Illustrative purposes only. Compiled from Queensland Department of Infrastructure & Planning records.

While every care is taken to ensure the accuracy of this product, East West Line Parks Pty Ltd, the Queensland Department of Infrastructure & Planning and Natural Resources & Water Queensland make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.

**Initial Scoping Study approximate areas:**

- **Steel Mills** (BF, BOF, CC) – 6 no. 100 Ha Blocks, with a 500m wide Service Corridor. (Each 1000m x 1000m).
- **Power Station** – 1 no. 25 Ha. Block (500m x 500m).
- **Stockyards** – 10 no. 15 Ha. Blocks (Each 1500m x 100m).
- **Coking Plant** – 13 no. 12 Ha. Coke Batteries. (Each 500m x 250m).
- **Air Plant Area** – 1 no. 6 Ha. Block. (250m x 250m).
- **Water** (1st Stage) – Approx 150 Ha.
- **Water** (2nd Stage) – Approx 100 Ha.
- **Bi-products and Recycling** – Approx 200 Ha.
- **Sintering Plant Area** – 1 no. 25 Ha. Block (500m x 500m)

**Total PIB Scoping Area + buffer zones: 1,500 to 2,000 Ha.**
**Other:**

- Proposed Chalco Refinery (Bauxite to Alumina) – Approx 300 Ha.
- Proposed Chalco Bi-products – Approx 375 Ha.

**Note on PIB Steelmaking $CO_2$ in comparison with a major national Steelmaker.**

The $CO_2$ big picture issue below for Bluescope Steel as Australia premier steelmaker is an emulated example major case issue for most of the worlds steelmakers and their Governments to face in various "plus or minus degrees" in regards to national and steel industry economically efficient economies. Steel is 87% of all metals used by the world (IISI).

In world $CO_2$ terms, the big 4 emitters are a) Fossil fuels, b) Coal Fired Power Stations, c) Steelmaking and d) Cement. The PIB concept and strategy can practically and dramatically effect and reduce all four categories. CEO Paul O'Malley's carefully constructed summary and succinct debate case hereunder is very well put; and thus for the many worldwide steel companies facing similar national and global serious business and social broad based economic effect issues of great future consequence.

As a Brownfield plant cost it is a major expense for Bluescope, by applying their figures to EWLP PIB as a "greenfield" project the following conclusion and equation may apply.

Brownfield Co-Gen upgrade 5m tpy plant capex Au$1Bn for a 1m tpy of $CO_2$ savings.

PIB has already indentified 8.7m tpy of $CO_2$ as a greenfield project therefore indicating a saving of $8.7bn (using the Bluescope figures) and it can also be argued that with a greenfield entry expense that this major $1bn capex expense is negated.

# The Australian http://www.theaustralian.news.com.au/

# Bluescope Steel warns on carbon scheme

Matt Chambers | *September 13, 2008*

**BLUESCOPE Steel, one of the nation's biggest carbon emitters, has warned that the Government's proposed emissions trading scheme risks shutting down local steel production if Australia acts alone.**

Addressing business representatives in Melbourne yesterday, Bluescope chief executive Paul O'Malley joined the growing chorus of industry voices opposed to the emissions trading scheme, though he applauded the push to reduce carbon emissions and the Government's consultation with industry.

"If we don't get a global solution and it's only an Australian solution, I think we'll lose our competitive advantage and you'll see the CO2 made somewhere else and the steel made somewhere else," Mr O'Malley told an American Chamber of Commerce lunch.

"Getting the policy right, so you get an actual reduction in $CO_2$, not just a headline, is very important," he said, adding that reducing Australian steel would result in imported steel made by worse emitters. Bluescope would be one of the hardest-hit Australian companies if an emissions trading scheme is introduced, with the steel-making process producing lots of carbon dioxide when it burns coal to remove impurities from iron ore.

Mr O'Malley also indicated an emissions trading scheme could threaten its proposed $1 billion-plus co-generation plant, which he said would be the "single largest $CO_2$-reducing project in Australia" and reduce emissions by as much as 1 million tonnes.

"To fund a project like that, you need to have a successful and healthy balance sheet and you need to be competitive in the market, still selling your product so you can actually get the cash," he said.

The co-generation plant, which Bluescope has previously said would reduce emissions by 800,000 tonnes, would take surplus gas from iron and steel making at the Port Kembla steel works and produce extra processing steam and power.

Bluescope has finished a feasibility study on the plant but says Government policy on trade-exposed industry is a critical part of its decision.

The Government is scheduled to make known the details of its carbon pollution reduction scheme in December and is currently taking submissions on a green paper.

The emissions trading scheme is proposed to start in 2010.

Mr O'Malley stressed he was encouraged by the Government's consultation on the issue.

"The process embarked on by the Government has actually been very inclusive. We feel like we've been able to put our point of view across," he said. "We feel like we've got feedback (and) we've changed our view based on that," he added, not expanding on what had changed.

Mr O'Malley said conversations with global peers saw European steel makers being very interested in reductions, though they had not been penalised for carbon emissions yet, while the growing economies of China, India and Russia were not so keen.

"With India and China, it is absolutely about the fact that 'you guys have had your day in the sun, you've emitted a lot of $CO_2$, now it's our turn and we're going to industrialise and we're going to urbanise'," he said, adding they were still willing to talk about reductions, though it would take a lot of time and work for progress. "If you move through Russia -- they're not interested," he said.

Steel mills in Latin America saw the opportunity to supply Europe, partly because there was lower potential $CO_2$ cost.

## Shane Condon:
## Project Founder and Team Leader

**Work Qualifications & Experience Brief.**

- **Contract Food Industry Management Consultancy-Australia and Asia/South Pacific: 20-years**
- **Leadership, Strategic Planning and Implementation Management Responsibilities:**
  - New and Existing Business; Project Development Efficiency/Expansion-Critical Process/Supply Chains-Recovery & Turnarounds.

- **New and Established Business Development and Growth:**
  Operations-Marketing-Product Development-Process/Quality & Product Improvement/Development-Efficiency-Analysis-Reports-Strategic Business and Operational Budget Financial Planning-Investigation-Project Management & Implementations. Agro and Fisheries Economic Development Programmes Asia/South Pacific "Government and Private Sectors".
- **Founded N- Australia Export/Domestic Seafood & Meat Business:**
  - **Award "Marketing & Business Excellence", Confederation of Industry and Government.**
  - Harvesting- Processing- Operations- Domestic and Export Processing, Marketing-Trading Business.
  - 120-staff and direct dependent contractors. $6 Mil internal + $5 Mil contract Marketing =$11 Mil pa.
- **Three successful Food Industry Turnaround Consultancies:** "Crisis Management & Leadership".
- **10 years USDA Registered Export Meat and seafood Industry Management Experience:**
  - Progressive early management career base experience from trainee-cadet to management of all key operations divisions. Boning Room-80 staff; Slaughter Floor-40 Staff; Export Cold Storage & Shipping; 5-Retail & Wholesale Butcher Shops; Large Pasture Farm (10,000 acre)-Grain Cropping, Intensive Piggery & Cattle Stud-up to 25 staff; Establishment of New Prawn Processing Factory & Prawn Trawler Fleet, Operations + Induction Training.
  - Export Market Research/Development/Implementations - Japan, USA, South America and SE Asia.
    - Reports to Executive Management and Board of Directors.
- **Aquaculture**: **Pioneered Australia's First Prawn Farm**, Port Roper NT. *Private project!*
- **International Packaging Awards** nominated "original" design concept as Australia's entry**.**
- **Establishment of "Leading" Worlds Best Practice Food Industry Product Standards:** "Quality/Price" for continuous leading benchmark product, process & operational standards.
- **Education Philanthropy Project Establishment – Pre-School, Fiji.** A Condon family philanthropy project to initiate, organise co-sponsor and jointly seed finance, with the Australian Embassy-Foreign Aide, to establish run and operate a much needed education gap facility - Church multiracial pre-school, accommodating over 80 Preschool Children in two daily sessions. Still operating.

**Education:**

- **2006: MBA, University of Queensland (near completion)**

  **Three High Distinction major report marks to date!**
- **2002: P-Grad Cert Degree. "Management" University of Queensland**

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## Gordon Thomson:
## Deputy Project Leader and Western Australia Team Leader

**BSc (Hons), MBA, F Fin**

**Engineer & Business Developer:**
**Process Engineering, Facilities Design, Project Management, Marketing, Business Development and Technical Authoring.**

**Career:**
Commenced engineering career with Shell International in 1974 with a three-year posting to the offshore oil/gas production operations in Qatar.

- **30 years as an Engineer and Business Developer** in UK North Sea, Norway, Brunei Darussalam and Australia.
- **Last 17 years to Present**: Operated a family-owned Perth & WA based private consultancy company as an independent contractor/consultant.

**Clients:**
Fluor-Daniel, Government of Western Australia, Technip France, Technip-Coflexip, Kimberley Oil, Amira International, UK Government, Water Corporation of Western Australia, BHPB Billiton Iron Ore and BHP Billiton Petroleum and Monadelphous Engineering.

**Academic:**

**1974** Batchelor of Science (Hons) in Mechanical Engineering
University of Strathclyde, Glasgow, Scotland.

**1989** Master of Business Administration
South Australian Institute of Technology, Adelaide, Australia.

**2000** Graduate Diploma in Applied Finance and Investment
Securities Institute of Australia, Perth, Australia.

**Memberships:**
Fellow of the Financial Services Institute of Australasia
Member of the Petroleum Club of Western Australia

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## Saul Eslake:
**Leader, Economics Marketing & Business, Media and Political**

**Chief Economist ANZ "Australia and New Zealand Banking Group"**
from Aug 1995**.**

- Member – Group Asset & Liability Committee: Mgt of ANZ's Bal/Sheet.
- Chairman of ANZ Cover – Internal Crime, Fraud & Prof/Indemnity Insur/Cover.
- Member – Corp. & Institutional Bank's Sustainability Steering Committee: Environmental & Social Issues.

**Previous Positions**:
1991-95: **Chief Economist** (Int) National Mutual Funds Management (now AXA Insur Group)
1981-86: **Chief Economist** Stockbroking Firm Mc Intosh Securities Ltd. (now Merrill Lynch)
< 1981: **Economist** Australian Government, including 2 years with Treasury.

**Education**: Hons Economics; Dip Applied Finance and Investment; 2003 Senior Executive Programme at Columbia Graduate School of Business, USA.

**Current Fellowships & Memberships**:
**The Australian Government**: Foreign Affairs Council / Trade Policy Advisory Council / World Trade Org Advisory Group / Tourism Forecasting Committee.
**Other:** Non-Exec Dir Aust Housing & Urban Research Institute; Dir University of Tasmania Foundation; Securities Institute of Australia; Assoc Aust/Institute of Management; Aust/Institute of Company Directors; USA National Association of Business Economists; The Australian Representative on the Int/Conference of Commercial Bank Economists.

**Services to Australian / State Governments & Institutions:**
CEO Victorian Gov. (Vic) Commission of Audit; Director Gascor – (Vic/Gov-Gas & Hospitals);
Invited & Accepted March 2005 – To Chair the Independent Project Management Committee for the City of Launceston, Tasmania. -To develop a vision for the community for the year 2020!

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## David Graham Russell RFD QC:
## Corporate Legal Business Facilitation Advisor

Called to the Bar in 1977, having been admitted as a solicitor in 1974.

Admitted to practise in New South Wales, Queensland, Victoria, the Northern Territory, the Australian Capital Territory and Papua New Guinea, David took silk in 1986 and holds that office in all the above jurisdictions, except Papua New Guinea.

He has served as a Judge Advocate and is a Wing Commander in the RAAF Legal Reserve.

David's principal area of practice is Revenue Law, which requires an understanding of commercial and administrative law. He has acted for Commonwealth and State Governments as well as individuals and corporations. David's other areas of expertise include: **Constitutional Law - Corporate Law - Equity**

David was President of the **Taxation Institute of Australia** (1993-5), and of the **Asia Oceania Tax Consultants' Association** (1996-2000). David served as Chairman of the National Education (1991-3) and International Relations (1995-2001) Committees of the Institute, is a member of its National Technical Committee and the **Law Council of Australia Business Law Section** Taxation Committee. He has been appointed an Honorary Adviser of the Asia Oceania Tax Consultants' Association. He served as a member of the Ministerial Consultative Committee for the Tax Law Improvement Project from 1994 to 1997 and as a member of the Steering Committee for the National Review of Standards for the Tax Profession in 1993 and 1994. From 1991 to 1995 he was a member of the National Tax Liaison Group.

David is the author of many published **articles and conference papers**, both inside and outside Australia, and is a member of the Advisory Editorial Board of **Australian Tax Practice.** He also lectures at the University of Queensland for the Master of Laws course, is an Adjunct Professor of the **Faculty of Business, Economics and Law** of the University of Queensland and is a member of the Industry Advisory Board of that University's **Australian Centre for Commerce and Taxation**. He is also an Advisory Board Member for Griffith University's **Key Centre for Ethics, Law, Justice and Government**.

He has been a member of the Management Committee **Australia - Japan Society, Queensland** since 1994, its Vice President in 1995-6 and President from 1996-2001. He was President of the **National Federation of Australia Japan Societies** from 2001 to 2005 and is a member of the Executive Committee for the **2006 Australia Japan Year of Exchange**.

David is actively involved in the operations of his family's business, Russell Pastoral Company. He is the third generation of his family to do so. **Russell Pastoral Company** carries on business at Dalby, Cunnamulla and Blackall. Its flagship property, **Jimbour**, is one of Queensland's oldest stations, dating back to 1841. In addition to pursuing the Company's interests in the cattle, wool, grain, wine and tourism industries, David has served as a director of the **Queensland Wine Industry Association**, the peak wine industry body for the state, and from 2002 served as its President. In 2003 he became a Committee member of the **Australian Regional Winemakers Forum**, and in 2004 was elected its Vice President and one of the members of the Council of the **Winemakers Federation of Australia**.

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## Prof Robert G (Jerry) Bowman, PhD, CPA:
## Chief Financial Officer

**PhD, Stanford University.**

**Emeritus Professor of Finance at The University of Auckland.**

- **Bank of New Zealand Professor of Finance**
- **Certified Public Accountant** (California, inactive).
- **University of Oregon, 1974-1987.**
- **Visiting Academic Positions**: Australian Graduate School of Management, University of Queensland, Southern Methodist University, National University of Singapore and Hong Kong Polytechnic University.
- **Published** numerous articles in international journals in Finance, Accounting and Economics.

**Presentations and Awards**:

- Invited guest presenter at numerous universities and international conferences.
- Awards for teaching and research.
- Executive education presentations for major corporations.

**Appointments and Positions:**

**Head of Department and Head of Finance for most of academic career.**

- Chair in Finance at the University of Auckland, 1987 to present.
- Head of Finance at the University of Auckland - 12 years;
  - Developed finance from no dedicated staff or curriculum into one of the top finance groups in Australasia.
- Head of the Department of Accounting and Finance - 3 years.
- Head of the Department of Accounting at the University of Oregon while on that faculty.

**Substantial commercial consulting and management experience.**

**Prior to Academic Career**

- **Audit manager** with Arthur Young & Company, USA
- **Treasurer and Chief Financial Officer** of Cohu, Inc., USA, diversified high technology company, then listed on the American Stock Exchange.

**Subsequent to Beginning of Academic Career**

- **Consultant and expert witness** for major companies in New Zealand, Australia, Fiji, Italy, Singapore and the United States.
- **Consulting engagements** primarily for regulated businesses and in three areas: Cost of Capital; Valuation; and Mergers and Acquisitions.
- **Advisor** to the National Competition Council (Australia); Ministry of Economic Development (New Zealand); Office of the Rail Access Regulator (Australia); Research work for the New Zealand Treasury.
- **Major Engagements** with Australian rail firms (Railways, Freightways, Northern Territories Rail, Queensland Rail, Rail Access Corporation and Western Australia Rail)

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## Professor Art Shulman:
## Leader, Best Practice, Project Editorial and Education Development Facilitation

**Professor of Business Griffiths University:** Art is a leading researcher, teacher and consultant in Knowledge Management, Innovation and Commercialisation Alliances (policy and practices).
**Duties Griffith University:** Administrative responsibilities within the Pro Vice Chancellor (Business and Law) office for ensuring that all facets of the School meet or exceed International best practice standards.
**Academic:** 39 PhDs supervised to completion, authored or co-authored over 100 publications.

**Research Tasks:** Focuses on improving public sector- private sector alliances.

Recent Work Grants

- **Australian Research Council grants**, LWRRDC and GRDC grants and competitive contracts from Government organisations including IPPA (Qld), HIC, PHARM, Murray Darling Basin Commission, QDPI, RTA-NSW, NSW Treasury,
- **Private sector consultancies** with Merck, Telstra, National Mutual, and Suncorp Metway.

**Business Advisor and Reviewer:**
- Research programs, corporate strategies, stakeholder communication practices and policy
- Commonwealth and State government agencies and collaborative research Centres in Australia and elsewhere. Scholarship recognised internationally.

**Awards**
- Fellowship status by the American Psychological Society for work in research methodology and fellowship status by the Board of Governors of the Communication Institute of Australia

**Honours**:
- Inaugural Ashworth Fellow- University of Melbourne, where he led a team of researchers in research with Telecom Australia developing methodologies for evaluating the social and economic impact of new telecommunication systems.
- Visiting Fellow appointments at the University of London, AGSM-UNSW, MIT best
- Published research paper awards.

**Presentations:** World Congress on Total Quality, at three National R&D Forums, the National Agricultural Systems Purchasers Forum, and for the Malaysian Ministry of Health sponsored WHO meetings on improving Medicine policies and practices.

**Previous:**
- Associate Professor of Management at the University of Queensland,
- Principal Research Fellow of the Communication Research Institute of Australia,
- Director of PHD programs in Organisational Behaviour and Social Psychology, Washington University, St Louis, Mo.USA.

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**Email:** art.shulman@ewlp.com.au
**Web:** www.griffith.edu.au

## Stephen Kennedy:
## Leader, Business Development Marketing/Planning Pre-and Feasibility Studies

**Senior Consultant – Investment and Business Planning**

- Experience of market and strategic studies within the non-ferrous and ferrous metals industries and financial modelling experience of process industry projects.
- Currently working with financial institutions, commodity traders and facility owners on corporate assessments from London, covering Europe, Russia & CIS, Africa, USA and the Middle East.
- Over 15 years experience on complex multi-disciplined energy, metals, minerals and infrastructure projects. Project roles have developed a strong capability in project management systems, contract management, cost engineering and scheduling. Strong foundation in the planning and design of mine infrastructure, major roadwork's and railways from various civil engineering roles.

**Key Skills:**

- Technical due diligence / reviews
- Pre-feasibility and feasibility studies
- Competent person's report
- Market studies
- Strategy development
- Financial modelling
- Valuations
- Project management
- Contract administration
- Cost engineering
- Planning and scheduling
- Mine infrastructure planning and design
- Major road infrastructure planning and design
- Railway planning and design

**Previous Positions**:
2002-03: **Consultant – Investment & Business Planning** Hatch Associates Limited (London)
2000-01: **Senior Project Engineer** Hatch Associates Limited
1998-99: **Senior Project Engineer** BHP Engineering Limited (now Hatch)
1996-97: **Civil Engineer** BHP Engineering Limited
1986-95: **Civil Engineering Technical Officer** – various roles with leading consulting engineering firms

**Education**:
Master of Business Administration - University of Queensland (2001)
Bachelor of Engineering (Civil) with Honours - Queensland University of Technology (1996)
Associate Diploma Civil Engineering - Queensland Institute of Technology (1987)

**Current Fellowships & Memberships**:
Member of the Institution of Engineers, Australia – Civil

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## Clem Tisdell:
## Environmental & Economics, Editorial Support

**Professor Emeritus, School of Economics**
**The University of Queensland**

**Previous Positions:**

| | |
|---|---|
| 1989-2004 | Professor of Economics<br>The University of Queensland |
| 1972-1989 | Professor of Economics<br>The University of Newcastle, NSW |
| 1964-1972 | Reader in Economics,<br>Australian National University.<br>Plus other positions in Economics |

**Education:**
B. Com with 1st Class Hons in Economics and University Medal, UNSW
PhD (ANU)

**Fellowships etc:**
- Fellow of the Academy of Social Sciences in Australia (FASSA)
- Honorary Professor, People's University of China

**Publications, Consultancies etc:**
Author of more than 60 books and over 700 articles, many dealing with environmental economics. Wide range of consultancies completed for Australian and international clients.

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## Anton Michielsen:
## Leader, Rail Line Planning & Construction

**Leighton Contractors Pty Ltd,**
**Design Director, Gateway Upgrade Project, Leigthon Abigroup Joint Venture**
Member of the Executive Management Team for LAJV's $1.88 billion Gateway Motorway and Bridge Upgrade Project (GUP) for the Queensland Motorways Ltd. As Design Director he led the projects strategic direction with respect to value engineering, design and construction delivery and project risk assessments. He engaged and directed a team of LAJV Design Managers and consultants, with over 250 people involved, in the preparation designs for tender, detailed design and construction plans. This combined inputs of from construction cost estimators, builders and consultants to develop innovative competitive tenders to client's specifications. The project is under construction and due for completion mid 2010.

Within Leighton Contractors (LCLP) the projects he has been involved in include;

- Gateway Upgrade Project D&C, $1880 mil, 20km motorway and 1700m long bridge in the Brisbane CBD
- Adviser to BLJV North-South Bypass Tunnel BOOT Project tender, $3000mil for Brisbane City Council
- Adviser to LCPL Airport Link Tunnel BOOT Project tender, for Qld Gov.

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**Previous Positions**:

**Feb 2005 till July 2005 MetTRIP Network Program Manager, Queensland Rail**
SEQIPP*Rail* (formerly MetTRIP) is a recent Qld Department of Transport program of major infrastructure capacity enhancements of the Brisbane Metropolitan Rail System. As Program Manager he was a member of the MetTRIP Steering Committees and he devised and promoted the program of project alliance agreements which were adopted for the delivery of QR's major metropolitan rail program.

**1987 to 2005 Maunsell-AECOM , ANZAME region– Director from 1997, Engineer from 1987**
Industry Director, Major Projects for Maunsell–AECOM, a US publicly listed engineering and professional services company with a turn over US$ 4000mil. He participated at a senior level in major transport projects in Australia and throughout Asia, including Singapore, Hong Kong, Philippines and Delhi, India. He was accountable and responsible for the project management and technical aspects of many complex multi-disciplinary transport facilities, motorways, transits, metro's, railways, freight stations . Major projects include;

- Delhi Metro MC1a D&C in India, 4 km underground metro in the northern sector of Dehli, US $500mil
- Urban Motorways and tunnels in Australia, Mitcham-Frankston Tollway, Pacific Motorway, Brisbane Inner City by-pass which won the national engineering excellence award in 2002.

**1983 to 1987 Hughes Trueman Ludlow Pty Ltd – Engineer**
Engineering design and contract administration of civil works, roads, sub-divisions and buildings

**Education**:
MBA at University of Queensland, 2005
B.E Civil Engineering (Hons), University of Adelaide. 1982
Engineering Contract Management, Bruce TAFE, ACT. 1985

**Affiliations:**
Member Engineers Australia, NPER No. 183898
Registered Professional Engineer of QLD RPEQ 6016

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## Ross Hunter:
## Leader, Precincts & Infrastructure Developments & Government Support Services

**Senior Consultant – Project Management: Rail Infrastructure**

- Extensive experience (30 years plus) major rail projects planning and delivery - new railways - major rollingstock acquisition projects.
- Registered Project Director (PMRC)
- Ten years as capital works program director for Queensland Rail, overseeing A$6 billion expenditure on infrastructure and rollingstock projects. Project Director/Manager major individual projects - Gold Coast Railway, Mainline Upgrade, Inner City Quadruplication, Cairns Tilt Train and Coal Rollingstock Projects.
- Four years overseeing engineering resources of Queensland Rail, comprising 500 engineering and technical staff covering all rail-engineering disciplines.
- Currently Senior Coal Transport Advisor to the Queensland Government, covering planning and integration of a major expansion of rail and port transport capacity within the Queensland coal supply chain.

**Key Skills**

- Rail transport planning; Project Director/Project Manager; Feasibility studies; Investment evaluation
- Capital works program management.

**Previous Positions**

- 2003-6**: Senior Consultant** – Coal Transport Advisor to Queensland Government;

  **: Director - Ranbury Management Group** (project management specialist consultancy group)
- 1999 – 2003: Group General Manager Technical Services, Queensland Rail
- 1990 – 1999: General Manager Projects, Queensland Rail
- 1972 – 1990: Various engineering and management positions, Queensland Rail, focussed on major project planning and delivery

**Education:**

- Bachelor of Civil Engineering (Honours)– University of Queensland (1972)
- Various post-grad subjects and courses

**Current Professional Affiliations**:

- Member Australian Institute of Project Management; Member Railway Technical Society of Australia
- Registered Professional Engineer of Queensland.

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**David Belham**
**Executive General Manager & Project Member**

**Membership Duties:**
International Investor Facilitation - Management & Co-ordination – Communications Including Media Project Spokesperson - Logistics' - Administration & Marketing.

**Career:**

- **Appointed by the Premier of Queensland to establish and open the Queensland Government Trade and Investment Office – India.**
- **2004 – 2007, Commissioner, Queensland Government Trade and Investment Office – India**, responsible to represent State of Queensland and for all Queensland Government activities in India.
- **Director, Information Management, Queensland Government 1998 - 2004**.
- Responsible for planning and implementation of economic and aid development projects throughout the South West Pacific and South East Asia 1992 -1998 for Federal Government.
- Senior officer in the United Nations Transition Authority in Cambodia during 1993.
- Extensive experience in the military, government and international affairs, including 25 years as a Department of Defence international communications specialist.

**Education:**

- Graduate, Army Command and Staff College 1991
- Graduate Diploma Management Studies, Canberra ACT 1994
- Bachelor of Professional Studies (Major Asian Studies) University of New England, Armidale NSW 1995

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**Matthew Magin**
**Central Queensland Business Coordination and Development**

**Current work position:** Regional Relationship Manager Abbot Point (Contract position with Ports Corporation of Queensland)

**Career:**

- 12 years Federal & State Govt experience both political &bureaucratic
- 5 years CEO of a regional economic development organisation
- 10 years self employed in business I started from scratch
- 20 years senior management experience in retail industry

**Career Highlights/Achievements**

- Ongoing investment Attraction-CHALCO Aluminum Smelter ($2-3b)
- Sino- Australia Coal Summit
- Regional Housing Summits
- $5M grant for Mining Simulator Training and R&D Centre for Mackay region
- $28M grant for Mackay Water Re-use scheme
- $2M grant for new library @ CQU Mackay campus
- $4M grant Mackay Aquatic Centre
- Development of Bowen Economic Development Strategy
- Aquaculture Industry development in the Mackay region
- Formation of International Education & Mining Services Industry Clusters
- Conduct overseas trade missions & facilitate inbound trade missions
- Manage > $2.5 M in State Development grants since 1998
- Development of the Mackay Regional Water Resource Strategy
- Attraction and retention of Queensland Mining Exhibition for Mackay region

**Key Strengths**

- Networking/ Establish and maintain internal & external relationships
- Strategic leadership skills.
- Organisation, co-ordination & facilitation skills
- Senior and general management

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**"Ryan" Hoyeon Jang:**
**EWLP - Korea/Asia Business Facilitation Officer**

**Education:**

- **Bachelor of Economics**
- **Advanced English & Business Course**
- **Defence Forces Operations/Training**
  **- Execution Responsibility & Leadership.**

**Career:**

- **2006 to 2008: Black & White Cabs Pty Ltd, Australia**
  Primary engagement to learn local Australian Culture, Dialect and Speaking English. Direct fast-track exposure to adapt and understand the different Australian culture.

- **2005 - 2006: Shop Manager, 'Fish On Ice' Westfield Shopping Centre, Australia**
  Managed a team of 6 staff to ensure smooth, efficient and timely delivery of service. Main duties included staff training, daily scheduling of resources, managing the shop's finance, marketing and sales whilst facilitating friendly customer service.

- **2003 - 2004: Language Teaching English/Korean**
  Casual English language teaching position in a middle and high school at Hansem Academy to assist students with their English.

- **2001 - 2002:** National Military Service, S-Korea Guard Post, Demilitarized Zone (DMZ) in Gangwondo, Korea.
  Military training included basic training programmes, ambush, patrol, infiltration, repelling from helicopters and assault.
  Assistant in mobile combat unit where I had to train and lead a team of 8 soldiers to be combat ready.

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**Haruhiko (Haru) Kinase:**
**Japan/Asia Business Manager**
**& Precinct Engineering & Environmental Planning Services.**

**Education:**

- **Master of Business Administration:** Anaheim University, USA, 2004.
- **Master of Engineering:** Chiba University, Japan, 1996.
- **Bachelor of Engineering:** Chiba University, Japan, 1994.

**Career:**

- **1996 to 2007: Mechanical Engineer with Asahi Shimbun, Tokyo – 11 years;**

  A Japanese newspaper company with a circulation of over 8 mil newspapers per day and with more than 5,500 employees in Japan. Haru's main role was in operating, repairing and maintaining the printing presses and other printing equipment.

  - **2004 - 2007: Positioned as a key member of the project team to renew and upgrade the existing printing press and other printing equipment**; the project costs more than A$20million.
  - **2004 - 2007: Member/Director of the Environmental Management System (ISO 14001) project at Asahi Shimbun.** As the Director of ISO14001, Haru managed and oversaw 20 project team members. The purpose of the project was to increase energy and resource saving as well as reduce waste. The project successfully set up and carried out PDCA (Plan- Do-Check-Action) cycle and ensured the continued ISO 14001 certification for the company.
  - **2006 - 2007: Member - Japanese Newspaper Association** which edited and published over 5,000 copies of "Newspaper Printing handbook" for distribution amongst the Japanese Newspaper Association to raise the level of technical skill and knowledge.

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**"Nick" Fei Meng:**
**Project Manager (China Asia-Pacific Trade Economist and Marketing)**

**Education**: BEc, MBA

- **Master of Business Administration,**
  Business School, The University of Queensland, Australia.
- **Advanced English,**
  Edinburgh's Telford College, UK;
  International student representative.
- **Bachelor of Economics in Foreign Trade,**
  Business School, Dalian University, China;
  Editor of "Campus Monthly"

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**Nick Fei MENG** completed his MBA in 2005 with a part-time position as Assistant Marketing Manager, Anti Wave International, 2003-2004, with responsibility for expanding business into the Chinese market, ensuring collaboration between the company and its Chinese subsidiary company, and building and managing relationships with Chinese customers, including the China 2008 Olympic Committee. Nick has honed his skills in marketing, import and export, customer service and management through his varied and international experiences.

**Previous Positions**:
1998-2002: China -Business Branch Manager of Korean Mega Trading Limited.
1996-98: China-Commercial Representative MINMETALS (Liaoning) Import & Export Ltd.

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**Matthew (Myung Hyo) Kang**
**EWLP Project Director & Member**

**Key Duties:**
Business Strategy Planning Advisor.
International Investor Facilitation
Management & Co-ordination – Communications

**Career:**

- **Appointed by the Premier of Queensland to establish and open the Queensland Government Trade and Investment Office – Korea**
- **Commissioner, Inaugural and Successful Queensland Government Trade and Investment Office In Korea 2000-2009.** Facilitation trade investment between QLD and Korea, responsible to represent State of Queensland and for all Queensland Government activities in Korea.
- A special advisor, QLD government. Facilitate Korean investment 1999-2000.
- Immigrated to Australia in 1989, became a Australian Citizen in 1996.
  Support migrants from Korea to settle in Australia as a private Ambassador.
- **MD, Saudi Arabia Project, Korean Conglomerate-more than 10 projects.**
- **Director, Publicity and Government Relationship, Korean Conglomerate, 15years.**
- A special correspondent of the AP Reuters in Korea
- A reporter for AFP(Agency French Press) in Korea

**Education:**

- Bachelor, Master of Arts
- Bachelor of English Literature

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## Rod Welford:
**EWLP Project Member & Division Director/Leader.**

**Key Duties:**
**Business Strategy Planning & Environmental Sustainability Division – Legal, Political & Regulatory Advisor.**

**Current Position:**
**Chief Executive of the Australia Council of Recyclers**, the national peak industry body for the recycling industry.

**Other Portfolio's:**
- **Member, the National Advisory Committee of the 1st Asia Pacific Conference on E-waste**
- Board Member, National Centre of Excellence in Desalination, Murdoch University
- Board Member, International River Foundation
- Chair of AstiVita Renewables Limited
- Managing Director of Integrated Resource Planners.

**Previous Positions:**

Retired March 2009 **State Parliament of Queensland** - 20 years as a legislator and policy maker. As a member of the Queensland Government held the following positions:
- Chair, Ministerial Advisory Committee on Sports Funding
- Chair, Review of Residential Tenancy Laws
- Chair, Parliamentary Criminal Justice Committee
- Minister for Environment & Heritage and Minister for Natural Resources
- Attorney General and Minister for Justice
- Minister for Education and Training and Minister for the Arts

**Education:**

Qualifications:
- Bachelor of Arts (First Class Honours)
- Bachelor of Laws
- Master of Science (Environmental Management)
- Graduate Diploma of Industrial Relations
- Graduate Diploma of Legal Practice and
- Certificate in Permaculture Design.

**Project Contacts:**
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## Thomas Michael James
## Project Director and Member

## Chairman and Director EWLP Project Alliance Planning, Design and Execution Team.

**Previous Positions:**

Tom is a leading Construction Industry executive of 30 years standing and brings significant experience in the successful planning and delivery of major infrastructure projects in Australia. Tom also brings General Management leadership experience gained whilst holding senior positions over a 24year career with Leighton Contractors Pty Limited, one of Australia's leading construction and development companies.

**2008 - Jul 09: Executive General Manager, Construction Division, Leighton Contractors Pty Limited.** Accountable for business performance in the Northern Region with annual turnover exceeding AUD1.3Billion and overseeing major projects such as the Clem 7 tunnel, the Gateway Upgrade Project and other infrastructure works of significant value.

**2005 – 2008: Project Director, LAJV, Gateway Upgrade Project**. Leading the design and construction team to deliver this major road and bridge project in Queensland, worth in excess of AUD1.8Billion.

**2000 – 2005: Civil Business Manager, Northern Region, Leighton Contractors Pty Limited** Overseeing the development and execution of many successful infrastructure projects in Queensland, including the Port of Brisbane FPE Seawall, AMCI coal mine site preparations, Aldoga site preparations, Port of Brisbane Motorway, remote sections of the Barkly Highway, the Wivenhoe Dam upgrade and key parts of the Pacific Motorway and Brisbane's Inner Northern Busway.

**1990 – 2000: Senior Project Manager** delivering various infrastructure projects in Victoria and Queensland including Moorabool River Diversion and Western Ring Road projects in Victoria and the Optus inter-capital Fibre Optic Cable roll out.

**Key Strengths and Experiences:**

- General Management leadership
- Planning and delivery of major infrastructure
- Respected figure in the construction industry
- Builds strong teams and values innovative solutions

**Education:**
- Bachelor of Engineering (Civil)
- Graduate, JMW Leader of the Future program.

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## Phil Shapiro: EWLP Member

### Project Leader, Information Technology & Communications; Chief Information Officer

**Experience:**
30+ years of experience encompassing focus in Tier 1 public and private enterprises from strategy development, to full lifecycle planning, design, delivery, sustainment and management of information technology systems and communications networks. The extent of the enterprise systems and networks covers the spectrum of national, state and city wide.

**Work Qualifications:**
Phil brings to EWLP a pragmatic information technology and communications (IT&C) experience and knowledge base. He has a balanced enterprise perspective gained from IT&C demand and supply side experiences spanning

**Key Strengths:**
- Trusted technology adviser
- Leadership roles at technology and professional service organisations
- Management roles in global multinational technology companies
- Business management roles with A$30 M P & L accountability
- Co founding a technology services organization and exiting to a global multinational

**Previous Positions:**
- Principal, Mocuity Pty Ltd - an ICT Consultancy strategic focus on Mobility and Unified Communications
- Territory Manager, ANZ - Symbol Technologies global innovator on Enterprise Mobility
- Practice Director APAC Delivery Centre, Avanade - a Microsoft/Accenture global software Joint Venture
- Cofounder GM, DCG Pty Ltd - a Microsoft managed partner software engineering Development Company
- Regional Manager, Enterprise Networks, Ericsson Australia
- State Manager, Private Networks, Business Communications Division, Siemens Industries Ltd
- Principal Consultant, Telecom Australia

**Clients**:
Fujitsu Australia Ltd, Australia Post, Powerlink, TAB Corp, Department of Defence, RLM Systems . JORN,
Central Qld Ports Authority, Bundaberg Sugar Ltd, Gold Coast City Council, Northern Rivers Health, Qld
Health, Australian Broadcasting Corporation, BHP Moranbah, Qld Rail,

**Project Contacts:**
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# David D Trude: EWLP Board of Directors Profile

## EWLP Board of Directors "Non-Executive Board Member" (appointment from February 2010)

## Current 2009 Position:

- **Country Manager and CEO Credit Suisse in Australia since 1999; Managing Director and Chairman of the Australian Executive Committee; Member of the Asia Pacific Operating Committee and Asia Pacific Country Management Committee.**
- **Board Member of E.L.& C. Baillieu, prominent Australian Retail Stockbroker (Credit Suisse owns 25%);**
- **Director and Board Member of the Stockbrokers Association of Australia.**

## Previous Positions:

| | |
|---|---|
| **1995 - 1998** | **Director, Global Head of Research Sales and Chief Operating Officer for Australia**<br>First Pacific Stockbrokers Limited, Sydney, Australia<br>(25% owned by CS First Boston) |
| **1988 - 1995** | **First Boston Corp. (later CS First Boston), Sydney, Australia Investment Bank; Took over MacNab Clarke Limited in 1988**<br>Director - Research Sales and Sydney Branch Manager;<br>Opened and Head of Australian desk in NY for CSFB; Head of Global Sales for Australian product and Chief Operating Officer for business, Sydney |
| **1983 - 1988** | **Sydney Managing Partner** *( Director on incorporation )*, **MacNab Clarke & Co** (later MacNab Clarke Limited), Melbourne |
| **1980 - 1983** | **Manager of Sydney Branch Office and Research Salesman**, Clarke & Co (Stockbrokers), Melbourne |
| **1975 – 1980** | **Investment Analyst (Banks), Sydney; Portfolio Manager, Sydney; NZ Investment Manager, Wellington, New Zealand; Senior Portfolio Manager, Sydney**<br>Westpac Bank (formerly Bank of New South Wales), Sydney<br>Investment Division – Australia and New Zealand |
| **1972 - 1974** | **International Portfolio Manager, Central Board of Finance of the Church of England**, London, United Kingdom |
| **1970 - 1971** | **Investment Analyst**, Corser Henderson & Hale (Stockbrokers), Brisbane |

## Education:

Bachelor of Commerce, University of Queensland, Brisbane, Queensland

## Project Contacts:

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# Appendix 14


PROJECT IRON BOOMERANG
east west line parks limited

# Referral of proposed action

## Project title: Galilee Infrastructure Corridor Project

# 1 Summary of proposed action

The Proponent East West Line Parks Limited (ABN 21 118 581 883), intends to build, own and operate a 600 km open access, multi user, multi-purpose infrastructure corridor (the Corridor) from the Port of Abbot Point to the coal mining regions of the Bowen and Galilee Basins.

The Corridor will be complete with rail and telecommunications infrastructure and be comprised of three elemental sections.

The Corridor will be used primarily to site a double track, standard gauge, heavy haul railway system and a carrier grade high availability communications network (for train control and general communications) with the capacity to provide coal and other freight services to current and future mining operations in the two coal mining regions, and other communities adjacent to the Corridor.

**NOTE:** You must also attach a map/plan(s) showing the location and approximate boundaries of the area in which the project is to occur. Maps in A4 size are preferred. You must also attach a map(s)/plan(s) showing the location and boundaries of the project area in respect to any features identified in 3.1 & 3.2, as well as the extent of any freehold, leasehold or other tenure identified in 3.3(i).

1.1 **Short description**

The three elemental sections of the Galilee Infrastructure Corridor are:-

1. a 390 kilometre length of corridor from the Abbot Point State Development Area to a junction north of North Goonyella in the Bowen Basin then continuing west to the northern end of the Galilee Basin;
2. a 210 kilometre length of corridor extending from the northern Galilee south along the length of the Galilee Basin and terminating near the town of Alpha to transport thermal coal from proposed mines; and
3. a junction near North Goonyella south to a narrow gauge transfer hub near Moranbah to service primarily the transport of metallurgical coal.

1.2 **Latitude and longitude**

Latitude and longitude details are used to accurately map the boundary of the proposed action. If these coordinates are inaccurate or insufficient it may delay the processing of your referral.

| | Latitude | | | Longitude | | |
|---|---|---|---|---|---|---|
| location point | degrees | minutes | seconds | degrees | minutes | seconds |

In Appendix there are two drawings PIB-SKE-0226 and PIB-SKE-G-0227. These drawings provide visual as well as project coordinates of the Galilee Infrastructure Corridor project

The Interactive Mapping Tool may provide assistance in determining the coordinates for your project area.

If area less than 5 hectares, provide the location as a single pair of latitude and longitude references. If area greater than 5 hectares, provide bounding location points.

There should be no more than 50 sets of bounding location coordinate points per proposal area.

Bounding location coordinate points should be provided sequentially in either a clockwise or anticlockwise direction.

If the proposed action is linear (eg. a road or pipeline), provide coordinates for each turning point.

**Do not use AMG coordinates.**

1.3 With reference to drawings PIB-SKE-0226 and PIB-SKE-G-0227 that are enclosed in the Appendix the following paragraphs describe the Corridor route.

The Corridor from the northern Galilee Basin to the junction at North Goonyella (west to east) follows the foothills of higher land formations at relatively flat longitudinal grade and remains to the north of the major black soil areas and, to the greatest extent possible, out of flood plains. This route minimises impacts on valuable agricultural lands to the south of the Corridor and can comfortably generate an earthworks cut-to-fill balance on the railway formation, thereby minimising the potential need for imported fill and its impact on land forms and surrounding property.

Adopting a generally north-south alignment along the Galilee Basin, the Corridor bypasses agricultural zones and remains close to all of the Galilee Basin mining tenements. The various emerging and future mines in the Galilee Basin may then be joined to the Corridor by a localised rail loop connection. In this way, the Corridor not only minimises impacts on landholders but also provides all potential Galilee Basin mines with a ready access to a single high capacity Corridor of high flood immunity without the need to build lengthy inefficient spur lines that disrupt the community and the environment.

The Proponent proposes a rail transfer hub near Moranbah to enable new and existing mining operations in the Bowen Basin an option to haul metallurgical coal on an efficient heavy-haul standard gauge railway to Abbot Point. The rail transfer hub will link to the current and emerging Bowen Basin mines via a spur line which will be either narrow gauge or standard gauge or dual gauge. (i.e. a combined narrow gauge and standard gauge track) as preferred. Equally, should particular mining companies prefer, the dual gauge line may be extended through to the Galilee Basin.

The Corridor route between North Goonyella and Abbot Point may deviate at two locations from that shown subject to further detailed analysis and ongoing landowner discussions to be concluded during the EIS study period. From approximately 60 km north of Moranbah the alignment will either be to the west of the Q-Coal tenements (as shown) or on an alignment through those tenements.

From approximately 25 km south of Collinsville, the Corridor to Abbot Point will be selected from one of two routes: the western alignment (as shown), which meets the Proponent's maximum up-gradient criterion of 1 in 320, or a route through the Clark Ranges which, although being 30 km shorter, exceeds this gradient criteria at localised points. Further train simulations are being undertaken to determine which of these options has the better whole-of-life cost efficiency.

The current Corridor alignment design has attempted to avoid sterilisation of known mining tenements. During the EIS evaluation further design optimisation will be undertaken in consultation with the relevant mining companies to ensure the least impact on or complete avoidance of mining tenements is achieved.

| | | |
|---|---|---|
| 1.4 | **Size of the development footprint or work area (hectares)** | The nominal corridor width is projected to be 150m wide and the Corridor length is projected to be 600 km. And the Corridor area is projected to be 8,550 hectares. |
| 1.5 | **Street address of the site** | See the Appendix, drawings PIB-SKE-G-0226 and PIB-SKE-G-0227 for visual projection and coordinates |

1.6 **Lot description**

Describe the lot numbers and title description, if known.

Not Applicable – refer to project coordinates on drawings PIB-SKE-G-0226 and PIB-SKE-G-0227

1.7 **Local Government Area and Council contact (if known)**

Please also review in the Appendix PIB-SKE-G-0228 for the General Electoral State Boundaries

Isaac Regional Council Area - Mayor Anne Baker and CEO Mark Crawley

Whitsunday Regional Council - Mayor Jennifer Whitney

Central Highlands Regional Council - Mayor Peter Maguire

If the project is subject to local government planning approval, provide the name of the relevant council contact officer.

1.8 **Time frame**

Specify the time frame in which the action will be taken including the estimated start date of construction/operation.

| Proposed Schedule | |
|---|---|
| **Milestones** | **Dates** |
| **Studies and Plans** | |
| Complete environmental constraints assessment and cultural heritage plan | Q1, CY12 |
| Prepare EIS draft Terms of Reference | Q2, CY12 |
| Submit Environmental Impact Statement (EIS) to Federal Government | Q3, CY13 |
| Complete Detailed Design and Planning Study | Q2, CY14 |
| Final Government approvals | Q2, CY14 |
| Order long-lead items (LLIs) | Q2, CY14 |
| **Construction** | |
| Start construction of railroad from Abbot Point to Alpha via Moranbah | Q2, CY14 |
| Complete railroad between Abbot Point and Moranbah | Q1, CY16 |
| Complete railroad between Moranbah and Alpha | Q2, CY16 |
| **Operations** | |
| Commence operations from Abbot Point to Bowen Basin | Q2, CY16 |
| Commence operations from Abbot Point to Galilee Basin | Q3, CY16 |

| | | |
|---|---|---|
| 1.9 **Alternatives to proposed action** Were any feasible alternatives to taking the proposed action (including not taking the action) considered but are not proposed? | **Yes** | Yes, you must also complete section 2.2 |
| 1.10 **Alternative time frames etc** Does the proposed action include alternative time frames, locations or activities? | **No** | |
| 1.11 **State assessment** Is the action subject to a state or territory environmental impact assessment? | **Yes** | Yes, you must also complete Section 2.5 |
| 1.12 **Component of larger action** Is the proposed action a component of a larger action? | **No** | Yes, you must also complete Section 2.7 |
| 1.13 **Related actions/proposals** Is the proposed action related to other actions or proposals in the region (if known)? | **Yes** | Yes, provide details:<br><br>The Galilee Infrastructure Corridor Project proposed action is similar to other current proposals (listed below) before various levels of Government. However from an environmental, flooding and waterways and social impact this |

proposal has significantly fewer issues. Please refer to the Appendix drawing PIB-SKE-G-0099 for visual representation of the competing corridors, that are listed below:

1. Adani Corridor TOR for EIS
2. BHPB Corridor TOR for EIS
3. QR National TOR Central Qld Integrated Rail
4. Hancock GVK TOR for EIS
5. Waratah Coal TOR for EIS

The Galilee Infrastructure Corridor Project proposed action markedly contrasts with other actions and proposals in the region in that the Galilee Infrastructure Corridor unlike the above listed five proposals was designed from the outset to be particularly sensitive to the need:-

1. to preserve valuable cropping land and existing farming and other key established land uses in the parts of regional Queensland that it traverses;
2. planned minimum encroachment on valuable agricultural cropping, cattle grazing lands and black soil floodplains;
3. specially designed rolling stock to minimise required trip frequencies and avoid dust emissions; and
4. of the Corridor minimising environmental and community impact.

From its terminus at Abbot Point the Corridor alignment to the south and west maximises its proximity as far as practical to the existing Bowen Basin rail corridor. Heading west from the junction at North Goonyella to the northern Galilee Basin it follows the foothills of higher land formations at relatively flat longitudinal grade and remains to the north of the major black soil areas and out of flood plains. Its route therefore minimises impacts on valuable agricultural lands to the south of the Corridor. Then adopting a generally north-south alignment along the Galilee Basin back towards its point of origin near the town of Alpha, the Corridor continues to bypass agricultural zones whilst remaining strategically close to all of the mining tenements.

Community consultation on the Project concept commenced in 2006 in cooperation with the Mayors of the Whitsunday and Isaac Regional Councils. Regular presentations and information updates have been given at Council meetings, community meetings, with land owners, with farmers, and peak local groups including the Corridor to Coast group and economic development enterprise organisations.

| | | | |
|---|---|---|---|
| 1.14 | **Australian Government funding**<br>Has the person proposing to take the action received any Australian Government grant funding to undertake this project? | **No** | Yes, provide details: |
| 1.15 | **Great Barrier Reef Marine Park**<br>Is the proposed action inside the Great Barrier Reef Marine Park? | **No** | Yes, you must also complete Section 3.1 (h), 3.2 (e) |

# 2 Detailed description of proposed action

**NOTE:** It is important that the description is complete and includes all components and activities associated with the action. If certain related components are not intended to be included within the scope of the referral, this should be clearly explained in section 2.7.

### 2.1 Description of proposed action

This should be a detailed description outlining all activities and aspects of the proposed action and should reference figures and/or attachments, as appropriate.

In context to the Environmental, Flooding, Waterways and Social Impact issues please refer to the Appendix and in particular to the tabulated documents - Galilee Corridor Infrastructure Project Constraints. The constraints documents correlate with drawings PIB-SKE-0099, PIB-SKE-G-0226 and PIB-SKE-G-0227 in particular the latter two relate the 90 project coordinates to the constraints document relative to the Environmental Issues and the Waterways, Flooding and Social Impact issues are visualised and articulated in the drawing PIB-SKE-G-0099 and the following Section 2 of this document. Included in this submission is the Initial Ecological Constraints Analysis, this document is 9Mb and to avoid an email bounce has been forwarded in a separate email.

### 2.2 Alternatives to taking the proposed action

This should be a detailed description outlining any feasible alternatives to taking the proposed action (including not taking the action) that were considered but are not proposed (note, this is distinct from any proposed alternatives relating to location, time frames, or activities – see section 2.3).

The Proponent has analysed numerous alignment options (totalling more than 36,000 route kilometres), which it assessed against its 15 point selection criteria (see page 10). The focus of the criteria is to provide the optimum economic freight efficiency and the minimal ecological impact to ensure comparative economic benefit is returned to all parties using the railway alignment / Corridor and minimal environmental and social impact that provides the least possible cost per tonne hauled.

These studied options had many things in common with other freight corridor proposals from the Galilee and Bowen Basins currently in the public arena for consideration, of which there appear to be at least five in number. These include three proposed corridors from the Galilee which traverse generally from south-west to north-east, an additional corridor mooted as an east-west connection from the central Galilee to Moranbah, a new corridor traversing generally northwards from Moranbah to Abbot Point and a brown fields upgrade of the existing narrow gauge rail line from Moranbah to Abbot Point is also proposed.

These alternative proposals therefore serve as useful comparators.

From publicly available data the Proponent has applied its 15 point multi criteria risk assessment criteria (see page 10) to analyse each of these proposed rail corridor options for the region and to determine the potential suitability of each to meet the Proponent's essential project objective: namely, an open access freight Corridor of optimum economic efficiency for the long term benefit of all users and stakeholders.

With reference to PIB-SKE-G-0099 (refer Appendix), in which the Proponent's preferred Corridor is identified as Line 1, the proposed alternative rail corridors (Lines 2 to 6 inclusive) may be broadly categorised as follows:

**Line 2 – Waratah Coal**: 25 tonnes load per axle coal wagons operating on a 40 tonnes load per axle standard gauge rail track from a tenement in the southern Galilee generally in a north-easterly direction to Abbot Point;

**Line 3 – Hancock GVK**: 32 tonnes load per axle standard gauge rail from a tenement in the southern Galilee Basin, generally in a north-easterly direction to Abbot Point.

**Line 4 – Adani**: 20 – 25 tonnes load per axle potentially dual gauge line from a tenement in the central Galilee east to Moranbah, with connections to lines 2, 3 or 6;

**Line 5 – BHPB**: 20 – 26 tonnes load per axle narrow gauge rail from the Bowen Basin, near Moranbah, through to Abbot Point proposed as part of a wider open-access corridor.

**Line 6 – QR National**: 20 – 26 tonnes load per axle set of narrow gauge rail corridors including brown fields upgrade from Abbot Point to North Goonyella with a new connection that joins it to Line 4 and thereafter becomes a twinset of diverging corridors which overlay parts of both Line 4 and Line 2.

The Proponent considers that each of these alternative corridors presents comparative disadvantages, including the following:

- Each of the alternative corridors best serves the single tenement from which it originates, whereas the GIC is designed to service all Galilee Basin tenements equitably;
- the alternative corridors are not suited to the aggregation of all Galilee Basin freight into a coordinated, optimum efficiency solution of required high capacity, whereas the GIC is selected for this purpose;
- each of the alternative corridors requires a network of additional trunk and spur lines of significant length to fully serve the Galilee Basin, whereas the GIC achieves this outcome via a single corridor of minimum length;
- the alternative corridors are not configured for direct heavy haul extension to economically service the potential future expansion of the North West Minerals Province around Mt Isa, whereas the Galilee Infrastructure Corridor is configured for this;
- the alternative corridor alignments do not suit the Galilee Infrastructure Corridor's proposal for a heavy haul 40 tonnes load per axle track and rolling stock operations, whereas this criteria is essential to achieving optimum economic efficiency on long haul freight; and
- the alternative corridor alignments add significant capital cost and operational and maintenance risk in traversing significant tracts of black soil, floodplains and/or rugged terrain, whereas the Galilee Infrastructure Corridor alignment minimises exposure to unfavourable costly topography.

The Proponent considers each of the options it has reviewed, including the proposed alternative alignments in the public domain, does not suit all of its 15 point risk assessment criteria (see page 10) and therefore does not meet its essential project objective: namely, an open access freight Corridor of optimum economic efficiency for the long term benefit of all users and stakeholders.

A 'do nothing' option, whilst avoiding potential adverse impacts on landholders and the environment in the region, would leave the Galilee Basin coal resources stranded and the Bowen Basin coal reserves under developed and further delay the realisation of the development potential for the North West minerals province. It would also fail to adequately service the new Abbot Point cargo facility and adjacent State development Area special zones, which demands a modern high capacity rail service for its economic potential to be reached.

### Summary of Key Strategic Benefits

The Project represents a unique opportunity to coordinate the Galilee coal transport requirements within a single Corridor by an efficient heavy haul railway system with maximum economic benefits to the Queensland economy, the broader community and the coal mining companies in the region well into the future.

The Project is of strategic significance in that it will:

- contribute to the Government's Infrastructure Policy, the promotion of domestic capital formation, and shape future infrastructure planning and development in Queensland;
- support the National Government's infrastructure priorities as outlined in the 2011 Report by Infrastructure Australia to the Council of Australian Governments including the delivery of Competitive International Gateways, A National Freight Network and a National Broadband Network;

- contribute to the long term employment sustainability in the regions for the existing industry sectors and open up upstream and downstream development opportunities realised by existing and potential industries utilising the Corridor;
- have the capacity to serve multiple sectors including agriculture and pastoral, not only the mining sector;
- significantly reduce disruption to landholders and to the valuable cropping and grazing lands with minimum environmental and social impact in the region;
- function as a trade Corridor and provide foundation customers in support of the Cargo Facility at the Port of Abbot Point;
- enable an efficient use of land and resources within the current corridors in the Abbot Point State Development Area and within the corridor owned by North Qld Bulk Ports;
- eliminate the need for multiple corridors connecting to the Galilee basin and thereby reduce financial costs involved in the development of a multiplicity of rail corridors currently proposed;
- have the capacity to provide for multiple uses into the future including water, energy and information and communication technology infrastructure to support regional development in Queensland;
- contribute to the utilisation of existing Government Owned Corporations (GOC) infrastructure and returns on such investments; and
- open up potential to service the North West minerals province and developments further afield.

The Corridor design criteria was sensitive to the need to preserve valuable cropping land and existing farming and other key established land uses in the parts of regional Queensland that it traverses. From its terminus at Abbot Point the Corridor alignment to the south and west maximises its proximity as far as practical to the existing Bowen Basin rail corridor. Heading west from the junction at North Goonyella to the northern Galilee Basin it follows the foothills of higher land formations at relatively flat longitudinal grade and remains to the north of the major black soil areas and out of flood plains. Its route therefore minimises impacts on valuable agricultural lands to the south of the Corridor. Then adopting a generally north-south alignment along the Galilee Basin back towards its point of origin near the town of Alpha, the Corridor continues to bypass agricultural zones whilst remaining strategically close to all of the mining tenements.

With its planned minimum encroachment on valuable agricultural cropping, cattle grazing lands and black soil floodplains, together with specially designed rolling stock to minimise required trip frequencies and avoid dust emissions, the Corridor therefore minimises environmental and community impact.

### 2.3 Alternative locations, time frames or activities that form part of the referred action

If you have identified that the proposed action includes alternative time frames, locations or activities (in section 1.10) you must complete this section.

Describe any alternatives related to the physical location of the action, time frames within which the action is to be taken and alternative methods or activities for undertaking the action. For each alternative location, time frame or activity identified, you must also complete (where relevant) the details in sections 1.2-1.9, 2.4-2.7, 3.3 and 4.

Please note, if the action that you propose to take is determined to be a controlled action, any alternative locations, time frames or activities that are identified here may be subject to environmental assessment and a decision on whether to approve the alternative.

The proposed Galilee Infrastructure Corridor is the preferred corridor which satisfies the Proponent's overall project objective: namely an open access freight Corridor of optimum economic efficiency for the long term benefit of all users and stakeholders.

The Corridor is the product of a refinement process by which the Proponent has applied multi-criteria risk assessment procedures to analyse numerous potential alignments (totalling approximately 36,000 route kilometres).

The Corridor will comprise a standard gauge, 40 tonnes load per axle heavy haul dual track rail freight system. The design criteria of a 40 tonnes load per axle rail design necessitates the selection of a flat corridor (nominal gradient of 1:320) on good foundation. This foundation is best found in the foot hills away from the flood plains and that in part was one of the 15 criteria applied to the Corridor selection.

### 2.4 Context, planning framework and state/local government requirements

Explain the context in which the action is proposed, including any relevant planning framework at the state and/or local government level (e.g. within scope of a management plan, planning initiative or policy framework).

## Potential Designations

Having regard to the multiple users and purposes for which the Corridor may be available to serve, the Government may, at the appropriate time, consider:

a) designating the Corridor as Community Infrastructure under the Sustainable Planning Act 2009 (Qld), or

b) declaring the Corridor as a State Development Area under the State Development and Public Works Organisation Act 1971 (Qld).

A Community Infrastructure designation, which can be made by the relevant Minister, would identify the Corridor land to facilitate the integration of land use and infrastructure planning, and the cost effective and efficient provision of the infrastructure.

Before designating land for Community Infrastructure, the designating Minister must be satisfied that:

- the proposal satisfied a public benefit test such that the project will contribute to environmental protection or ecological sustainability, or satisfy community expectations for the efficient and timely supply of infrastructure, and
- there has been adequate environmental assessment, including adequate public consultation, and also adequate account of issues raised in the public consultation.

Similarly, the potential for the Corridor to be declared a State Development Area could be given future consideration having regard to the potential uses of the Corridor land for purposes of strategic significance to the State's economic future. Such uses could include:

- communication network facilities;
- railway lines and associated facilities including general freight ;
- water infrastructure or infrastructure for water cycle management;
- energy infrastructure;
- waste management facilities;
- oil and gas pipelines;
- operating works under the Electricity Act (1994 (Qld);
- emergency services facilities; and

- storage and works depots and the like including administrative facilities associated with the provision or maintenance of any of the above infrastructure facilities.

The Proponent will engage with the Government and the community further on this matter in the course of the EIS as the potential of the corridor to meet the relevant criteria becomes clearer.

The Proponent's analysis acknowledged the following essential freight Corridor attributes as the appropriate 15 point criteria by which a Corridor to Abbot Point should be determined:

1. aggregates freight from all Galilee Basin mine tenements via a single Corridor of minimum length, inclusive of spurs (essential for optimum freight efficiency, and limit land use impact);
2. integrates with the Bowen Basin coalfields (essential for optimum efficiency and service utility);
3. incorporates state-of-the-art standard gauge rail (an essential starting point for Pilbara style freight efficiency);
4. enables 40 tonnes load per axle track and wagon capacity (essential for optimum freight efficiency rail and wagon capacity);
5. maximum 1:320 gradient against the loaded train consist (essential for optimum operational efficiency);
6. enabled for cost efficient duplication to >350 Mtpa capacity (essential for achieving full Galilee Basin capacity in a single Corridor or dual track);
7. incorporates state-of-the-art carrier grade telecommunications and wireless overlay network (essential to enable real time locomotive management and train control signalling for optimum operational efficiency);
8. incorporates advanced train control signalling on a common shared platform for optimal freight efficiency in a multi user environment (essential for an efficient environment to enable mining companies to be masters of their destiny);
9. accommodates future community utility services (essential for maximum shared community benefit);
10. minimum encroachment on valuable agricultural cropping and cattle lands (essential for minimum land use impact);
11. minimises foundations on black soil floodplains and other poor natural materials (essential for minimum capital cost and land use impact and to minimise long term operational risk);
12. minimum earthworks and rock excavation and optimum cut-fill balance (essential for minimum capital cost and land use impact);
13. minimum drainage and flood mitigation measures and the avoidance of floodplains (essential for minimum capital cost and risk of operational disruption due to flooding events);
14. suitably configured for direct heavy haul rail Corridor extension west to the Mt Isa region and the North West minerals province and beyond (to catalyse and promote its economic development); and
15. maximises practical alignment proximity to existing rail corridors (in order to reduce land use impact).

The Proponent's preferred Corridor, as shown in the Appendix see drawing PIB-SKE-G-0099, adheres to these criteria and has the following particular attributes:

- provides a single, multi user infrastructure Corridor to Abbot Point servicing the doorstep of all mining tenements in the entire Galilee Basin whilst minimising the required length of railway including spurs;
- simultaneously provides a standard gauge heavy haul freight solution to Abbot Point from an integrated rail location central to the Bowen Basin coalfields;
- builds in optimum economic operational efficiency for all users by having standard gauge, heavy haul railway line of 40 tonnes load per axle capacity with maximum up gradient of 1:320, duplicated as demand builds;
- enables the use of the latest generation of American heavy haul noise silenced locomotives;

- the proposed use of closed lid coal wagons that eliminate in transit dispersion of coal dust as well as being environmentally desirable with increased efficiencies through reduction in aerodynamic drag thereby reducing the usage of locomotive diesel fuel;
- enabled for cost efficient line duplication to 350Mtpa capacity;
- incorporates state-of-the-art, carrier grade, high availability communications technology;
- incorporates a train management strategy enabling optimal multi user freight density and efficiency;
- accommodates other potential future community utility services: e.g. water, gas, power, enhanced telecommunications etc;
- minimises land use impacts and encroachment on valuable agricultural cropping and cattle grazing lands;
- minimal floodplain encroachment (with reference to the Appendix see drawing PIB-SKE-G-0099), minimising costly drainage requirements with reduced risk of operational disruption due to flooding events;
- minimises areas of poor soil foundations and rugged rocky terrain, thereby minimising construction costs and operational risk;
- facilitates cut/fill balance with minimum earthworks and imported fill by selecting topographically suitable terrain;
- aligns adjacent to existing rail corridors, where practical to do so, to minimise land use impacts;
- aligns for direct heavy haul extension further west to service the development of the Mt Isa region and the North West Minerals Province;
- avoids townships (e.g., Collinsville) and minimises impacts on other recognised settlement areas and significant rural infrastructure (e.g. homesteads, stockyards, stock dams, bores);
- avoids environmentally sensitive areas such as National Parks and known declared nature reserves;
- avoids existing and planned mines and other infrastructure; and
- locates required ancillary infrastructure (e.g. unloading infrastructure and rail loops at Abbot Point) all within close proximity to existing key infrastructure.

With reference to the Appendix drawing PIB-SKE-G-0099, the extents of the flood plains illustrated is the most recent interim floodplain assessment overlay sourced from the Queensland Reconstruction Authority website.

Describe any Commonwealth or state legislation or policies under which approvals are required or will be considered against.

**Approvals Required for the Project**

The following approvals and triggers are a preliminary assessment having regard to the desktop work and preliminary surveys. It is expected that a complete list of approvals will be included in the draft Environmental Impact Statement.

Approvals required for all stages of the Project will include development approvals from local governments or other applicable assessing authorities, building and safety approvals relating to permanent and temporary structures, international standards, licences and permits for heavy lifts and loads, materials stored on site/transported to the site, emissions from construction machinery, operational works, disposal of waste, and all other impacts involved in the construction of a Corridor.

The legislation, policies and information on the likely approvals required for the Project, including ISOs, has been sourced from the Agency websites and from the State and Commonwealth Administrative Arrangements Orders.

| **Australian Government Approvals Required For The Project** | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |

| **Australian Government Approvals Required For The Project** | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |
| Fauna and Flora of National Significance | Environment Protection and Biodiversity Conservation Act 1999 (Cth) | Department of Sustainability, Environment, Water, Population & Communities | Desktop survey work has been undertaken, survey work has been undertaken for other mining and corridor projects within the Study Area. It appears likely that ground truthing and survey work will reveal fauna and flora of national significance will be present within the survey area |
| Protection of Critical Infrastructure | Critical Infrastructure Protection National Strategy,<br>/NZS 4360:2004 Risk Management,<br>HB 167:2006 Security Risk Management,<br>HB 221:2004 Business Continuity Management,<br>HB 292-2006 & HB 293-2006 Business Continuity Management. | Attorney General's Department: National Security | Critical Infrastructure Protection National Strategy, |
| Native Title Act 1993 (Qld) | Approvals, agreements | Attorney General's Department | Negotiations and agreements with Traditional Owners and claimants regarding access to their land |
| Frequency Allocation for Rail Communications and Signalling | Telecommunications Act 1997 (Cth) subsection 56 (1) | Australian Communications and Media Authority and Attorney General's Department | Frequency Allocation for Rail Communications and Interception Capability Plans |

| **Queensland Government Approvals Required For The Project** | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |
| Abbot Point State Development Area | State Development & Public Works Organisation Act 1971 (Qld) | Office of the Coordinator General | Not required for the construction of this Infrastructure Corridor, however, approval will be sought should set down areas be required for the machinery and equipment required to construct the Infrastructure Corridor |
| Security Response to Incidents | Queensland Counter-Terrorism Strategy<br>Queensland Infrastructure Protection and Resilience | Office of the Coordinator General | Security Response to Incidents |

| Queensland Government Approvals Required For The Project | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |
| | Framework<br>Queensland Government Information Security Classification Framework | | |
| Approval to clear vegetation | Vegetation Management Act 1999 (Qld) | Dept Environment & Resource Management | |
| Water permit to take water from a watercourse, lake or spring or groundwater if required for construction purposes | Water Act 2000 (Qld)<br>Water Act Regulations | Water permit to take water from a watercourse, lake or spring or groundwater if required for construction purposes | |
| Watercourse Crossings | Water Act 2000 (Qld)<br>Water Act Regulations | Dept Environment & Resource Management | |
| Removal of vegetation from a watercourse – Riverine Protection Permit | Water Act 2000 (Qld)<br>Water Act Regulations | Dept Environment & Resource Management | |
| Road and infrastructure crossings | Transport Infrastructure Act 1994 (Qld) | Dept. Transport & Main Roads | |
| | Petroleum and Gas (Production & Safety) Act 2004 (Qld) | Dept. Employment, Economic Development and Innovation | |
| Use of State Controlled Roads | Transport Infrastructure Act 1994 (Qld) | Dept. Transport & Main Roads | |
| Use of Local Government Roads | Local Government Act 2009 (Qld) | All Councils | |
| Accreditation for Operator | Transport (Rail Safety) Act 2010 (Qld) | Dept. Transport & Main Roads | |
| Protection of fauna and flora | Nature Conservation Act 1992 | Dept. Environment & Resource Management | |
| Environmentally Relevant Activities | Environment Protection Act 1994 (Qld) Schedule 2 Environment Protection Regulation | Dept. Environment & Resource Management | |
| Air Quality | Environment Protection (Air) Policy 2008 (Qld) | Dept. Environment & Resource Management | |
| Noise Emissions | Environment Protection (Noise) Policy 2008 (Qld) | Dept. Environment & Resource Management | |
| Water Quality | Environment Protection (Water) Policy 2009 (Qld) | Dept. Environment & Resource Management | |
| Waste Management | Environment Protection (Waste Management) Regulation 2000 (Qld) | Dept. Environment & Resource Management | |
| Waste Management | Environment Protection (Waste Management) Policy 2000 (Qld) | Dept. Environment & Resource Management | |
| Cultural Heritage, Cultural Heritage Management Plans | Aboriginal Cultural Heritage Act 2003 (Qld) | Dept. Environment & Resource Management | |
| Cultural Heritage | Queensland Heritage Act 1992 (Qld) | Qld Heritage Council | |
| Workers' health and safety | Workplace Health & Safety Act 1995 (Qld) | Dept. Justice & Attorney General | |
| Movements and storage of goods | Dangerous Goods Safety Management Act 2001 | Dept. Justice & Attorney General | |

| Queensland Government Approvals Required For The Project | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |
| | (Qld) & Regulation | | |
| Purchase of land, right of way over land for location of Corridor | Negotiated agreements with land owner, change to title deed | | |
| Land Title Practice Manual | Property Law Act 1974 (Qld) | | |

| Local Government Approvals Required For The Project | | | |
|---|---|---|---|
| **Activity/Approval Trigger** | **Legislation, Policy, Standard, Permit, Licence** | **Administering Authority** | **Activity** |
| Development approval | Whitsunday Regional Council Planning Scheme | Whitsunday Regional Council | |
| Development approval | Isaac Regional Council Planning Scheme | Isaac Regional Council | |
| Development approval | Charters Towers Regional Council Planning Scheme | Charters Towers Regional Council | |
| Development approval | Barcaldine Regional Council Planning Scheme | Barcaldine Regional Council | |
| Development approval | Sustainable Planning Act (Qld) 2009 | Department of Local Government & Planning | |
| Building approvals | Building Act 1975 (Qld)<br>Building Act Regulations<br>Building Code of Australia | Department of Local Government & Planning | |
| Blackwater & grey water on-site sewage systems for construction crews | Plumbing & Drainage Act 2002 (Qld)<br>Standard Plumbing & Drainage Regulation<br>Plumbing & Wastewater Code | Department of Local Government & Planning | |
| Potable water supply for construction crews | Water Allocation Register | Department of Environment & Resource Management | Approval may or not be required under the Water Act 2000 (Qld) |
| Water supply for wash down areas and for site construction watering needs | Water Allocation Register | Department of Environment & Resource Management | Approval may be required to use grey water for wash down and site construction watering needs |
| Local Government | Department of Environment & Resource Management | Approval may be required to use grey water for wash down and site construction watering needs | |
| Food handling, waste control for temporary site facilities | Local Govt approval for Environmentally Relevant Activities | Separate approvals from each Council | |

### 2.5 Environmental impact assessments under Commonwealth, state or territory legislation

If you have identified that the proposed action will be or has been subject to a state or territory environmental impact statement (in section 1.11) you must complete this section.

Describe any environmental assessment of the relevant impacts of the project that has been, is being, or will be carried out under state or territory legislation. Specify the type and nature of the assessment, the relevant legislation and the current status of any assessments or approvals. Where possible, provide contact details for the state/territory assessment contact officer.

**Description of the Existing Environment**

**Natural Environment**

This section sets out the key environmental factors relevant to the Project. **Potential Impacts of the Project** commencing on page 20, will identify the potential impacts of the Project.

A more detailed description and evaluation of its attributes in terms of potential impacts of the construction and operations of the railway will be provided in the detailed EIS to be prepared.

**Land**

The proposed Corridor for the preferred alignment traverses a variety of land forms and land uses.

The area of northern Galilee basin is in the Desert Uplands bioregion, which is characterised by plateau residuals, ridges and sand plains. Soils are of low fertility and land use is predominantly low intensity grazing of native pastures (approximately 94% of region). It is mainly a beef cattle area though some sheep are raised in the western parts.

Vegetation is mainly eucalypt woodlands with a grassy or spinifex understorey. Acacia spp. woodlands are widespread, especially where clearing has occurred and fire has been a feature. It has a semi-arid climate with seasonally highly variable rainfall (median rainfall of 450 mm approximately) which predominantly falls in the summer months.

The Corridor route crosses the Great Dividing Range and other significant catchment divides including Darkes Range, which confine drainage in the Belyando and associated tributaries, and two significant lake systems – Lake Galilee and Lake Buchanan.

The majority of the route from North Galilee to Moranbah and north to beyond Collinsville, as well as the southern spur line from North Galilee to Alpha, traverses a broad area known as the Brigalow Belt bioregion.  This is an area of complex landforms and soils including extensive areas of cracking clays and sodic texture contrast soils with challenging properties for construction.

Landforms consist of undulating to rugged ranges and extensive areas of alluvial plains, the latter subject to widespread flooding in storm events. Vegetation is mainly Acacia harpophylla (Brigalow) and other Acacia spp., eucalypt woodlands and grasslands.

Climate ranges from semi-arid in the south and west to tropical in the northern parts above Collinsville. Median rainfall is about 590 mm and is summer dominant.

The route traverses much of the catchment area of the Burdekin Falls Dam and crosses the Belyando, Isaac and Bowen Rivers and their tributaries.

North-west of Collinsville, the route diverges around and through the Clarke Ranges and enters the coastal draining system of the Bogie River which flows to the ocean north of Abbot Point after skirting the Mt Aberdeen National Park. This area has a sub-tropical to tropical climate with strongly summer dominant rainfall (mean annual rainfall of 1,010 mm) and a moderate chance of cyclonic events. The area is unusual for north Queensland in that it is known as the dry tropics, being in a rain shadow to some degree though with an annual long term range of up to 2,000+ mm.

The route traverses several mountainous areas of the Clarke and Connors Ranges which are characterised by tall eucalypt forests and areas of evergreen rainforest and vine thicket. Modest earthquakes are known to occur in this area and as recent as mid-2011 and the final route alignment will factor in avoidance or mitigation measures through earthquake zones. Coastal wetlands and mangroves within the Abbot Point State Development Area occur beyond the end of the Corridor.

The geology of the route covers a broad range of lithologies and unconsolidated sediments, including:

- large tracts of Quaternary Alluvium (sands, silts and clays);
- carboniferous pyroclastics, flows, quartzose sandstones and fine grained sediments, with some lateritised overlays of Tertiary clayey sandstones;
- devonian sediments and meta-sediments with minor volcanics;
- permian sediments and areas of Tertiary duricrust on the plateau surfaces;
- tertiary basalts;
- permian sediments to the west of the Clarke Range; and
- large areas of Upper Carboniferous to Lower Permian granitic rocks of the Clarke Range before descending to the coastal lowlands.

**Hydrology**

There are several major waterways intercepted along the route. The majority of the route lies within the Burdekin River catchment draining via mainly ephemeral systems including the Belyando, Suttor and Bowen/Broken Rivers.

The Corridor will require six major river crossings and 29 creek and watercourse crossings. The river crossings are at the following rivers and creeks, some of which will be crossed more than once: Elliot, Bogie, Bowen, Suttor, Belyando Carmichael, Splitters, Finley, Sandy, Glen Blazes, Capsize, Herbert, Johnnycake, Table Mountain, Pelican, Twelve Mile, Rosell, Suttor North, Eaglefield, Kennedy, Eaglefield again, Verbena, Serpentine, Black Wattle, Bull, Bully, Sandy, Eight Mile, Laglan Spring and Forrester creeks.

Two ephemeral lakes, namely Lake Galilee and Lake Buchanan, lie towards the western end of the Project area.

Further investigations may be needed into groundwater resources of the route area as the route lies to the east of the Great Artesian Basin (GAB) and overlies the shallower groundwater resources of the Tasman Basin. Bores are predominantly for stock water and domestic use and are of variable depth and salinity.

**Air**

The area is dominated by rural land use, with grazing of native pastures being the most extensive form and only smaller areas of cultivation. Cultivation is largely confined to heavy cracking clay soils deeper than 60 cm in the region as these are the only soils with sufficient water holding capacity to sustain rain-fed cropping in about 75% of years. Dust from both these sources is low and generally short-term associated with cultivation and mustering activities.

The existing airshed of the regions along the proposed route is not generally affected by dust from mining or other economic activity. The region is notable for having generally a very low to low incidence of dust storms. Hydrocarbon emissions are associated with mining and cultivation activities but the spatial distribution is such that impacts are relatively small.

Noise impacts in the rural area is low as there is little regular activity associated with heavy machinery, cultivation equipment or other noise generating sources. Noise emissions associated with operating mines are high, but these are well separated from likely areas of noise nuisance.

**Ecosystems**

The relevant regional ecosystems are set out above and in the Initial Ecological Constraints Assessment

There are a number of relevant matters listed under the Environmental Protection and Biodiversity Conservation Act 1999 (Cth). Threatened plant and animal species are dealt with in the following section. Other Matters of National Environmental Significance (MNES) identified from a Protected Matters database search are shown in Table 1.

**Table 1: Summary of MNES – EPBC Protected Matters search**

| Item | Number (10 km buffer around proposed corridor) | Description |
|---|---|---|
| World Heritage Properties | 1 | Great Barrier Reef |
| National Heritage Places | 1 | Great Barrier Reef |
| Wetlands of International significance (Ramsar Wetlands) | 1 | Coongie Lakes |
| Great Barrier Reef Marine Park | Relevant | General Use Zone and Habitat protection |
| Commonwealth Marine Areas | Relevant | General provision |
| Commonwealth Lands | None | - |
| Commonwealth Heritage Places | 1 | Great Barrier Reef Region |
| Commonwealth Reserves | None | - |
| World Heritage Properties | 1 | Great Barrier Reef |

Additionally, seven nationally important wetlands have been identified, which apart from Lake Buchanan, largely occur in the northern and coastal vicinity of the Corridor.

**Flora and Fauna**

A preliminary review of public databases has indicated that there are several flora and fauna species likely within the Corridor that are listed under the Nature Conservation (NC Act) Act 1992 (Qld) and the EPBC Act. A summary of these, taken from the EPBC Protected Matters search, is shown in Table 2.

**Table 2: Summary of scheduled species – EPBC Protected Matters search**

| Threatened species | Number (10 km buffer around proposed Corridor) |
|---|---|
| Ecological communities | 4 |
| Threatened species | 41 |
| Migratory species | 45 |
| Listed marine species | 88 |
| Whales and other cetaceans | 12 |
| Critical Habitats | None |

It is likely that not all of these species as identified in the database search process will be found and impacted by the corridor. Nevertheless, the EIS will specifically target these identified species to assess the potential impacts and develop appropriate mitigating measures where needed.

**Social and Economic Environment**

The proposed Corridor traverses parts of Whitsunday, Charters Towers, Barcaldine and Isaac Regional Council local government areas. Significant towns within or near to Corridor include Bowen, Abbot Point, Charters Towers, Collinsville, Moranbah and Alpha. Outside of the towns, rural and agricultural activity dominates the social and economic character of the region.

**Economic and Demographic Characterisation**

Readily available regional statistics have been obtained from a search of the PIFU database using the Bowen Basin Population Report, 2010 (Office of Economic and Statistical Research, Qld Government, June 2010) and an OESR generated report for Central highlands and Charters Towers regions (www.oesr.qld.gov.au 23 October 2011)

The rural community is largely associated with extensive grazing properties and is broadly distributed while Moranbah and Bowen/Abbot Point are predominantly urban communities. A summary of key population statistics is provided in Table 3.

**Table 3: FTE populations for the Bowen Basin, June 2010 (after OESR Bowen Basin Population report, 2010)**

| Statistical Local Area (SLA)* | Resident population estimated | Total non-resident workers | FTE population estimate | Percentage of non-resident workers |
|---|---|---|---|---|
| Belyando | 12,091 | 3,278 | 15,369 | 21 |
| Nebo | 2,989 | 3,714 | 6,703 | 55 |
| Bowen | 14,442 | 479 | 14,921 | 3 |
| Total | 29,522 | 7,471 | 36,993 | 26 |
| Belyando | 12,091 | 3,278 | 15,369 | 21 |
| Nebo | 2,989 | 3,714 | 6,703 | 55 |

* These three SLAs represent the full route coverage

Belyando SLA covers the North Galilee to Moranbah area, while Nebo and Bowen SLAs cover the northern section through Collinsville to Abbot Point.

**Accommodation and Housing**

It is clear that a significant component of the SLAs that represent the mining provinces depend on non-resident workforce to the extent of 21% and 55% respectively, while Bowen (including Collinsville) is sufficiently close to the coast to attract a full time resident population. This highlights the importance of fly-in-fly-out (FIFO) and drive-in-drive-out (DIDO) populations to the mining industry. The lack of well distributed urban centres along the route highlights the critical need to establish attractive employment opportunities to encourage regional growth and development.

There is limited availability of commercial accommodation (houses, motels, boarding houses etc.) in the region with the great proportion of non-residents being housed in mine-supplied single person quarters (SPQs). A brief summary of accommodation options for the Bowen Basin or relevance to this proposal is provided in Table 4.

**Table 4: Non-resident workers – accommodation sources for the Bowen Basin, June 2010 (after OESR Bowen Basin Population report, 2010)**

| Statistical Local Area (SLA)* | Number of non-resident workers | Hotels/motels | Caravan parks/other | Total |
|---|---|---|---|---|
| Belyando | 2,711 | 210 | 357 | 3,278 |
| Nebo | 3,607 | 62 | 45 | 3,714 |
| Bowen | 243 | 23 | 213 | 479 |
| Total | 6,561 | 295 | 615 | 7,471 |

*These three SLAs represent the full route coverage

The major source of accommodation is dependent on the provision of SPQs, which service both FIFO/DIDO and semi-permanent workforces. This restricts the ability of families to relocate to the region and to establish viable communities. EWLP recognises that the Queensland Government is seeking to limit the impact of FIFO/DIDO workforces and will investigate ways in which this may be achieved.

**Social and Recreational Services**

There are limited social and recreational facilities available in Collinsville and Moranbah to meet the needs of a largely temporary workforce while servicing the needs of the resident population. EWLP recognises the potential for large itinerant workforces to involve some adverse impacts on local communities.

**Cultural Heritage (Indigenous and non-indigenous)**

A number of Native Title claims are likely to be active over the route of the Corridor. The Jangga and Birri peoples have active claims in the region affected. Contact will be made with representatives of the local Traditional Owner groups to seek cultural heritage clearance for the route investigation and eventual construction process.

Consultation will include the nature and form of Indigenous Land Use Agreements (ILUA) where appropriate and the development of a Cultural Heritage Management Plan (as set out in Section 7.4 below of this IAS) as part of the construction process. It will be necessary to initiate discussions with the claimants at the appropriate time.

Landholders and local historical groups will be approached also to determine the European heritage values of the area. Given its interesting history of settlement and the long-standing of several homesteads, it will be desirable to ensure that these values are protected to the maximum extent possible. Detailed assessment will be initiated and appropriate consultation undertaken with representative bodies in the course of undertaking the EIS.

**Built Environment**

Townships near the route are Bowen, Collinsville, Moranbah and Alpha. The route does not go directly through these townships but passes close by some of the communities. The Corridor terminates at the Abbot Point State Development Area, which has been dedicated by the Queensland Government as an industrial and port complex and nearby and to the north west of the township of Alpha.

The principle infrastructure along the route consists of grazing and mining operations, roads, bridges and existing railways. Substantial mining operations already exist in the Bowen Basin and drilling is well underway within mining tenements of the Galilee Basin.

**Infrastructure**

The Corridor route traverses largely undeveloped country; however there is some infrastructure in the region that will be potentially impacted.

There are Council and State controlled roads in the region, and the Corridor is intended to approximately parallel the existing QR National corridor north of Moranbah. The Corridor will require measures to address crossings involving:

- Eight State Controlled Roads
- Sixteen unsealed Local Government Roads, and
- Nineteen Stock Routes

Ergon and Powerlink hold rights of way for power lines in the area of the Bruce Highway near Abbot Point State Development Area and transmission lines on several properties will cross the Corridor. Powerlink, in particular, has transmission lines which would cross the Corridor within the following properties: CeSalis, Strathalbyn (north west of Collinsville), Havilah, and Eastern Creek (south of Collinsville)

Numerous other crossings occur where there are low voltage power lines for local distribution of power.

A Sunwater Pipeline runs through the region. The Corridor is closely aligned beside the pipeline in several locations and crosses it once near the North Goonyella mine.

The North Queensland Gas Pipeline runs through the region. The Corridor runs close beside it in several locations and also crosses it once near the North Goonyella mine.

**Traffic and Transport**

The preferred Corridor will intersect the Bruce Highway and the Gregory, Suttor, Cerito and Bowen Development Roads, as well as numerous smaller shire roads.

Unsealed local government controlled roads potentially affected include: Glenore, Strathalbyn, Herbert Creek, Johnny Cake, Strathmore, Myuna North, Myuna South, Collinsville Elphinstone, Broadmeadow, Kilcummin-Diamond Downs, Stratford, Moray-Bulliwallah, Moray-Carmichael, Laglan Lou Lou Park, Jerico-Degulla, Degulla roads.

Detailed investigations will be undertaken for the preferred route during the EIS phase. It is likely that many internal property access tracks will also be impacted by the Corridor.

The remoteness of most of the route is unlikely to generate traffic management issues relevant to the Project.

**Community Amenities**

There are limited social and recreational facilities available in Collinsville and Moranbah to meet the needs of a largely temporary workforce while servicing the needs of the resident population. There are no key social amenities and services affected by the Project. Investment by the Proponent in social amenities for workers during the construction and operational phases will be addressed more fully in the EIS.

**Land Use and Tenures**

The dominant land use is beef cattle on leasehold lands and coal mining by open cut methods. Significant areas of rain-fed cropping land occur with smaller areas of irrigated cropping along the Bowen-Broken Rivers near Collinsville.

North-west of Collinsville, the route diverges around and through the Clarke Ranges and enters the coastal draining system of the Bogie River which flows to the ocean north of Abbot Point after skirting the Mt Aberdeen National Park. The predominant land use is cattle grazing and agricultural.

**Key Local and Regional Land Uses**

Key land uses, local government areas, protected areas and mining development areas have been addressed above. These include agricultural, mining, urban township, crown and environmental reserves and transport and utility infrastructure.

**Key Local and Regional Land Tenures**

Existing tenures in the region to be traversed by the Corridor include:

- Freehold;
- Crown land;
- Pastoral leases;
- Easements, covenants and rights of way; and
- Native title.

The regions west of Moranbah consist of lands predominantly used for beef cattle production. Current assessment indicates the following properties will be potentially affected by the Corridor.

- Eighteen grazing properties between Abbot Point and Moranbah
- Eleven grazing properties between Moranbah and North Galilee
- Nineteen grazing properties between Galilee North and Alpha

The Corridor terminates at Abbot Point State Development Area and associated coastal management zone. The port at Abbot Point will potentially affect the Great Barrier Reef World Heritage Area, however, the port development per se is not part of the Corridor within the scope of this Project. Four local government areas are affected and the Abbot Point State Development area will be subject to a development control plan.

The Proponent intends to acquire all land needed for the Corridor under either Freehold title or long term leases or by way of easement rights so as to provide security of tenure to users of the Corridor to meet their commercial requirements under long term contracts. Freehold title will also facilitate access to capital for development costs.

Where freehold title is not feasible, the Proponent proposes to discuss with government the availability of alternative tenure arrangements that will still ensure long term security for the Corridor, whether through alternative designations of Project land or under arrangements analogous to those provided for in the Transport Infrastructure Act 1994 (Qld) in relation to rail corridor land and acquisition of land for use as part of a rail transport corridor.

**Native Title**

The Native Title (NT) Act 1993 recognises the rights and interests of indigenous peoples with respect to their traditional laws and customs where they can demonstrate a continuing involvement with the land.

Claims have been registered over various parts of the overall route by the Birri People, Wiri People (core country claim) and the Jangga People (as per the Federal Court National Native Title Tribunal - 30 September 2011). Determinations of Native Title over these areas are pending.

**Planning Instruments, Government Policies**

There are a series of approvals required for significant project declaration and which are part of the Environment Impact Statement (EIS) process. The Coordinator-General has powers under the State Development and Public Works Organisation Act 1971 (Qld) (SDPWO Act) to direct that an EIS be undertaken for significant projects and these may involve referral to the Commonwealth Government for determination under the EPBC Act.

When an EIS is being conducted under the SDPWO Act, the Integrated Development Assessment System (IDAS) approvals under the Sustainable Planning Act 2009 (Qld) (SPA) as well as other approvals processes of other relevant Acts are suspended. This suspension remains in place until the Coordinator General's evaluation report is completed and sent to the IDAS assessment manager and other approval managers for their consideration.

Other legislation that may have relevance to the Project is set out below.

- Native Title (Queensland) Act 1993 (Qld);
- Aboriginal Cultural Heritage Act 2003 (Qld);
- Environmental Protection Act 1994 (Qld);
- Vegetation Management Act 1999 (Qld);
- Nature Conservation Act 1992 (Qld);
- Water Act 2000 (Qld);
- Dangerous Goods Safety Management Act 2001 (Qld);
- Petroleum and Gas (Production and Safety) Act 2004 (Qld);
- Transport Infrastructure Act 1994 (Qld); and
- Mineral Resources Act 1989;

There are also several Policies and Guidelines that must be complied with such as air, noise, water, waste and riverine protection permitting. The Project will be subject to several Environmentally Relevant Activities (ERA) requiring approvals by Department of Environment and Resource Management (DERM).

**Potential Impacts of the Project**

**Natural Environment**

Construction of the Corridor and rail lines will have potential impact on land and water resources. Regional vegetation communities affected include the Desert Uplands and Brigalow communities.

During clearing and earthworks operations required for the construction of the rail formation and site access roads and during excavation activities for culvert installations there are likely to be impacts associated with runoff from bare surfaces leading to sedimentation in streams. Similar impacts will arise from quarrying activities established within relative proximity external to the Corridor for the supply of suitable track formation and rail ballast materials and in relation to the establishment and operation of concrete batch plants.

Properly understanding the flow characteristics of streams in catchments upstream and downstream of the Corridor will be important to the design of Corridor infrastructure (rail, road, bridge, pipes and culverts) to minimise impacts on the catchments and downstream floodplains.

Coal dust contamination of areas adjacent to the Corridor will be averted by virtue of the need for only one rail transport Corridor and the proposal in this Project to use specially designed closed-lid coal freight wagons. This will protect nearby grazing pastures from contamination and also minimises the risk of fire outbreaks.

The on-site haulage of materials and the use of the site access roads to bring construction equipment and permanent materials including reinforcing steel and concrete materials to site are likely to have ongoing sediment runoff impacts. The road transport of construction materials from off-site locations to site may also have impacts on the integrity of the local road network.

Selection criteria for the Corridor route alignment included:

- avoiding known sensitive environmental areas, homesteads, townships and minimising the impact to other infrastructure;
- avoiding National Parks, existing mines and urban concentrations;
- reducing the risk within flood prone areas, major watercourses and difficult topography by locating the alignment in higher ground, positioning major watercourse crossings as upstream as conceivably possible whilst avoiding flood plains and avoiding mountainous terrain;
- grade separation of major road, rail and existing infrastructure crossings;
- a desktop geotechnical investigation of the proposed Corridor route identifying high risk areas such as poor foundation materials (black soil), sources of suitable borrow materials for embankment construction and rock areas for crushing for ballast supplies;
- optimising the Corridor route and width to accommodate a minimum of two railway lines to potentially service the greatest number of mines within a single Corridor and thereby minimise the land footprint;
- impose less social, biological and ecological impact than the multiple alternative corridors under consideration by minimising the amount of grazing and agricultural land sterilised for the transport of coal; and
- allow within the Corridor for expansion to four rail lines and extension to Mt Isa, the North West Minerals Province and beyond.

Such an innovative approach to infrastructure and resource management has the following advantages:

- minimises impacts on identified Strategic Cropping Land areas and other good quality agricultural land;
- minimises exposure to flood-prone areas risk of operational impairment of the railway during wet seasons;
- minimises impacts within black soil areas considered as high risk potential of substandard foundation conditions and instability;
- provides grade separated crossings to major arterial roads and railways removing risk of vehicular/train collisions and traffic delays to the public;
- minimises environmental impacts, including greenhouse gas emissions, by introducing heavy haul freight capacity rolling stock carrying significantly greater tonnages per travel event thereby requiring significantly fewer travel events for any given amount of product moved to port, compared to existing practices in Queensland ;
- provides covered/enclosed coal wagons, thus significantly reducing environmental impacts of dust loss on local communities adjacent to the Corridor; and
- allows mine operators to share costs and retain valuable capital funds to underwrite further development by avoiding a high level of investment in individual separate rail infrastructure.

Operation of the facility is likely to involve minimal impact on land resources however care will be needed to address impacts on overland water flows.

There are environmentally sensitive areas in the region and these will be subject to more detailed assessment as part of the EIS process. Final route selection will however avoid, for example, Blackwood and Mt Aberdeen National Parks and remnant forests associated with the Leichhardt Range and uncleared areas within the Burdekin Dam catchment.

Potential impacts on fauna and flora are likely to be confined to loss of habitat along the Corridor and indirect impacts where the Corridor may bisect faunal corridors or affect adjacent habitat/communities. Where vegetation is partially cleared, this may lead to edge effects and potential impacts on the sustainability of the smaller remnant plant community. During construction, there are also likely to be impacts from frequent vehicular movements between properties in regard to the potential spread of flora pest species.

**Amenity – Including Noise, Air Quality, Vibration, Lighting, Urban Design and Visual Aesthetics**

Construction and operation of the railway within the Corridor will involve some dust emissions associated with earthmoving machinery and other vehicular activity.

Though most of the Corridor is in remote or sparsely populated rural locations, rail operation will generate potential noise and vibration impacts which, will need to be managed, in particular where the route approaches or is adjacent to homesteads and townships.

A significant benefit of this proposed open access, heavy haul 40 tonnes load per axle railway compared to proposals to construct multiple less efficient lines and corridors is that significantly less train movements will be required resulting in correspondingly less noise and amenity impacts for the same tonnage of coal hauled.

Visual amenity is unlikely to be significantly affected by the Project however this will be assessed in more detail, in particular in relation to township development.

**Social Environment – Beneficial and Adverse Potential Impacts**

The social environment is characterised largely by rural communities and towns. The key issues in relation to social impact are potential impacts on social amenity, noise and vibration, construction impacts, employment, housing and accommodation and cultural heritage.

The issues relating to the construction workforce are discussed elsewhere in this document. Housing and accommodation will need to be addressed in the context of construction and ongoing operation of the Project.

Indigenous culture may be affected and this will need to be assessed and managed as part of the EIS.

**Economic Effects**

The Project will clearly have beneficial impacts on employment and attraction of a workforce to the area. This will in turn provide an injection of private expenditure into local economic activity which could and may assist in the revival or growth of regional townships.

The Corridor will also potentially enhance access to freight services for township and rural production outputs and provide a Corridor for delivery of fuel and other services to the regions through which the Corridor passes. As a multipurpose Corridor, the potential for upgraded communications and other utility services will be presented also.

**Built Environment**

The Project will involve the construction of several rail-over-river and road-over rail bridges to meet the needs of the Project and avoid impacts on the travelling public. Power, water and telecommunications will be provided as components of the construction, including state-of-the-art wireless communications and signalling technology.

The Proponent is already a licensed carrier under the Commonwealth Telecommunications Act, and as well as the digital wireless overlay system, plans to offer a best of breed Train Control System (TCS) to other operators so that all train command and control operations are on a single shared platform to facilitate maximum efficiency. The installation of this infrastructure will have minimal impacts due to its modest footprint.

The Corridor will intersect the Gregory, Suttor and Bowen Development Roads as well as several shire roads. A detailed inventory will be developed during the EIS of all likely impacts on established roads and farm tracks. This will include traffic studies to identify impacts on significant roads. Nevertheless, the Proponent intends to ensure there will be no impact on the general travelling public and will construct road-over-rail (or rail-over-road where landform enables it) to provide for continuity of operation and maximum public safety.

**Matters of National Environment Significance**

There are matters, including threatened species, listed under the Environmental Protection and Biodiversity Conservation Act 1999 (Cth). Other Matters of National Environmental Significance (MNES) identified from a Protected Matters database search are shown in Table 5 above. Several wetlands of national importance, largely in the northern and coastal vicinity of the Corridor, while not directly affected by the Corridor, will need to be assessed in the context of the EIS.

**Environmental Management - Mitigation Measures**

This proposed single, multi user infrastructure Corridor has many environmental benefits compared to alternative options which would require multiple corridors and its carefully selected route aims to eliminate their potentially divisive social impacts.

Having the capacity to handle all coal freight from the Galilee Basin and significant quantities from the expanding Bowen Basin coalfields, it will obviate the need to construct any of the other multiple haulage routes proposed, which traverse in different directions from separate points along the Galilee Basin to Moranbah and/or Abbot Point.

It will also enable the development of all future mines in the Galilee coal basin by the addition of only short spur lines within the mining tenement areas, which other proposed multiple routes cannot facilitate due to their cross-country remoteness.

The proposed Corridor alignment substantially avoids floodplains and farm cropping lands thereby minimising the requirement for significant flood mitigation structures. In addition, by selecting a topographically suitable route, it generates reduced earthworks quantities thus minimising the requirement for imported fill.

For optimum economic freight efficiency the proposed Corridor adopts a maximum 1:320 loaded gradient and utilises 40 tonnes load per axle closed lid coal wagons rolling stock. This economic efficiency is gained hand in hand with fewer train movements with consequent reduction in environmental impact e.g. noise, coal dust and diesel exhaust emissions.

The Proponent proposes to produce an environmental management system for the construction and operational phases of the Corridor that is consistent with the principles of ISO14001 and is amenable to independent third party audit against accepted standards of performance.

**Natural Environment**

In the Environmental Management Plan for the Project, key measures to avoid or minimise environmental impact on the land, water and vegetation resources of the affected route will be addressed.

Impacts from clearing of vegetation will be minimised due to the largely open nature of the selected route. No burning of vegetative waste will be allowed and all material will be mulched and used for batter stabilisation.

Potential impacts with fauna and flora are likely to be confined to loss of habitat along the Corridor and indirect impacts where the Corridor may bisect faunal corridors or affect adjacent habitat/communities. Where appropriate, consideration will be given to providing underpass or overpass structures to aid Fauna and flora habitat connectivity. Where plant communities are partially cleared, this may lead to edge effects and potential risks to fauna reliant on the smaller community remnant. In such cases, appropriate offsets will be proposed and implemented. Detailed investigation of the Regional Ecosystems listed for the proposed route will validate existing mapping and be used to develop effective management approaches to impacts.

The construction EMP will establish procedures to avoid sedimentation of streams and impacts on ecosystems along the route. All areas disturbed by construction will be rehabilitated progressively on completion of activities in that section. Water will mainly be required for the construction period only and appropriate measures will be taken to acquire appropriate supplies with no impact on local demand for stock and domestic supplies.

The Project when operational will have minimal to no impact on surface and groundwater as flooding risk will be managed through design intervention and the covered wagons will prevent fugitive coal dust entering the surface water environment.

Thorough investigation will be undertaken of all MNES during preparation of the EIS. The database search results are indicative and not definitive for the Corridor and will be tested for validity. The Corridor has been selected to avoid all presently known environmentally sensitive areas and will be refined as detailed information comes to hand. Appropriate management or recovery plans will be developed as and if necessary. As the development does not drain to the Cooper Basin, there will be no impacts on the Ramsar Wetlands in the Coongie Lakes area.

**Built Environment**

A detailed inventory will be developed during the EIS of all likely impacts on established roads, stock routes and landholder access roads and tracks. This will include a traffic study to identify impacts on significant roads. Nevertheless, the Proponent has already determined that there should be no impact on the general travelling public and will construct road-over-rail (or rail-over-road where landform enables it) to provide for continuity of operation and maximum public safety.

In developing solutions on properties where internal tracks (and also traditional cattle movement to watering points or during mustering cycles) are disrupted, the Proponent will involve landholders in the process to ensure that property management is not impacted. Alternative thoroughfares either under or over the railway will be considered.

The Proponent proposes to provide social and recreational facilities at the construction accommodation villages, where appropriate, to ensure that the temporary workforce does not cause disruption to existing established communities. These amenities may be available to communities on completion of the construction project for their continued use.

**Social Impact Management Plan**

This proposal offers the reduction of multiple haulage routes to a single, carefully selected Corridor which will minimise the impact on land, the grazing industry and landholders. This will also greatly reduce the fragmentation of rural properties and disruption of normal daily farm management activities.

Air and noise emissions limits will be subject to the Construction EMP to be developed for the Project. Strategies to minimise long term emissions will include real time locomotive management via the wireless overlay network, and regular maintenance of locomotives to ensure the most efficient consumption of diesel fuel. Additionally, the use of covered coal wagons will avoid the release of coal dust to the atmosphere. The capacity to move larger volumes with fewer trains will help limit both air quality issues and noise emissions.

A social impact management plan (SIMP) addressing all the key issues outlined will be prepared in consultation with industry, the community and all levels of Government. The SIMP will be prepared in accordance with the Sustainable Resources Communities Policy, current environmental impact assessment and resource development legislation, policies and procedures. The SIMP will be submitted as part of the EIS prior to the public consultation period and updated with the final EIS to reflect the outcomes of consultation.

The SIMP will establish the roles and responsibilities of the Proponent, stakeholders and communities from project approval onwards throughout the life of the project, in mitigating social impacts and opportunities during the construction and operation of the GIC. In prescribed format, the SIMP will address the identification and analysis of impacts along with mitigation and management strategies; and establish monitoring, reporting and review mechanisms along with engagement strategies and dispute resolution mechanisms.

**Cultural Heritage Management Plan (Indigenous)**

The development of a Plan to address indigenous cultural heritage will be undertaken through discussions with the traditional owners and the outcomes of the current native title claims. Appropriate investigations will be undertaken in line with the EIS. A Cultural Heritage Management Plan (CHMP) and Indigenous Land Use Agreement (ILUA) as required will be entered into with the relevant Traditional Owners (TO) following negotiations.

Where significant artefacts, places and other areas of interest are identified these will be dealt with having regard to the desires of Traditional Owners.

**Non-Indigenous Cultural Heritage Management**

This will be addressed as part of the EIS although there do not appear to be any places registered on the Inventory of Heritage Places that will be affected by the Corridor. Landholders and local historical groups will be approached to determine the European heritage values of the area. European heritage will be preserved or relocated where required in situations where it cannot be avoided. Given its interesting history of settlement and the long-standing of several homesteads, it will be important that these values are protected to the maximum extent possible.

**Greenhouse Gas Management Plan**

Construction and operation of the Corridor will result in some greenhouse gas emissions. The Corridor design and operational configuration of the freight services using it are intended to optimise the efficiency of operation and minimise emissions substantially compared to all other currently proposed alternatives.

The EIS will estimate the quantum of emissions GHGe likely to be produced per year in line with standard estimating procedures using the Queensland Government's Guidelines for Preparing a Climate change Impact Statement (CCIS) (EPA 2008). Although a CCIS is normally only required for a proposal submitted to Cabinet, these guidelines provide a basis for assessing specific expectations regarding assessment of potential climate change impacts.

Emissions will be quantified as far as is practicable. Inputs such as embodied energy associated with steel manufacture for the rail lines and other materials to be used in construction will not be considered for the construction phase EIS.

The use of a much greater haulage capacity with the 40 tonnes load per axle wagons has potential to significantly reduce the volume of GHGe per unit of coal transported, making the Project more efficient in this respect. It is in the economic interest of the Project that the efficiencies, especially in energy use, will be optimised and an Energy Management Plan will be developed for the operational **phase of the Project.**

**Waste Management**

The construction phase of the Project will be likely to generate waste materials which require management. This will be coordinated as part of the Environmental Management System for the Project to ensure waste is minimised and where feasible recycled, given that most materials will need to be transported in to the construction site/s. Clear procedures to address these issues will be established as part of the Construction EMP.

As the route hugs the foothills of the ranges and avoids the clay plains, there will be sources of rock and spoil that can be used for rail embankment construction. Additionally, as there are significant outcrops of basalt and granitic rocks, it is likely that this material can be used for aggregate in concrete and ballast for the rail tracks, avoiding waste and the necessity for long haulage costs from existing sources.

Where earthworks are involved and particularly at river crossings, all site runoff water will be captured in detention basins to treat sediment loads and used for dust suppression. Discharge to land will only be permitted when sediment loads are within normal runoff limits. All wastes will be appropriately managed through treatment and disposal by approved methods and sites will be fully restored on completion.

Grey water generated from the camp population will either be treated on site and recycled on garden areas within the camp facilities or removed from site and disposed of in accordance with the Local Council Bylaws within approved disposal areas.

**Hazard and Risk, and Health and Safety**

Hazards and risks with the potential to adversely affect people, property or the environment will be fully assessed as part of the EIS for the Project. Key hazards relate to the construction phase of the Project, particularly in respect of workplace safety. Operational phase safety issues will be similar to that required of existing rail operations so far as potential operating workforce and third party impacts are concerned. Appropriate risk management strategies and tools will be developed as part of the EIS and the Workplace Health and Safety Plan for the Project.

**Environmental Management**

A series of sub-plans will constitute The EMS for the Project as follows:

- Construction Environmental Management Plan (CEMP)

During the EIS phase a Draft CEMP will be prepared identifying the environmental elements that will need to be addressed during construction. Once a head contractor has been appointed and a construction methodology is confirmed, this Draft CEMP will be expanded to accurately reflect specific aspects of the proposed delivery mechanisms. Detailed risk assessment will be undertaken by the project team to ensure that all likely impacts are identified and mitigated as far as possible. The CEMP will then target residual risks.

Key components of the CEMP will include for each element:

- likely impacts;
- responsible person/authority;
- corrective measures;
- reporting requirements;
- monitoring and review procedures;
- communications with personnel for updates; and
- continuous improvement strategy.

The Contractor will appoint staff responsible for the implementation of the CEMP and ensure that compliance with all procedures is achieved in line with conditions imposed by the regulating authorities.

- Operational Environmental Management Plan (OEMP)

A similar format will be adopted for the operational phase of the Project.

- Workplace Health and Safety Plan (WHSP)

A WHSP will be developed in conjunction with the CEMP and a responsible officer appointed to be charged with ensuring that all activities comply with State and Federal guidelines and standards. Safety of the workforce in a remote location is of critical importance where access to medical support faces significant time delays.

Regular toolbox talks and provision of adequate water, PPE, shade and sun protection cream will be key attributes of the WHSP. Officers will be trained in such measures as snake bite treatment given the rural and isolated nature of much of the construction route.

- Decommissioning Plan

As the Corridor is seen to have much wider potential than just the Corridor from the Galilee to Abbot Point, it is not critical at this juncture to plan for a decommissioning plan. It is understood that the expected life of several mines in the Galilee Basin alone is more than 150 years, though much of this depends on the world's future global patterns of continued use of fossil fuels for both thermal and manufacturing purposes.

Describe or summarise any public consultation undertaken, or to be undertaken, during the assessment. Attach copies of relevant assessment documentation and outcomes of public consultations (if available).

**Community and Stakeholder Consultation**

**Stakeholder Engagement**

The Proponent commenced its broad stakeholder communication and engagement Strategy in 2010.

Discussions were held with the Mayors of Whitsunday, Isaac, Cloncurry and Barcaldine Regional Councils to determine how the peak groups and individuals in their communities preferred to be briefed on the Project.

Upon their advice and information given by officers from the Office of the Coordinator General the following briefings were given. All issues raised at these briefings were documented with a view to ensuring that the issues are addressed as part of the environmental impact assessment process.

| Table of Stakeholder Engagement | | | |
|---|---|---|---|
| **Person/Group** | **Type of Briefing** | **Place & Date** | **Issues Raised** |
| Mayor Mike Brunker, Bowen Shire Council Deanne Kelly, Local Member, Mark Gaudry, Councillor, David Nebauer, Bowen's Economic Development Manager, Les Cox, Burdekin Electorate's Media Liaison Officer, Matthew Magin, NQBP, Dr Paul Joice, Queensland Nationals candidate for Whitsunday | Introduction & Briefing on Project | 05 Jul 06 | Industrial park at Abbott Point |
| Indigenous representatives Joe Henaway, James Gaston, Chairman, Gudjuda Reference Group Aboriginal Corporation | Introduction & Briefing on Project | 06 Jul 06 | Sustainable benefits Job Training and Subsequent jobs Community development |
| Strategic Advisory Committee, Townsville Enterprise Ltd Representatives, Chamber of Commerce | Briefing on Project | 11 Aug 08 | Emission Trading Scheme (ETS) Feasibility Study(FS) Concerns over land acquisition processes |
| Mayor Lyn Mclaughlin, Burdekin Shire Council<br>Ayr and Home Hill Chamber of Commerce | Briefing on Project | 11 Aug 08 | Federal & States govt approach<br>Rail Link from Moranbah to Abbot Point |
| Mayor Brunker and Whitsunday Council | Briefing on Project | 11 Aug 08 | |
| Mackay Area Industry Network (MAIN)<br>Chamber of Commerce | Briefing on Project | 11 Aug 08 | |
| Matthew Magin, NQBP | Briefing on current Project status | 22 Jun 11 | Interest by Meijin Energy<br>EOI T4-T7 timing<br>Coal wagon efficiencies |
| Keith Davies (CoG) Public Forum at Clermont | Community consultation and EWLP briefing of single Corridor | 29 Jun 11 | Concerns of multiplicity of rail corridors planned<br>Concerns over land acquisition processes |
| Kate Weir/Peter Hughes, CoG APSDA Planning Group | Presentation on the Project proposal and impacts within APSDA | 01 Jul 11 | Impact of rail loops on APSDA<br>Land parcels and location – planning perspective |

| Table of Stakeholder Engagement | | | |
|---|---|---|---|
| **Person/Group** | **Type of Briefing** | **Place & Date** | **Issues Raised** |
| | | | QR duplication of T1 NG rail entry,<br>Rail entry into APSDA and stockpile areas T4-T7<br>Lack of rail access to multi-cargo berths |
| Bradley Chandler, Department of Transport | Briefing on Project status and land acquisition issues, corridor sharing with QRN | 19 Jul 11 | Current lease arrangements on QRN corridor,<br>New corridor arrangement procedures |
| Mayor Marshall and Isaac Council | Updated briefing on the Project including outline of proposed route for our single Corridor open access multi user solution | 20 Jul 11 | |
| Mayor Brunker and Whitsunday Council | Updated briefing on the Project including outline of proposed route for our single Corridor open access multi user solution | 02 Aug 11 | Timing of Development Application and EIS submission |
| Business Council, Bowen | Updated briefing on the Project including outline of proposed route for our single Corridor open access multi user solution | 02 Aug 11 | |
| Meeting with Mining companies | Overview of the Project including outline of proposed route for our single Corridor open access multi user solution | Qtr 4 CY 2011 | Timing for coal delivery |
| David Stolz, Office of Coordinator General | Overview of the Project including outline of proposed route for our single Corridor open access multi user solution | 05 Sep 11 | |
| NQBP Brad Fish | General Cargo Wharf discussion<br>Timelines for port development | 21 Sep 11 | |
| Bill Schoch - Waratah | Infrastructure financing – EWLP – ATrade<br>Use of EWLP MUIC | 18 Nov 11 | Time frames |
| Yogendra Sharma - Adani | Use of EWLP MUIC | 15 Nov 11 | Time frames |

**2.6 Public consultation (including with Indigenous stakeholders)**
Your referral must include a description of any public consultation that has been, or is being, undertaken. Where Indigenous stakeholders are likely to be affected by your proposed action, your referral should describe any consultations undertaken with Indigenous stakeholders. Identify the relevant stakeholders and the status of consultations at the time of the referral. Where appropriate include copies of documents recording the outcomes of any consultations.

Please refer to the above Table of Stakeholder Engagement

### 2.7 A staged development or component of a larger project

If you have identified that the proposed action is a component of a larger action (in section 1.12) you must complete this section. Provide information about the larger action and details of any interdependency between the stages/components and the larger action. You may also provide justification as to why you believe it is reasonable for the referred action to be considered separately from the larger proposal (eg. the referred action is 'stand-alone' and viable in its own right, there are separate responsibilities for component actions or approvals have been split in a similar way at the state or local government levels).

The proposed action is not a component of a larger action; the referred action is 'stand-alone' and viable in its own right. By way of explanation the following are the reasons why GIC is a stand-alone project.

The Galilee Infrastructure Corridor project (GIC) project was created by East West Line Parks Limited (EWLP) in June 2011 as a separate project, in the same manner as other EWLP projects such as Project Iron Boomerang (PIB) and the Smart Materials project (SMP) were created, i.e. on a business case. The people behind the EWLP concept are eminent Australians that have the fundamental belief in realising the EWLP Vision is in the Nation's best interest. EWLP is entirely funded from non-government sources. As the GIC project evolved global and domain experts contributed to the fundamental design, including consulting global financiers connected to the international Capital markets.

While there appears to be recent State Government support for particular parts of the Galilee basin to be serviced by two other new rail corridors plus additional spur lines, the GIC project proposed by EWLP is a favourably located, single, heavy-haul freight corridor which will have far less impact on agricultural lands and the environment.

Further, a recently concluded independent Technical and Economic study commissioned by EWLP to assess and compare the freight efficiency, economic benefits and long term sustainability of the GIC over the other proposed rail lines from the Galilee Basin has demonstrated the significantly better comparative economic case for the GIC over the other proposed rail lines. The study also demonstrated the project can be delivered within the required timeframe to meet currently proposed increases in port capacity at Abbot Point.

While the Galilee basin has the potential for development of vast reserves of thermal coal, EWLP understands that the significant falls in the commodity's price in the first half of 2012 have drawn attention to the marginal economic case for the proposed developments and to the critical importance of the freight cost component. The GIC freight solution uniquely brings the essential economic freight advantage to lower input costs and promote long term sustainable development.

The GIC proposal thereby brings the potential to boost national economic productivity. At the same time its favourable agricultural and environmental credentials will benefit the important social elements of all proposed developments in the Galilee basin.

EWLP is the proponent of the GIC. EWLP is the entity behind the proposal to build one of Australia's largest infrastructure projects, Project Iron Boomerang (PIB). PIB consists of a transcontinental multi-user rail infrastructure corridor and steel manufacturing complexes, sustainably planned for the long term (100 years), which will revolutionise global steel manufacturing. If realised, PIB proposes to use a portion of the rail alignment in the GIC (refer to PIB-SKE-G-0099 in particular LINE 1- GALILEE INFRASTRUCTURE POSSIBLE FUTURE EXTENSION) to connect from the Abbot Point State Development Area to the Pilbara.

For all the aforementioned reasons, EWLP believes the GIC project deserves the strong support of all levels of Government and the community.

# 3 Description of environment & likely impacts

## 3.1 Matters of national environmental significance

Describe the affected area and the likely impacts of the proposal, emphasising the relevant matters protected by the EPBC Act. Refer to relevant maps as appropriate. The interactive map tool can help determine whether matters of national environmental significance or other matters protected by the EPBC Act are likely to occur in your area of interest.

Your assessment of likely impacts should refer to the following resources (available from the Department's web site):

- specific values of individual World Heritage properties and National Heritage places and the ecological character of Ramsar wetlands;
- profiles of relevant species/communities (where available), that will assist in the identification of whether there is likely to be a significant impact on them if the proposal proceeds;
- *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*; and
- associated sectoral and species policy statements available on the web site, as relevant.

**Note that even if your proposal will not be taken in a World Heritage area, Ramsar wetland, Commonwealth marine area, the Great Barrier Reef Marine Park or on Commonwealth land, it could still impact upon these areas (for example, through downstream impacts). Consideration of likely impacts should include both direct and indirect impacts.**

### 3.1 (a) World Heritage Properties

**Description**

Please review Galilee Infrastructure Project Constraints Workshop for the Environmental, Flooding & Waterway and Social Impact Issues in the Appendix.

**Nature and extent of likely impact**

Address any impacts on the World Heritage values of any World Heritage property.

Please review the Appendix for the tabulated constraints output on Key Identified Issue, Issue Descriptor, Risk Category, Proposed Mitigation Strategy as well as the Initial Ecological Constraints Analysis document (9 Mb emailed separately)

### 3.1 (b) National Heritage Places

**Description**

Please review Galilee Infrastructure Project Constraints Workshop for the Environmental, Flooding & Waterway and Social Impact Issues in the Appendix.

**Nature and extent of likely impact**

Address any impacts on the National Heritage values of any National Heritage place.

Please review the Appendix for the tabulated constraints output on Key Identified Issue, Issue Descriptor, Risk Category, Proposed Mitigation Strategy as well as the Initial Ecological Constraints Analysis document (9 Mb emailed separately)

### 3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

**Description**

Please review Galilee Infrastructure Project Constraints Workshop for the Environmental, Flooding & Waterway and Social Impact Issues in the Appendix.

**Nature and extent of likely impact**

Address any impacts on the ecological character of any Ramsar wetlands.

Please review the Appendix for the tabulated constraints output on Key Identified Issue, Issue Descriptor, Risk Category, Proposed Mitigation Strategy as well as the Initial Ecological Constraints Analysis document (9 Mb emailed separately)

### 3.1 (d) Listed threatened species and ecological communities

**Description**

Please review Galilee Infrastructure Project Constraints Workshop for the Environmental, Flooding & Waterway and Social Impact Issues in the Appendix.

**Nature and extent of likely impact**

Address any impacts on the members of any listened threatened species (except a conservation dependent species) or any threatened ecological community, or their habitat.

Please review the Appendix for the tabulated constraints output on Key Identified Issue, Issue Descriptor, Risk Category, Proposed Mitigation Strategy as well as the Initial Ecological Constraints Analysis document (9 Mb emailed separately)

### 3.1 (e) Listed migratory species

**Description**

Please review Galilee Infrastructure Project Constraints Workshop for the Environmental, Flooding & Waterway and Social Impact Issues in the Appendix.

**Nature and extent of likely impact**

Address any impacts on the members of any listed migratory species, or their habitat.

Please review the Appendix for the tabulated constraints output on Key Identified Issue, Issue Descriptor, Risk Category, Proposed Mitigation Strategy as well as the Initial Ecological Constraints Analysis document (9 Mb emailed separately)

### 3.1 (f) Commonwealth marine area

(If the action is in the Commonwealth marine area, complete 3.2(c) instead. This section is for actions taken outside the Commonwealth marine area that may have impacts on that area.)

**Description**

Please review Galilee Infrastructure Project Constraints Workshop for the Environmental, Flooding & Waterway and Social Impact Issues in the Appendix.

**Nature and extent of likely impact**

Address any impacts on any part of the environment in the Commonwealth marine area.
Please review the Appendix for the tabulated constraints output on Key Identified Issue, Issue Descriptor, Risk Category, Proposed Mitigation Strategy as well as the Initial Ecological Constraints Analysis document (9 Mb emailed separately)

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### 3.1 (g) Commonwealth land

(If the action is on Commonwealth land, complete 3.2(d) instead. This section is for actions taken outside Commonwealth land that may have impacts on that land.)

Not Applicable

**Description**

If the action will affect Commonwealth land also describe the more general environment. The Policy Statement titled *Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies* provides further details on the type of information needed. If applicable, identify any potential impacts from actions taken outside the Australian jurisdiction on the environment in a Commonwealth Heritage Place overseas.

**Nature and extent of likely impact**

Address any impacts on any part of the environment in the Commonwealth land. Your assessment of impacts should refer to the *Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies* and specifically address impacts on:

- ecosystems and their constituent parts, including people and communities;
- natural and physical resources;
- the qualities and characteristics of locations, places and areas;
- the heritage values of places; and
- the social, economic and cultural aspects of the above things.

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### 3.1 (h) The Great Barrier Reef Marine Park

**Description**

Not Applicable

**Nature and extent of likely impact**

Address any impacts on any part of the environment of the Great Barrier Reef Marine Park.

Note: If your action occurs in the Great Barrier Reef Marine Park you may also require permission under the *Great Barrier Reef Marine Park Act 1975* (GBRMP Act). If so, section 37AB of the GBRMP Act provides that your referral under the EPBC Act is deemed to be an application under the GBRMP Act and Regulations for necessary permissions and a single integrated process will generally apply. Further information is available at www.gbrmpa.gov.au

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## 3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

You must describe the nature and extent of likely impacts (both direct & indirect) on the whole environment if your project:

- is a nuclear action;
- will be taken by the Commonwealth or a Commonwealth agency;
- will be taken in a Commonwealth marine area;
- will be taken on Commonwealth land; or
- will be taken in the Great Barrier Reef marine Park.

Your assessment of impacts should refer to the *Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies* and specifically address impacts on:

- ecosystems and their constituent parts, including people and communities;
- natural and physical resources;
- the qualities and characteristics of locations, places and areas;
- the heritage values of places; and
- the social, economic and cultural aspects of the above things.

| | | | |
|---|---|---|---|
| **3.2 (a)** | **Is the proposed action a nuclear action?** | **No** | Yes (provide details below) |
| | **If yes, nature & extent of likely impact on the whole environment** | | |

| | | | |
|---|---|---|---|
| **3.2 (b)** | **Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?** | **No** | Yes (provide details below) |
| | **If yes, nature & extent of likely impact on the whole environment** | | |

| | | | |
|---|---|---|---|
| **3.2 (c)** | **Is the proposed action to be taken in a Commonwealth marine area?** | **No** | Yes (provide details below) |
| | **If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f))** | | |

| 3.2 (d) | **Is the proposed action to be taken on Commonwealth land?** | **No** | Yes (provide details below) |
|---|---|---|---|
| | **If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))** | | |

| 3.2 (e) | **Is the proposed action to be taken in the Great Barrier Reef Marine Park?** | **No** | Yes (provide details below) |
|---|---|---|---|
| | **If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))** | | |

## 3.3 Other important features of the environment

Provide a description of the project area and the affected area, including information about the following features (where relevant to the project area and/or affected area, and to the extent not otherwise addressed above). If at Section 2.3 you identified any alternative locations, time frames or activities for your proposed action, you must complete each of the details below (where relevant) for each alternative identified.

For a response to 3.3 (a) to 3.3 (m) inclusive please review the Appendix for the tabulated constraints output for the Galilee Corridor Infrastructure Project Constraints Workshop on Key Identified Issues, Issue Descriptor, Risk Category and Proposed Mitigation Strategy and the Initial Ecological Constraints Analysis (9Mb document emailed separately)

**3.3 (a) Flora and fauna**

**3.3 (b) Hydrology, including water flows**

**3.3 (c) Soil and Vegetation characteristics**

**3.3 (d) Outstanding natural features**

**3.3 (e) Remnant native vegetation**

**3.3 (f) Gradient (or depth range if action is to be taken in a marine area)**

**3.3 (g) Current state of the environment**

Include information about the extent of erosion, whether the area is infested with weeds or feral animals and whether the area is covered by native vegetation or crops.

**3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values**

**3.3 (i) Indigenous heritage values**

**3.3 (j) Other important or unique values of the environment**

Describe any other key features of the environment affected by, or in proximity to the proposed action (for example, any national parks, conservation reserves, wetlands of national significance etc).

**3.3 (k) Tenure of the action area (eg freehold, leasehold)**

**3.3 (l) Existing land/marine uses of area**

**3.3 (m) Any proposed land/marine uses of area**

# 4 Measures to avoid or reduce impacts

**Note:** If you have identified alternatives in relation to location, time frames or activities for the proposed action at Section 2.3 you will need to complete this section in relation to each of the alternatives identified.

Provide a description of measures that will be implemented to avoid, reduce, manage or offset any relevant impacts of the action. Include, if appropriate, any relevant reports or technical advice relating to the feasibility and effectiveness of the proposed measures.

For any measures intended to avoid or mitigate significant impacts on matters protected under the EPBC Act, specify:
- what the measure is,
- how the measure is expected to be effective, and
- the time frame or workplan for the measure.

Examples of relevant measures to avoid or reduce impacts may include the timing of works, avoidance of important habitat, specific design measures, or adoption of specific work practices.

Provide information about the level of commitment by the person proposing to take the action to implement the proposed mitigation measures. For example, if the measures are preliminary suggestions only that have not been fully researched, or are dependent on a third party's agreement (e.g. council or landowner), you should state that, that is the case.

Note, the Australian Government Environment Minister may decide that a proposed action is not likely to have significant impacts on a protected matter, as long as the action is taken in a particular manner (section 77A of the EPBC Act). The particular manner of taking the action may avoid or reduce certain impacts, in such a way that those impacts will not be 'significant'. More detail is provided on the Department's web site.

For the Minister to make such a decision (under section 77A), the proposed measures to avoid or reduce impacts must:
- clearly form part of the referred action (eg be identified in the referral and fall within the responsibility of the person proposing to take the action),
- be must be clear, unambiguous, and provide certainty in relation to reducing or avoiding impacts on the matters protected, and
- must be realistic and practical in terms of reporting, auditing and enforcement.

More general commitments (eg preparation of management plans or monitoring) and measures aimed at providing environmental offsets, compensation or off-site benefits CANNOT be taken into account in making the initial decision about whether the proposal is likely to have a significant impact on a matter protected under the EPBC Act. (But those commitments may be relevant at the later assessment and approval stages, including the appropriate level of assessment, if your proposal proceeds to these stages).

# 5 Conclusion on the likelihood of significant impacts

Identify whether or not you believe the action is a controlled action (ie. whether you think that significant impacts on the matters protected under Part 3 of the EPBC Act are likely) and the reasons why.

## 5.1 Do you THINK your proposed action is a controlled action?

| | |
|---|---|
| **Yes** | Yes, complete section 5.3 |

## 5.2 Proposed action IS NOT a controlled action.

Specify the key reasons why you think the proposed action is NOT LIKELY to have significant impacts on a matter protected under the EPBC Act.

## 5.3 Proposed action IS a controlled action

Type 'x' in the box for the matter(s) protected under the EPBC Act that you think are likely to be significantly impacted. (The 'sections' identified below are the relevant sections of the EPBC Act.)

| | **Matters likely to be impacted** |
|---|---|
| | World Heritage values (sections 12 and 15A) |
| **X** | National Heritage places (sections 15B and 15C) |
| **X** | Wetlands of international importance (sections 16 and 17B) |
| **X** | Listed threatened species and communities (sections 18 and 18A) |
| **X** | Listed migratory species (sections 20 and 20A) |
| | Protection of the environment from nuclear actions (sections 21 and 22A) |
| | Commonwealth marine environment (sections 23 and 24A) |
| | Great Barrier Reef Marine Park (sections 24B and 24C) |
| **X** | Protection of the environment from actions involving Commonwealth land (sections 26 and 27A) |
| | Protection of the environment from Commonwealth actions (section 28) |
| | Commonwealth Heritage places overseas (sections 27B and 27C) |

Specify the key reasons why you think the proposed action is likely to have a significant adverse impact on the matters identified above.

# 6 Environmental record of the responsible party

**NOTE:** If a decision is made that a proposal needs approval under the EPBC Act, the Environment Minister will also decide the assessment approach. The EPBC Regulations provide for the environmental history of the party proposing to take the action to be taken into account when deciding the assessment approach.

| | | Yes | No |
|---|---|---|---|
| **6.1** | **Does the party taking the action have a satisfactory record of responsible environmental management?**<br><br>**Provide details** | | No |
| **6.2** | **Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application - ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?**<br><br>**If yes, provide details** | | No |
| **6.3** | **If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?**<br><br>**If yes, provide details of environmental policy and planning framework** | TBA | |
| **6.4** | **Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?**<br><br>**Provide name of proposal and EPBC reference number (if known)** | | No |

# 7 Information sources and attachments

(For the information provided above)

## 7.1 References

- List the references used in preparing the referral.
- Highlight documents that are available to the public, including web references if relevant.

Communicating the Imperative for Action: A report to the Council of Australian Governments. June 2011

http://www.infrastructureaustralia.gov.au/2011_coag/

Queensland Government, Community Engagement Guidelines

http://www.qld.gov.au/web/community-engagement/guides-factsheets/

Commonwealth Government, Administrative Arrangement Order

http://www.dpmc.gov.au/parliamentary/index.cfm

Environmental Protection Agency, 2008, Guidelines for Preparing a Climate change Impact Statement (CCIS)

Queensland Government, Guidelines for the Preparation of an Initial Advice Statement

http://www.deedi.qld.gov.au/cg/resources/guideline/guideline-initial-advice-statement.pdf

Queensland Government, Guidelines for the Preparation of Terms of Reference

http://www.deedi.qld.gov.au/cg/terms-of-reference-eis.html

Queensland Government, Guidelines for the Preparation of Social Impact Assessments

http://www.deedi.qld.gov.au/cg/resources/guideline/simp-guideline.pdf

Queensland Resources Council, Mineral and Energy Resources Sector in Queensland: Economic Impact Study

http://www.queenslandeconomy.com.au/economic-report

East West Line Parks Pty Ltd, Pre-Feasibility Study Report, October 2008

Queensland Government Administrative Arrangement Order

http://www.premiers.qld.gov.au/publications/categories/policies-and-codes/admin-arrange-order.aspx

Toward Q2: Tomorrow's Queensland

http://www.towardq2.qld.gov.au/tomorrow/strong-economy.aspx

## 7.2 Reliability and date of information

For information in section 3 specify:

- source of the information;
- how recent the information is;
- how the reliability of the information was tested; and
- any uncertainties in the information.

MWHGlobal (MWH) and Biodiversity Assessment And Management Pty Ltd (BAAM) were commissioned by EWLP to undertake the Initial Ecological Constraints Analysis and draft TOR's for the GIC project. The information is current as at May 2012 and has a high reliability as they follow the standards as required under legislation.

## 7.3 Attachments

Indicate the documents you have attached. All attachments must be less than two megabytes (2mb) so they can be published on the Department's website. Attachments larger than two megabytes (2mb) may delay the processing of your referral.

| | | ✓ attached | Title of attachment(s) |
|---|---|---|---|
| **You must attach** | figures, maps or aerial photographs showing the project locality (section 1) | ✓ | PIB-SKE-G-0099 EWLP GIC et al<br>PIB-SKE-G-0226 GIC Coordinates<br>PIB-SKE-G-0227 GIC Coordinates<br>Initial Ecological Constraints Analysis |
| | figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 3) | ✓ | PIB-SKE-G-0099 EWLP GIC et al<br>PIB-SKE-G-0226 GIC Coordinates<br>PIB-SKE-G-0227 GIC Coordinates<br>Initial Ecological Constraints Analysis |
| **If relevant, attach** | copies of any state or local government approvals and consent conditions (section 2.5) | | |
| | copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6) | ✓ | Galilee Infrastructure Corridor Constraints Workshop<br>1. Flooding & Waterway Issues<br>2. Environmental Issues<br>3. Social Impact Issues<br>Initial Ecological Constraints Analysis |
| | copies of any flora and fauna investigations and surveys (section 3) | ✓ | Galilee Infrastructure Corridor Constraints Workshop<br>1. Flooding & Waterway Issues<br>2. Environmental Issues<br>3. Social Impact Issues<br>Initial Ecological Constraints Analysis |
| | technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4) | ✓ | Galilee Infrastructure Corridor Constraints Workshop<br>1. Flooding & Waterway Issues<br>2. Environmental Issues<br>3. Social Impact Issues<br>Initial Ecological Constraints Analysis |
| | report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3) | ✓ | See Table of Stakeholder Engagement – page 26 |

# 8 Contacts, signatures and declarations

**NOTE:** Providing false or misleading information is an offence punishable on conviction by imprisonment and fine (s 489, EPBC Act).

Under the EPBC Act a referral can only be made by:

- the person proposing to take the action (which can include a person acting on their behalf); or
- a Commonwealth, state or territory government, or agency that is aware of a proposal by a person to take an action, and that has administrative responsibilities relating to the action[1].

## Project title: Galilee Infrastructure Corridor Project

### 8.1 Person proposing to take action

This is the individual, government agency or company that will be principally responsible for, or who will carry out, the proposed action.

If the proposed action will be taken under a contract or other arrangement, this is:

- the person for whose benefit the action will be taken; or
- the person who procured the contract or other arrangement and who will have principal control and responsibility for the taking of the proposed action.

If the proposed action requires a permit under the Great Barrier Reef Marine Park Act[2], this is the person requiring the grant of a GBRMP permission.

The Minister may also request relevant additional information from this person.

If further assessment and approval for the action is required, any approval which may be granted will be issued to the person proposing to take the action. This person will be responsible for complying with any conditions attached to the approval.

If the Minister decides that further assessment and approval is required, the Minister must designate a person as a proponent of the action. The proponent is responsible for meeting the requirements of the EPBC Act during the assessment process. The proponent will generally be the person proposing to take the action[3].

| | |
|---|---|
| Name | Tom James |
| Title | Project Director Rail |
| Organisation | East West Line Parks Limited |
| ACN / ABN (if applicable) | 21 118 581 883 |
| Postal address | GPO Box 899 Brisbane Qld 4001 |
| Telephone | 07 3221 6966 |
| Email | Tom.james@ewlp.com.au |
| Declaration | I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.<br>I understand that giving false or misleading information is a serious offence.<br>I agree to be the proponent for this action.<br>I acknowledge that I may be liable for fees related to my proposed action following the introduction of cost recovery under the EPBC Act. |
| Signature | Date 29th July 2012 |

[1] *If the proposed action is to be taken by a Commonwealth, state or territory government or agency, section 8.1 of this form should be completed. However, if the government or agency is aware of, and has administrative responsibilities relating to, a proposed action that is to be taken by another person which has not otherwise been referred, please contact the Referrals Business Entry Point (1800 803 772) to obtain an alternative contacts, signatures and declarations page.*

[2] *If your referred action, or a component of it, is to be taken in the Great Barrier Reef Marine Park the Minister is required to provide a copy of your referral to the Great Barrier Reef Marine Park Authority (GBRMPA) (see section 73A,* EPBC Act*). For information about how the GBRMPA may use your information, see http://www.gbrmpa.gov.au/privacy/privacy_notice_for_permits.*

[3] *If a person other than the person proposing to take action is to be nominated as the proponent, please contact the Referrals Business Entry Point (1800 803 772) to obtain an alternative contacts, signatures and declarations page.*

**8.2 Person preparing the referral information (if different from 8.1)**

Individual or organisation who has prepared the information contained in this referral form.

| | |
|---|---|
| Name | |
| Title | |
| Organisation | Organisation name should match entity identified in ABN/ACN search |
| ACN / ABN (if applicable) | |
| Postal address | |
| Telephone | |
| Email | |
| Declaration | I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.<br>I understand that giving false or misleading information is a serious offence. |
| Signature | Date |

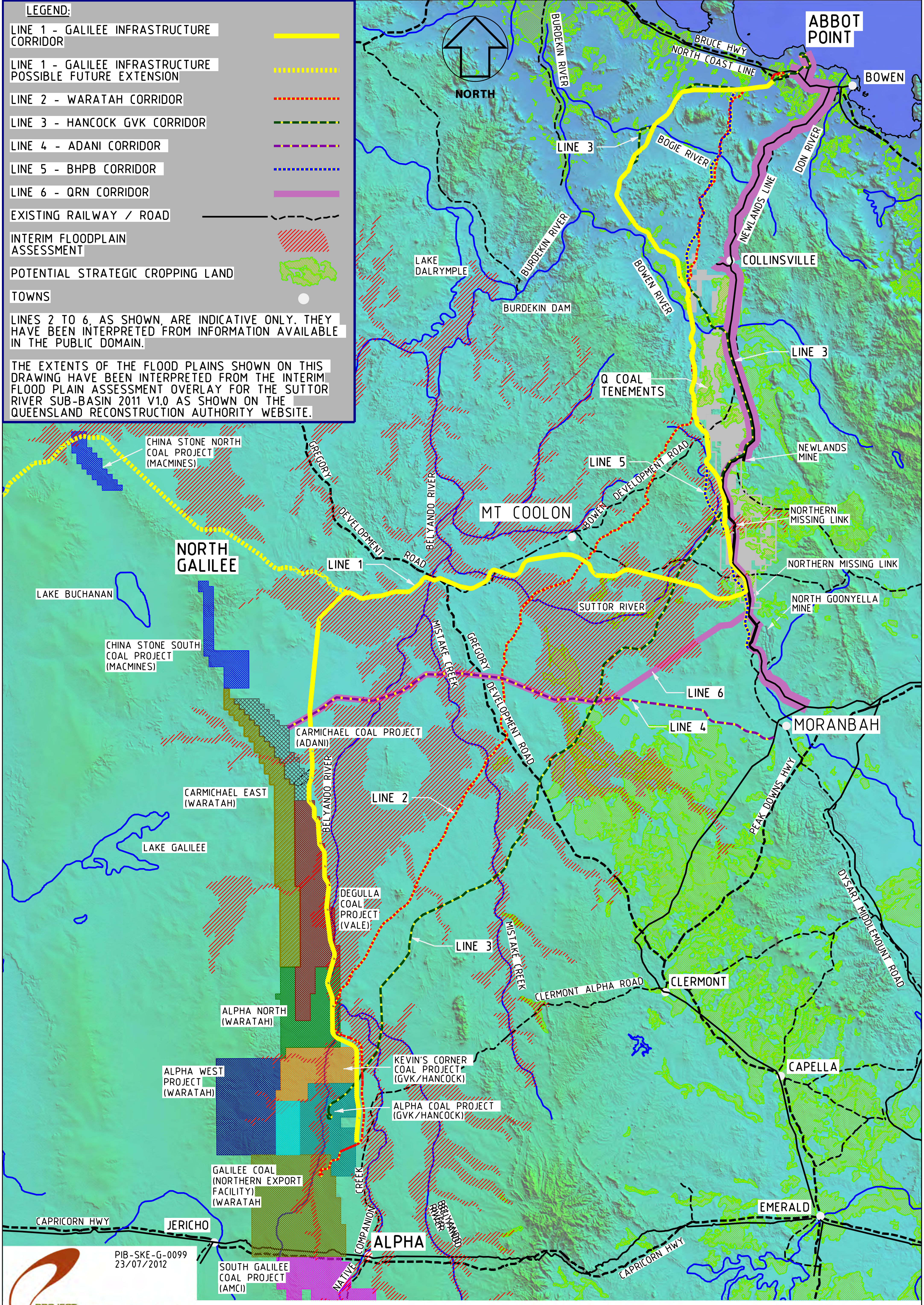
# REFERRAL CHECKLIST

NOTE: This checklist is to help ensure that all the relevant referral information has been provided. It is not a part of the referral form and does not need to be sent to the Department.

**HAVE YOU:**

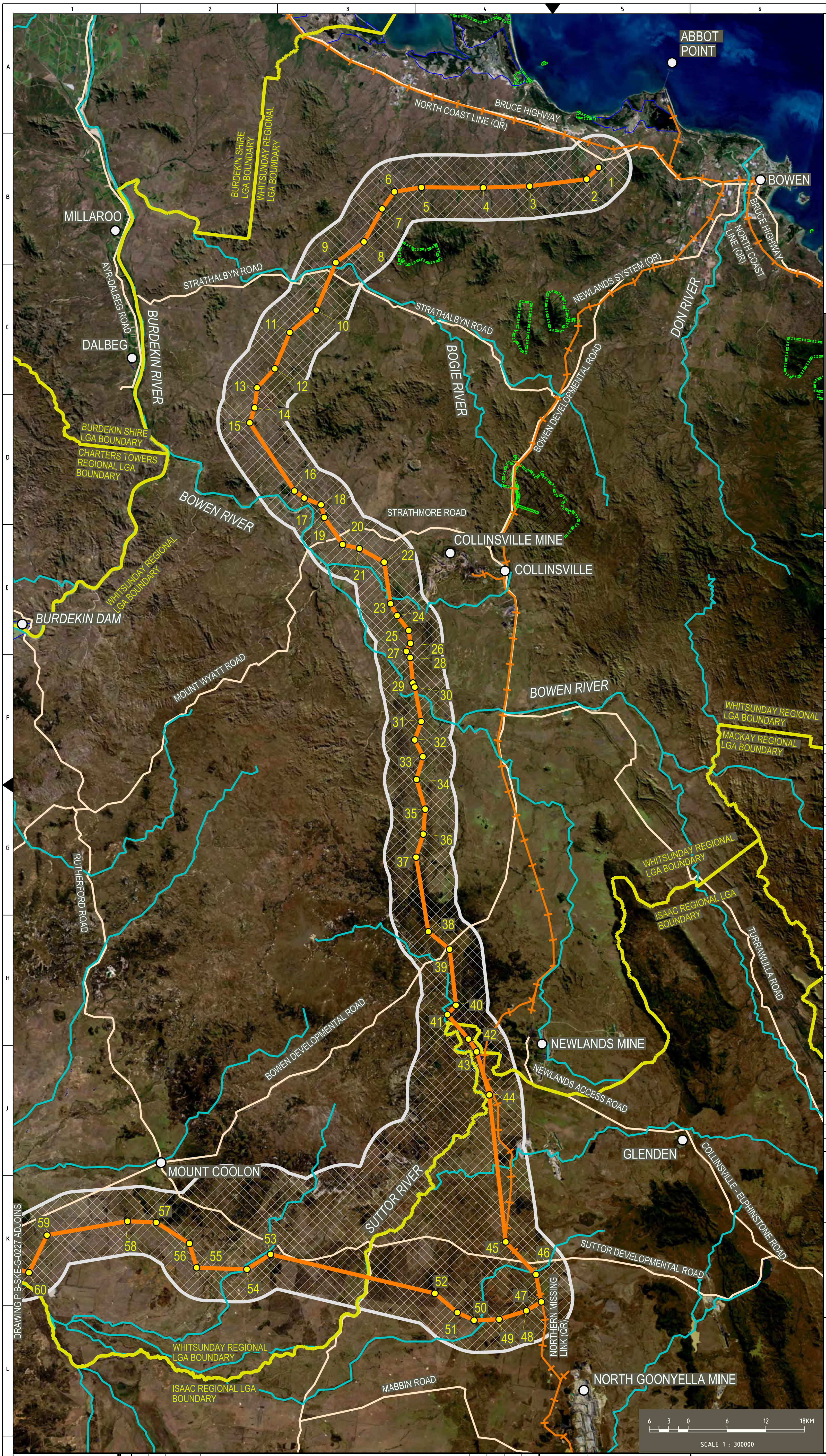
- ✓ Completed all required sections of the referral form?
- ✓ Included accurate coordinates (to allow the location of the proposed action to be mapped)?
- ✓ Provided a map showing the location and approximate boundaries of the project area?
- ✓ Provided a map/plan showing the location of the action in relation to any matters of NES?
- ✓ Provided complete contact details and signed the form?
- ✓ Provided copies of any documents referenced in the referral form?
- ✓ Ensured that all attachments are less than two megabytes (2mb)?
- ✓ Sent the referral to the Department (electronic and hard copy preferred)?

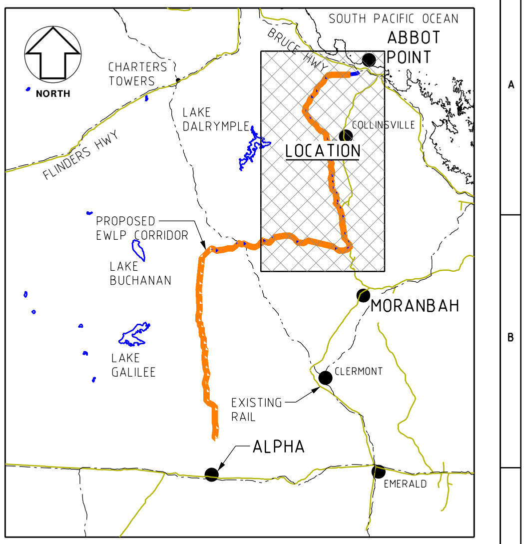
# Appendix




PROJECT IRON BOOMERANG
east west line parks limited

# EAST WEST LINE PARKS
# GALILEE INFRASTRUCTURE CORRIDOR




LOCALITY PLAN - NTS

LEGEND:

- PROPOSED EWLP INFRASTRUCTURE CORRIDOR
- STUDY CORRIDOR 10KM MIN
- SETOUT POINT AND NUMBER
- TOWN / POINT OF INTEREST
- EXISTING RAIL
- ROADS
- CREEK / RIVER / WATERCOURSE
- PROTECTED AREAS (NATIONAL PARKS / STATE FOREST)
- LOCAL GOVERNMENT BOUNDARY

## PROJECT COORDINATES TABLE

| POINT NUMBER | LONGITUDE | LATITUDE |
|---|---|---|
| 1 | E 147°58'57.36" | S 19°59'42.36" |
| 2 | E 147°57'54.72" | S 20°0'40.68" |
| 3 | E 147°52'51.6" | S 20°1'18.12" |
| 4 | E 147°48'45.36" | S 20°1'26.76" |
| 5 | E 147°43'16.68" | S 20°1'26.4" |
| 6 | E 147°40'53.04" | S 20°1'49.44" |
| 7 | E 147°39'48.24" | S 20°3'15.12" |
| 8 | E 147°38'12.48" | S 20°6'1.44" |
| 9 | E 147°35'43.8" | S 20°7'46.2" |
| 10 | E 147°33'59.4" | S 20°11'45.24" |
| 11 | E 147°31'39.72" | S 20°13'37.56" |
| 12 | E 147°30'20.88" | S 20°16'40.08" |
| 13 | E 147°28'46.56" | S 20°18'15.84" |
| 14 | E 147°28'34.32" | S 20°19'57" |
| 15 | E 147°28'7.68" | S 20°21'12.24" |
| 16 | E 147°32'7.44" | S 20°26'53.88" |
| 17 | E 147°32'59.28" | S 20°27'29.52" |
| 18 | E 147°34'29.28" | S 20°28'3" |
| 19 | E 147°34'46.56" | S 20°29'6.36" |
| 20 | E 147°36'24.84" | S 20°31'22.08" |
| 21 | E 147°37'54.48" | S 20°31'42.24" |
| 22 | E 147°40'6.6" | S 20°32'50.28" |
| 23 | E 147°40'41.88" | S 20°36'19.08" |
| 24 | E 147°41'16.8" | S 20°37'18.12" |
| 25 | E 147°42'19.44" | S 20°38'33" |
| 26 | E 147°42'28.8" | S 20°39'37.08" |
| 27 | E 147°42'7.2" | S 20°40'17.4" |
| 28 | E 147°42'27.72" | S 20°40'48.36" |
| 29 | E 147°42'42.84" | S 20°42'56.52" |
| 30 | E 147°42'52.92" | S 20°43'17.04" |
| 31 | E 147°43'28.2" | S 20°46'9.84" |
| 32 | E 147°42'54" | S 20°47'42.36" |
| 33 | E 147°43'38.28" | S 20°49'6.24" |
| 34 | E 147°43'4.44" | S 20°51'1.08" |
| 35 | E 147°43'51.6" | S 20°53'29.76" |
| 36 | E 147°43'41.52" | S 20°55'35.4" |
| 37 | E 147°43'4.08" | S 20°57'31.32" |
| 38 | E 147°44'11.4" | S 21°3'45" |
| 39 | E 147°46'5.88" | S 21°5'12.48" |
| 40 | E 147°46'41.16" | S 21°9'54" |
| 41 | E 147°45'55.08" | S 21°10'41.52" |
| 42 | E 147°47'48.84" | S 21°12'43.2" |
| 43 | E 147°48'33.12" | S 21°13'47.28" |
| 44 | E 147°49'41.52" | S 21°17'23.28" |
| 45 | E 147°51'14.4" | S 21°29'41.64" |
| 46 | E 147°53'57.48" | S 21°32'24.36" |
| 47 | E 147°54'27.36" | S 21°34'41.52" |
| 48 | E 147°53'7.08" | S 21°35'26.52" |
| 49 | E 147°50'40.56" | S 21°36'10.44" |
| 50 | E 147°48'26.64" | S 21°36'15.84" |
| 51 | E 147°46'55.92" | S 21°35'37.32" |
| 52 | E 147°44'55.32" | S 21°34'1.56" |
| 53 | E 147°30'12.96" | S 21°30'48.96" |
| 54 | E 147°28'6.24" | S 21°32'4.56" |
| 55 | E 147°23'35.88" | S 21°31'57" |
| 56 | E 147°22'57.36" | S 21°29'55.68" |
| 57 | E 147°19'58.44" | S 21°28'10.2" |
| 58 | E 147°17'24.72" | S 21°28'4.44" |
| 59 | E 147°10'13.08" | S 21°29'15" |
| 60 | E 147°8'36.24" | S 21°32'23.64" |



## STANDARD NOTES

### SURVEY

| | |
|---|---|
| COORDINATE REFERENCE SYSTEM | MAP GRID OF AUSTRALIA (MGA94,ZONE 55) |
| HEIGHT DATUM | AUSTRALIAN HEIGHT DATUM (AHD) |
| SCALE FACTOR | THE DESIGN COORDINATES SHOWN ARE IN TERMS OF MGA94. DISTANCES SHOWN ARE GRID DISTANCES. |

### GENERAL

1. ALL DIMENSIONS IN METRES UNO.
2. CONTOUR INTERVAL 10m.
3. DESIGN SURVEY DATA - SHUTTLE RADAR TOPOGRAPHY MISSION (SRTM) VERTICAL ACCURACY +/- 10m APPROX.
4. EWLP CORRIDORS SHOWN ARE PRELIMINARY CONCEPTS AND SUBJECT TO FURTHER DESIGN.
5. TOPOGRPHICAL BACK GROUND MAPPING PROVIDED UNDER COPYRIGHT COMMENWEALTH OF AUSTRALIA GEOSCIENCE AUSTRALIA 2008.

PROJECT IRON BOOMERANG
east west line parks limited



REVISIONS

| REV | DRN | DATE | DESCRIPTION | CHK | DE | PM | CM |
|---|---|---|---|---|---|---|---|
| B | CMF | 20.07.12 | BOUNDARIES REVISED TO INCLUDE ALTERNATE CORRIDOR OPTIONS | | | | |
| A | CMF | 12.07.12 | ISSUED FOR REVIEW | | | | |

| | SIGNATURE | DATE |
|---|---|---|
| DRAWN | CMF | 12.07.12 |
| CHECKED | | |
| DISCIPLINE ENG | | |
| PROJECT MGR | | |
| ENG. MGR | | |
| CLIENT MGR | | |

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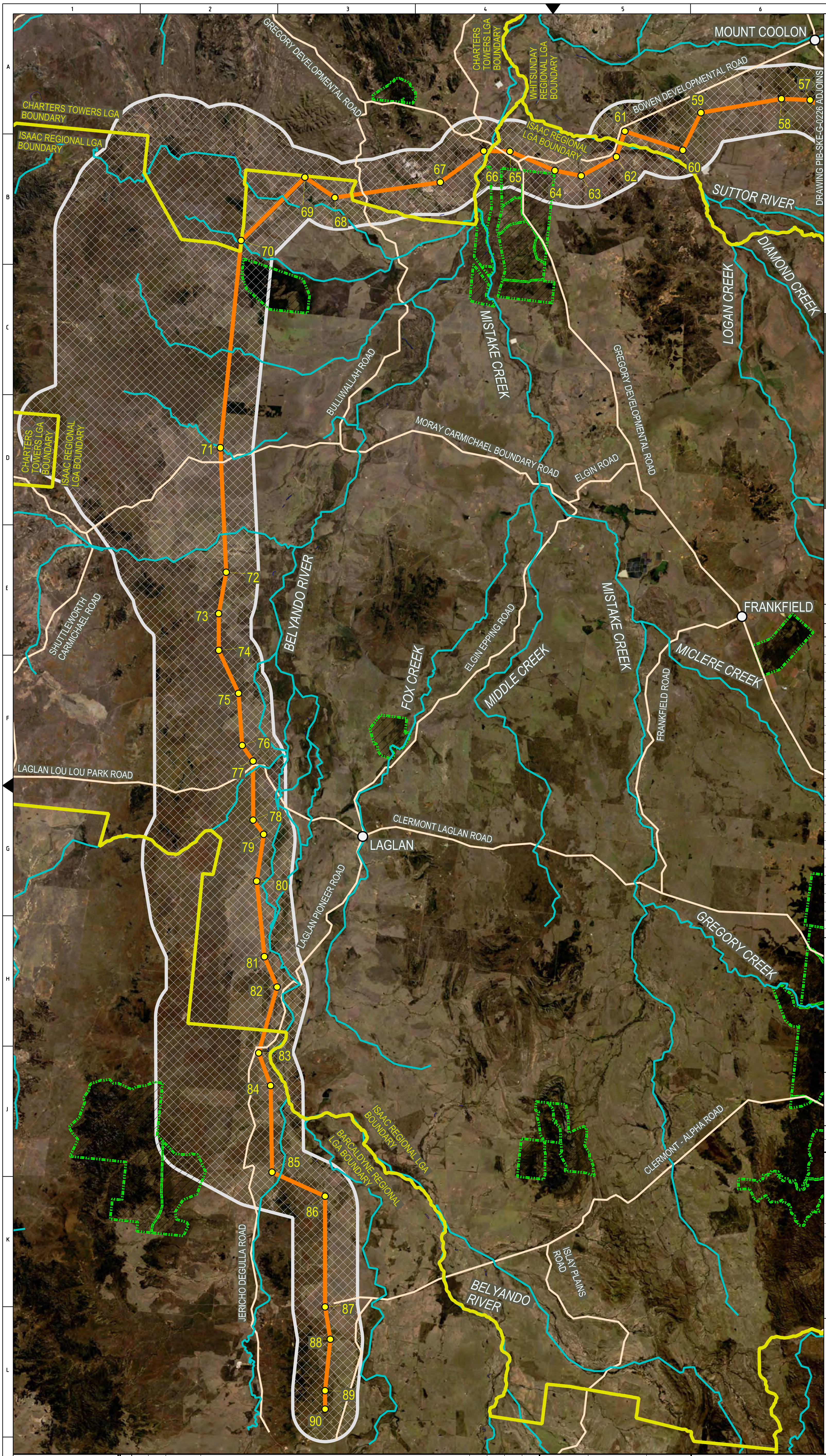
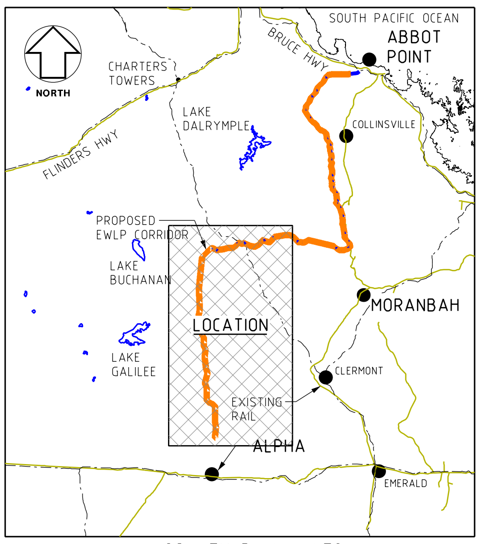
EAST WEST LINE PARKS LIMITED
GALILEE INFRASTRUCTURE CORRIDOR PROJECT
PROJECT COORDINATES
SHEET 1 OF 2

SCALE: 1:300000 AT A1 | SIZE: A1
DRAWING No: PIB-SKE-G-0226 | REV: B
PROJECT No: 9069B




LOCALITY PLAN - NTS

LEGEND:

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- STUDY CORRIDOR 10KM MIN
- SETOUT POINT AND NUMBER
- TOWN / POINT OF INTEREST
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## PROJECT COORDINATES TABLE

| POINT NUMBER | LONGITUDE | LATITUDE |
|---|---|---|
| 57 | E 147°19'58.44" | S 21°28'10.2" |
| 58 | E 147°17'24.72" | S 21°28'4.44" |
| 59 | E 147°10'13.08" | S 21°29'15" |
| 60 | E 147°8'36.24" | S 21°32'23.64" |
| 61 | E 147°3'25.56" | S 21°30'48.24" |
| 62 | E 147°2'39.84" | S 21°32'56.76" |
| 63 | E 146°59'31.2" | S 21°34'32.16" |
| 64 | E 146°57'10.08" | S 21°34'5.52" |
| 65 | E 146°53'8.88" | S 21°32'29.04" |
| 66 | E 146°50'48.48" | S 21°32'27.24" |
| 67 | E 146°46'55.2" | S 21°35'3.84" |
| 68 | E 146°37'29.28" | S 21°36'20.16" |
| 69 | E 146°34'48.72" | S 21°34'37.2" |
| 70 | E 146°29'5.28" | S 21°39'54" |
| 71 | E 146°27'10.08" | S 21°57'13.68" |
| 72 | E 146°27'38.88" | S 22°7'38.64" |
| 73 | E 146°26'57.48" | S 22°11'6.36" |
| 74 | E 146°26'57.48" | S 22°14'10.68" |
| 75 | E 146°28'42.96" | S 22°17'46.68" |
| 76 | E 146°29'2.04" | S 22°22'8.4" |
| 77 | E 146°30'0.36" | S 22°23'26.88" |
| 78 | E 146°29'59.64" | S 22°28'23.16" |
| 79 | E 146°30'56.16" | S 22°29'34.8" |
| 80 | E 146°30'17.64" | S 22°33'29.52" |
| 81 | E 146°30'58.32" | S 22°39'48.6" |
| 82 | E 146°32'6.36" | S 22°42'21.24" |
| 83 | E 146°30'25.56" | S 22°47'51.72" |
| 84 | E 146°31'29.28" | S 22°50'35.88" |
| 85 | E 146°31'35.76" | S 22°57'50.4" |
| 86 | E 146°36'22.68" | S 22°59'51.72" |
| 87 | E 146°36'21.24" | S 23°9'7.2" |
| 88 | E 146°36'49.32" | S 23°11'49.92" |
| 89 | E 146°36'19.8" | S 23°16'7.68" |
| 90 | E 146°36'19.8" | S 23°17'39.84" |

6 3 0 6 12 18KM

SCALE 1 : 300000



## STANDARD NOTES

### SURVEY

| | |
|---|---|
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| HEIGHT DATUM | AUSTRALIAN HEIGHT DATUM (AHD) |
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### GENERAL

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5. TOPOGRPHICAL BACK GROUND MAPPING PROVIDED UNDER COPYRIGHT COMMENWEALTH OF AUSTRALIA GEOSCIENCE AUSTRALIA 2008.

PROJECT IRON BOOMERANG
east west line parks limited



REVISIONS

| REV | DRN | DATE | DESCRIPTION | CHK | DE | PM | CM |
|---|---|---|---|---|---|---|---|
| B | CMF | 20.07.12 | BOUNDARY REVISED TO INCLUDE ALTERNATE CORRIDOR OPTIONS | | | | |
| A | CMF | 12.07.12 | ISSUED FOR REVIEW | | | | |

| | SIGNATURE | DATE |
|---|---|---|
| DRAWN | CMF | 12.07.12 |
| CHECKED | | |
| DISCIPLINE ENG | | |
| PROJECT MGR | | |
| ENG. MGR | | |
| CLIENT MGR | | |

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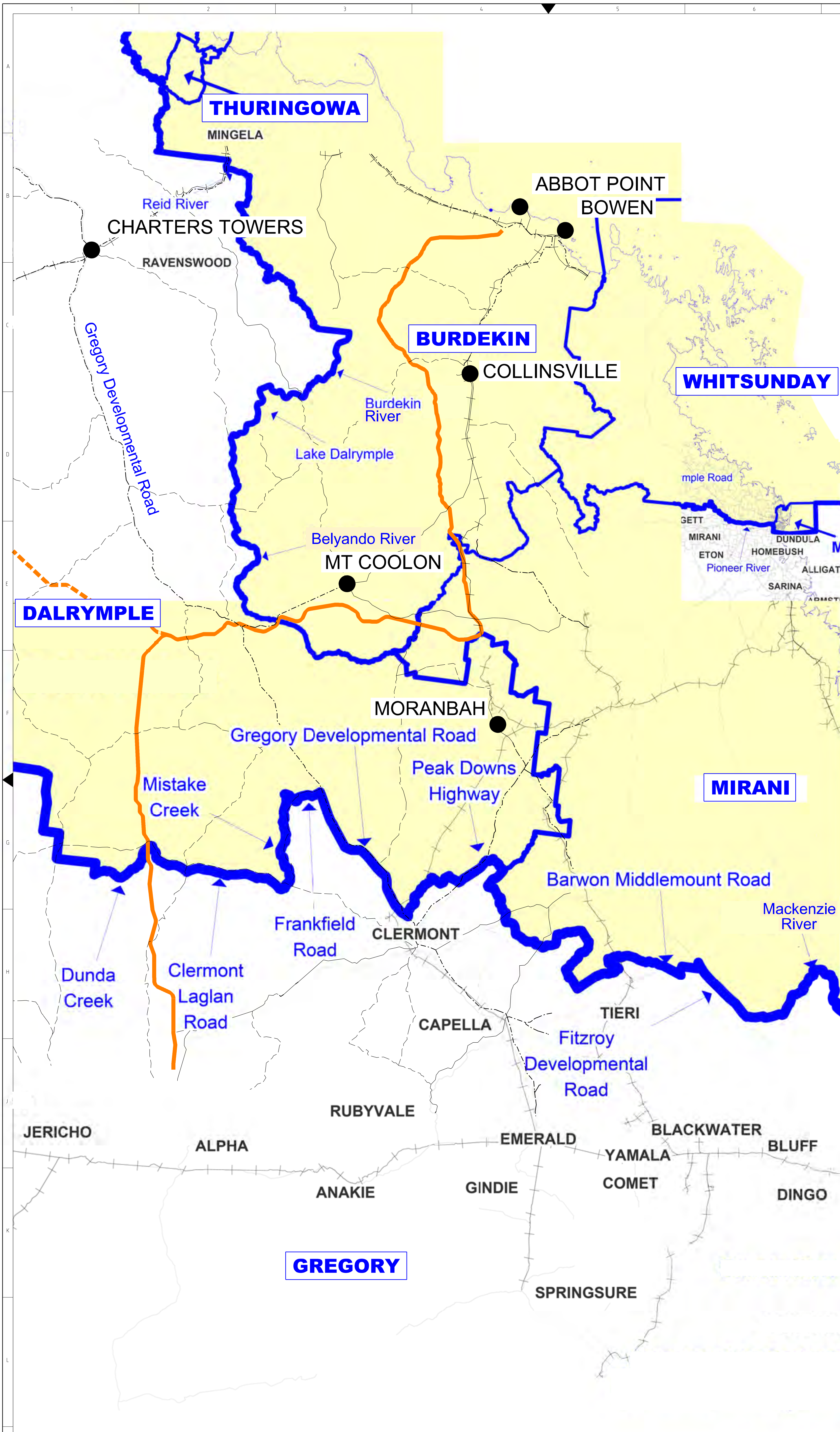
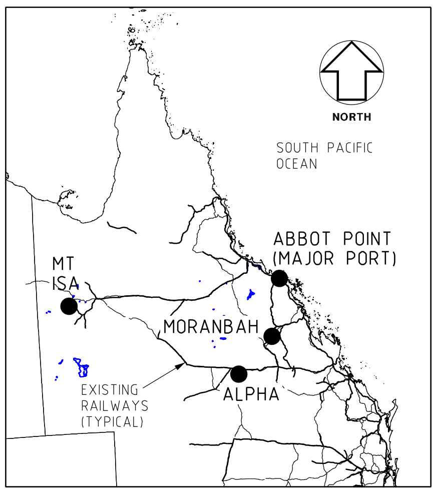
EAST WEST LINE PARKS LIMITED
GALILEE INFRASTRUCTURE CORRIDOR PROJECT
PROJECT COORDINATES
SHEET 2 OF 2

SCALE: 1:300000 AT A1 | SIZE: A1
DRAWING No: PIB-SKE-G-0227 | REV: B
PROJECT No: 9069B




LOCALITY PLAN - NTS

LEGEND

- EWLP RAIL ALIGNMENT
- ELECTORAL BOUNDARY
- MIRANI — ELECTORATE NAME
- EXISTING RAIL
- EXISTING ROAD

BASED ON OR CONTAINS DATA PROVIDED BY THE STATE OF QLD (DERM) (2010). IN CONSIDERATION OF THE STATE PERMITTING USE OF THIS DATA YOU ACKNOWLEDGE AND AGREE THAT THE STATE GIVES NO WARRANTY IN RELATION TO THE DATA (INCLUDING ACCURACY, RELIABILITY, COMPLETENESS, CURRENCY OR SUITABILITY) AND ACCEPTS NO LIABILITY (INCLUDING WITHOUT LIMITATION, LIABILITY IN NEGLIGENCE) FOR ANY LOSS, DAMAGE OR COSTS (INCLUDING CONSEQUENTIAL DAMAGE) RELATING TO ANY USE OF THE DATA. DATA MUST NOT BE USED FOR MARKETING OR BE USED IN BREACH OF THE PRIVACY LAWS.

STANDARD NOTES

SURVEY

| | |
|---|---|
| COORDINATE REFERENCE SYSTEM | MAP GRID OF AUSTRALIA (MGA94, ZONE 55) |
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| SCALE FACTOR | THE DESIGN COORDINATES SHOWN ARE IN TERMS OF MGA94. DISTANCES SHOWN ARE GRID DISTANCES. |

GENERAL

1. ALL DIMENSIONS IN METRES UNO.
2. MINING LEASE TENURE INTERPRETED SUBJECT TO FURTHER DEFINITION.
3. DESIGN SURVEY DATA - SHUTTLE RADAR TOPOGRAPHY MISSION (SRTM) VERTICAL ACCURACY +/- 10m APPROX.
4. EWLP CORRIDORS SHOWN ARE PRELIMINARY CONCEPTS AND SUBJECT TO FURTHER DESIGN.

PROJECT IRON BOOMERANG
east west line parks limited



| REV | DATE | DRN | DESCRIPTION | CHKD | APPR | PROJ |
|---|---|---|---|---|---|---|
| A | 12.07.12 | GBM | ISSUED FOR INFORMATION | | | |

DRAWING REVISION

| | DATE | NAME |
|---|---|---|
| DRAWN BY | 11.07.12 | G.MOLLOY |
| CHECKED BY | | |
| APPROVED BY | | |
| ENG MGR | | |

SCALE: NTS — FORMAT SIZE: A4

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EAST WEST LINE PARKS LIMITED
PROJECT IRON BOOMERANG
GENERAL ARRANGEMENT
STATE ELECTORAL BOUNDARIES

DRAWING No. PIB-SKE-G-0228 — REV. A

# Environmental issues

| | | | | | |
|---|---|---|---|---|---|
| **Galilee Corridor Infrastructure Project Constraints Workshop** | | | | | |
| | **Key identified issues** | **Issue descriptor** | **Issue risk category** | **Proposed mitigation strategy** | **Comments and notes** |
| | **Soils and Geology** | | | | |
| **Alpha to North Galilee Section** | Soil types to be traversed | - Desert uplands (deep sands)<br>- Variability<br>- Difficulty with rehabilitation with dispersive subsoils present leading to erosion risk<br>- Poor materials for cutting/embankments<br>- High resolution soil data will be difficult to obtain given terrain and access issues | High | - Undertake detailed soil survey to improve on existing small scale data for whole of route/corridor<br>- Additional geotechnical survey to target areas identified by soils mapping as higher risk | - Sandy soils will have low shrink/swell properties<br>- The scale of soil survey and overlap with geotechnical investigation should be clarified |
| | Erosion | - Erodible in areas of high/moderate slope | Low | - Implement controls as per standard practices | Erosion is likely to be an issue during construction and in the rehabilitation process. Low annual rainfall with seasonal storms will make achieving ground cover an issue. |
| | Salinity/sodicity | - Texture contrast soils expected to be associated with salinity and sodicity<br>- Sandy soils not expected to be susceptible | Medium | - Identification of problem areas is important<br>- Minimise exposure of subsoils | |
| | Fill materials (availability, transport) | - Cut and fill section associated with Desert Uplands means generally local sources and short transport distances<br>- A material balance has not yet been undertaken | Medium | - Balancing of cut/fill is likely to be reasonable through this section but suitability for fill materials unknown | Some fill materials maybe sodic and subject to dispersion when exposed to rainfall |
| | Spoil management | If cut to fill does not balance then may be issues with disposal of unwanted spoil and its stabilisation | Medium | Plan for spoil disposal in suitable sites and apply appropriate erosion control measures | |
| | Lithology | - Sedimentary rocks present, though some metamorphics<br>'- should not present excavation difficulties but stability of embankments may be a risk | Low | - Desert uplands reasonably stable | |
| | Seismic activity | - Seismic issues largely unknown at this point | Low | - Desert uplands reasonably stable | - Geotechnical report to be assessed by MWH |
| | Landform | - Areas near Macmines/Carmichael are relatively steep, cut of 10-20 m noted<br>'- Embankment stability may be an issue with soils | Medium | - Realignment to minimise impacts on mining tenement | - Steep areas caused by avoiding mining tenements. Realignment may be possible. |
| | | | | | |
| **North Galilee to Goonyella Hub** | Soil types to be traversed | - A lot more variability in soils across this section than for Desert Uplands area<br>- Shrink/swell soils common on floodplains<br>- Mapping scale is too small for accurate delination of soil types for the alignment | High | - Detailed soil survey required to satisfy both planning/design needs and expectation of the regulator<br>- Additional geotechnical survey | - sands, texture contrast, and shrink/swell clays (~20-30% clays by area) |
| | Erosion | - Landform change (steepness) presents greater risk of erosion<br>- Flood erosion risk and waterway crossings | Low | - Implement controls as per standard practices | Alignment of route generally at right angles to flow direction will minimise risks on floodplains |
| | Salinity/sodicity | - Texture contrast soils are likely to be sodic and saline in subsoils<br>- Clay soils not expected to present problems | Medium | do not expose subsoils and separate topsoil for subsequent replacement over shaped fill areas during rehabilitation | |
| | Fill materials (availability, transport) | as above but may be an issue where the floodplain is not bridged and embankment fill is needed | Medium | Need to investigate sources of fill materials. May be able to acquire from suitable mine spoil stockpiles? | |
| | Spoil management | - Likely to be balanced cut/fill across the section | Low | Needs confirmation | |
| | Lithology | - Variability etc. as per soil types, particularly with alluvia on floodplains | Low | No excavation difficulties anticipated | |
| | Seismic activity | - Information not currently available | Low | Nevertheless, region has been largely stable for recorded history | |
| | Landform | - More detailed topo data required<br>- Generally low gradient in the western portion. Steeper grades in the eastern extremity<br>- Watercourses present in the western end of the section<br>- Alignment crosses several floodplains | Medium | Issues to be considered more closely during field investigations for detailed design and route refinement phase | |
| | | | | | |
| **Goonyella Hub to Abbot Point (Includes Moranbah link)** | Soil types to be traversed | - Gap in soils mapping in a small portion of the alignment | High | - Several EIS undertaken in the same areas with potentially a lot of information publically available. Nevertheless, detailed route assessment required to fill gaps. Some potential for ASS in near coastal areas when approaching SDA dependig on actual route. | - Cracking clays and texture contrast in the Bowen alluvium<br>- North of the Bowen River - Cracking clays (shallow), texture contrast further north<br>- Bogey River - texture contrast soils<br>- Northern section - old alluvium |
| | Erosion | - Higher risk of erosion occurring in this section, however considered to be manageable | Low | Apply appropriate soil erosion measures | |
| | Salinity/sodicity | - Highest risk of salinity in this section<br>- Detailed information may be available through existing EISs | Medium | Use EIS data and published Government soil and land use mapping where available | - Bogey River - texture contrast soils (sodic and quite dispersive) |
| | Fill materials (availability, transport) | - Cut/fill balance likely to be reasonably equal<br>- High likelihood of suitable fill materials, except in the area around Q Coal | Low | Requires more detailed investigation during final design planning | |
| | Spoil management | If cut to fill does not balance then may be issues with disposal of unwanted spoil and its stabilisation due to constrained spatial options | Medium | Plan for spoil disposal in suitable sites and apply appropriate erosion control measures | |
| | Lithology | More variable in this area, particularly in vicinity of the ranges and the near coastal section | Medium | Needs to be factored into rehabilitation plan for erosion control and plant selection for revegetation | |
| | Seismic activity | - Event recorded in 2011 in vicinity of Clarke Range<br>'- Seismic records adequate | Low | Needs geotechnical assessment for incorporation into detailed design | |

## Galilee Corridor Infrastructure Project Constraints Workshop

## Environmental issues

| | Key identified issues | Issue descriptor | Issue risk category | Proposed mitigation strategy | Comments and notes |
|---|---|---|---|---|---|
| | Landform | - Alignment traverses steeper area, as well as some floodplains<br>- Several large watercourse crossings (associated with floodplains)<br>- Additional topo data are needed and refinement of alignment will likely occur, This will affect the corridor assessment for the EIS. Route options somewhat more confined in this section by landform constraints | High | Detailed field investigations required to refine route to account for landform and land use constraints | |
| | **Land use** | | | | |
| **Alpha to North Galilee Section** | Mines | - Impacting mining tenements depending on whether western or eastern option adopted<br>'- Information on potential tenements is a large gap that may affect western route alignment selection | High | - Mining tenement spatial data gathering required<br>- Stakeholder liaison needed to gain agreement on preferred western option to minimise impacts on mines and avoid constraints of eastern option | |
| | Grazing (low intensity) | - Low intensity grazing dominates as native pastures have low stocking capacity and pasture improvement only limited success | Low | Low impacts on land use and alignment on eastern property boundaries likely to be more acceptable to landowneers | - Western alignment thought to present less risk to grazing than the eastern alignment |
| | Cropping | - No cropping is known or likely | Low | | |
| **North Galilee to Goonyella Hub** | Mines | - No impact on existing mining tenements | Low | Traverses grazing and minor agricultural land only | |
| | Grazing | - Higher value grazing land compared to desert uplands | Low | Alignment to minimise impacts on property operations and stock movement will be important. | |
| | Cropping | - Some SCL present, particularly in the eastern end of the section | Low | | |
| | Remnant vegetation | - Large areas of uncleared land, though generally lesser status under the VMA. Some potential for grassland issues | Medium | Detailed field investigations required to refine route to account for vegetation constraints and to determine any need for formal offsets | |
| **Goonyella Hub to Abbot Point** | Mines | - Running adjacent to several mine tenements | Medium | May be confined to existing corridor in part | |
| | Grazing | - Highest value grazing lands of the route | Medium | Some arable lands also and grazing lands limited in extent due to limited lateral extent of land available | |
| | Cropping | - More cropping land present including irrigated cropping and pastures) | Medium | See comments re SCL later | |
| | Remnant vegetation | - More likely to occur in the western alignment | Medium | Most likely associated with route option to the west of Collinsville | |
| | **Land tenure** | | | | |
| **Alpha to North Galilee Section** | Leasehold | Predominantly Leasehold | Low | | |
| | Mining leases | Affected mainly only if eastern route option used (H) as western route sits outside mining tenements (L) and only connecting spur liines would be impacted - these would be the responsibility of the individual mines | Low | Western route most likely | |
| | Freehold | No Freehold Lots known for this route | Low | To be determined with detailed route assessment | |
| | Land purchase vs easements | - Government to decide approach to corridor 'acquisition'<br>- Not seen as a significant issue for the purposes of environmental investigation | High | May be High risk for corridor acquisition (i.e. Business risk) but will not affect environmental assessment provided access is available for assessment | - EWLP's preference is to acquire land for the corridor |
| **North Galilee to Goonyella Hub** | Mining leases | - None present (as currently known) | Low | Route may just intersect mine lease in north of route | |
| | Leasehold | - Mainly leasehold land | Low | To be determined with detailed route assessment | - 12-14 landholders identified |
| | Land purchase vs easements | - Government to decide approach to corridor 'acquisition'<br>- Not seen as a significant issue for the purposes of environmental investigation | High | As above | |
| **Goonyella Hub to Abbot Point** | Mining leases | - The alignment avoids mining tenements | Low | | |
| | Leasehold/Freehold | - More freehold land occurs in this section<br>- Still relatively low number of landholders (~20) | Medium | Issues depends on resolution of next risk | |
| | Land purchase vs easements | - Government to decide approach to corridor 'acquisition'<br>- Not seen as a significant issue for the purposes of environmental investigation | High | As above | |
| | **Groundwater** | | | | |
| **Alpha to North Galilee Section** | Stock and domestic bores | - Information of groundwater status along the corridor is slim<br>- Watertable likely to be deep | High | Groundwater in Desert Uplands limits grazing development so maybe a sensitive issue | |
| | Construction water supplies | - Water supply for construction is likely to be an issue due to lack of groundwater in the desert uplands | Low | Likely to be a low environmental risk but a High construction risk due to paucity of good supplies. Risk of impacts on groundwater supplies for stock and domestic users | |
| | Eastern alignment issues | - On the Belyando floodplain and likely to have a relatively high watertable | Medium | For eastern alignment, there could be riosk of construction and operational risks on floodplain shallow watertables where present. Needs further investigation. | |
| **North Galilee to Goonyella Hub** | Stock and domestic bores | - Minimal information known<br>- Higher potential for groundwater impacts around the floodplains<br>- Risk of interference with groundwater flow if embankment loading on alluvial soils impedes shallow groundwater systems, especially in flood events | Medium | For eastern alignment, there could be riosk of construction and operational risks on floodplain shallow watertables where present. Needs further investigation. | |

# Galilee Corridor Environmental Constraints Workshop

Infrastructure Project Issues

Environmental Issues

| | Key identified issues | Issue descriptor | Issue risk category | Proposed mitigation strategy | Comments and notes |
|---|---|---|---|---|---|
| **Goonyella Hub to Abbot Point** | Groundwater occurrence | - Shallow groundwater present in a number of places, though deeper in others<br>- May be an increase in stock and domestic bores closer to Collinsville and the near coastal route sections (M) | **Low** | Needs further field investigations to determine extent of impact | |
| | | | | | |
| | **Strategic cropping land** | | | | |
| **Alpha to North Galilee Section** | N/A | No SCL identified and this section lies west of Western Cropping Management Zone for both route options | No risk identified | | |
| | | | | | |
| **North Galilee to Goonyella Hub** | SCL | - Eastern end of section impacts on mapped SCL<br>'- Soil mapping is currently insufficient to address SCL assessments | **Medium** | Requires detailed field assessment to determine extent of SCL and potential for direct impact by final route | |
| | | | | | |
| **Goonyella Hub to Abbot Point** | SCL | - Highest frequency of SCL in this section<br>- Most SCL in southern section near Goonyella and in Collinsville option | **Medium** | Route refinement should be able to avoid any impacts | |
| | | | | | |
| | **Infrastructure issues** | | | | |
| **Alpha to North Galilee Section** | Roads | - Carmichael Highway will be crossed<br>- Local gravel roads with low traffic volume<br>- Unlikely to be a major issue | **Low** | all road crossings will be engineered with either at grade or overpasses depending on approaching landform, need and frequency of road traffic | |
| | Powerlines | - No major powerlines known in the area | **Low** | To be confirmed | |
| | Pipelines (gas, water) | - No major pipelines known in the area | **Low** | To be confirmed | |
| | Mine infrastructure (existing and proposed) | - Interface with other mines (particularly proposed infrastructure) difficult to assess | **Medium** | Level of impact depends on route with eastern option (H) and western option (L). Impact on future tenements unknown at this stage | |
| | Stockroutes | - At least one known stockroute will be affected by the alignment | **Low** | Managed with underpass if required or alternative design to allow for infrequent use | |
| | Railways | - No known lines present in this section | **Low** | No current plans for further rail lines in this section | |
| | Properties (homesteads, yards, fences, dams) | Anticipated to be L for western option as route hugs their eastern property boundaries but M-H for eastern route option | **Low** | Need detailed field assessment to determine actual impacts on property assets and need for relocation/reinstatement | |
| | | | | | |
| **North Galilee to Goonyella Hub** | Roads | Gregory Highway, Bowen Development Road, Suttor Development Road | **Low** | Satisfactory engineering solutions available for major road crossings either at grade or as overpasses | |
| | Powerlines | - Several powerlines likely to be crossed, but limited information currently available | **Low** | Satisfactory engineering solutions available for major lines | |
| | Pipelines (gas, water) | - Gas and water pipelines expected to be affected in the eastern extent<br>- No significant environmental risk areas | **Low** | To be accommodated within corridor if possible or route refined to avoid | |
| | Mine infrastructure (existing and proposed) | - Not known currently | **Low** | To be determined with final route selection | |
| | Stockroutes | - Several stockroutes are affected by alignment | **Medium** | Will require coordinated approach to ensure regional stock movement and drought access not impeded by route | |
| | Railways | - Potential for other proposed coal rail lines | **Medium** | May be avoided if government decides on a single route or single corridor to accommodate both standard (new) and narrow gauge (existing) lines | |
| | Properties (homesteads, yards, fences, dams) | Impact likely to increase in both southern section and sections beyond Collinsville through to coast | **Medium** | May require relocation and/or reinstatement of assets so as not to impede normal property management inputs | |
| | | | | | |
| **Goonyella Hub to Abbot Point** | Roads | Bowen Development Road, Suttor Development Road, and many local roads in the Moranbah section | **Medium** | Apply standard design solutions | |
| | Powerlines | - HV powerlines present in the north of the alignment (north of Bowen River) | **Medium** | Should not require relocation but will coordinate with Powerlink if towers need to be raised or moved | |
| | Pipelines (gas, water) | - Water and gas pipelines crossed | **Medium** | Apply standard design solutions | |
| | Mine infrastructure (existing and proposed) | Potential to impact on existing hub or need for connection if western diversions are used<br>- Will avoid Qcoal site | **Low** | Level of impact depends on final route selection | |
| | State Development Area (Abbot Point) | Impacts within SDA not considered for this EIS at this stage. Impacts will depend on how eventual project develops | **Low** | Depends on government decision re SDA development | |
| | Stockroutes | - Several present crossed by alignment | **Medium** | Measures as above | |
| | Railways | Potential for co-location of narrow gauge (existing) and standard gauge (proposed) in same corridor for this section. Impact depends on width of corridor in this more constrained area. | **Medium** | Depends on government decision re final option | |
| | Properties (homesteads, yards, fences, dams) | - Increased number of properties along alignment compared to other sections<br>- Properties generally smaller in extent to other two sections leading to highr potential for more frequent intersection with property assets | **Medium** | Extent of impact will require detailed assessment of final route at design stage | |
| | | | | | |
| | **Flora/Fauna** | | | | |
| | **EPBC** | | | | |
| | TECs | - Brigalow TEC is present for the eastern alignment, and far northern portion of western alignment<br>'- Native grassland TECs present in the shared alignment in the far south near Alpha | **High** | - Groundtruthing and offsetting strategies are required | - TECs will likely impact on the eastern alignment<br>- Minimal effect on western alignment |

Environmental issues

# Galilee Corridor Infrastructure Project Constraints Workshop

| | Key identified issues | Issue descriptor | Issue risk category | Proposed mitigation strategy | Comments and notes |
|---|---|---|---|---|---|
| Alpha to North Galilee Section | Listed species | - Few records of listed threatened species likely reflects limited past survey effort in this section<br>- Existing mapping of habitat areas for these species is generally poor | High | - Detailed mapping exercise needed (based on RE and species' records), and then targetted field studies<br>- Follow DSEWPC survey guidelines as far as practicable | |
| | Offsets | - Information required to determine offsets (residuals)<br>- This is tied to the above information requirements<br>- Finding equivalent offsets | High | Can only be determined once field investigations define extent of offsets required. Can accumulate total offset needs and seek one-site solution rather than looking for multiple sites for offset along the route. | - High for eastern alignment<br>- Medium for western alignment |
| | **VM Act** | | | | |
| | REs | - More endangered RE in the eastern alignment<br>- More least concern RE (and remnant vegetation generally) on the western alignment<br>- More of concern RE in the western alignment | High | More detailed survey required to document field condition | |
| | Threshold REs | - Limited occurrence in both alignments except in the far southern portion near Alpha | Medium | More detailed survey required to document field condition | |
| | HVR | - Minor areas on both routes<br>- Relatively low across section | Medium | More detailed survey required to document field condition | |
| | Offsets | | Medium | Area needed to be determined by field assessment | |
| | Essential Habitat | -None present (as mapped currently) | Low | To be confirmed by field assessment | |
| | **NC Act** | | | | |
| | Listed Species | - Few records of listed threatened species likely reflects limited past survey effort in this section | High | | |
| | Referable Wetlands | - Generally not present but wesern alignment crosses Bingeringo Aggregation, a DIWA wetland of National Importance<br>- Some along Belyando country | Medium | Level of actual impact to be determined by field investigation | |
| | Coastal Protection | N/A | | | |
| | BPA | - Much remnant vegetation, particularly on western alignment is regarded as having State biodiversity value<br>- Small portion of State corridor in the far north-east of this section | Medium | Level of actual impact to be determined by field investigation | |
| | | | | | |
| North Galilee to Goonyella Hub | **EPBC** | | | | |
| | TECs | - Greater occurrence of TECs (compared to Alpha to North Galilee)<br>- Western end - moderate occurrence of TEC on alignment (M)<br>- In the eastern extent, the northern option (M) has fewer constraints than southern (H) | - risks as per individual (..) | Level of actual impact to be determined by field investigation | |
| | Listed species | - Few records of listed threatened species likely reflects limited past surveyeffort, but records of Ornamental Snake suggest habitat for this species is likely to be present<br>- Eastern end - Southern option (H) will likely present more habitat than the north (M) | - risks as per individual (..) | Level of actual impact to be determined by field investigation | |
| | Offsets | - As above | | Level of actual impact to be determined by field investigation | |
| | **VM Act** | | | | |
| | REs | - Eastern end - southern option will impact on more endangered RE, whereas the northern option will impact on more remnant vegetation (but mostly least concern) | High | Level of actual impact to be determined by field investigation | |
| | Threshold REs | - Western end traverses large areas of threshold RE (least concern) | Medium | Level of actual impact to be determined by field investigation | |
| | HVR | - Eastern end - Southern option traverses large portions of Brigalow and grassland regrowth (H), whereas Northern option traverses little HVR (L) | Medium | Level of actual impact to be determined by field investigation | |
| | Offsets | - Cumulative issues are significant | High | Level of actual impact to be determined by field investigation | |
| | Essential Habitat | - Very little mapped essential habitat present | Low | Level of actual impact to be determined by field investigation | |
| | **NC Act** | | | | |
| | Listed Species | - Few records of listed threatened species likely reflects limited past survey effort int his section, but records of Ornamental Snake suggest habitat for this species is likely to be present<br>- Eastern end - Southern option (H) will present more habitat for listed species than the northern section (M) | - risks as per individual (..) | Level of actual impact to be determined by field investigation | |
| | Referable Wetlands | - Route traverses major river lines (i.e. riparian vegetation) | High | To be managed through avoidance where possible and by design and construction methodology where impact is unavoidable | |
| | Coastal Protection | N/A | | | |
| | BPA | - Alignment traverses a State significant biodiversity corridor<br>- Eastern end - northern option largely misses the corridor (L) | Medium | To be managed through avoidance where possible and by design and construction methodology where impact is unavoidable | |
| | | | | | |
| | **EPBC** | | | | |
| | TECs | - All options similar for impacts on TECs | High | Level of actual impact to be determined by field investigation | |
| | Listed species | - More records of listed threatened species likely reflects greater survey effort in this section<br>- habitat for the listed species is likely to present a constraint throughout the alignment | High | Level of actual impact to be determined by field investigation | - Noxious weeds have not been considered but will be an issue for all routes during construction and rehabilitation phases |

# Environmental issues

| | | | | | |
|---|---|---|---|---|---|
| **Galilee Corridor Infrastructure Project Constraints Workshop** | | | | | |
| | **Key identified issues** | **Issue descriptor** | **Issue risk category** | **Proposed mitigation strategy** | **Comments and notes** |
| **Goonyella to Abbot Point** | Offsets | - TECs likely to be impacted and offsets required<br>- The Semi-evergreen vine thicket TEC also appears in this section, and this is harder to offset because of specific landform and habitat requirements | High | Level of actual impact to be determined by field investigation | |
| | **VM Act** | | | | |
| | REs | - Mapped REs affect both alignments - more endangered RE on eastern but more of concern RE on westeern alignment<br>- Western option traverses more remnant | High | Level of actual impact to be determined by field investigation | |
| | Threshold REs | - Threshold RE areas are minimal in this section<br>- Similar areas traversed by both options | Low | Level of actual impact to be determined by field investigation | |
| | HVR | - Predominantly occurs in the south of the alignment<br>- Similar HVR by both alignments | Medium | Level of actual impact to be determined by field investigation | |
| | Offsets | - Extent of RE and TEC, likely to have large cumulative affect for requiring and finding offsets | High | Level of actual impact to be determined by field investigation | |
| | Essential Habitat | - Most essential habitat of all the sections, though still a relatively small amount<br>- Western (M), Eastern (L) | Medium | Level of actual impact to be determined by field investigation | |
| | **NC Act** | | | | |
| | Listed Species | - Better survey along this area, with improved mapping<br>- habitat for the listed species is likely to present a constraint throughout the alignment | High | Level of actual impact to be determined by field investigation | |
| | Referable Wetlands | - Several large watercourses, with dispersed wetlands<br>- Similar for both alignment options | Medium | Level of actual impact to be determined by field investigation | |
| | Coastal Protection | - Both options traverse areas of High Ecological significance close to Abbot Point | High | Level of actual impact to be determined by field investigation | |
| | BPA | - Western alignment option traverses greater area of State significant biodiversity corridor, lesser for the eastern alignment | Medium | Level of actual impact to be determined by field investigation | |
| | | | | | |
| | **Approvals** | | | | |
| **Alpha to North Galilee Section** | EPBC Act referral | Referral required under EPBC Act as set out above under flora/fauna assessment | High | Likely to be a 'controlled action'. Referral needs to document issues under EPBC Act jurisdiction clearly and concisely to facilitate a determination early in the process | |
| | State legislation | - Range of ERAs under the EP Act for construction and operation<br>- Likely approvals under VM Act and other Acts to be determined during actual EIS process<br>- EIS may be conducted for EPBC Act under the State process | High | EIS investigations should target the level of information and detail on issues to be addressed in the various approvals applications required for project approval | |
| | Local government | - Local roads (access, and maintenance<br>- temporary infrastructure and camps | Medium | - Range of Local Authorities involved will determine number and type of permits and licences etc required as Council requirements vary across jurisdictions.<br>- Meet with all relevant Councils early in investigation process to define range of permits etc required | |
| | | | | | |
| **North Galilee to Goonyella Hub** | As above | | | | |
| | | | | | |
| **Goonyella Hub to Abbot Point** | As above | - Difficulty of coordinating with other projects<br>- Interaction with government delays decision making | Medium | Open channels for corrdination early in project | |
| | | | | | |
| | **Waste management issues** | | | | |
| **Alpha to North Galilee Section** | Camps | Need for both temporary and permanent sites during construction and operational phases | High | - Careful siting to avoid sensitive areas while meeting needs of project for location, travel times, servicing, access etc<br>- May require landholder agreement, easements, land purchase or other options<br>- need to implement separation of putrescible, recyclables and other solid wastes for disposal<br>- treatment of sewage and management of effluent will be critical | |
| | Construction phase | Issues such as management of wastes from concrete, steel offcuts, timber containers (e.g. paints, oils and greases, and chemicals) | High | Incorporate all management measures in comprehensive draft EMP | |
| | Operational phase | Management of permanent operational areas such as workshops, stockpiles, servicing centres, loading equipment, fuel storage, hubs with other mines | High | Ensure SBMP for operation addresses all ongoing issues and provides for regular review and update | |
| | | | | | |
| **North Galilee to Goonyella Hub** | As above | | | | |
| | | | | | |
| **Goonyella Hub to Abbot Point** | As above<br>- Only differs with respect to management of interface with SDA operations | - Coordinate with other plans for SDA management<br>- Recent withdrawal of government funding support for port development may impact delivery of overall project support infrastructure | High | - Open channels for coordination early in project<br>- Initiate discussions with government to assess timing and funding implications | |
| | | | | | |

# Flooding and Waterway issues

| Galilee Corridor Infrastructure Project Constraints Workshop | | | | | |
|---|---|---|---|---|---|
| | **Key identified issues** | **Issue descriptor** | **Issue risk category** | **Proposed mitigation strategy** | **Comments and notes** |
| | **Floodplains** | | | | |
| **Alpha to North Galilee Section** | Belyando Floodplain | - Belyando floodplain is quite wide in the vicinity of Carmichael ML (up to 15 km)<br>- This presents difficulty in hydrological studies due to definitioon of flow paths and prediction of depth and velocity<br>- The two proposed alignments are relatively low impact, but the western alignment (not on the floodplain) is preferred to the eastern one that skirts the floodplain<br>- Afflux management is important, but due to the remoteness of the area, the hydrology impacts are of lesser impact than in a more developed area<br>- In the northern section, where the options traverse the floodplain, it's thought that the eastern alignment management is relatively low because the alignment does not skew across the direction of flow<br>- WQ issues minimal, likely to be more of an issue for the eastern alignment due to the possible influence on the floodplain | Low | - Align bridges/culverts at right angles to all stream crossings<br>- ensure adequate protection of all abutments, particularly in dispersive soils<br>- Prepare comprehensive environment management plans to cater for all sections of the route in respect to specific issues and ensure compliance with EMPs to avoid off-site impacts | - The Belyando floodplain option is considered to not have a great impact on afflux/flow diversion because it is running parallel to the watercourse |
| | Water Quality | - Water Quality Objectives are not available for the area and will need to be developed from Queensland Water Quality Guidelines | Medium | Processes exist for allocation of WQ guidelines where published values not available | |
| | | | | | |
| **North Galilee to Goonyella Hub** | Belyando Floodplain | - Narrow floodplains intersected perpendicular to stream direction | Low | Hydrological and hydraulic impacts minimised and residual impacts more easily managed by aligning bridges/culverts at right angles to flow path to avoid turbulence etc | |
| | Suttor Floodplain | - As above | Low | As above | |
| | Waterway crossings | - Crossings are perpendicular to flow direction (both Belyando and Suttor)<br>-<br>- Construction water quality issues (dealt with by management processes)<br>- Likely to be crossing major streams at defined channel (higher velocity floods). Easier to manage than lower velocity, large flood plane areas.<br>- Sufficiently detailed ARR data are not likely to be available for modelling/design<br>- Unlikely to be much stream water quality data available | Low | As above | - Note that stream guages are present in the vicinity of the proposed stream crossings<br>- Note that catchment definition may be an issue for data collection and flood AEP design, where catchments can join and produce higher flows |
| | | | | | |
| **Goonyella Hub to Abbot Point** | Suttor Floodplain | | | | |
| | Bowen Floodplain | - Occurs in the cyclone belt, but this is well known and information is available.<br>- Some embankments will be required in lower areas around the Bowen River | Medium | - If alignments skew across floodplain, which may present some issues and will need to be studied; particularly wrt embankments that may impede flows | |
| | Bogie Floodplain | As above | Medium | As above | |
| | Elliot Floodplain | As above | Medium | As above | |
| | Waterway crossings | - Comments as above<br>- | Medium | As above | |
| | Coastal estuaries | - Need to understand if any small estuaries are encountered prior to the State Development Area | Medium | Detailed investigation required to define extent of issues | |
| | | | | | |
| | **Waterways** | | | | |
| **Alpha to North Galilee Section** | Waterway barriers (fish passage) | - Detailed information of minor streams (including ephemeral), stream order >1, will be required to determine waterway barrier (fish passage) requirements for assessment of the EIS<br>'- LiDAR imagery (~20 cm contours) will be required to provide mapping. Ground truthing will likely be required for at least some areas. | High | - Detailed design requires accurate and detailed imagery for planning and design, and so LiDAR topography is likely to be needed for other aspects | |
| | | | | | |
| **North Galilee to Goonyella Hub** | As above | | | | |
| **Goonyella Hub to Abbot Point** | As above | | | | |
| | | | | | |
| | **Climate Change** | | | | |
| **All areas** | Impact on AEPs (rainfall intensity) | - Climate change assessment guidelines (rainfall intensity escalation etc.) are readily available | Medium | Investigations and consideration of impacts needs to be based on a range of scenarios (i.e. both anticipated and then less than and more than) to take account of different outcomes to modelled change. | * Note - Climate change impacts on flora/fauna - typically involves maintaining fauna corridors and biodiversity |
| | Potential impact on plant and animal communities and particularly on rehabilitation success | Actual impacts at present speculative and any planning for potential impacts needs to be adaptive to take account of projected changes | Medium | As above | |
| | | | | | |

# Social Impact issues

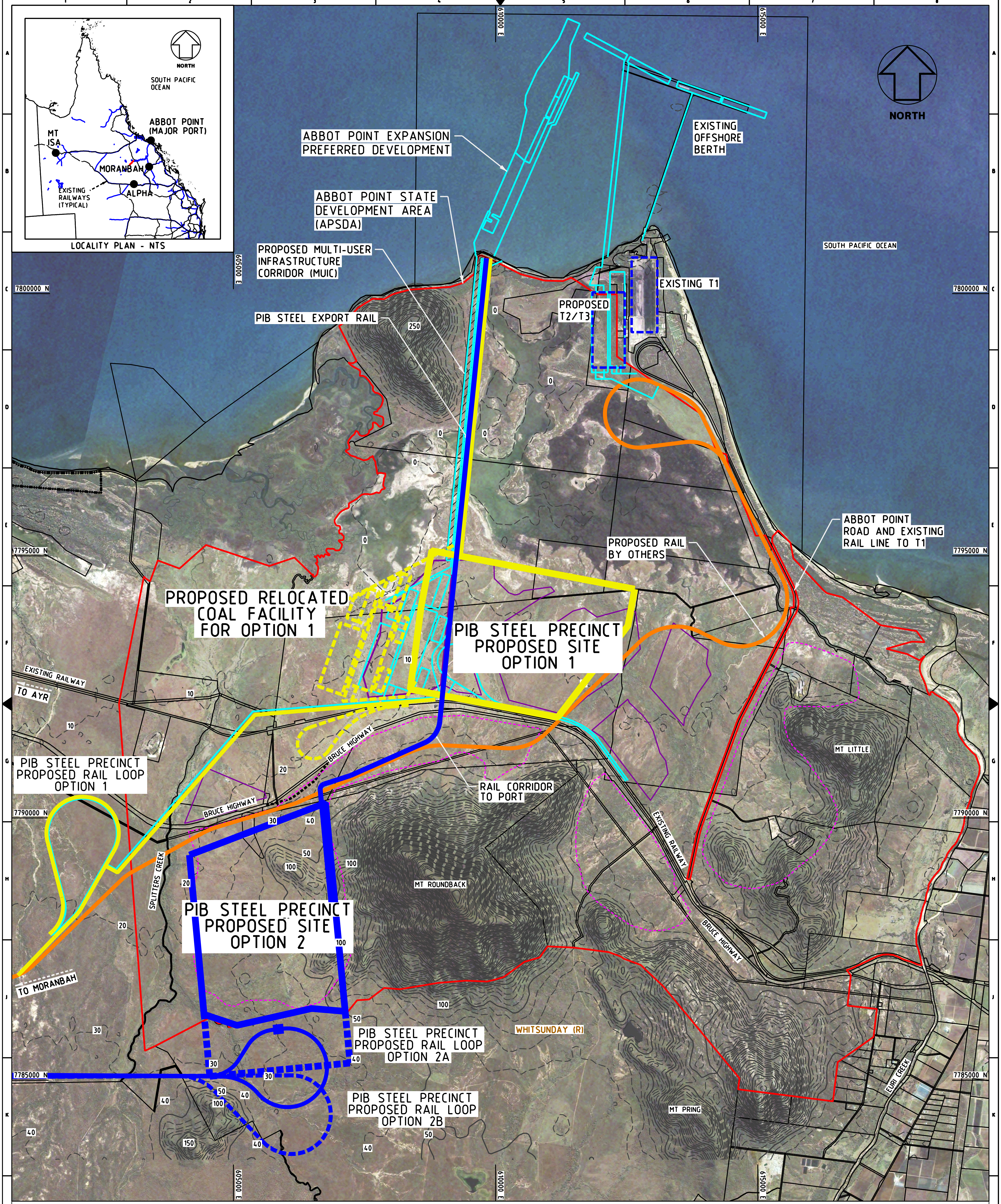
| Galilee Corridor Infrastructure Project Constraints Workshop | | | | | |
|---|---|---|---|---|---|
| | **Key identified issues** | **Issue descriptor** | **Issue risk category** | **Proposed mitigation strategy** | **Comments and notes** |
| | **Social Impacts** | | | | |
| **Project factors - general** | EIS Consultation | - Requires early management and consultation<br>- Information will be required regarding landholders, nearby towns, and any other special stakeholders<br>- Landowners may already be tired/annoyed by consultation associated with other projects and have a preconceived attitude or alternatively be more receptive due to likely lower impact of EWLP<br>- availability of and access to public venues for landholder meeetings may be very restricted | **Medium** | - Carefully plan comunication strategy to give maximum opportunity for full range of means of communication about the project<br>- Isolated and low density landholder locations to be catered for<br>- comprehensive stakeholder ID process<br>- undertake several rounds of consultation and maintain open means of contact, particularly for out of hours to account for property managment availability<br>- ensure a 'no surprises' approach to information dissemination | |
| | Communication | - Risk of over-consultation due to number of other concurrent projects<br>- Landholders may be confused by multiple projects and not easily differentiate advantages of EWLP | **High** | - Clarity of communication vital<br>- clarify consultation process and procedures to all stakeholders<br>- advise of timeframes for consultation and range of opportunities at various stages of project | |
| | Landowners | - Consultation and landholder dealings will need to be managed<br>- Landholders often widely separated and public venues/opportunities may be few leading to difficulties with coverage<br>- Potential opposition to easement acquisition or purchase of land for corridor and rejection of access for investigation | **Medium** | - Manage one-on-one interaction to deal with reduced availability of group meeting opportunities<br>- adopt strongly respectful and open consultative approach to all negotiations | |
| | Worker behaviour/community interaction | - Concerns about public safety, mixing with locals, drug and alcohol usage.<br>- Potential for adverse reaction of fly in fly out non-residents with locals | **Medium** | - Lack of existing towns for accommodation along majority of route minimises this risk. Mackay and other large coastal towns less of a risk but accommodation opportunities scarce<br>- establish a code of contact for workforce<br>- consider wet vs dry camp and provision of leisure activities in camps | |
| | Traffic and Transport | - FIFO/DIDO issues re access and impacts on towns and transport demands affecting local usage<br>- Lack of good local road network and impacts on local usage, particularly during times of cattle movement<br>- Increased traffic and damage to road network<br>- Interaction with safety risks such as school bus travel times and heavy vehicle movement | **High** | - Plan appropriate mitigation measures to manage risk<br>- Regularly enforce protocols with workforce to manage possible community impacts<br>- Provide bussing and other measures to avoid traffic impacts and schedule heavy haulage so as not to affect cattle movements at peak times | |
| | Cost of living and Community Services | - Isolation and scattered communities may reduce impacts on services as much of activity may be self-contained to camps and not affect local demand<br>- may affect house/rental costs in larger coastal cities for non-resident workforce | **Medium** | - Coastal towns already under these pressures from other existing and planned projects<br>- Opportunities for proponent to introduce measures to meet own demands as well as offset local impacts by providing access to services, transport of goods etc as a tradeoff | |
| | Social factors | - Impacts on social resources (i.e. education, medical, commercial, accommodation, recreation …)<br>- Impacts on community ethos and culture | **Low** | - Reduce impacts on local communities by provision of dedicated services to workforce<br>- Offer local communities and individuals to have shared access to Proponent provided services | |
| | Indigenous | - Multiple TO groups to deal with<br>- Multiple NT claims to be managed<br>- Consultation process delays | **Medium** | - Allow adequate time to negotiate with all groups<br>- Establish ILUAs with all groups and CHMPs should be in place prior to starting field investigations and detailed planning<br>- Agree communication strategies for all phases<br>- Involve all TO groups in construction phase as well as investigation phase for CH clearance<br>- Offer employment and apprentice opportunities to TO groups to gain commitment to project | |
| | Reputation | Reputation of project suffers through poor public image for a range of reasons | **High** | - Be proactive with general community, all stakeholders and landowners as well as workforce to promote a positive image of the project<br>- promote project benefits and plan with community for project legacies | |
| | Cumulative impacts | Risk of broader community along complete route having multiple impacts from several projects affecting larger areas of properties | **High** | - Promote value of single corridor to eliminate/minimise cumulative impacts<br>- undertake benchmark studies to identify possible trends and manage avoidance of increased impacts<br>- promote benefits of covered haulage to reduce cumulative ipmacts of coal dust on human health | |

# Social Impact issues

| Galilee Corridor Infrastructure Project Constraints Workshop | | | | | |
|---|---|---|---|---|---|
| | **Key identified issues** | **Issue descriptor** | **Issue risk category** | **Proposed mitigation strategy** | **Comments and notes** |
| **Construction phase** | Communication | - Mis-communication leads to adverse community reaction to project | **Medium** | - Ensure all communications are vetted for accuracy and content before releasing<br>- Manage information release through key personnel only<br>- Provide regular community update through a number of media and set up opportunities for local groups to visit site when appropriate to understand the nature and progress of the project | |
| | Air quality and dust | - Adverse impact on landholders and road users | **Low** | - Identify locations along the corridor where residences, towns or roads occur and implement construction management to minimise stirring up dust (including tracking dirt onto sealed roads)<br>- Liaise with stakeholders in the area about construction timings<br>- establish monitoring program | |
| | Noise/vibration | - Construction noise causes annoyance to landholders and towns<br>- Blasting rock impacts on landholders and cattle | **Low** | - Landholders and towns are very low density along most of the corridor<br>- Liaise with stakeholders in the vicinity of construction works (particularly regarding blasting)<br>- establish mon itoring program<br>- undertake pre-condition reports where necessary | |
| | Traffic, transport and access | - Landholder nuisance due to need for private property access, use of gates etc.<br>- Damage to landholder property due to heavy vehicle access | **Medium** | - Understand needs of individual stakeholders in the vicinity of construction works in terms of access through their property<br>- Manage private property access to turning radii, implement erosion and sediment control where needed and agree on any repair needs with landholder<br>- undertake condition reports prior to construction starting and at end of construction period | |
| | Project Legacies | Risk of project 'taking' and not 'giving' anything in return from a community that is traditionally pastoral and about to be the centre of a mining province | **Medium** | Ensure that Proponent implements a range of community projects to provide community with social and service needs that are currently not being met in the region | |
| | Non-resident workforce | - size and location of camps<br>- rostering procedures and rate of movements<br>- transport arrangements and impacts on local road traffic<br>- impacts on public transport services | **Medium** | - plan appropriate management to avoid identifiable impacts<br>- provide recreational opportunities for FIDO/DIDO workforce | |
| **Operation phase** | Air quality | - Air emission impacts at loading/unloading facilities on landholders and customer staff<br>- Air emission nuisance in transit | **Low** | - Implementation of engineered controls to minimise dust and procedures to minimise worker exposure to dust at loading/unloading facilities<br>- Transit air emisions will be minimised through covered wagons and modern specification locomotives | |
| | Noise/Vibration | - Noise/vibration impacts at loading/unloading facilities to landholders and customer staff<br>- Noise nuisance in transit | **Low** | - Implementation of engineered controls to minimise noise and procedures to minimise worker exposure to noise at loading/unloading facilities<br>- Noise levels from moving trains is relatively minor and the corridor traverses remote areas | |
| | Landowners | - Maintenance works could impact on landholders access and operations | **Low** | - Utilise road access within rail corridor<br>- Liaise with landholders in the vicinity of maintenance works and access points to notify of the works and identify possible needs<br>- establish land access protocols and compensation as necessary | |
| | Traffic | Long-term impacts on local roads and property management due to frequent train traffic both across properties as well as on lesser Council roads crossed at grade | **Medium** | - Plan to minimise issues through design and operational timing of movements<br>- Base maintenance/repairs on pre-condition reports | |
| | Project legacies | Risk that legacies are handed over to the LGAs/local communities without funds to sustain them in the long-term | **Medium** | - Ensure that legacies have sustainable measures incorporated so that they do not become a drain on LGA or community funding ability<br>- legacies may include bores and campsite facilities established as part of construction program as well as purpose built/provided facilities/services | |

# Appendix 15


PROJECT
IRON BOOMERANG
east west line parks limited




**LEGEND:**

- PIB OPTION 1 CONCEPT
- PIB OPTION 2 CONCEPT
- ABBOT POINT PROPOSED EXPANSION
- PROPOSED ALT ABBOT POINT EXPANSION



NOTE:
ABBOT POINT STATE DEVELOPMENT AREA (APSDA)
ABBOT POINT EXPANSION AP-X PROJECT
DRAWING NUMBER 227194-G-1094

1000 0 1000 2000 3000 m

SCALE 1 : 100000

PROJECT IRON BOOMERANG
east west line parks limited



| REV | DATE | DRN | DESCRIPTION | CHKD | APPR | PROJ |
|---|---|---|---|---|---|---|
| A | 14.02.13 | BC | ISSUED FOR INFORMATION | | | |

DRAWING REVISION

| | DATE | NAME |
|---|---|---|
| DRAWN BY | | |
| CHECKED BY | | |
| APPROVED BY | | |
| ENG MGR | | |

SCALE 1:100000 | FORMAT SIZE A4

engenium
ENGENIUM PTY LTD
Level 8, 178 St Georges Tce
Perth WA 6000 Australia
ABN 52 105 152 994
Tel: +61 8 6465 7777
Fax: +61 8 6465 7799

EAST WEST LINE PARKS LIMITED
PROJECT IRON BOOMERANG
GENERAL ARRANGEMENT - ABBOT POINT
STEEL PARK LOCALITY CONCEPT PLAN

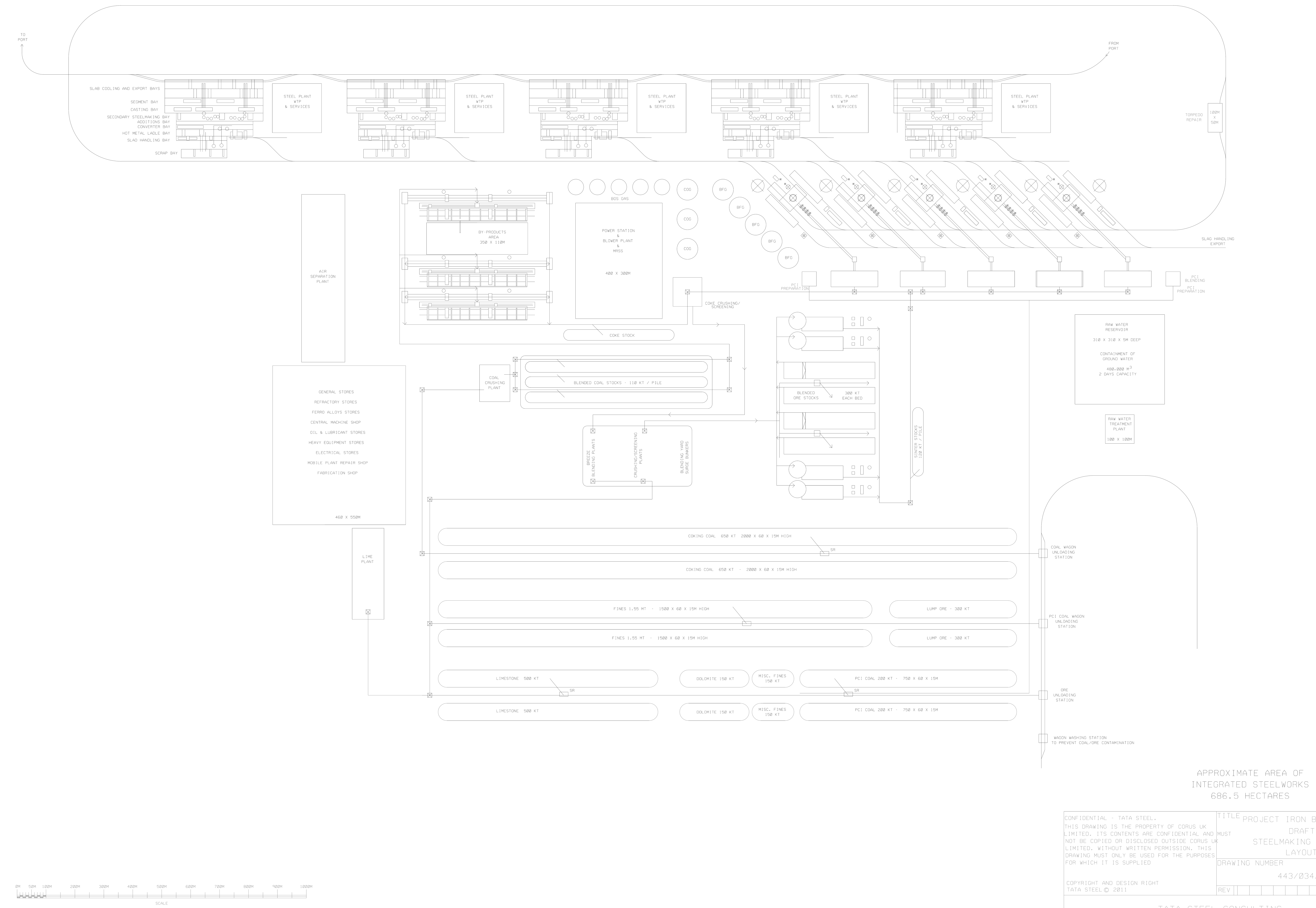
DRAWING No. PIB-SKE-G-0042 - FIGURE 1 | REV. A

# Appendix 16


GAS
WATER
POTENTIAL FUTURE SERVICES
PROJECT IRON BOOMERANG CONTINENTAL RAIL CORRIDOR
OPTIC FIBRE
COMMUNICATIONS
PROJECT
IRON BOOMERANG
east west line parks limited

| DRAWING NUMBER | PART NUMBER | DESCRIPTION | MATERIAL OR REMARKS | NO. OFF |
|---|---|---|---|---|

DRAWN: S.A.GLASPER
DATE: 08/05/2011
DEPARTMENT: E.S.F.
CHECKED: P.LEONARD
APPROVED:
ALTERATIONS




APPROXIMATE AREA OF
INTEGRATED STEELWORKS
686.5 HECTARES

PROJECT OFFICE FILE NO. 44334PIB0001
PROJECT NUMBER
SCALE:
LIMITS: (NOT STATED)
ASSEMBLY DRAWING
PROJECT DEPARTMENT



TITLE PROJECT IRON BOOMERANG
DRAFT
STEELMAKING COMPLEX
LAYOUT

DRAWING NUMBER
443/034/PIB 0004

REV

TATA STEEL CONSULTING

TATA STEEL

TATA

# Appendix 17


PROJECT IRON BOOMERANG
east west line parks limited

By Email: APXROI@dsdip.qld.gov.au

Registration of Interest – AP-X

Attention: Project Director

Infrastructure Policy

Department of State Development

Dear Sir/Madam,

East West Line Parks Limited (EWLP) refers to the abovementioned ROI process which seeks to identify private sector development proponents and prospective capacity seekers for the AP-X, with a view to awarding terminal development rights for parties with defined coal projects.

EWLP is not a proponent of a coal project and therefore may not fit the essential criteria as a Respondent to the ROI, however wishes to bring to your attention that it is the proponent of Project Iron Boomerang (PIB), a significant industrial project which we have proposed to the State will occupy a significant amount land within the Abbot Point State Development Area (APSDA).

EWLP has responded as a proponent to the separate Request for Information by the Coordinator General on behalf of the State, for developer interest in locating industries and infrastructure other than coal at the APSDA. We address this further below.

In addition, EWLP is also supporting a separate Response by its subsidiary FRSM Pty Limited (FRSM) which proposes to establish an iron making facility within APSDA, on which we provide further information below.

**Project Iron Boomerang (PIB)**

We attach, for your information, a copy of our Response ('Project Iron Boomerang Steelmaking Project') which addresses the CG's RFI request, and draw your attention to the following elements of our PIB proposal which are relevant to its establishment within the APSDA alongside any coal handling facilities that may also be proposed.

PIB is an infrastructure and manufacturing project which will develop a steel industry of international significance in Northern Australia. It includes the building of significant infrastructure including a transcontinental heavy haul rail line within a multi-user corridor 3,300 km in length linking the Bowen Basin metallurgical/coking coal mines in Central Queensland with the Pilbara iron ore mines of Western Australia.

PIB proposes to establish a Steel Precinct within the APSDA, linked by the rail corridor to a similar facility in the Pilbara, each of which will manufacture 22 million tonnes of slab steel products annually for export from its adjacent coast line.

Through its partnership with TATA Steel Consulting – UK (TSC), EWLP has confirmed PIB's strong economic case for the development in Northern Australia of the most globally competitive steel manufacturing and export facilities in the world. PIB will be Australia's largest infrastructure and manufacturing project, involving Capex of approximately $15 billion for the steel complex and associated infrastructure at APSDA, a similar amount in the Pilbara and approximately $14 billion for the transcontinental rail crossing. The value of high quality slab steel products exported from APSDA to the world's expanding markets will exceed $10 billion annually and a similar amount will be generated from the Pilbara complex. In addition, secondary industries established downstream on the back of surplus heat and energy from the steel complex at APSDA, including cement manufacturing, bio-fuels and bio-plastics, will be capable of generating products for export with a value of approximately $5 billion.

EWLP is strongly pursuing the planning and development of PIB's necessary infrastructure, manufacturing plants and associated facilities while at the same time securing its necessary investment and technical input from steel manufacturing companies in Japan, Korea and their participation in the ongoing development of the project.

By consolidating international supply chain logistics PIB will change forever the current industry paradigm that Australia chooses only to export its world class coking coal and iron ore and import steel rather than 'value add' to its raw materials domestically. In doing so, PIB will also replace the need to ship more than twice the export tonnage of raw materials with the consolidated export of finished steel slab product, thereby improving national productivity and generating significant economic benefits to Queensland and the nation as a whole.

Separate from the sound economic case for PIB, as a matter of potential interest, we draw your attention to the economic benefits that will accrue to the nation from the transcontinental rail line which is already apparent from a separate study, by Ernst and Young and Everything Infrastructure for PIB. That study has demonstrated that the proposed rail corridor and 40 tal line provides by far the most efficient freight solution for coal from Queensland's Galilee Basin to Abbot Point, even as a stand alone project without any reliance on PIB's own tonnages.

EWLP has progressed its planning for PIB to the stage where it requires securing suitable land within the Abbot Point State Development Area to establish the Queensland smelter park Steel Precinct.

In this context, we draw your attention to the significant area of land with good port access required for PIB (approx 1200 ha) as identified in our aforementioned Response to the CG's RFI. In particular, you will note in section 4 thereof that we identify two site options for PIB within APSDA, referred to therein as Option 1 and Option2. We consider that each of these identified sites, which it has discussed with representatives of the State over many years, is compatible with its current understanding of heavy industry and other land uses proposed for the Abbot Point SDA and Port.

Further, you will note in section 4 of the Response that Option 1 requires the State's necessary understanding and acceptance that the proposed new coal facilities may be translated several hundred metres to the west of their currently indicated location as shown in the recent AP-X Invitation registration document. This minor adjustment would appear to allow an accommodation of the interests of both the proposed coal handling facilities and the proposed steel plant at the Option 1 site. Alternatively, a suitable accommodation for PIB's 1200 ha site in the locality of Option 1 could be achieved by adjusting the proposed location of the Hancock-GVK standard gauge coal rail corridor which is shown to pass through the eastern end of APSDA. Such an adjustment would appear to be possible and would also assist to secure a reservation for heavy industry at the eastern end of the APSDA, separate from coal at the western end.

We have also put forward our particular requirements for use of the common-user corridor in which PIB will require incorporating a duplicate standard gauge rail line for the export of finished steel products and a conveyor by which it will receive deliveries from the wharf of significant raw materials.

We have also put forward PIB's requirements at the Port, in particular, suitable general cargo wharf facilities to receive essential incoming raw materials from bulk cargo ships and high value engineered products for installation in the steel complex construction phase. Our attached Response to the CG's RFI also describes the 'roll-on-roll-off' load out facilities required at the port to facilitate PIB's purpose designed Panamax size ships which will export the finished slab steel products.

EWLP considers that a spirit of openness in discussions about land use at APSDA would allow a suitable accommodation for all concerned and we confirm our strong desire to continue to participate in such discussions until a satisfactory solution is reached.

**FRSM's SMART Materials Concept (SMC)**

As introduced above, EWLP is also supporting a separate Response by its subsidiary FRSM Pty Limited (FRSM), which has launched an intensive pre-feasibility study into the SMART Materials Concept (SMC).

Please find attached for your further information and consideration a copy of FSRM's Response to the CG's RFI in response to this other significant project.

FSRM's intended site, as has been identified in discussions with the State for some time, would appear to present no particular conflict with the proposed coal facilities, however it is essential that its intended use of the common user corridor is understood and accepted in any future planning activities.

East West Line Parks Limited understands the importance of coal exports for Queensland and that coal requires a strong presence within the APSDA, however we are most keen to protect the interests of its nation-building projects, PIB and SMC. We are therefore strong advocates for ensuring that a suitable accommodation is arrived at for all concerned within APSDA.

We therefore look forward to mutually satisfactory discussions with the State on the development of our PIB and SMC proposals and to amicably resolving any land planning issues that might arise.

We request that your further enquiries on this matter be addressed in the first instance to our Mr Tom James at tom.james@ewlp.com.au or 0411 487 518

Yours faithfully,

Shane Condon

Managing Director & Founder

East West Line Parks Limited

# Abbot Point State Development Area

## Response to Request for Information – Possible development proposals

February 2013

## FRSM Pty Limited

(A wholly owned subsidiary of East West Line Parks Limited)

## SMART Materials Concept

### Contact:


Haruhiko Kinase, Executive Project Manager

Haruhiko.kinase@ewlp.com.au

07 3221 6966

# Table of Contents

# Executive Summary

FRSM Pty Limited (FRSM) is the proponent of an innovative R&D and commercialisation project to initiate industry collaboration across the supply chain of the motor vehicle parts manufacturing industry both in Australia and internationally.

The purpose of the collaboration is the enable the supply of suitable-grade iron and steel products as a material feedstock to the industry internationally at a significantly more competitive cost than currently accessible. The project is therefore called the SMART Materials Concept (SMC) as it involves embedding improved supply chain logistics (from raw materials to parts manufacturing) into the iron and steel materials supplying the industry.

FRSM is a subsidiary of East West Line Parks Limited (EWLP) which is undertaking a related project involving potential steel production in Australia.

The current stage of development of the project has seen FRSM co-ordinate a cluster of significant local and international companies and industry bodies to undertake an intensive pre-feasibility study into the SMART Materials Concept.

Led by FRSM, this project is being undertaken in collaboration with

1) Nomura Research Institute (NRI), a leading Japanese Consulting Firm
2) A major Japanese Steel Company
3) A major Japanese Shipping Company
4) A major Japanese Trading Company
5) An Australian Mining Company
6) Some key Australian Car Parts Manufacturers
7) Industry Capability Network (ICN) and
8) The Australian Federation of Automotive Products Manufacturers (FAPM).

The project has also received strong support from the Queensland Government, Victoria Government, South Australian Government and Australian Federal Government.

The SMC aims to revolutionise the process for the manufacture of steel and vehicle parts in Australia, so that steel and other related products can be exported from Australia to the expanding markets of Asia-Pacific region.

This new opportunity aims to 'value add' to the existing Australian sourced raw materials to make higher value use of those resources domestically, provide avenues for import substitution for vehicle parts and other steel products made from such raw materials otherwise shipped to foreign markets, and improve the competitiveness of the manufacturing process for these products in Australia.

The improved efficiency of the supply chain will deliver triple bottom line benefits in terms of improved environmental outcomes through lower carbon emissions and economic dividends flowing from comparative competitive advantage.

Thus the project will deliver:

- Improved supply chain cost efficiencies
- Reduced carbon emissions
- Improved resource management/consumption sustainability
- Value-added steel product manufacturing

- Domestic employment security in Auto parts manufacturing.

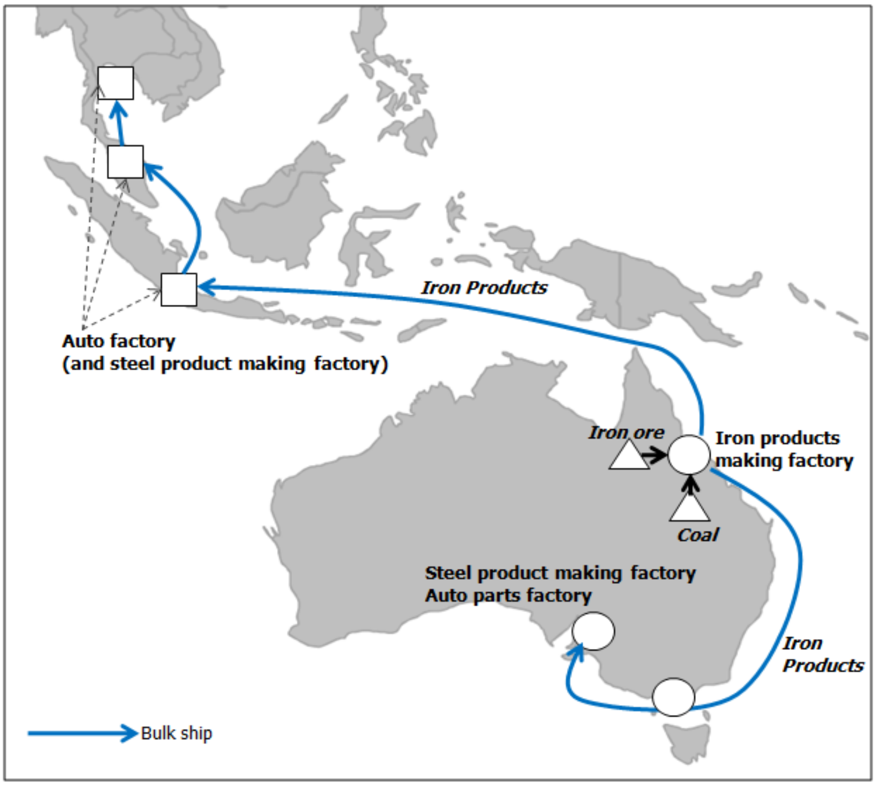



**Figure 1: Illustration of the SMC High Level Supply Chain**

The SMC is based on using iron products from a new highly efficient, high-tech iron making complex in Queensland, so that the steel and other materials can be manufactured into value-added products for international export to the expanding markets of Asia Pacific. This will allow this added value to be captured in Australia instead of shipping large volumes of raw materials to Asia.

By co-ordinating the links of the supply chain from raw materials extraction to motor vehicle manufacturing, the SMC has great potential to transform the steel and parts manufacturing sector in Australia and generate significant benefits for the industrialised states of Victoria and New South Wales and the resource rich states of Queensland and South Australia. The SMC would thereby consolidate supply chain logistics, improve productivity through operations efficiency and initiate new iron production in Australia.

The now completed Pre-Feasibility Study Report has identified significant new business opportunities within Australia and the potential for exports from Australia to South East Asia.

These new opportunities to 'value add' to the existing manufacturing process for these products will replace the need to ship large volumes of non-value-added raw materials to foreign markets from which source materials must be imported back into Australia for steel products manufacturing, including car parts.

The main findings of the report are as follows:

- Indicative FOB (Free on Board) prices of iron products at Abbot Point, Queensland were **USD 323.1** as of Sep 2012, **USD 380.1** as of Dec 2011 and **USD 261.6** as of Sep 2007. These prices were much lower than global scrap steel market prices (price range: **USD 350-390** as of Sep 2012, **USD 410-460** as of December 2011 and **USD 320-370** as of September 2007, Reference: Metal Bulletin).

- Pre-Feasibility Study analysis shows that SMC has a great potential global cost competitiveness for selling iron products from Queensland to Asian countries in both booming (e.g. Sep 2007), and depressed (e.g. Sep 2012 and Dec 2011) economic cycles.
- This new model will benefit domestic manufacturers through increased viability by tapping into the local production of Iron Products. For example, our indicative CNF Prices of iron products at South Australia were **USD 339.5** (Sep 2012), **USD 399.1** (Dec 2011) and **USD 299.3** (Sep 2007) and these numbers were lower than market price of scrap steel (providing a **USD 11- 70** cost advantage).
- Estimated annual CO2 Emission savings through supply chain consolidation are **81,746 tonnes** (per year).
- Estimated annual carbon price saving is around **USD 1.9 million** every year (USD1.9 saving for every ton of iron/steel products) achieved by carbon footprint reduction.
- Combined with the SMC innovation model being proposed to global auto manufacturing sectors, this also creates business opportunities for auto parts industries in Australia.
- In the global scrap steel market, USA dominates as the No.1 scrap steel exporter. USA is also the biggest scrap steel exporter to Thailand, Malaysia and Indonesia. Due to the long freight distance, CNF prices at these countries are high and volatile. However, Thailand, Malaysia and Indonesia have had little choice but to continue to import scrap steel from USA due to limited available supplies from other countries. As a result, our estimated scrap steel CNF prices at these countries (from USA) are higher than world average scrap steel prices. Australia is also one of the biggest scrap steel exporters (No.2 or No.3) to Thailand, Malaysia and Indonesia.
- The new model proposes to expand Australia's opportunity to export iron products which can replace scrap steel to the mass market in South East Asia. The advantage of this is that estimated price savings at these countries are **USD 43-151/tonne** (price reduction).
- There are opportunities to reduce/stabilise the procurement cost of raw materials (iron ore and coal from resources proximate to the proposed iron production site at Abbot Point State Development Area).
- Lower grade iron deposits have been identified in waste waste spoil piles and residue located relatively near the port of Townsville. There are also some potential new iron ore deposits in the adjacent area. Collaboration with a Queensland-based mining company and a Japanese steel company is continuing to identify, quantify and value the potential resources.
- Another Queensland (coal) company operating near Abbot Point is considering new projects; including one which will not have any processing plant at the mine site. If the quality of coal satisfies the requirements from the steel company to utilise with its latest technology, it could have potential to reduce the procurement cost of coal.
- The SMC would also consolidate supply chains and logistics, as well as iron production and provide productivity gains through operations efficiency and lower environmental impact.

## 1. Details of Respondent

### 1.1 Name and Address of Respondent

FRSM Pty Limited, company incorporated in Queensland

(a subsidiary of East West Line Parks Limited)

Level 16, 344 Queen Street Brisbane QLD 4000

### 1.2 Business Registration Details

ACN Number: 152 994 940
ABN Number: 67 152 994 940

## 2. Details of Project

### 2.1 Project Name

SMART Materials Concept

### 2.2 Type of Industry/Sector

1. Iron and steel industry
2. Logistics/supply chain
3. Car Parts Industry
4. Mining Industry (Iron Ore and Coal)
5. International Trade

## 3. Import or Export

### 3.1 Import or Export Facilities Required

The following facilities will be required to store and transport the raw materials received from local suppliers.

Import:

| Raw materials, additives & utilities | Required facilities |
|---|---|
| Iron ore and coal (QLD resources) | Road, Rail and related infrastructure (loading/ unloading facility, conveyors, stockyard) |
| Natural Gas | Pipeline and storage area |
| Water | Pipeline and storage area |
| Oxygen, Nitrogen, Industrial Air and Processing air | Storage area |

Export (to port and beyond):

| Products | Required facilities |
|---|---|
| Iron Products | Road, Rail and other related infrastructure (unloading/ loading facility, conveyors, stockyard)<br>Loading Facilities |

## 4. Land Requirements

### 4.1 Size of Site

In relation to Abbot Point SDA, the project once implemented will involve situating an iron making facility in a suitable location with access to rail infrastructure for material and other supplies, and to the port of export ot other Australian states and overseas.

The total site footprint is anticipated to be approximately 24 ha (e.g. 300m x 800m or 400m x 600m)


### 4.2 Compatibility with Other Land Uses

The proponent considers that the site it has identified for its SMART Materials Concept is compatible with its current understanding of heavy industry and other land uses proposed for the Abbot Point SDA and Port.

FRSM proposes to undertake more detailed design and site investigation to determine the most suitable site and to enter into more detailed discussions with the State and other relevant planning authorities to establish the compatibility with other proposed industries and land uses.

### 4.3 Topography and Geology Requirements

The proposed iron manufacturing facility represents the heaviest of industrial applications and will require suitable natural ground conditions and the provision of heavy duty plant foundations.

The particular foundation designs are required for any particular part of the iron making site has not been determined yet.

While the proponent has done desktop reviews of the geological conditions likely to be encountered at various parts of the APSDA, a full site investigation including an assessment of subsurface conditions, soil strength, depth to rock, and groundwater attributes will be undertaken at an appropriate time to determine suitable types of foundation design solutions.

### 4.4 Flood Immunity Requirements

The proponent is unaware of any detailed flood studies done for the APSDA site and has therefore not yet assessed its proposed site for natural flood immunity characteristics.

The iron making site will be designed with a flood immunity return interval of 1:100 years.

### 4.5 Extreme Weather Immunity

The plant will be designed to comply with Australian engineering design codes including assessments to withstand cyclonic winds.

## 5. Project Design

### 5.1 Proximity to other Port Infrastructure

It will be essential that the project facility located at APSDA have access to port facilities as detailed below. Current investigations also give consideration to having access to -

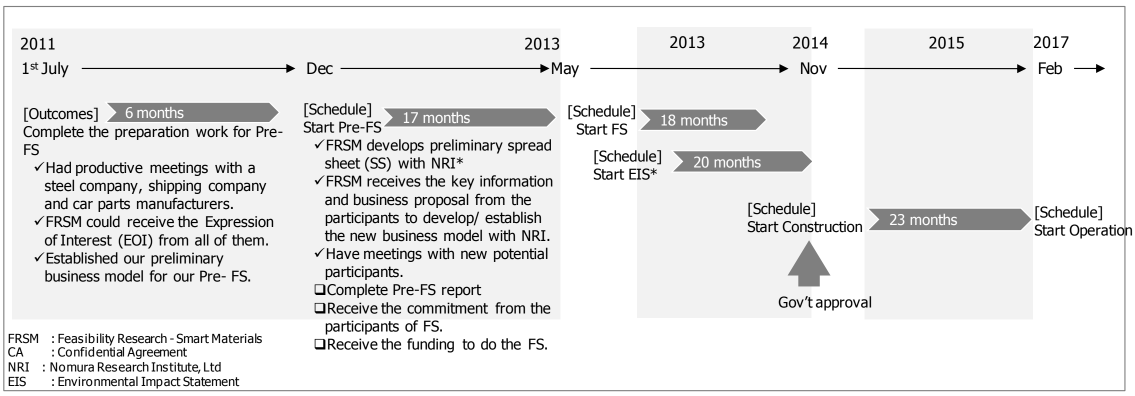
1) Townsville port or
2) Gladstone port

### 5.2 Plant Layout Structure - Preliminary

Full details of the structure and layout of the plant are in the planning stage now and will need to be refined depending on the nature of the site ultimately identified and agreed with Government as suitable. Further details can be provided confidentially to government when appropriate.

### 5.3 Proposed Timing

**Indicative Schedule**



### 5.4 Waste Facilities

The iron making plant, currently proposed to be established by an international steel company, will be a state of the art iron making facility to enable the production or iron nuggets. The type of plant proposed will have considerably lower emissions of $CO_2$, $SO_2$, $NO_x$ and other constituents than blast furnaces, and avoids the environmental problems of coke ovens and sinter plants.

The following wastes will be produced and require the following management:

1) Air treatment,

2) Water treatment

3) Materials recycling centre

4) Slag

The iron making plant will also produce the "slag" as a by-product. Slag will be utilised for the manufacture of cement, asphalt and coral reef rehabilitation.

## 5.5 Conveyor and Rail Infrastructure requirements

### 5.5.1 Conveyors (between the site and a port)

| | Production volume per day | Unit | Production volume per year | Unit |
|---|---|---|---|---|
| Iron Products | 2,740 | MT/day | 1,000,000 | MT/Year |

Please refer to the map in section 4.1.

### 5.5.2 Rail Connectivity

The rail connectivity will be an essential requirement of the proposed iron making plant with a spur from the existing Queensland railway line to the site (Transport iron ore and coal)

Please refer to the map in section 4.1.

## 5.6 Pipelines Required

A water and possible gas pipeline connection to the site will be required.

## 5.7 Cooling Ponds/Towers

At this stage, design of the water treatment plant and the specifics of heat exchangers either by cooling towers or closed circuit cooling systems has not been developed and will be subject to further discussion and development with technological equipment designers.

## 6. Port Design

### 6.1 Port Capacity Required

A General Cargo wharf will be required to export the iron products. Conveyor access will also be required at the port to facilitate ship loading.

The expected volume of the iron products is as follows:

| | Production volume per day | Unit | Production volume per year | Unit |
|---|---|---|---|---|
| Iron Products | 2,740 | MT/day | 1,000,000 | MT/Year |

It is anticipated that Panamax and/ or Handy-max international cargo ships will be used to transport the iron products to export destinations. Further information will be sought and requirements discussed with the Japanese shipping company participating in the project.

### 6.2 Ship Loading Separation distances

Normal navigation rules for Panamax vessels would apply. The proponent understands that at berth alongside the wharf, the required tail to tail distance is the length of the Panamax ship plus a minimum clearance of 33m.

### 6.3 Shipping Separation distances

Under steam, the proponent understands the minimum side to side clearance for the Panamax size ship 100 metres and the required tail to tail clearance is the length of the Panamax ship plus a minimum clearance of 500 metres.

### 6.4 Channel Clearance for Passing Vessels

Similarly, the proponent understands the minimum width of the channel to allow Panamax size vessels to pass side by side is 165.1 metres (5 times the beam/width of the ship)

### 6.5 Safety Exclusions Zone Requirements

Not applicable to this project.

### 6.6 Dangerous Goods Exclusion Zones Requirements

Not applicable to this project.

# 7. Impact on Community and Benefits to the State

## 7.1 Key Benefits for the Region/State/Nation

The key benefits likely to be delivered by this project are:

- New investment in industrial facilities at APSDA
- Increased diversity of economic activity in the SDA and the region
- A new opportunity to 'value add' to the existing Australian sourced raw materials
- Improved supply chain logistics for raw and value added materials
- Linking the supply chains of raw materials to predetermined end markets
- Significant new employment in both construction and operational phases
- Technology transfer benefits through the introduction of specialist iron production techniques and plant not currently available in Australia

The SMC will kick-start specialized direct reduced iron (DRI) manufacturing locally in Australia to enable cost effective materials to be made readily available for local steel and car parts manufacturers. This will dramatically improve the potential for local manufacturing of steel and related steel parts, capturing this added value in Australia and creating the potential to export these products to the expanding markets of Asia.

The project will facilitate collaboration between steelmakers and manufacturers to transform Australia's steel and parts manufacturing sector.

Leveraging the locally available primary materials with production of an Australian-based industrial iron production complex and partnering with Japanese companies with access to best-available technologies, Australian steel and auto parts manufacturing companies will gain the potential to significantly enhance their global competitiveness.

Key Australian auto parts manufacturers and the national Federation of Automotive Products Manufacturers (FAPM) are participant members of the R & D cluster formed to undertake the feasibility assessments of the project. Other participants, as outlined above, include international steel, shipping and car making companies.

## 7.2 Labour Force Requirements and Community Impacts

1) Labour Force Requirements

   | | |
   |---|---|
   | Construction Phase: | 1,000 -1,500 direct employees |
   | Operation phase: | 100 direct employees |

2) Community Impacts

   The are no adverse impacts given the location of the facility. The project anticipates that 300-400 employees will also be required for supporting service industries associated with the project.

## 7.2 Airspace

### 7.2.1 Airspace Impacts

The iron making site comprising iron making plant and many associated purpose designed plant elements for the iron making processes At this stage the buildings have not been designed in detail.

## 8. Throughput

### 8.1 Product Type and Volume

Based on new technology, source iron product is to be produced as a possible replacement for high quality scrap steel/pig iron as inputs for the Basic Oxygen Furnace or Electric Arc Furnace process in steel manufacturing.

The project aims to produce an annual target of 1 million tonnes of cost effective iron products (i.e. iron nugget).

### 8.2 Key Inputs and Outputs of Production

- Key Inputs

| Items | | | Unit consumption per day<br>Iron nugget production | Unit | Unit Consumption per annum<br>Iron Nugget Production | Unit |
|---|---|---|---|---|---|---|
| Raw Materials | 1) | Pellet feed/ iron Ore Fine | 4,110 | MT | 1,500,000 | MT |
| | 2) | Non Coking Coal | 1,370 | MT | 500,000 | MT |
| | 3) | Iron Oxide (lump ore / Pellet) | | MT | | MT |
| | 4) | Natural Gas | | GJ | | GJ |
| Additives & Utilities | 1) | Natural Gas Burner Fuel | 12,603 | GJ | 4,600,000 | GJ |
| | 2) | Electricity | 547,945 | kWh | 200,000,000 | kWh |
| | 3) | Water | 5,479 | $m^3$ | 2,000,000 | $m^3$ |
| | 4) | Oxygen | | $m^3$ | | $m^3$ |
| | 5) | Nitrogen | 32,877 | $m^3$ | 12,000,000 | $m^3$ |
| | 6) | Industrial Air, Processing Air | 232,877 | $m^3$ | 85,000,000 | $m^3$ |

- Key

| | Production volume per day | Unit | Production volume per annum | Unit |
|---|---|---|---|---|
| Iron Products | 2,740 | MT/day | 1,000,000 | MT/y |

## 9. Logistics

### 9.1 Freight Infrastructure Requirements

| | |
|---|---|
| Rail/ Train | Iron Ore and Coal |
| Road/ Truck | Iron Ore and Coal |
| Shipping | Iron Products |

### 9.2 Rail/Train Transport Requirements

| | Annual Consumption (thousand tpy) |
|---|---|
| Iron ore (Local) | 1,500 |
| Coal (Local) | 500 |

### 9.3 Road/Truck Transport Requirements

| | Annual Consumption (thousand tpy) |
|---|---|
| Iron ore (Local) | 1,500 |
| Coal (Local) | 500 |

### 9.4 Shipping Requirements

| | Annual Production (thousand tpy) | Loading capacity of each ship (thousand ton) | Number of trips per year |
|---|---|---|---|
| Iron product (QLD->Thai) | 1,000 | 50 | 20 |

## 10. Utilities

### 10.1 Water Infrastructure Requirements

| **Required water infrastructure** | **Annual water consumption** |
|---|---|
| Water Supply Facility | 2,000,000 $m^3$ tpy |
| Water Treatment Facility | |
| Water Storage Facility | |

### 10.2 Energy Infrastructure Requirements

| **Required Energy infrastructure** | **Annual Power consumption** |
|---|---|
| Power Supply Facility | 200,000,000 kwh tpy |
| Power Transmission Facility | |
| Power Storage Facility | |

### 10.3 Gas Infrastructure Requirements

| **Required Gas infrastructure** | **Annual Gas consumption** |
|---|---|
| Gas Supply Facility | 4,600,000 GJ tpy |
| Gas Transmission Facility | |
| Gas Storage Facility | |

## 11. Suppliers and Customers

### 11.1 Product Source

Qld Mining Companies (Iron Ore and Thermal Coal)

### 11.2 Supplier Information

A Japanese Steel Company

An Australian Steel Company

### 11.3 Customer Information

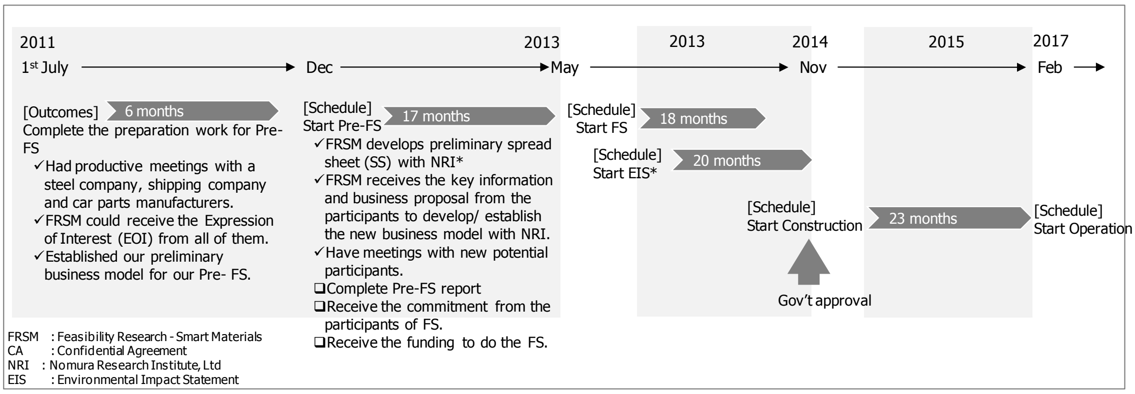
Australian Car Parts Manufacturers

A Japanese Trading Company

## 12. Project Status

### 12.1 Project Planning

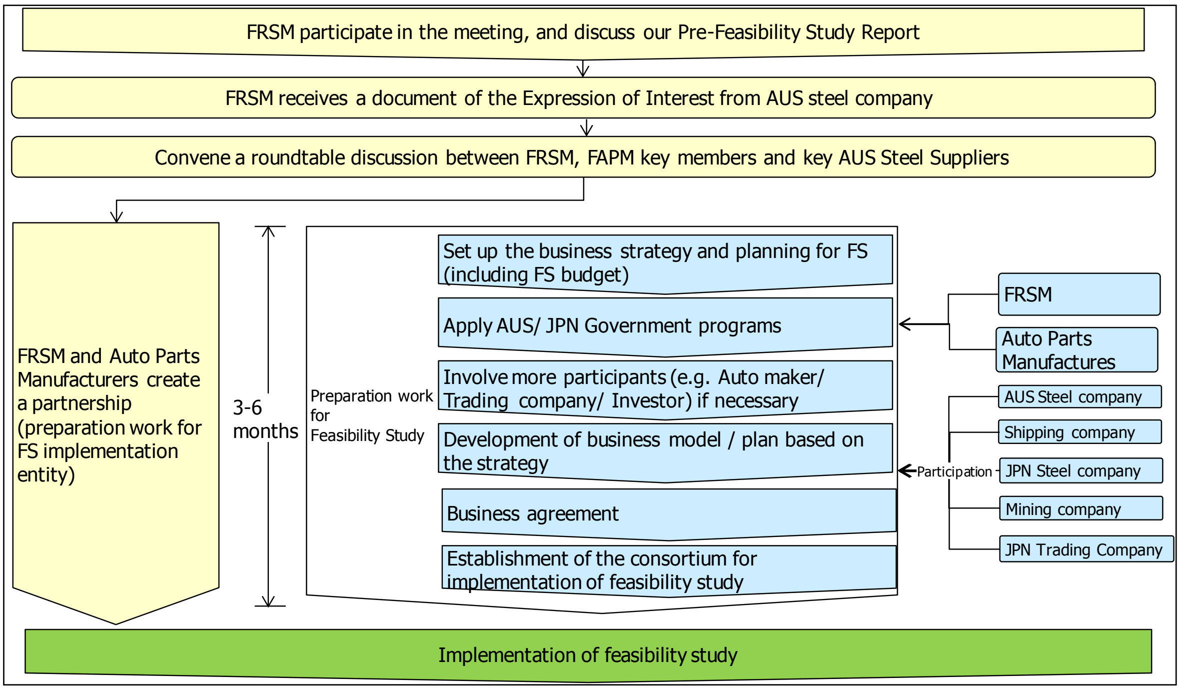
**Indicative Schedule**




### 12.2 Project Next Steps

As the project has received interest from Australia and overseas, there are two major steps which FRSM has as follows:

1) business model developed for next stage of Feasibility Study collaboration

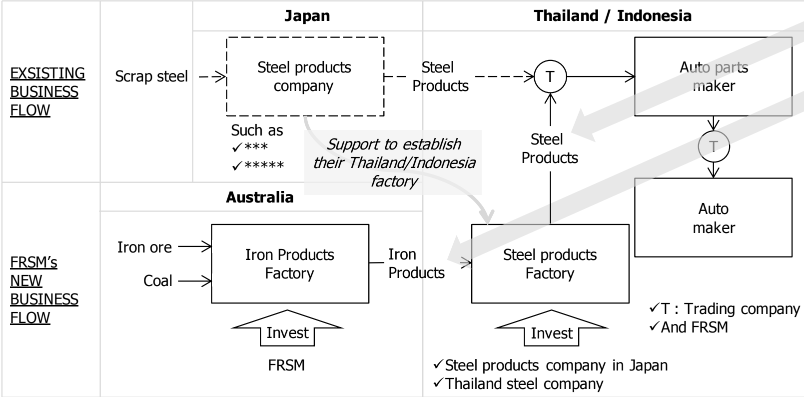



After receiving Expressions of Interest from the Car Parts Manufacturers, FRSM and FAPM (Car Parts Manufacturers in Australia) are preparing to convene a Roundtable of relevant stakeholders to clarify information needs and gaps to enable feasibility to assess commercial and business profitability.
The Roundtable between FRSM and FAPM key members will also enage an Australian Steel company. The ICN (Industry Capability Network) which has is providing liaison support with key partners and Australian Steel companies.

A key outcome of the Roundtable will be the forging of a partnership between FRSM and strategic auto parts manufacturers to oversee work in preparation for a FS Implementation Project Management entity.

2) Develop the business model in South East Asia from Australia

- Business flow
  - FRSM plans to establish a new business flow to introduce a steel products factory beside Auto makers in Thailand / Indonesia in order to implement our iron products business in Australia.




- R&Ds are needed
  - Task 1 : R&D for creating production method, procedure, technologies and techniques to produce high quality steel products as car parts using iron products.
  - Task 2 : R&D for identification of iron products specification to produce high quality steel products.
- Budget for R&D implementation
  - Total AUD**,***
    *,***,*** as \90/AUD
  - Australian Federal government fund with cooperation of Queensland state government (45%)
  - JPN NEDO or other government institution for R&D support (45%)
  - Thailand/ Indonesia government or other fund for developing industries in developing countries organized entities such as World Bank, UNDP and UNEP (10%).
- Participants for R&D implementation
  - Leader : FRSM Pty Limited
  - Members :
    - JPN steel products company as a entity to identify production process, create technologies and techniques, and identify iron products specification
    - Thailand/ Indonesia steel company as a entity to review production process and create process design with Thailand's/ Indonesian law and regulation
    - JPN iron products production system maker as a entity to customize iron production system to fit identified iron products specification
  - Advisor:
    - JPN trading company as a entity to support to identify specifications of high quality steel products and supply chain to Auto parts maker / Auto maker
    - JPN auto maker as a entity to identify specifications of high quality steel products
  - Organizer : Nomura Research Institute, Ltd

After receiving the interest from the Japanase steel company and trading company associated with internation auto makers, FRSM plans to establish a new business partnership to establish a steel products factory beside auto makers in Thailand and Indonesia.

FRSM, the Japanese steel company and auto industry trading company will then look to collaborate with Government to implement the following things:

i. Creating production method, procedure, technologies and techniques to produce high quality steel products as car parts using our iron products

ii. Identification of iron products specification to produce high quality steel products

# Abbot Point State Development Area

## Response to Request for Information – Possible development proposals

February 2013

East West Line Parks Limited

## Project Iron Boomerang Steelmaking Project


Contact:

Tom James, Project Director

tom.james@ewlp.com.au

0411 487 518

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# Executive Summary

East West Line Parks Limited (EWLP) is the proponent of the nation-building project known as Project Iron Boomerang (PIB), an infrastructure and manufacturing project which will develop a steel industry of international significance in Northern Australia.

The project includes the building of significant infrastructure including a transcontinental heavy haul rail line within a multi-user corridor 3,300 km in length linking the Bowen Basin metallurgical/coking coal mines in Central Queensland with the Pilbara iron ore mines of Western Australia.

PIB proposes to establish a Steel Precinct within the Abbot Point State Development Area (APSDA), linked by the rail corridor to a similar facility in the Pilbara, each of which will manufacture 22 million tonnes of slab steel products annually for export from its adjacent coast line.

Through its partnership with TATA steel Consulting – UK (TSC), the proponent has examined its 2007 Pre-feasibility Study at a deeper level and recently (2012/13) reconfirmed PIB's strong economic case to develop a more competitive steel manufacturing industry in Northern Australia than anywhere else in the world. PIB will will be Australia's largest infrastructure and manufacturing project, involving Capex of approximately $15 billion for the steel complex and associated infrastructure at APSDA, a similar amount in the Pilbara and approximately $14 billion for the transcontinental rail crossing. The value of high quality slab steel products exported from APSDA to the world's expanding markets will exceed $10 billion annually and a similar amount will be generated from the Pilbara complex. In addition, secondary industries established downstream on the back of surplus heat and energy from the steel complex at APSDA, including cement manufacturing, bio-fuels and bio-plastics, will be capable of generating products for export with a value of approximately $5 billion.

The proponent is continuing to strongly pursue the planning and development of the required infrastructure, manufacturing plants and associated facilities while at the same time securing necessary investment and ongoing technical input from steel manufacturers. The proponent has developed strong relationships with the leading steel manufacturing companies in Japan, Korea and China and is pursuing the ongoing development of the project with the following committed planning partners.

1) TATA Steel Consulting, UK (TSC) - a leading consultant to the world steel industry
2) Nomura Research Institute (NRI) - a leading Japanese consulting firm
3) Engenium – Australia's leading heavy haul rail designers.

By consolidating international supply chain logistics PIB will change forever the current industry paradigm that Australia chooses only to export its world class coking coal and iron ore and import steel rather than 'value add' to its raw materials domestically. In doing so, PIB will also replace the need to ship more than twice the export tonnage of raw materials with the consolidated export of finished steel slab product, thereby improving national productivity and generating significant economic benefits to Queensland and the nation as a whole.

With a strong focus on productivity, longterm sustainability and energy efficiency, TSC has assessed the proposed steel plant meets world's best productivity benchmarks for slab steel production with a labour input of 0.25 manhours/tonne compared to a typical world figure of 0.5 manhours/tonne.

TSC estimates the energy consumption of the facility to be approximately 16GJ/tonne of slab, which is of the order of 15-20% better than typical world wide practice. Further, it will also deliver an environmentally sound plant with low emissions to the atmosphere by world standards. These environmental benefits on a world scale add to the substantial savings in greenhouse gas emissions from the supply chain consolidation that accrues by shipping finished slab steel outside Australia, rather than shipping more than double the volume of iron ore and coal as raw materials.

The focus on long-term sustainability and energy efficiency brought into play a collaboration between TSC and NRI, to develop sustainable uses for surplus gas, energy and heat from the steel complex. This collaboration has identified the potential to develop significant secondary industries including cement manufacture, bio-fuels and bio-plastics which would naturally follow the establishment of the steel complex. PIB would create the world's first sustainable industrial and residential complex located in Queensland, sustaining upwards of 40,000 people who will be drawn to the region's newfound industrial profile.

The improved efficiency of the supply chain will deliver triple bottom line benefits in terms of improved environmental outcomes through lower carbon emissions and economic dividends flowing from its competitive efficiency advantage.

Separate from the sound economic case for PIB, the proponent notes the economic benefits that will accrue to the nation from the transcontinental rail line which are already apparent from a separate study, by Ernst and Young and Everything Infrastructure for PIB. The study has demonstrated that the proposed rail corridor and 40 tal line provides by far the most efficient freight solution for coal from Queensland's Galilee Basin to Abbot Point, even as a stand alone project without any reliance on PIB's own tonnages.

Thus Project Iron Boomerang will deliver:

- A nation building opportunity to leverage domestic raw materials into a modern, internationally competitive steel industry on a significant scale.
- Australia's largest infrastructure and manufacturing project.
- Improved supply chain cost efficiencies and technology transfer benefits through partnerships with international steel companies with access to world's best technologies
- Improved resource management/consumption sustainability
- Reduced carbon emissions on a global scale
- Facilitation of significant secondary industries at the APSDA
- Significant regional domestic employment in both construction and operational phases
- Increased diversity of economic activity in the APSDA and the region
- A transcontinental, standard gauge rail line with 40 tonne-axle-load efficiency which will open up the enormous economic potential of stranded inland mineral reserves.


**Figure 1: Locational Overview of Project Iron Boomerang**

EWLP has progressed its planning for PIB to the stage where it requires to secure suitable land within the Abbot Point State Development Area to establish the Queensland smelter park Steel Precinct.

Accordingly, we respond herewith to the Coordinator-General's Request for Information (RFI) which seeks developer interest in locating industries and infrastructure other than coal at Abbot Point (APSDA). In doing so, we present an outline of our proposed nation-building project, which will develop an environmentally and economically sustainable world-class steel industry in Northern Australia.

PIB will contribute to significant regional development in Queensland. It will continue to deliver nation-building benefits to the State and the Commonwealth for the long term and, accordingly, deserves the State's strong support when allocating land appropriately within the APSDA.

The proponent draws attention to the significant area of land with good port access required for PIB (approx 1200 ha) and we identify two site options for PIB within APSDA, referred to as Option 1 and Option2. We considers that each of these identified sites, which we have discussed with representatives of the State over many years, is compatible with our current understanding of heavy industry and other land uses proposed for the Abbot Point SDA and Port.

Further, the proponent also requests that the realisation of Option 1 would require the State's necessary understanding and acceptance that the proposed new coal facilities may be translated several hundred metres to the west of their currently indicated location as shown in the recent AP-X Invitation registration document. This minor adjustment would appear to allow an accommodation of the interests of both the proposed coal handling facilities and the proposed steel plant at the Option site. Alternatively, a suitable accommodation for PIB's 1200 ha site at Option 1 could be achieved by adjusting the proposed location of the proposed standard gauge coal rail corridor which is shown to pass through the eastern end of APSDA. Such an adjustment would appear to be possible and would also assist to secure a reservation for heavy industry at the eastern end of the APSDA, separate from coal at the western end.

The proponent also puts forward herein its requirements at the Port for suitable general cargo wharf facilities at which PIB would receive essential incoming raw materials from bulk cargo ships and high value engineered products for installation in the steel complex construction phase. It also describes the 'roll-on-roll-off' load out facilities required at the port to facilitate its purpose designed Panamax size ships which will export the finished slab steel products.

The proponent considers that a spirit of openness in discussions about land use at APSDA and development of suitable facilities at the Port would arrive at a suitable accommodation for all concerned and confirms its strong desire to continue to participate with the State in such discussions until a satisfactory solution is reached.

## 1. Details of Respondent

### 1.1 Name and Address of Respondent

East West Line Parks Limited

Level 16, 344 Queen Street Brisbane QLD 4000

### 1.2 Business Registration Details

ACN Number: 118 581 883
ABN Number: 21 118 581 883

## 2. Details of Project

### 2.1 Project Name

Project Iron Boomerang

### 2.2 Type of Industry/Sector

1. First stage steel products manufacture
2. Logistics/ supply chain industry
3. Multi-disciplinary heavy construction
4. Mining Industry (Iron Ore and Coal)
5. International Trade
6. Power Industry
7. Secondary Manufacturing Industries (incl cement, bio-fuels and bio-plastics)

## 3. Import and Export Facilities

### 3.1 Import and Export Facilities Required

The following facilities will be required to store and transport the raw materials procured for the steel manufacturing process and the steel slab products produced.

**Import or Generate:**

| Raw materials, additives & utilities | Required facilities within the Steel Precinct |
|---|---|
| Iron ore and coking coal (resources from Qld and WA) | Transcontinental Rail and related infrastructure (loading/ unloading stacker reclaimers, conveyors, stockyard) |
| Limestone, dolomite and miscellaneous fluxes (shipped to Abbot Point Port) | Port unloading facilities, conveyor, stockyard. |
| Natural Gas (regional Queensland resource) | Pipeline and storage |
| Water (regional Queensland resource) | Pipeline and storage |
| Oxygen, Nitrogen, Industrial Air and Processing air | Air Separation plant and storage |
| Coke for blast furnaces and sinter plants | Coke oven plants |
| Burnt lime for sinter plants and steel plants | Lime plant and storage |
| Sinter | Sinter Plant |
| Iron production | 5 Blast furnaces each of 4.4 million tonnes of hot metal per annum |
| Steel | Steel plant |

**Export (at the port):**

| Products | Required facilities |
|---|---|
| Steel as slab (or perhaps as coil) | Overhead crane tong lifters at the steel plant, twin rail tracks to the port, rail wagons for roll-on-roll-off loading of special purpose slab ships. |

## 4. Land Requirements

### 4.1 Size of Site

PIB’s Steel Precinct at Abbot Point will be a manufacturing project on a world scale and occupy a site of approx 1200 ha (approx 4600m x approx 2600m).

In addition, on the back of the surplus gas, energy and heat it produces, manufacturing facilities in related industries are likely be developed requiring a further 800 ha of land.

PIB’s pre-eminence as a nation building project requires careful attention be given to ensuring it is appropriately situated. While the significant size of the 1200 ha Steel Precinct limits the number of possible sites on which to locate it within the APSDA, the proponent has identified 2 such options.

Option 1: On northern side of the Bruce Highway and North Coast Rail line.

Option 2 (2A and 2B): On the southern side of the Bruce Highway and North Coast Rail line, to the west of Mt Roundback.

Figure 2 is a location map of the Abbot Point SDA and Port site showing existing and proposed coal and port facilities and on which we have overlaid the two site options identified for PIB’s proposed Steel Precinct. It also shows proposed indicative locations for rail and other infrastructure for the receival of of raw materials and the export of PIB’s finished slab steel products.

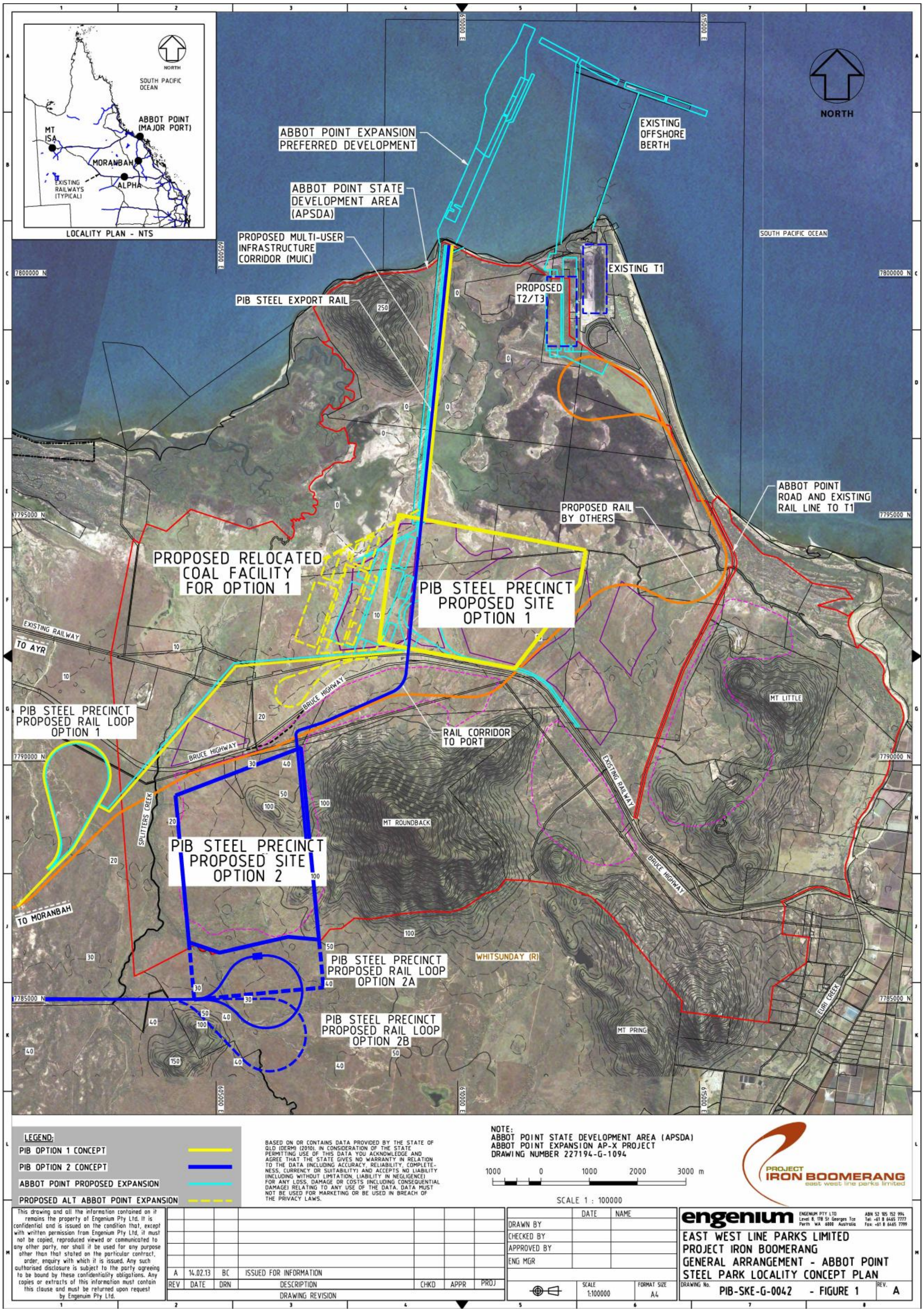



**Figure 2: Steel Precinct Site Options**

Option 1 is shown in perspective view in Figure 3.

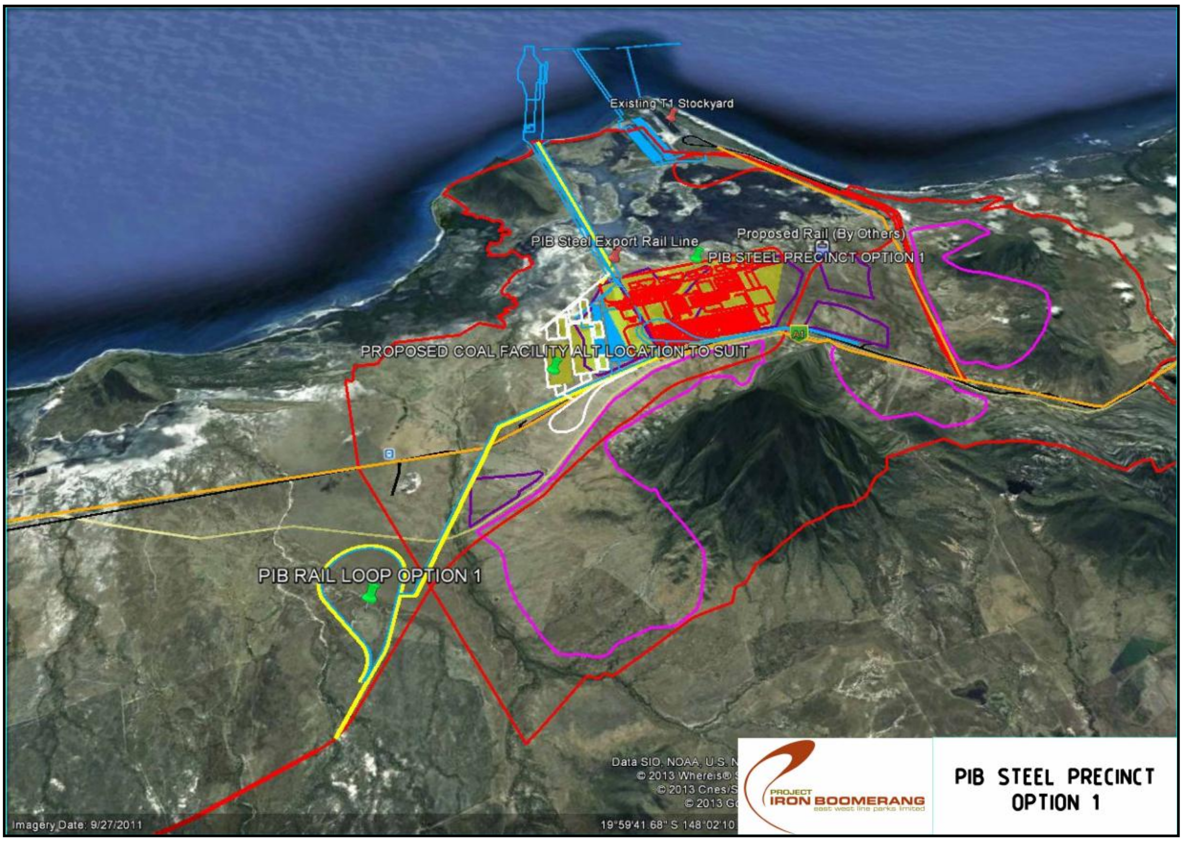



**Figure 3: Site Location Option 1**

Option 2A is shown in perspective view in Figure 4.

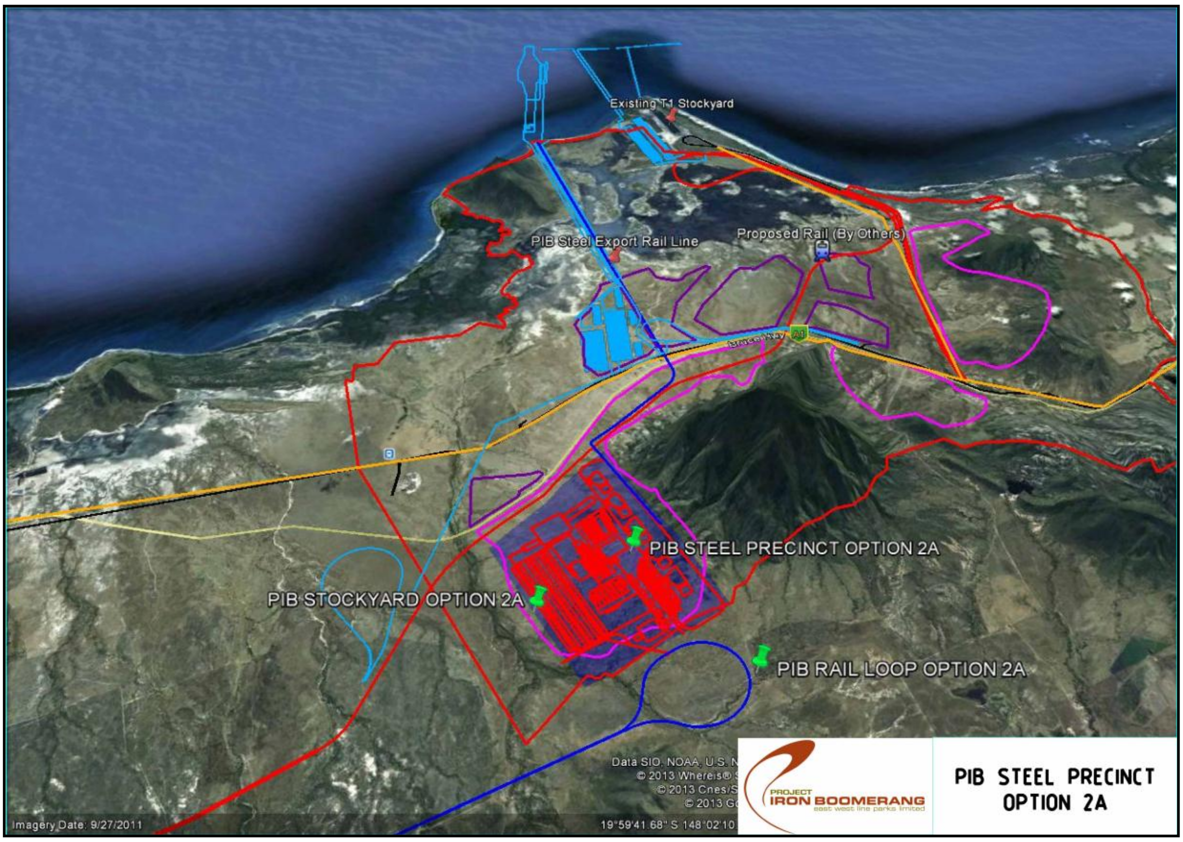



**Figure 4: Site Location Option 2A**

Option 2B is shown in perspective view in Figure 5.

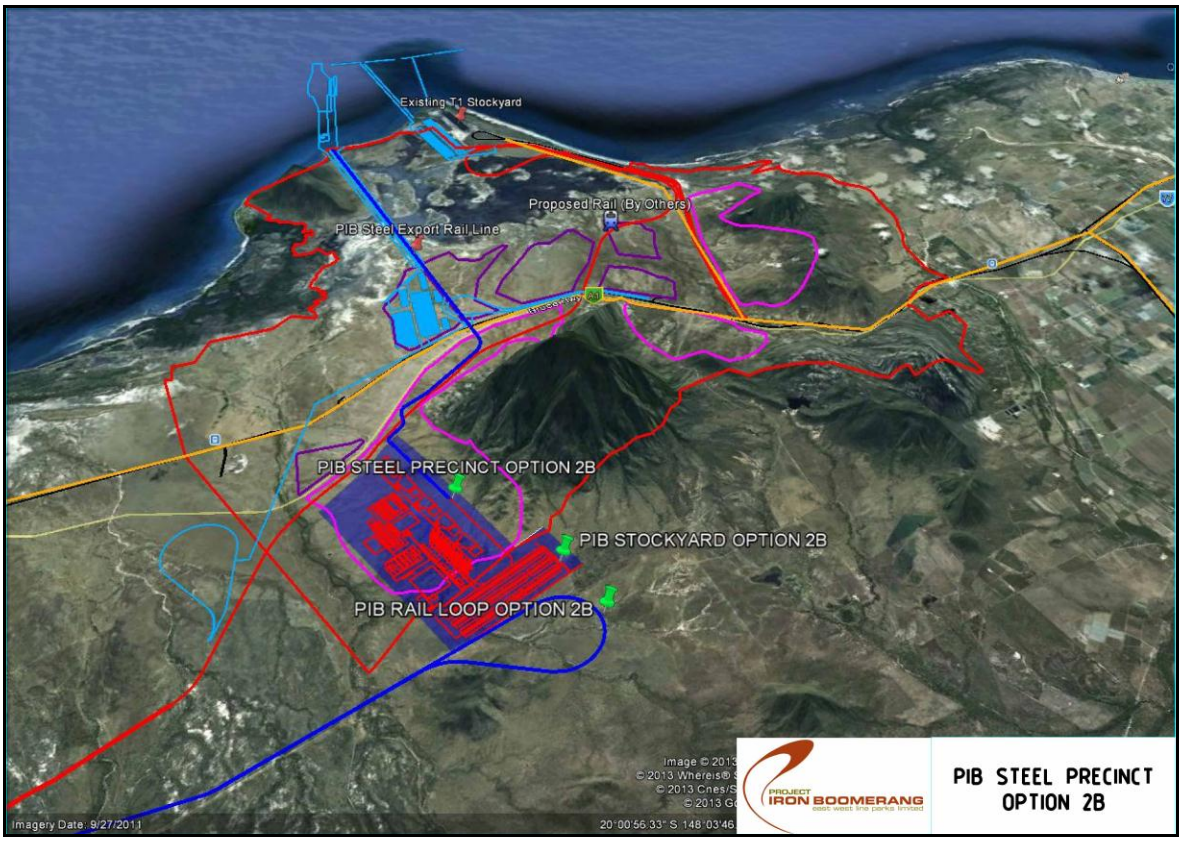



**Figure 5: Site Location Option 2B**

## 4.2 Compatibility with Other Land Uses

The proponent considers that each of the sites it has identified as options on which to locate its PIB Steel Precinct are compatible with its current understanding of heavy industry and other land uses proposed for the Abbot Point SDA and Port.

PIB proposes to undertake more detailed design and site investigation to determine the most suitable site and to enter into more detailed discussions with the State and other relavant planning authorities to establish the compatibility with other proposed industries and land uses.

The proponent makes the following additional comments in respect to its options 1, 2A and 2B as outlined in the foregoing site location plans and perspective views.

**Option 1:** Located adjacent to FRSM's proposed SMART Materials Concept plant (refer to parallel RFI Response submission by FRSM Pty Limited), this option would centralise heavy industry within the APSDA on the eastern side of the proposed multi-user corridor. Locating the Steel Precinct adjacent to the corridor provides ready access to the Port via a proposed heavy-haul, standard gauge rail line that PIB proposes to construct within it. Implementing this option requires an understanding and acceptance that the proposed new coal facilities may be translated several hundred metres to the west of their currently indicated location, as indicated in the AP-X Invitation registration document, to accommodate the steel plant. This minor layout adjustment would appear to allow an accommodation of the interests of both the proposed coal handling facilities and the proposed steel plant at the Option site. Alternatively, a suitable accommodation for PIB's

1200 ha site at Option 1 could be achieved by adjusting the proposed location of the proposed standard gauge coal rail corridor which is shown to pass through the eastern end of APSDA. Such an adjustment would appear to be possible and would also assist to secure a reservation for heavy industry at the eastern end of the APSDA, separate from coal at the western end.

**Option 2A:** Located in the south-western corner of the APSDA, wedged between Mt Roundback and Splitters Ck, this site option does not appear to present sufficient usable land. PIB's further design development and site investigations will determine if it is suitable. In regard to logistics of materials movements, PIB's intent is that key raw materials (iron ore and coal) will arrive via its proposed trans-continental heavy haul rail line terminating at the south-western corner of the APSDA.  Finished steel slab product is to be railed to the Port via a heavy-haul, standard gauge rail line that crosses the Bruce Highway and the North Coast rail line and it situated within the proposed multi-user corridor.

**Option 2B:** This option is put forward as a means of overcoming the probable land shortfall at the south-western corner, as identified in regard to Option 2A, by proposing to locate the raw material stockyards outside the APSDA. The proponent will give further consideration to planning issues associated with this option in conjunction with its ongoing development of the Steel Precinct design.

### 4.3 Topography and Geology Requirements

The proposed steel manufacturing facility represents the heaviest of industrial applications and will require suitable natural ground conditions and the provision of heavy duty plant foundations.

In its preliminary design undertaken thus far TSC has not as yet determined the particular foundation designs required for any particular part of the steel complex.

While the proponent has done desktop reviews of the geological conditions likely to be encountered at various parts of the APSDA, a full site investigation including an assessment of subsurface conditions, soil strength, depth to rock, and groundwater attributes will be undertaken at an appropriate time to determine suitable types of foundation design solutions.

The Option 2 site poses particularly challenging topography and, wedged between Mt Roundback and Splitters Creek, it is tightly constrained by natural features which may somewhat restrict its appropriateness as a site for the steel complex. Given this uncertainty, this potential site requires a more detailed study by PIB and its partners.

### 4.4 Flood Immunity Requirements

The proponent is unaware of any detailed flood studies done for the APSDA site and has therefore not yet assessed its proposed site Options 1 and 2 for natural flood immunity characteristics.

The steel complex will be designed with a flood immunity return interval of 1:100 years.

### 4.5 Extreme Weather Immunity

The plant will be designed to comply with Australian engineering design codes including assessments to withstand cyclonic winds.

## 5. Project Design

### 5.1 Overview

The proponent engaged TATA Steel Consulting – UK (TSC) in 2012 to carry out a pre-feasibility study of the Iron and Steelmaking elements of Project Iron Boomerang (PIB) bringing to the fore its up to date costing and robust economic assessment tools and industry comparators. The TSC study report confirms PIB's credentials, as earlier established in its 2007 pre-feasibility study, for making steel more economically - by a significant margin - than at any other benchmark location in the world.

In the process TSC has developed a concept design for the Abbot Point steel complex to manufacture and export 22 Mtpa of high quality slab steel products using World's Best technology. With a strong focus on productivity, longterm sustainability and high energy efficiency the proposed steel complex will also deliver environmentally conscious outcomes with an exceptionally low level of greenhouse gas emissions to the atmosphere. TSC estimates the energy consumption of the facility to be approximately 16GJ/tonne of slab, which is of the order of 15-20% better than typical world wide practice. Further, TSC has assessed that the plant approaches world's best productivity benchmarks for slab steel production with a labour input of 0.25 manhours/tonne compared to a typical world figure of 0.5 manhours/tonne.

In addressing the PIB brief, TSC has determined that the required quantity of steel would best be produced from 5 blast furnaces each with a capacity of 4.4 Mtpa and associated steel plants within a smelter park with many shared facilities and services including Coke Plant, Lime Plant and the key gas outputs from the Air Separation Plant.

The focus on long-term sustainability and energy efficiency brought into play a collaboration between TSC and Nomura Research Institute (NRI), to develop sustainable uses for surplus gas and energy from the steel complex. This collaboration has identified the development of suitable and significant downstream industries including cement manufacture, bio-fuels and bio-plastics which would logically follow the establishment of the steel complex. NRI would also engineer a sustainable township development for upwards of 40,000 people expected to be drawn to the region's newfound industrial profile.

**Figure 6. Proposed Steel Precinct - Perspective View by TSC**

The collaboration between the proponent and its highly credentialed consultants, TSC and NRI, has yielded significant, high-level planning outcomes for the proposed steel complex and associated township, which are best expressed in the following key metrics table.

**Project Iron Boomerang**
**Abbot Point Steel Precinct and Associated Projects**
**Products, Output and Utilities Demand/Supply**

(shaded) : to be assessed with related companies and organisations

Industrial Complex & Shared Services

| Area | Facilities | Land Area Approx | Capacity (/y) (Supply) Indicative | Indicative Employment Numbers | Approx Demand | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Water (GL/y) | Power (MWh/y) | Heat (GJ/y) | Natural Gas (GJ/y) |
| Industrial Complex | Iron Making | 1,200 ha | 1 Mt | 4,000 | 86 | 200,000 | - | 4,600,000 |
| | Iron/Steel Making | | 22 Mt | | | 7,500,000 | - | - |
| | Cement Making | 800 ha | 10 Mt | 570 | | 875,000 | 14,500,000 | - |
| | Other hard products | | 11 Mt | | | | | |
| | Bio-plastic Making | | 400,000 t | 60 | | | | |
| | Bio-fuel Production | | 36,000 t | 80 | | | | |
| | Clean biomass production | | 25,000t | 40 | | | | |
| Shared infrastructures | Water supply | | | 250 | | | | |
| | Power supply | | 4,500,000 MWh | | | | | |
| | Heat supply | | 87,000,000 GJ | | | | | |
| | Gas supply | | | | | | | |
| | Recycling | | | | | | | |
| | Shared Stockyard | | | | | | | |
| | Power storage and supply | | | | | | | |
| | Mega solar / thermal | 100ha | 360GWh | | | | | |
| | Community Bus/Light Rail Track System | | | | | | | |
| Public services | School, Shopping Centre, hospital, etc... | 12 ha | | 15,000 | | | 4,500,000 | |

Residential Area

| Area | Site | Land Area | Numbers | Demand | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water (GL/y) | | Power (MWh/y) | | Heat (GJ/y) | Natural Gas (GJ/y) |
| | | | | Potable | Non-potable | Daytime | Night time | | |
| Housing Area | Unit Site | 0.1ha | 4,800 rooms | 1.283 | 2.023 | 27,666 | 45,308 | | |
| | | | 480 units | | | | | | |
| | House Site | 477ha | 9,532 houses | | | | | | |
| Park | Sports field, BBQ Area... | 110ha | | | | | | | |

**Figure 7: Key Outputs and Utilities Metrics - Industrial Complex and Residential Area**

## 5.2 Proximity to other Infrastructure

The proponent's intent for PIB in the Abbot Point area is that key raw materials (iron ore and coal) will arrive via its proposed trans-continental heavy haul rail line at a rail loop located at the south-western corner of the APSDA. The finished steel slab products will be sent from the Steel Precint by rail to the Port along the proposed multi-user corridor and exported in purpose designed slab ships.

Significant items of modular construction and other raw materials, including limestone, will arrive by incoming ship at a general cargo wharf at the Port and be moved along the multi-user corridor to the Steel Precinct. Still other goods and services including for plant construction and maintenance will rely on existing rail and road networks servicing the area.

The proponent's Option 1 locates the Steel Precinct on the eastern side of the APSDA in a proposed heavy industrial zone along with EWLP's proposed SMART Materials Concept Project. There it would be situated adjacent to the multi-user corridor with good accessibility to and from the port. With this option, the proponent's current planning is to have raw materials delivered from the transcontinental rail loop to the stockyard by conveyor, although a rail connection within the APSDA remains an alternative possibility to achieve this.

Sited at Option 2, in the south-western corner of the APSDA, the Steel Precinct is further removed from the Port precinct and has different solutions for rail access within the APSDA (ref Figure 2). The aforementioned Figure 2 shows indicative locations for proposed rail and other infrasructure for the receival of raw materials and the export of PIB's finished slab steel products for Options 1 and 2. The following sections provide more information in regard to conveyor, rail and port facilities.

## 5.3 Plant Layout Structure - Preliminary

Figure 8 provides an indication by TSC of the general layout proposed for the Steel Precinct.

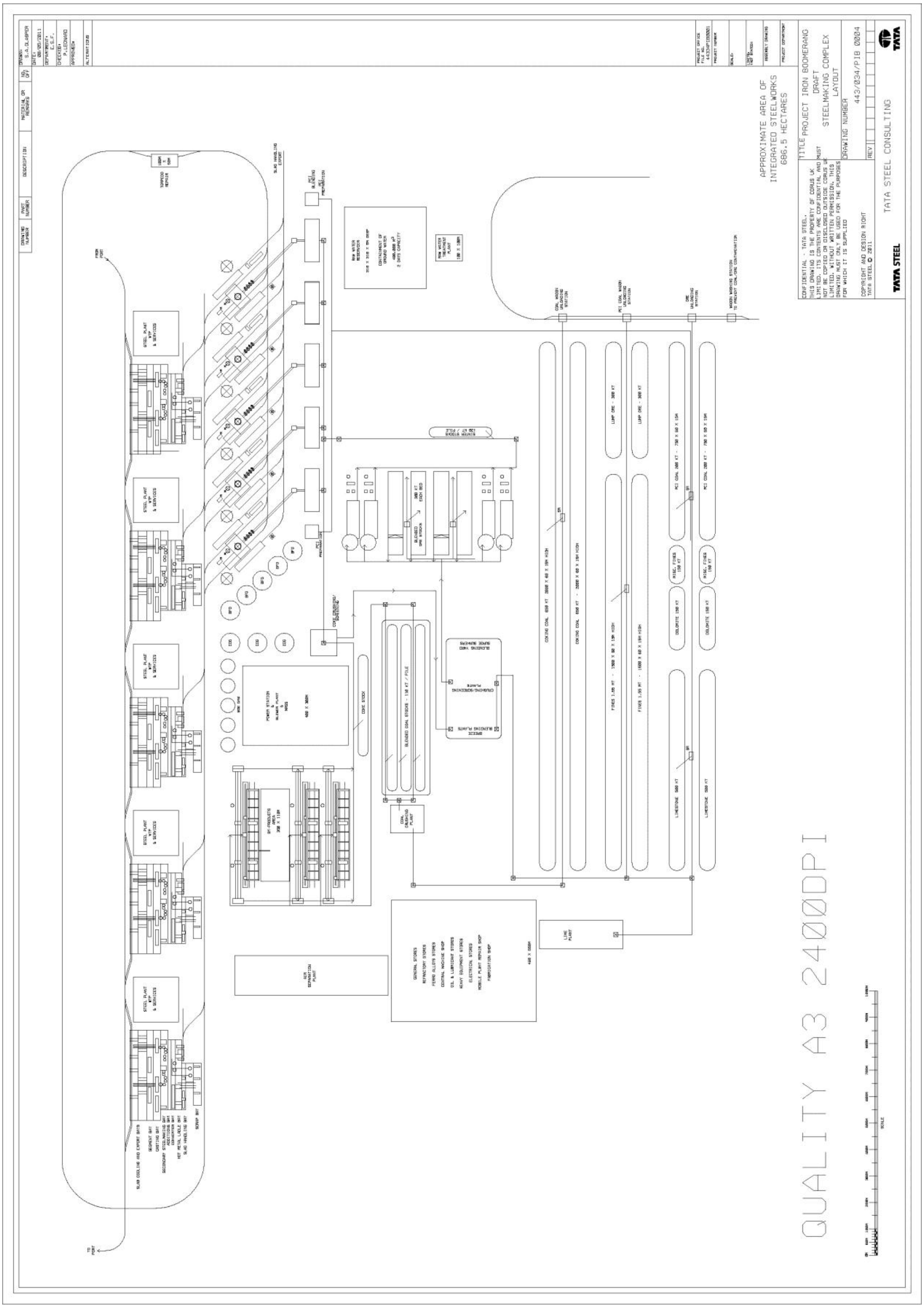


**Figure 8: Steel Precinct General Layout - TSC**

## 5.4 Proposed Timing

The following time schedule briefly summarises the proponent's progress thus far on its Abbot Point Steel Precinct development and lays out its plan to advance this nation-building PIB project through the BFS and other studies and then on to detailed design, construction and phased implementation works to completion.

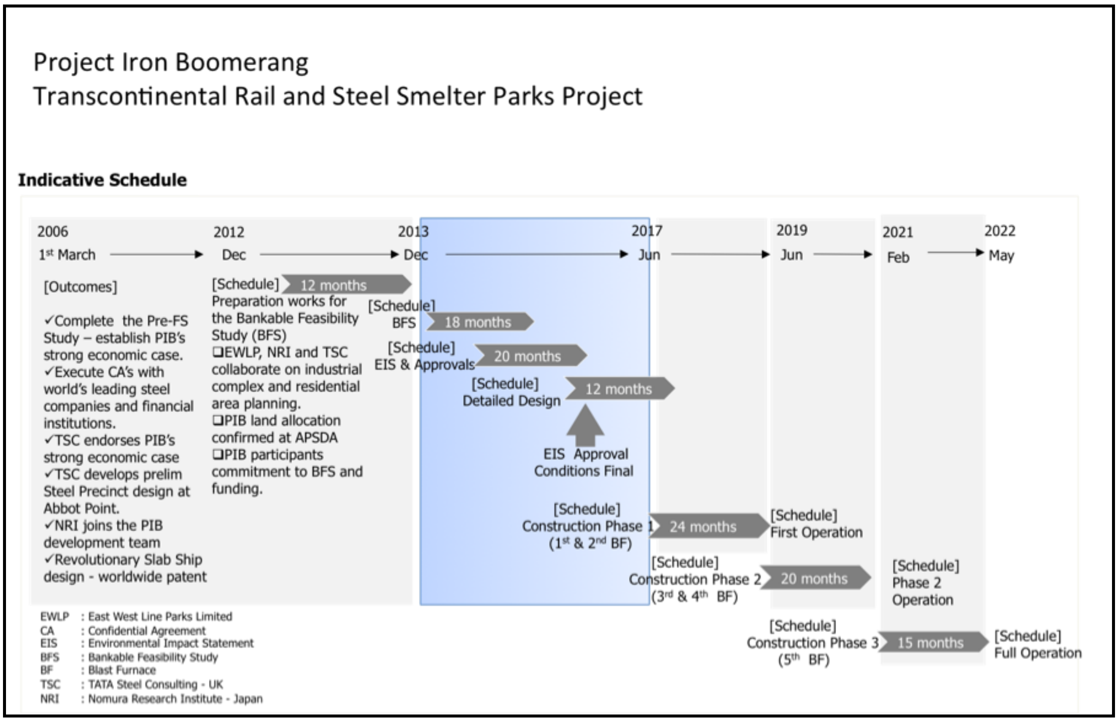



**Figure 9: Project Schedule**

## 5.5 Waste Facilities

The steel plant proposed by PIB and its international design partners TSC and NRI will employ the most advanced technology. In terms of environmental performance, the equipment will be selected to meet Best Available Techniques (BAT) references for Iron and steel production. Any discharges from the site in terms of water, air and solids will be pretreated to meet BAT requirements. The scale of the complex will allow for the optimisation of energy use and the export of surplus energies for the surrounding areas consumption, thus minimising the impact of greenhouse gas emissions. By-products from the iron and steelmaking production processes will be reused by other downstream processes such as cement manufacture and for other construction materials.

## 5.6 Conveyor and Rail Infrastructure requirements

### 5.6.1 Conveyors

With the Steel Precinct located at either the Option 1 or Option 2 site (refer to Figure 2), the proponent intends to deliver key raw materials by its proposed transcontinental, standard gauge, heavy haul rail line and for their unloading to occur at the rail loop at the south-western corner of the APSDA.

For the Option 1 site, the proponent currently plans that the iron ore and coal will then be moved by conveyor across the existing Bruce Highway and North Coast rail line to the materials stockyard area within the steel manufacturing precinct.

The approximate tonnages to be handled by conveyor in this manner are as follows:

| | Approx Daily Tonnage | Unit | Approx Annual tonnage | Unit |
|---|---|---|---|---|
| Iron Ore | 90,000 | T/day | 32 | MT/Year |
| Coal | 42,000 | T/day | 15 | MT/Year |

With the Steel Precinct located at Option 2 these tonnages would be transferred by conveyor for the relatively short distance from their unloading point at the transcontinental rail loop to the materials stockyard.

In addition to these tonnages, on current planning, limestone and dolomite (approx 28,000 T/day,10 MT/Year) will arrive by ship to the Abbot Point Port and be moved along the multi-user corridor to the Steel Precinct either by rail or conveyor. However, it remains possible that some of this significant tonnage will arrive at Abbot Point via the transcontinental rail line unloading loop, in which case it will be transported by conveyor to the materials stockyard area in the same way as the aforementioned iron ore and coal. It is also possible, in service of the wider PIB operations, that limestone having arrived by ship at Abbot Point will be loaded onto empty wagons and backloaded to the Pilbara via the transcontinental rail line. As such, whether the Steel Precinct is established at the Option 1 or Option 2 site, it is possible that an internal conveyor (or rail) will be required to transport incoming raw materials from the Port to the south-western corner of the APSDA.

#### 5.6.2 Rail Connectivity

1) External Rail Connectivity to the Steel Precinct

- As aforementioned, with the Steel Precinct located at either the Option 1 or Option 2 site (refer to Figure 2), PIB proposes that key raw materials will be delivered by its transcontinental, standard gauge, heavy haul rail line to the rail loop at the south-western corner of the APSDA.

  The approximate volumes arriving in this manner are, the same as in 5.6.1 above, as follows:

| | Approx Daily Tonnage | Unit | Approx Annual Tonnage | Unit |
|---|---|---|---|---|
| Iron Ore | 90,000 | T/day | 32 | MT/Year |
| Coal | 42,000 | T/day | 15 | MT/Year |

- For the Steel Precinct located at the Option 1 site, after unloading at the transcontinental rail loop, as an alternative to the conveyor proposed in 5.6.1 above, it is possible that these raw materials will be delivered to the Steel Precinct stockyard by a rail line connection within APSDA, which would cross the Bruce Highway and North Coast rail line.

- As aforementioned in 5.6.1 above, significant tonnages of limestone and dolomite (approx 28,000 T/day,10 MT/Year) will arrive either by ship for unloading at the Abbot Point Port or, in part, via the transcontinental rail line for unloading at the rail loop in the south-western corner of the APSDA. Whether from the Port or the transcontinental rail line unloading loop it is possible that the limestone transference will occur by rail as an alternative to the aforementioned conveyors.

- In regard to other external rail connectivity, the proponent also plans to use the existing North Coast railway for delivery of other materials to the Steel Precinct and to facilitate ongoing maintenance activities.

2) Rail between Steel Precinct and the Port

The following table provides approximate intended daily and annual tonnages of finished steel slab product to be railed out from the steel precinct to purpose built slab ships.

| | Tonnage produced per day | Unit | Production tonnage per year | Unit |
|---|---|---|---|---|
| Slab Steel | 62,000 | T/day | 22 | MT/Year |

A dedicated standard gauge heavy haul rail line and associated infrastructure is proposed to be constructed between the Steel Precinct and the Port. As shown in Figure 2, for site Options 1 and 2, it will be located within the nominated multi user corridor to the Port and elsewhere, as appropriate, within the APSDA.

This dedicated rail line may also be used by PIB for the delivery from the Port to the Steel Precinct of items that will arrive by ship, including significant fabricated items for modular construction during the precinct development phase and also, as an alternative to a conveyor, certain raw materials (including limestone) required in the ongoing steel manufacturing process.

### 5.7 Pipelines Required

1) Gas

The collaboration between TATA Steel Consulting – UK (TSC) and Nomura Research Institute (NRI) has identified the requirement in the steel manufacturing process for approximately 4,600,000 GJ natural gas per year, separate from that which would be needed to feed gas fired power plants should that be the preferred means of power generation. The proponent's planning to date has made the assumption that natural gas will secured from current gas reserves in Queensland and supplied by pipeline to the APSDA.

2) Water

TSC further identified the annual requirement for water in the steel manufacturing process and associated uses of approx 87 GL. The proponent's planning to date has made the assumption that this will be secured from available water resources in Queensland and supplied by pipeline to the APSDA.

### 5.8 Cooling Ponds/Towers

At this stage, design of the water treatment plant and the specifics of heat exchangers either by cooling towers or closed circuit cooling systems has not been developed and will be subject to further discussion and development with technological equipment designers.

## Port Design

### 6.1 Port Capacity Required

As referred to in 5.6.1 above, significant quantities (up to 10 Mtpa) of limestone and dolomite will be received at Abbot Point Port for use in the steelmaking process. Unloading facilities will be required at the port to transfer this product to conveyor or rail systems for delivery to the Steel Precinct.

Also, during the establishment and construction phase of PIB, a general cargo wharf will be required to take delivery of large modular constructed plant items and load them onto suitable road or rail transport for transfer within the APSDA and installation in the Steel Precinct.

The 22 Mtpa of finished steel products for export will be loaded onto wagons at the Steel Precinct and railed through the APSDA and the multi-user corridor to the port. The wagons will transport approximately 650,000 steel slabs per annum (or an equivalent tonnage in coils) and be suitable for roll-on roll-off loading directly onto a purpose designed Panamax size slab ship which will offload the slabs using overhead cranes built into the ship's structure.

The slab ships will be stern loaded as indicated in Figure 11. Logistics arrangements including tonnages and frequency of ship movements are included in section 10.4 hereof. The full scale operation of the steel plant facilities will ultimately require the availability of 3 berths in the stern facing configuration for 'roll-on-roll-off' loading and unloading.

**Figure 10: Purpose Built Slab Ship**

The expected tonnage of the steel products is as follows:

| | Production volume per day | Unit | Production volume per year | Unit |
|---|---|---|---|---|
| Iron Products | 62,000 | T/day | 22 | MT/Year |

### 6.2 Ship Loading Separation distances

The slab ship addresses the wharf end on and is stern loaded in roll-on roll-off fashion from the rail wagons, thereby making more economical use of berthline facilities than the typical sidelong mooring.

The special purpose slab ship is a Panamax size vessel intended to be stern loaded by 'roll-on-roll-off' rail wagons.

At berth it will be moored aside a finger wharf with the stern facing the main wharf. The minimum side to side distance in the other direction to the next finger wharf is 100m as indicated in Figure 9.

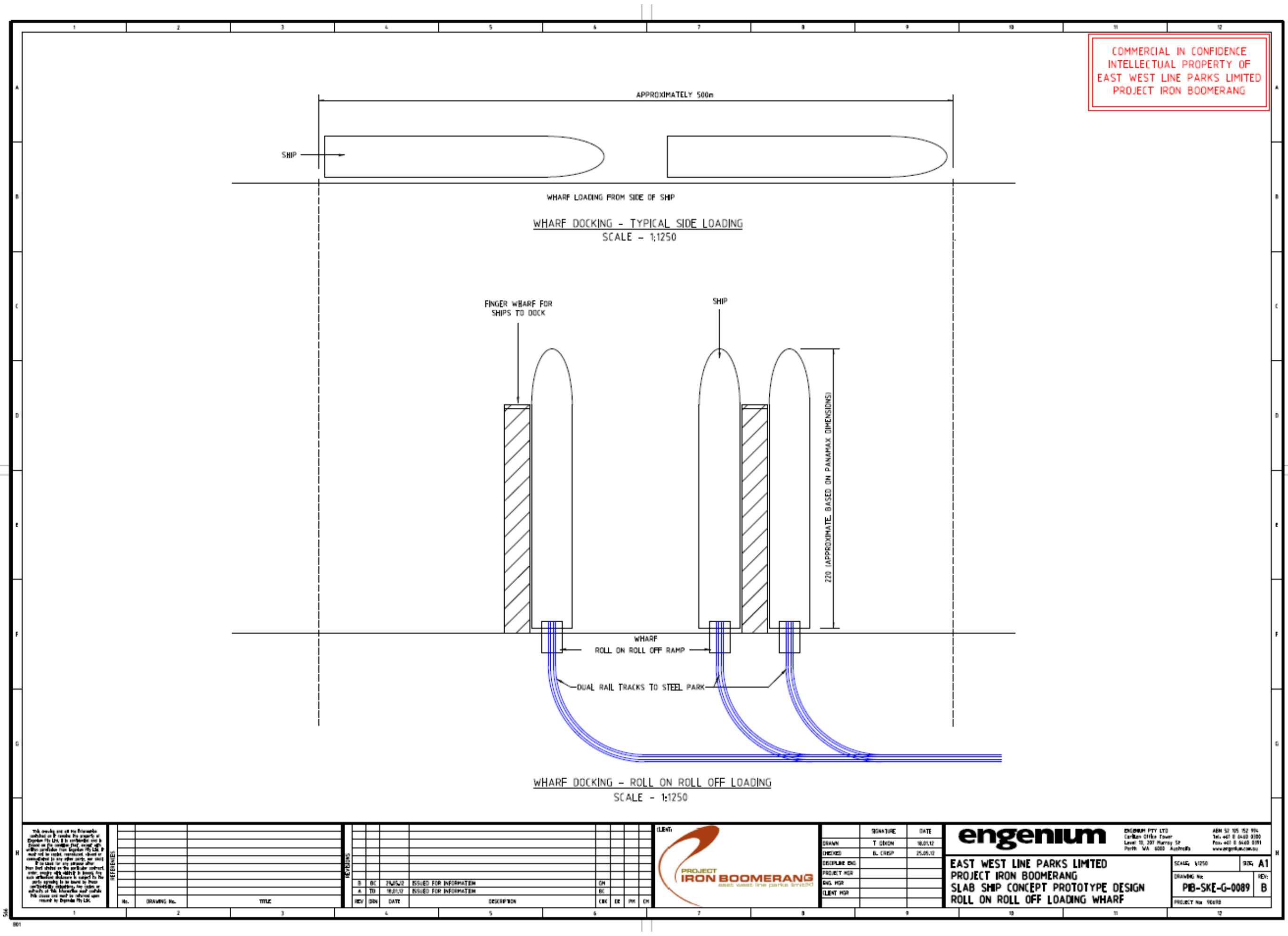



**Figure 11: Berthing Arrangements at Wharf**

### 6.3 Shipping Separation distances

Normal navigation rules for Panamax vessels would apply. The proponent understands that at berth alongside the wharf, the required tail to tail distance is the length of the Panamax ship plus a minimum clearance of 33m.

Under steam, the proponent understands the minimum side to side clearance for the Panamax size ship 100 metres and the required tail to tail clearance is the length of the Panamax ship plus a minimum clearance of 500 metres.

### 6.4 Channel Clearance for Passing Vessels

Similarly, the proponent understands the minimum width of the channel to allow Panamax size vessels to pass side by side is 165.1 metres (5 times the beam/width of the ship)

### 6.5 Safety Exclusions Zone Requirements

Not applicable to this project.

### 6.6 Dangerous Goods Exclusion Zones Requirements

Not applicable to this project.

## 7. Impact on Community and Benefits to the State

### 7.1 Key Benefits for the Region/State/Nation

The key benefits likely to be delivered by this project are:

- New Capex investment in industrial facilities at APSDA worth approximately of $15 billion (and a similar amount at the Pilbara complex).
- Associated new Capex on the PIB transcontinental rail line of up to $14 billion.
- Export Sales of high quality steel slab products from APSDA of $10 billion pa (and a similar value from the Plibara complex).
- Development of secondary industries at the APSDA with potential sales value of $5 billion pa.
- Increased diversity of economic activity in the SDA and the region.
- A nation building opportunity to leverage the locally available primary materials into an Australian-based industrial steel production complex.
- Improved supply chain logistics for raw and value added materials.
- Significant new employment in both construction and operational phases.
- Technology transfer benefits through the partnerships with international steel manufacturing companies with access to world's best technologies.

The proponent's focus on long-term sustainability and energy efficiency brought into play a collaboration between TSC and Noruma Reaearch Institute (NRI), which has actively sought sustainable uses for surplus gas and energy from the steel complex. This collaboration has identified the development of significant suitable downstream industries including cement manufacture, bio-fuels and bio-plastics which are a natural fit with the steel complex.

With reference to the Key Metrics table in Figure 7, page 14 from section 5.1 above, one of the significant planning outcomes for the proposed steel complex and associated industry is that a township of up to 40,000 people would be drawn to the region's newfound industrial profile.

### 7.2 Labour Force Requirements and Community Impacts

1) Labour Force Requirements

   Construction Phase: 5,000 - 8,000 direct employees

   Operation phase: 4,000 direct employees

   Ancillary industry: 1,000 direct employees

2) Community Impacts

   The proponent has assessed there is potential requirement for an additional 15,000 employees in supporting industries in the region as a consequence of establishing the steel complex and associated industries.

   NRI brings also a specialty in sustainable township development and has proposed that PIB would create the world's first sustainable industrial and residential complex located in Queensland. NRI considers that a sustainable residential township for the 40,000 anticipated additional people would be established on 580 ha land.

**Figure 12: NRI Image of Township**

# 8. Airspace

## 8.1 Airspace Impacts

The Steel Precinct comprising blast furnaces and many associated purpose designed plant elements for the iron and steel making processes will extend across the 1200 ha site within the APSDA.

At this stage the buildings have not been designed in detail, however to give an indication the following estimate is provided.

| Building | Approx Height (m) |
|---|---|
| Sinter Plant | 50 |
| Sinter Stack | 80 |
| Blast Furnace | 80 |
| Coke Ovens | 30 |
| Coke Ovens Stack | 80 |
| Steel Plant | 80 |
| Lime Plant | 50 |

The proponent has not at this stage addressed operational airspace restrictions however considers it unlikely that the Steel Precinct buildings and exhaust stacks will present as an interference to aviation.

## 9. Throughput

### 9.1 Product Type and Volume

The essential requirement of the Abbot Point steel smelter park is to produce 22 Mtpa of slab steel products at. TSC has produced a confidential design report for the steel complex and determined the key inputs to the process are as outlined below.

### 9.2 Key Inputs and Outputs of Production

- Key Inputs

On the basis of TSC's concept design for the steel complex, the following approximate quantities of key inputs are planned for the steel production process.

| Items | | | Indicative Daily Consumption | Unit | Indicative Annual Consumption | Unit |
|---|---|---|---|---|---|---|
| Raw Materials | 1 | Iron Ore | 90,000 | t | 32 | Mt |
| | 2 | Coking Coal | 42,000 | t | 15 | Mt |
| | 3 | Limestone & dolomite | 28,000 | t | 10 | Mt |
| | 4 | Natural Gas | 13,000 | GJ | 4,600,000 | GJ |
| Additives & Utilities | 1 | Water | 250,000 | $m^3$ | 87,000,000 | $m^3$ |
| | 2 | Electricity (gross) | 20,000 | MWh | 7,500,000 | MWh |
| | 3 | Oxygen | 13,000 | t | 4,700,000 | t |
| | 4 | Nitrogen | 8,000 | t | 3,000,000 | t |
| | 5 | Argon | 250 | t | 90,000 | t |
| | 6 | Burnt Lime | 8,000 | t | 3,000,000 | t |

- Key Outputs

The fundamental output requirements for the Steel Precinct are the following:

| | Daily production | Unit | Annual Production | Unit |
|---|---|---|---|---|
| Steel Products | 62,000 | t/day | 22 | Mt/day |

## 10. Logistics

### 10.1 Freight Infrastructure Requirements

The proponent summarises its reliance on road and rail infrastructure and shipping for key freight items as follows.

- Iron ore and metallurgical/coking coal, the key raw materials for the steel manufacturing process, will be railed to the steel complex at APSDA on the standard gauge, 40 tonne-axle-load transcontinental line, which the proponent will provide as a central plank in delivering PIB's economic efficiency.
- Limestone and dolomite is most likely to be shipped to the steel complex via the Abbot Point port.
- Other raw material inputs may be transported by the QRN rail network to the APSDA.
- Road transport will be relied upon heavily during the construction phase.
- Finished steel slab products will be railed within the APSDA site onto purpose built slab ships for export from Abbot Point Port.

### 10.2 Rail/Train Transport Requirements

| Item | Annual Consumption (Mtpa) | Train Payload (t) | Train Frequency |
|---|---|---|---|
| Iron Ore (from WA) | 32 | 32,700 | 2.92 per day |
| Coking/Metallurgical Coal (Bowen Basin) | 15 | 19,500 | 2.92 per day |
| Other raw materials | tba | varies | varies |

### 10.3 Road/Truck Transport Requirements

The proponent is not planning for significant deliveries by road of the main raw materials items used in the steelmaking process. However, it will rely heavily on road transport and infrastructure during the construction phase of the project and for delivery of lesser volume inputs to the steelmaking process and in the ongoing operations maintenance activities of the steel complex and its associated infrastructure at the APSDA.

### 10.4 Shipping Requirements

1) Imports

| Item | Annual Consumption (Mtpa) | Ship payload (t) | Ship frequency |
|---|---|---|---|
| Limestone & dolomite | 10 | 56,000 | 1 per 2 days |
| Construction Items | tba | varies | varies |

3) Export

The suggested berthing arrangement for the proposed stern loading of the Panamax size special purpose slab ship is provided in section 6.2 hereof. Logistics arrangements including tonnages and frequency of ship movements are included in the following table. The full scale operation of the steel plant facilities will ultimately require the availability of 3 berths in the stern facing configuration for 'roll-on-roll-off' loading and unloading.

| Item | Annual Production (Mtpa) | Ship payload (t) | Ship frequency |
|---|---|---|---|
| Steel Slab Products | 22 | 65,000 | 1 per day<br>(with 2 days for loading) |

## 11. Utilities

PIB's Steel Precinct at Abbot Point will have the impacts and benefits as outlined in section 7.1 above for the region, state and nation.

The tabulation therein summarised the demand and supply for utility services within the steel complex.

### 11.1 Water Infrastructure Requirements

| Required water infrastructure | Annual water consumption |
|---|---|
| Water Supply Facility | |
| Water Treatment Facility | 87,000,000 $m^3$ |
| Water Storage Facility | |

The proponent's planning to date has assumed that this will be secured from available water resources in Queensland and supplied by pipeline to the APSDA.

### 11.2 Energy Infrastructure Requirements

| Required Energy infrastructure | Annual Power consumption (gross) |
|---|---|
| Power Supply Facility | |
| Power Transmission Facility | 7,500,000 MWh |
| Power Storage Facility | |

The focus on energy efficiency within the steel complex and township by TSC in collaboration with NRI, has identified that secondary generation and capture of heat and electricity within the key manufacturing processes will reduce this gross annual power generation requirement for the steel complex by at least 2,200,000 MWh.

### 11.3 Gas Infrastructure Requirements

| Required Gas infrastructure | Annual Gas consumption |
|---|---|
| Gas Supply Facility | |
| Gas Transmission Facility | 4,600,000 GJ |
| Gas Storage Facility | |

The proponent's planning to date has assumed that natural gas will be secured from current gas reserves in Queensland and supplied by pipeline to the APSDA.

## 12. Suppliers and Customers

### 12.1 Product Source

The sources of input materials PIB intends for the steel manufacturing process are outlined in section 3.1 of this Response.

In particular, the raw materials will be drawn from the Bowen Basin coking coal fields of Queensland and iron ore mines in Western Australia's Pilbara region. PIB will deliver these key input materials directly to the steel complex at Abbot Point via its transcontinental heavy haul rail line, which is strategically located to maximise the proximate procurement choice to steel manufacturers to the richness of these resources.

### 12.2 Supplier Information

The PIB economic model is that each of the steel manufacturers which own and operate the 5 blast furnaces will share ownership of the smelter park complex.

PIB is currently engaged in confidential discussions with the world's major steel manufacturers, in particular those in Japan, Korea and China and will confirm the particular manufacturing partners it will be moving forward with at an appropriate time.

### 12.3 Customer Information

PIB expects that the steel manufacturers that establish within its Abbot Point facility will plan to export their finished steel slab products worldwide to their existing and new customers.

## 13. Project Status

The schedule outlined in section 5.4 of this Response briefly summarises the proponent's progress thus far towards the realisation of PIB and lays out its plan to advance the project through the future studies, design and phased construction and implementation works to completion of the Abbot Point Steel Precinct elements.

The proponent is developing the project in strong partnership with leading steel industry facilitators including world renowned steel complex designers and steel economics consultants, TSC and NRI.

Based on the demonstrated strength of PIB's economic case and well advanced technical plan we have developed mutually strong relationships with the world's major steel manufacturers, in particular those in Japan, Korea and China. We have made significant progress towards putting in place the project planning and essential strategic partnerships which will ensure this economically sustainable nation building project progresses through its BFS stage and is successfully developed.

The proponent will begin negotiations and development of the significant scope of linear infrastructure, including essential utility services required, in line with its overall project timeline.

# Appendix 18


PROJECT IRON BOOMERANG
east west line parks limited

# **SMaRT Complex** of the Project Iron Boomerang
# Realisation of a Sustainable Industrial and Residential Complex in Queensland, Australia

**Information package**

February, 2013

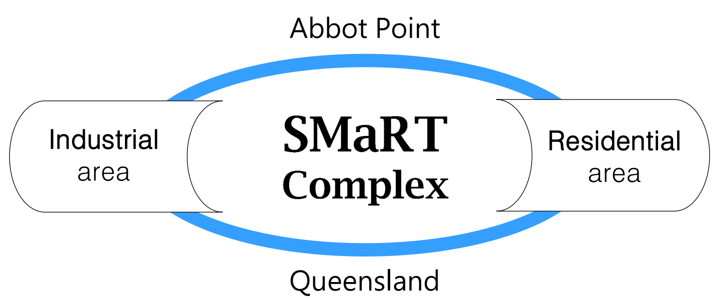

EAST WEST LINE PARKS LIMITED

TATA STEEL CONSULTING

Nomura Research Institute, Ltd.

# Industrial and residential complex in Queensland, Australia

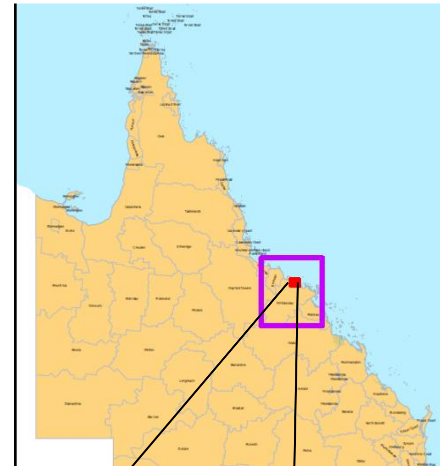
- The aim of the Sustainable Industrial and Residential Complex at Abbot Point is to create the world's first smart and sustainable industrial and residential complex located in Queensland.
- Within the industrial area, products that are manufactured from steel will have a lower carbon foot-print, therefore minimising the impact on the environment. The Industrial Area will produce bio-fuels and bio-plastics which will be sold underneath a unified brand and within a unified marketing strategy to the global market.
- In the residential area, there will be an abundant surplus of heat and energy generated by the industrial area that will be used to provide people's daily needs free of charge. A large proportion of the by-products created by the industrial area will be used for civil and construction work within the residential area.

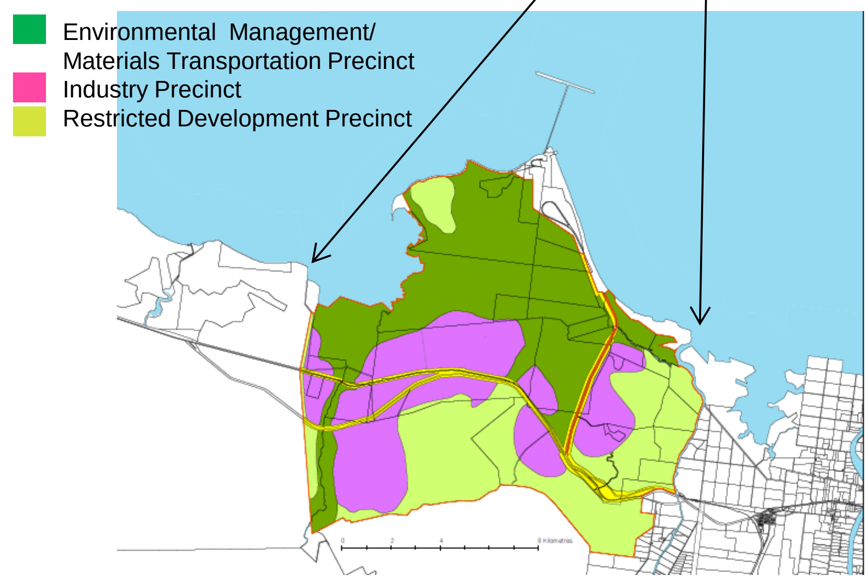



Sustainable
Manufacturing
and
Residential
Town

# Location of Abbot Point

- Declared in 2008, the 16,230-hectare Abbot Point State Development Area (SDA) is located approximately 20 kilometres west of Bowen, in North Queensland.
- It was established to facilitate large-scale industrial development of regional, state and national significance.
- The Abbot Point SDA lends itself to industrial development due to its:
  - ✓ Close proximity to the Port of Abbot Point
  - ✓ Easy access to rail and road networks
  - ✓ Considerable distance from urban areas.






REF: http://www.nqbp.com.au/abbot-point/,http://www.dlg.qld.gov.au/land-for-industry/abbot-point.html

# World's Best Practice for the Next Generation

- The world's lowest carbon foot-print model will be achievable by adopting the most advanced global technology such as :
  - ✓ A cascade usage of materials in the industrial area and
  - ✓ Utilising surplus energy and by-products which will be generated from the industrial area towards the residential area

Abbot Point

Industrial area | **SMaRT Complex** | Residential area

Queensland

Industrial area → Residential area

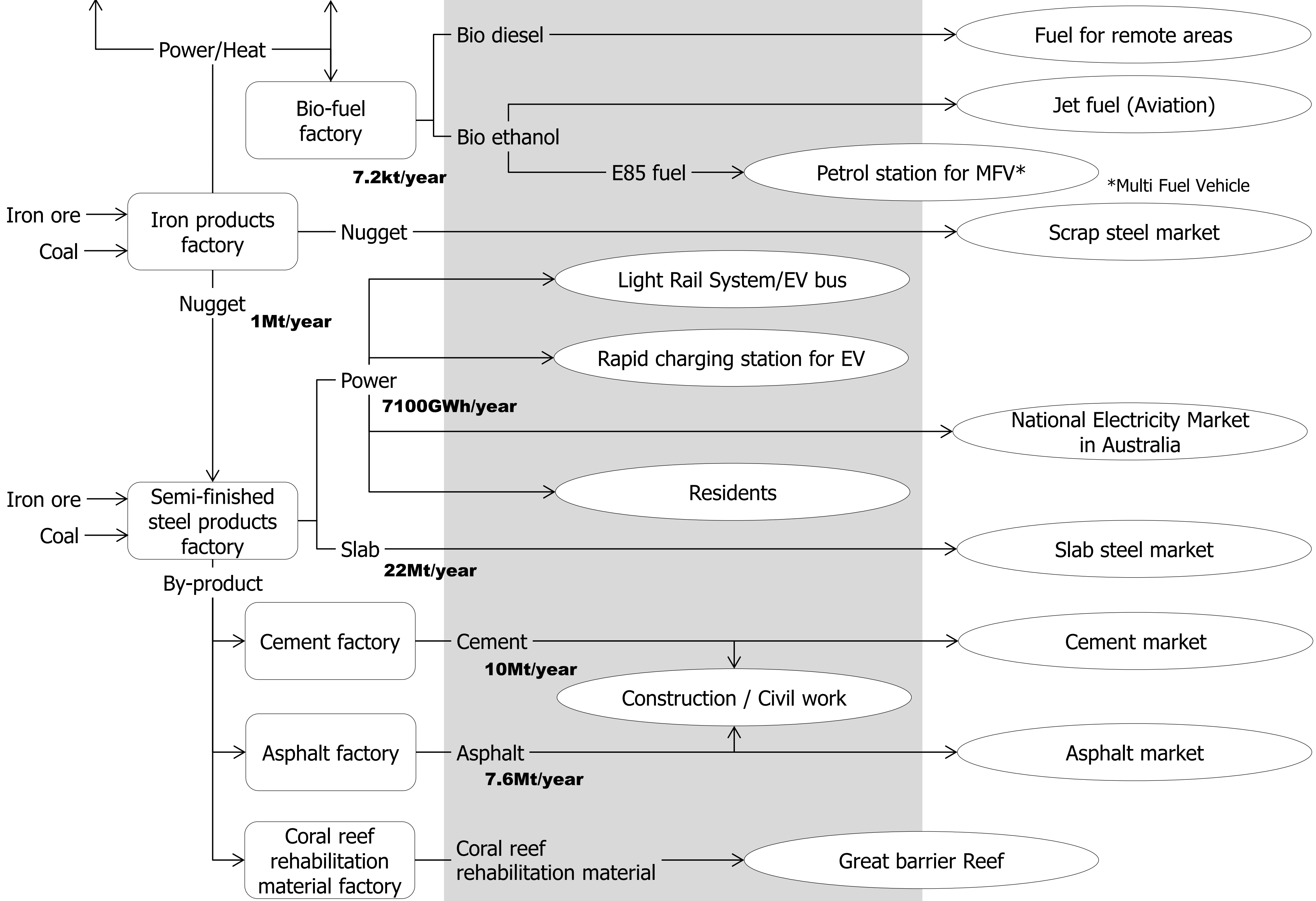
Raw Material → Medicine /Nutrient Supplements factory → Medicine/Supplement → Medical/Health market

**25kt/year**

Clean Biomass Factory

Bio-plastics factory → Bio-plastics → Auto Parts Industry

**400kt/year**


Power/Heat
Bio-fuel factory
Bio diesel
Fuel for remote areas
Jet fuel (Aviation)
Bio ethanol
E85 fuel
Petrol station for MFV*
7.2kt/year
*Multi Fuel Vehicle
Iron ore
Coal
Iron products factory
Nugget
Scrap steel market
Light Rail System/EV bus
Nugget
1Mt/year
Rapid charging station for EV
Power
7100GWh/year
National Electricity Market in Australia
Residents
Iron ore
Coal
Semi-finished steel products factory
Slab
Slab steel market
22Mt/year
By-product
Cement factory
Cement
Cement market
10Mt/year
Construction / Civil work
Asphalt factory
Asphalt
Asphalt market
7.6Mt/year
Coral reef rehabilitation material factory
Coral reef rehabilitation material
Great barrier Reef

# Industrial Area

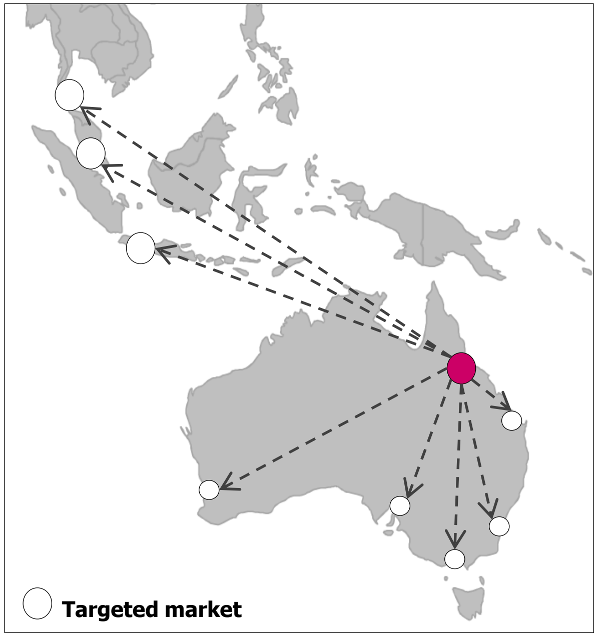
- Produce "SMART" services and products:

Turnover **US$ 15.9 billion** per annum ( 1,270 billion Yen)

| | | |
|---|---|---|
| ✓ Iron product : | US$ 380 million | 1.0Mt / y |
| ✓ Semi-finished steel product : | US$ 10,000 million | 22.0Mt / y |
| ✓ Cement and Asphalt : | US$ 1,800 million | 17.6Mt / y |
| ✓ Coral reef rehabilitation material : | US$ 1,900 million | 3.8Mt / y |
| ✓ Bio-Plastic and Bio-fuel : | US$ 1,000 million | 400kt / y |
| ✓ Clean Biomass product : | US$ 750 million | 72kt / y |

- CAPEX : (Semi steel product only) **US$15.3 billion**
- Size of Area: **2,000 ha**
- Employees : **20,000 people**

*Figures are indicative.



# Residential area

- The industrial area will be provided with highly motivated employees from a life-rich “SMART” residential area.
- To maximize efficiency, the “SMART” residential area will use surplus energy/materials from the Industrial area
- It will Provide “SMART” infrastructure service such as:

✓ free electricity and chilled/heating services and air conditioning (by using the surplus energy generated from the Industrial area)

✓ potable and non-potable water will be separated (by using the regional water supply for the non-potable water supply)

- Area and Population :

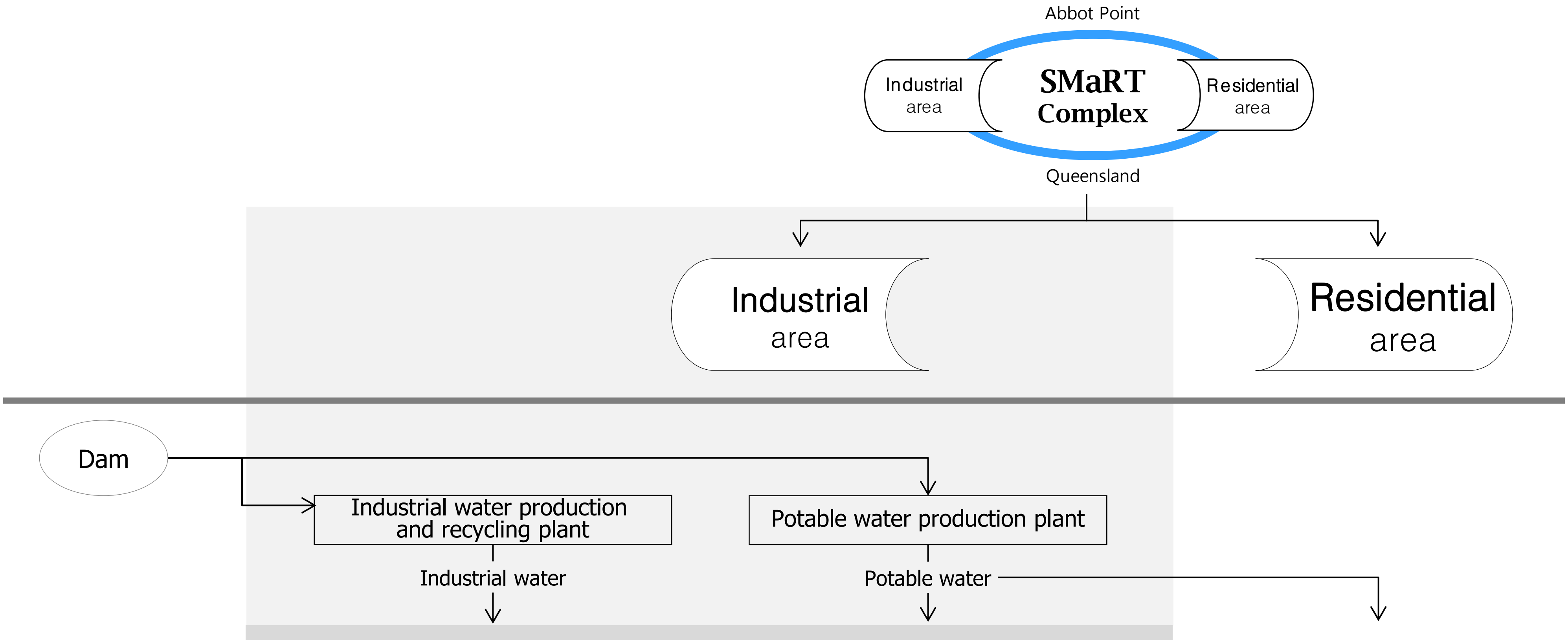
580 ha and

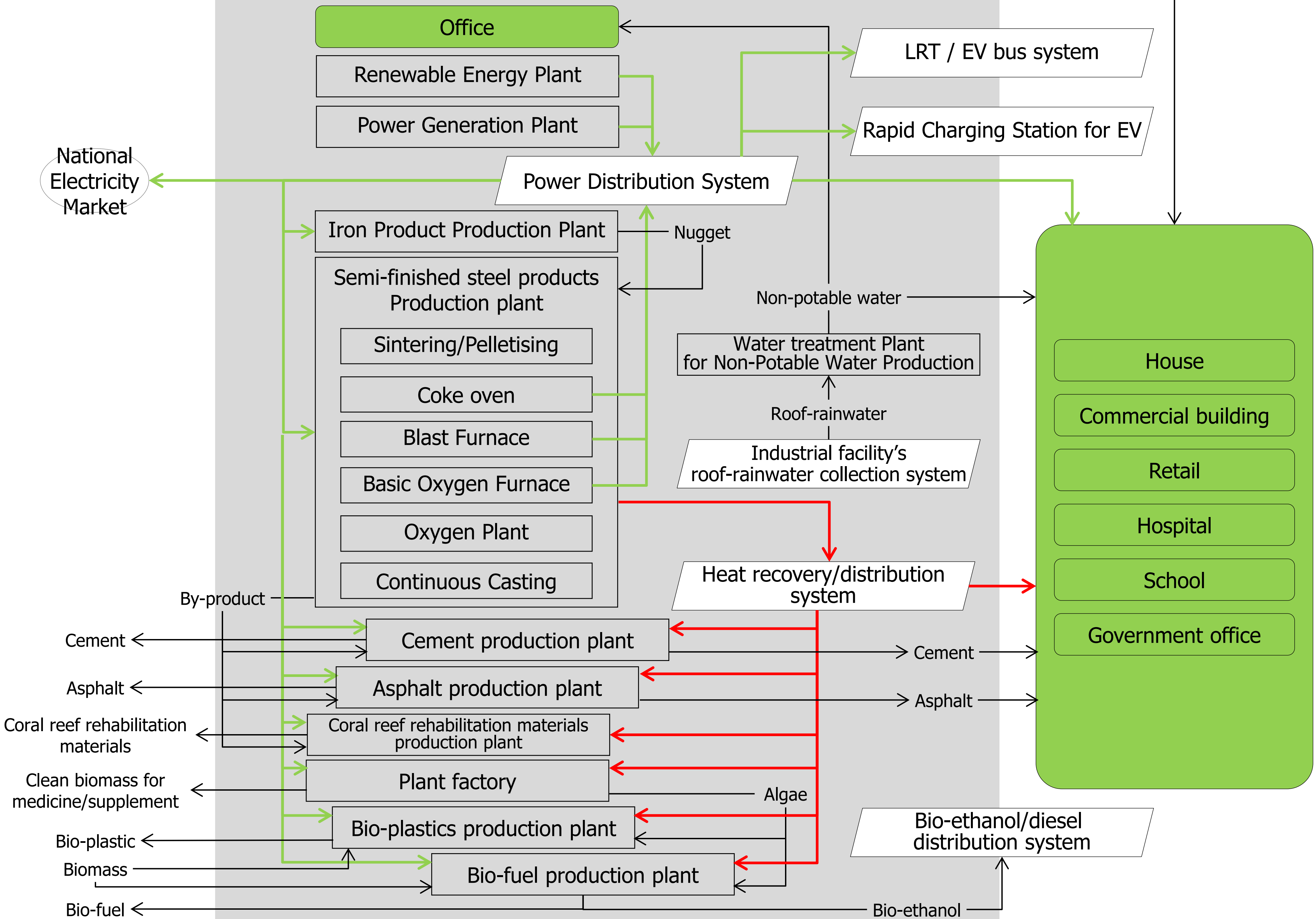
41,000 people

# Infrastructure

- The complex will produce high quality services and products with:
- ✓ Low carbon footprint
- ✓ A minimised ecological foot print
- ✓ Energy and material savings

- Establishment of a unified brand image based on sustainable complex




Office
Renewable Energy Plant
Power Generation Plant
LRT / EV bus system
Rapid Charging Station for EV
National Electricity Market
Power Distribution System
Iron Product Production Plant
Nugget
Semi-finished steel products Production plant
Sintering/Pelletising
Coke oven
Blast Furnace
Basic Oxygen Furnace
Oxygen Plant
Continuous Casting
Non-potable water
Water treatment Plant for Non-Potable Water Production
Roof-rainwater
Industrial facility's roof-rainwater collection system
Heat recovery/distribution system
House
Commercial building
Retail
Hospital
School
Government office
By-product
Cement
Cement production plant
Cement
Asphalt
Asphalt production plant
Asphalt
Coral reef rehabilitation materials
Coral reef rehabilitation materials production plant
Clean biomass for medicine/supplement
Plant factory
Algae
Bio-plastic
Bio-plastics production plant
Bio-ethanol/diesel distribution system
Biomass
Bio-fuel production plant
Bio-fuel
Bio-ethanol

# Business structures

- Land Development:
  - Land will be developed by EWLP with a support from the Local Government.

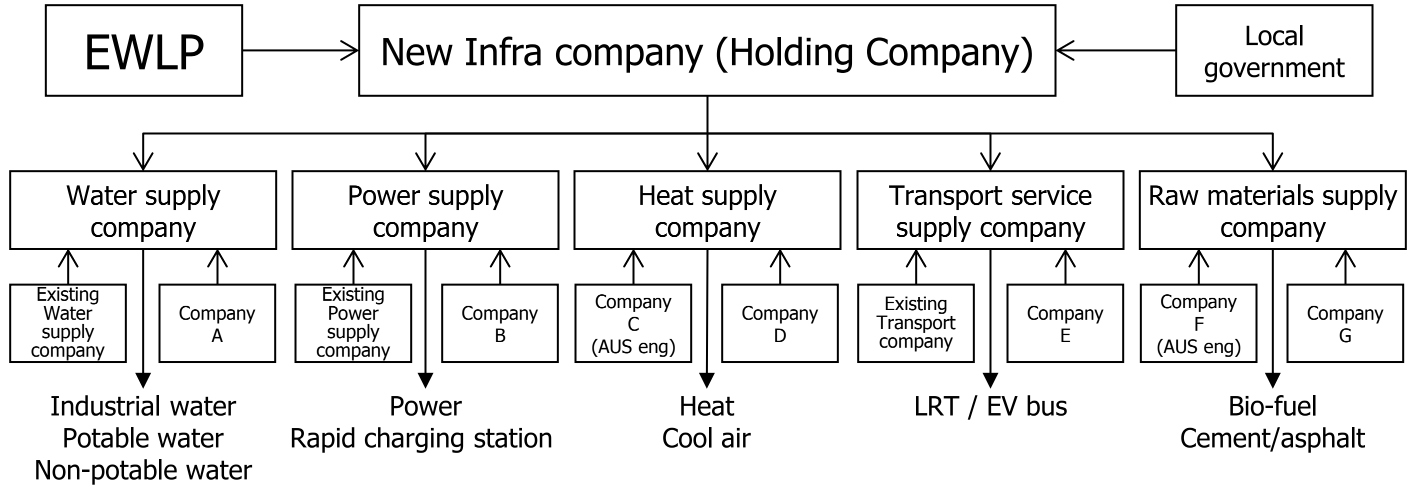
- Infrastructure (Shared facilities):
  - A new infra company (holding company) will be established jointly with a number of other companies (a support from the Local Government).

  → Establishing a Holding company (Parent company)
  - Required subsidiary companies will be established by the holding company.
  - The subsidiary companies will own the licenses and appoint the appropriate companies to operate.

- Marketing
  - A new marketing company will be established between EWLP and an existing marketing company.
  - The new marketing company will establish and maximise the unified brand image. They will also create the SMaRT Complex based company who will manage a certificate and license of the unified brand image.

| | **Industrial area** | **Residential area** |
|---|---|---|
| **Land development** | EWLP | |

## Infrastructures

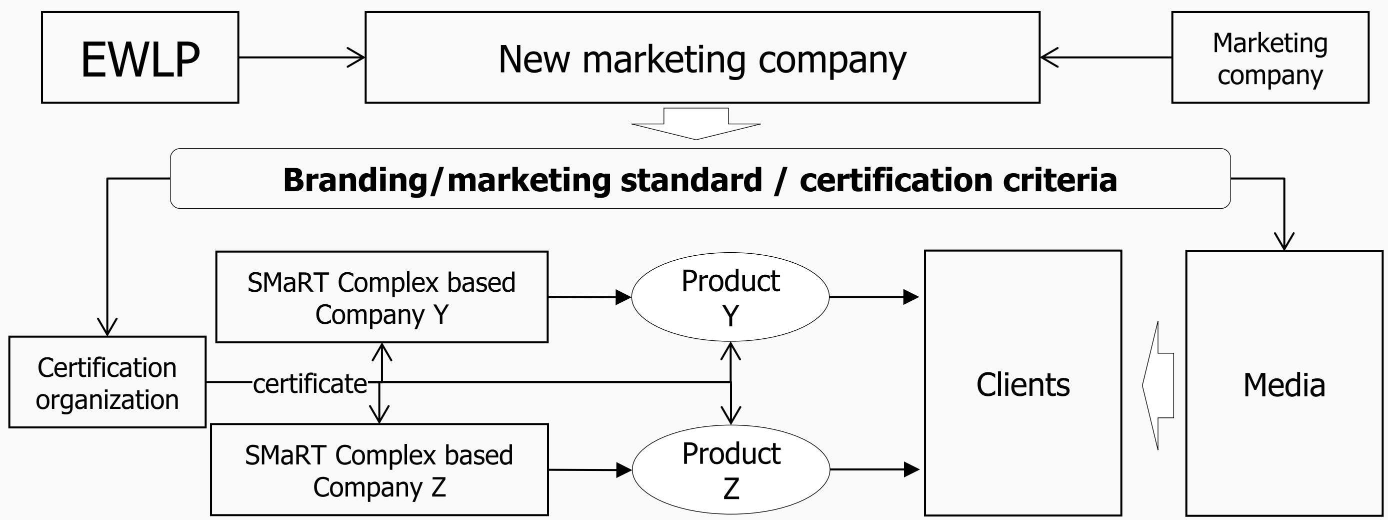



## Facilities

- Steel producers
- Iron producers
- Cement Producers
- Bio-plastic Bio-fuel
- Biomass Raw materials
- Others

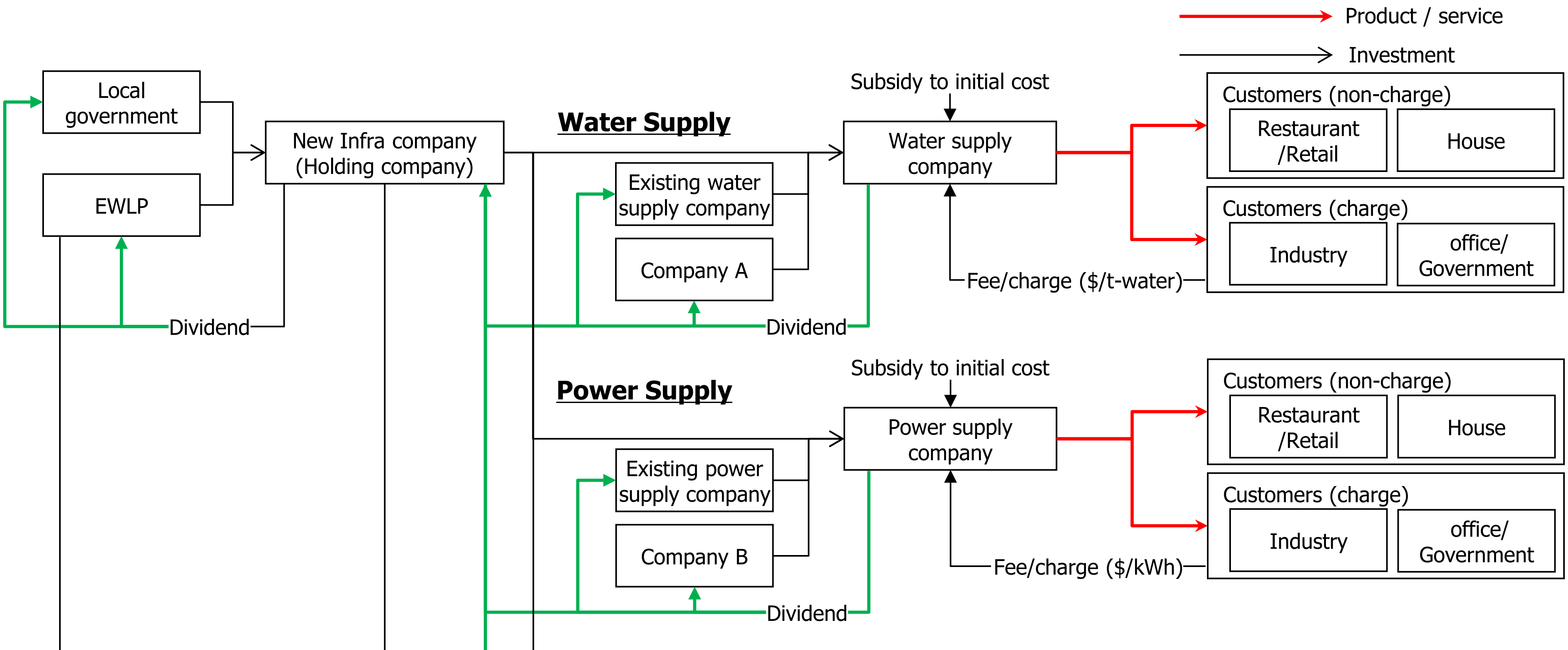
- Home builders
- Retailers
- Restaurants
- Local councils
- Schools
- Other public facilities

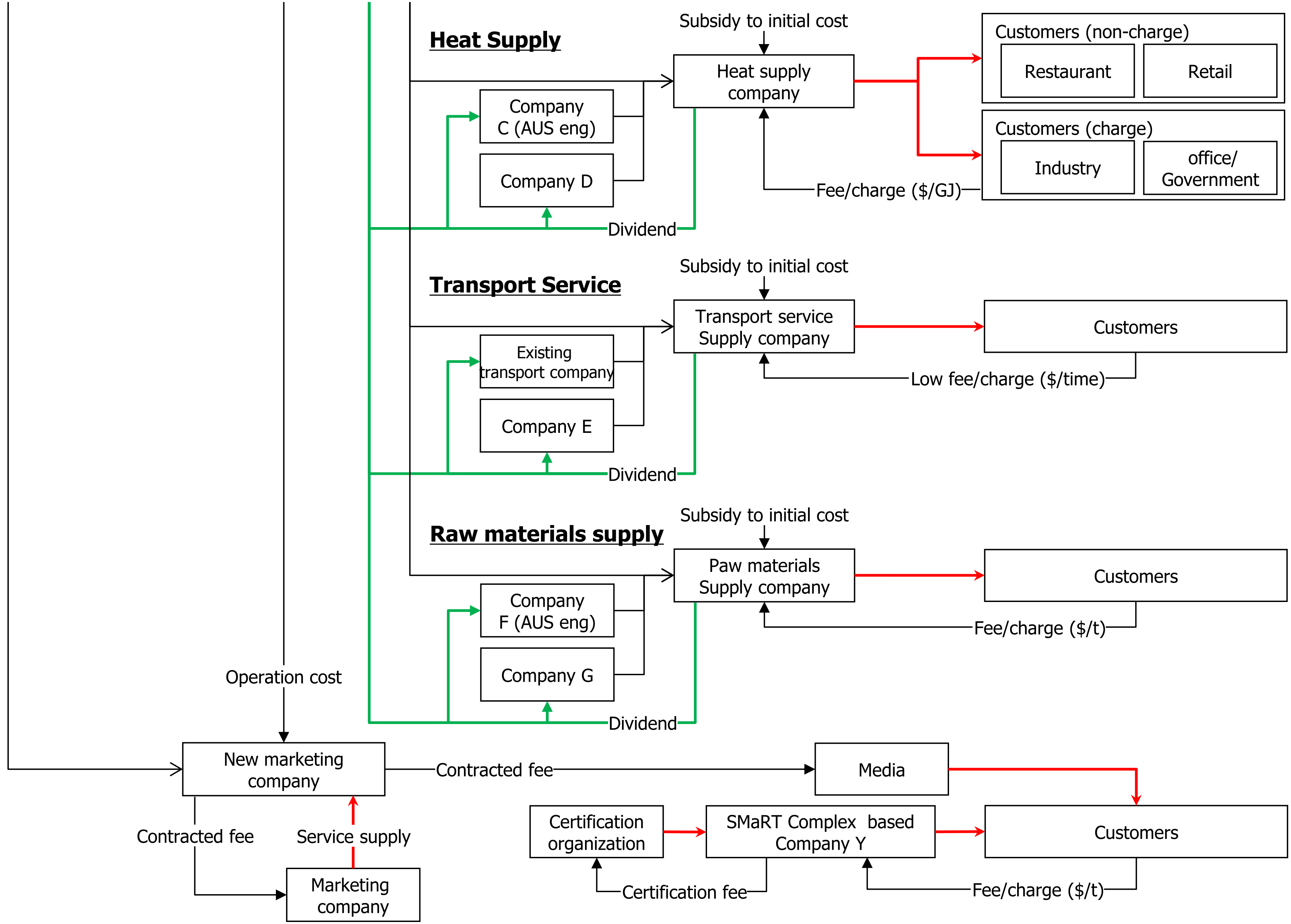
## Marketing of "SMaRT Complex" products



# Business models

- A new infra company ("holding company") will be established by the local government and EWLP.
- The holding company will establish the required subsidiary companies who will build, own and operate the shared facilities with the guidance of the world's best companies who specialise in their selected fields (supplying water, power, etc).
- A new marketing company will be established by EWLP and an existing marketing company who will provide the services to establish and maximise the unified brand image. They will also create the SMaRT Complex based company who will manage a certificate and license of the unified brand image.





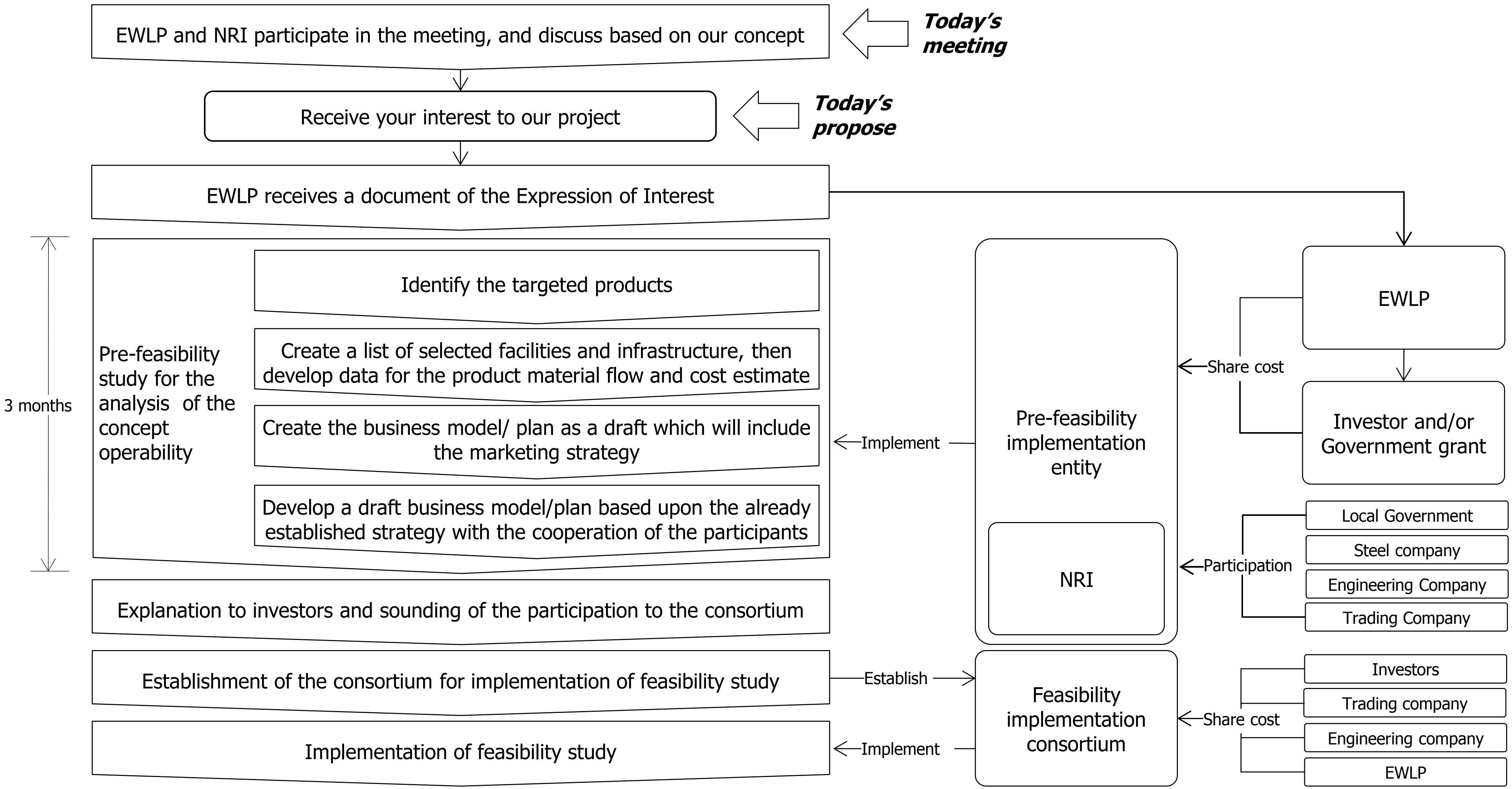
Heat Supply
Subsidy to initial cost
Heat supply company
Customers (non-charge)
Restaurant
Retail
Customers (charge)
Industry
office/ Government
Company C (AUS eng)
Company D
Fee/charge ($/GJ)
Dividend
Transport Service
Subsidy to initial cost
Transport service Supply company
Customers
Existing transport company
Company E
Low fee/charge ($/time)
Dividend
Raw materials supply
Subsidy to initial cost
Paw materials Supply company
Customers
Company F (AUS eng)
Company G
Fee/charge ($/t)
Dividend
Operation cost
New marketing company
Contracted fee
Media
Customers
Certification organization
SMaRT Complex based Company Y
Contracted fee
Service supply
Marketing company
Certification fee
Fee/charge ($/t)

# Schedule

| | January 2013 | January 2015 | January 2016 | 2017 | 2019/ 2020 |
|---|---|---|---|---|---|
| **Feasibility study and government approval** | → | → | | | |
| **Constructions of Industrial area** | | → | → | → | → |
| **Start constructions of Residential area** | | → | → | → | → |
| **First Residents** | | | ■ | | |
| **Export first product** | | | | ■ | |
| **Full operation** | | | | | → |

# Next step working with you

■ EWLP proposes implementation of final desktop Pre-feasibility study for analysis of concept operability



# Specifications

: to be discussed with related companies and organisations

## Industrial Complex & Shared Services

| Area | Facilities | Land Area | Capacity (/y) (Supply) | Employment | Demand | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Water (GL/y) | Power (MWh/y) | Heat (GJ/y) | Natural Gas (GJ/y) |
| Industrial Complex | Iron Making | 2,000 ha | 1.0 Mt | 3,917 | 86 | 200,000 | - | 4,600,000 |
| | Iron/Steel Making | | 22.0 Mt | | | 7,533,013 | - | - |
| | Cement Making | | 10.0 Mt | 538 | | 876,000 | 14,500,000 | - |
| | Asphalt Making | | 7.6 Mt | | | | | |
| | Coral reef rehabilitation material making | | 3.8 Mt | | | | | |
| | Bio-plastic Making | | 400,000 t | 55 | | | | |
| | Bio-fuel Production | | 36,000 t | 77 | | | | |
| | Clean biomass production | | 25,000t | 33 | | | | |
| Shared infrastructures | Water supply | | | 244 | | | | |
| | Power supply | | 4,534,532 MWh | | | | | |
| | Heat supply | | 87,210,942 GJ | | | | | |
| | Gas supply | | | | | | | |
| | Recycling | | | | | | | |
| | Shared Stockyard | | | | | | | |
| | Power storage and supply | | | | | | | |
| | Mega solar / thermal | 100ha | 360GWh | | | | | |
| | Community Bus/Light Rail Track System | | | | | | | |
| Public services | School, Shopping Centre, hospital, etc… | 12 ha | | 14,823 | | | 4,410,000 | |

## Residential Area

| Area | Site | Land Area | Numbers | Demand | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Water (GL/y) | | Power (MWh/y) | | Heat (GJ/y) | Natural Gas (GJ/y) |
| | | | | Potable | Non-potable | Daytime | Night time | | |
| Housing Area | Unit Site | 0.1ha | 4,800 rooms | 1.283 | 2.023 | 27,666 | 45,308 | | |
| | | | 480 units | | | | | | |
| | House Site | 477ha | 9,532 houses | | | | | | |
| Park | Sports field, BBQ Area… | 110ha | | | | | | | |

# Appendix 19


PROJECT
IRON BOOMERANG
east west line parks limited

# Galilee Infrastructure Corridor Project

## Comparative Economic Study

**20 December 2012**

Ernst & Young
Quality In Everything We Do

Everything Infrastructure

# Introduction

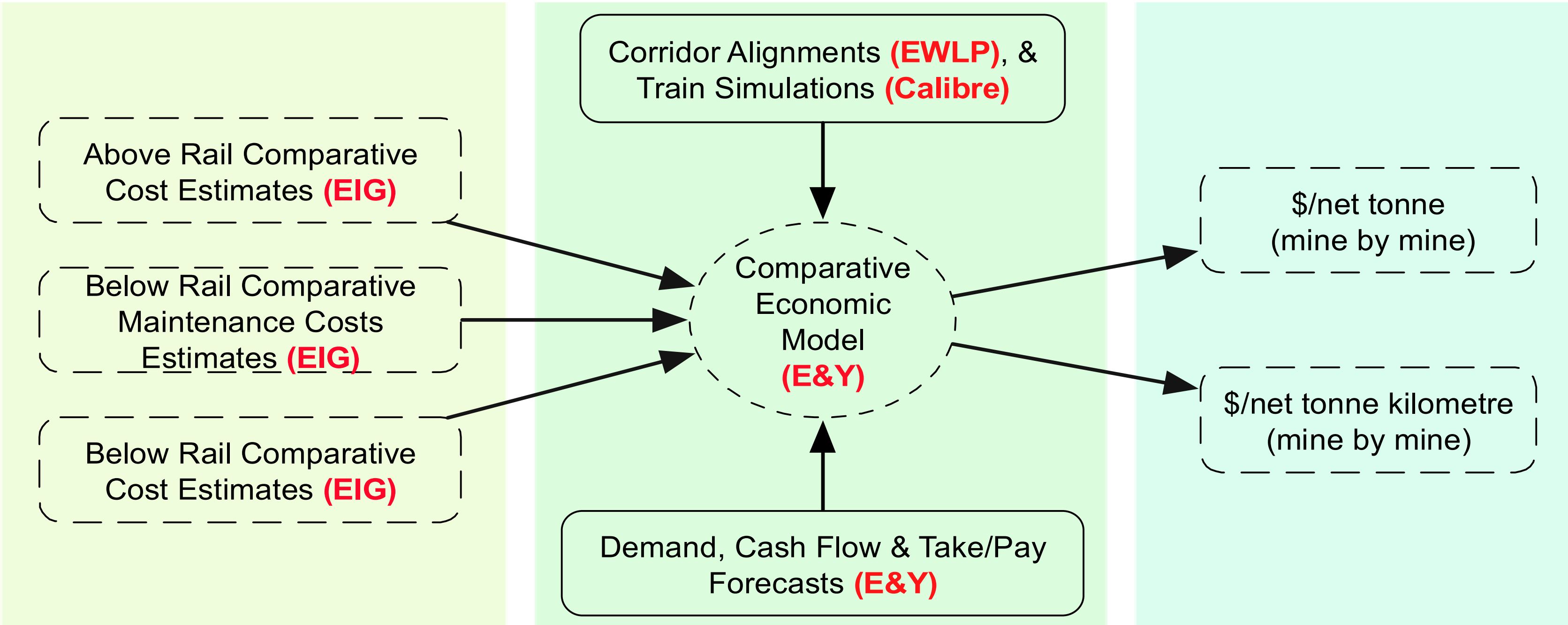
- East West Line Parks Ltd ("**EWLP**") are proposing to develop an open access, multi user, multipurpose infrastructure corridor from the Port of Abbot Point to the coal mining region of the Galilee Basin. The proposed corridor is referred to as the Galilee Infrastructure Corridor Project ("**GICP**").

- EWLP has engaged Everything Infrastructure ("**EIG**") and Ernst & Young ("**E&Y**") to undertake an economic study, comparing the GICP against other Galilee Basin rail lines.

# Economic Study Objective

- The objective of the economic study was to assess and compare the superior freight efficiency, economic benefits and long term sustainability of the GICP.
- GICP was compared against the two rail corridors announced by the Government on 6 June 2012, namely the GVK North South corridor ("GVK") and the QRN East West corridor ("QRN").
- Whilst the study primarily focused on the economic aspects of GICP compared with the other rail corridors, secondary considerations were given to major environmental and community differences between the corridors.

# Overview of the Economic Study




- Input assumptions are consistent with projects in the "Project Identification Phase" as defined by DOTR's "Best Practice Cost Estimation Guide for Rail Construction".

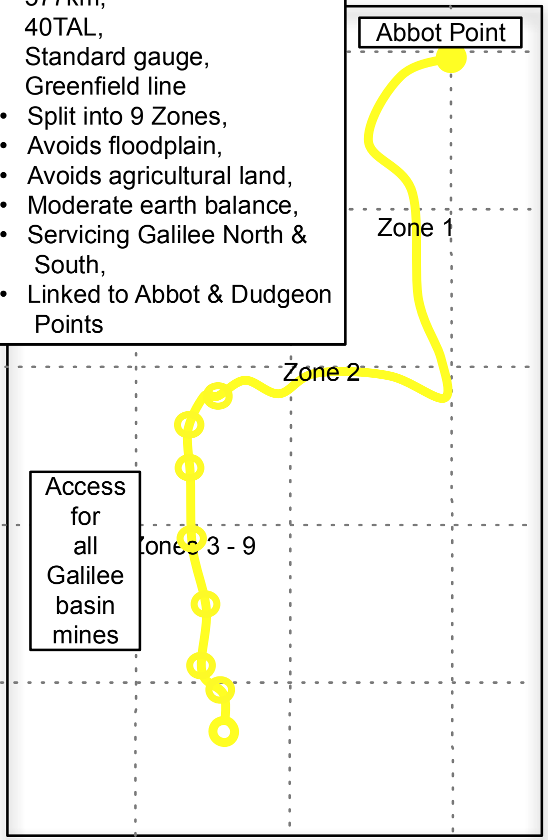
# Key Aspects of the Economic Study

- The comparative cost analysis identified qualitative and quantitative differences in the following areas;
  - Alignment and access;
  - Capacity;
  - Below rail elemental costs; and
  - Operating efficiency.

# Alignment and Access Related Differences

**GICP**

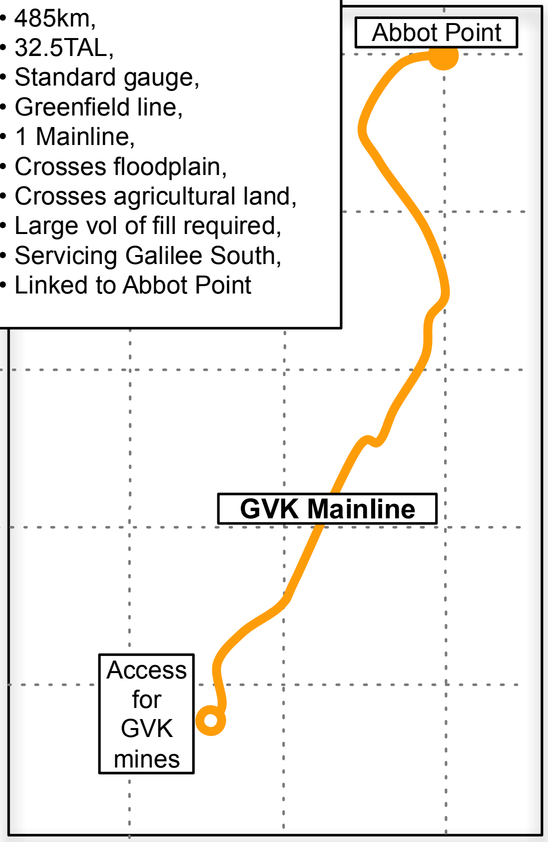
- 577km,
- 40TAL,
- Standard gauge,
- Greenfield line
- Split into 9 Zones,
- Avoids floodplain,
- Avoids agricultural land,
- Moderate earth balance,
- Servicing Galilee North & South,
- Linked to Abbot & Dudgeon Points




- Loaded ruling grade 1:320
- Unloaded ruling grade 1:100
- Train payload ~ 35,000t

**GVK**

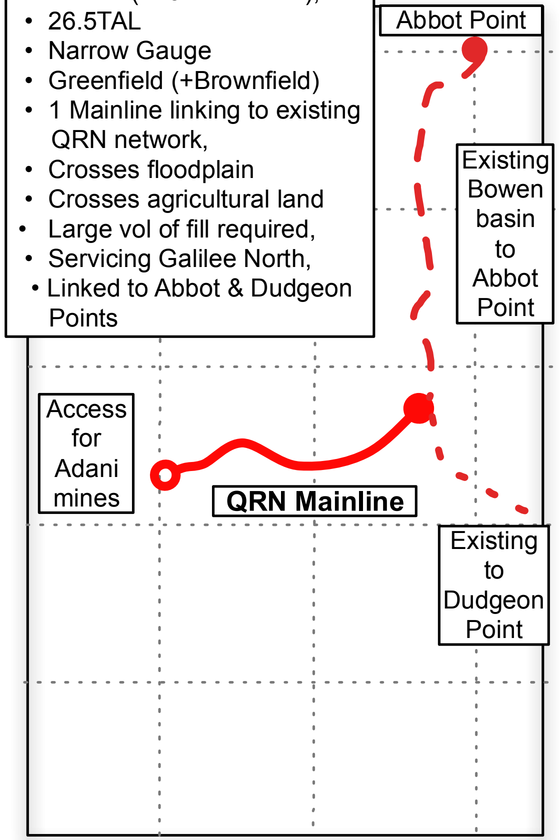
- 485km,
- 32.5TAL,
- Standard gauge,
- Greenfield line,
- 1 Mainline,
- Crosses floodplain,
- Crosses agricultural land,
- Large vol of fill required,
- Servicing Galilee South,
- Linked to Abbot Point




- Loaded ruling grade 1:320
- Unloaded ruling grade 1:100
- Train payload ~ 25,000t

**QRN**

- 174km (+207km+22km),
- 26.5TAL
- Narrow Gauge
- Greenfield (+Brownfield)
- 1 Mainline linking to existing QRN network,
- Crosses floodplain
- Crosses agricultural land
- Large vol of fill required,
- Servicing Galilee North,
- Linked to Abbot & Dudgeon Points



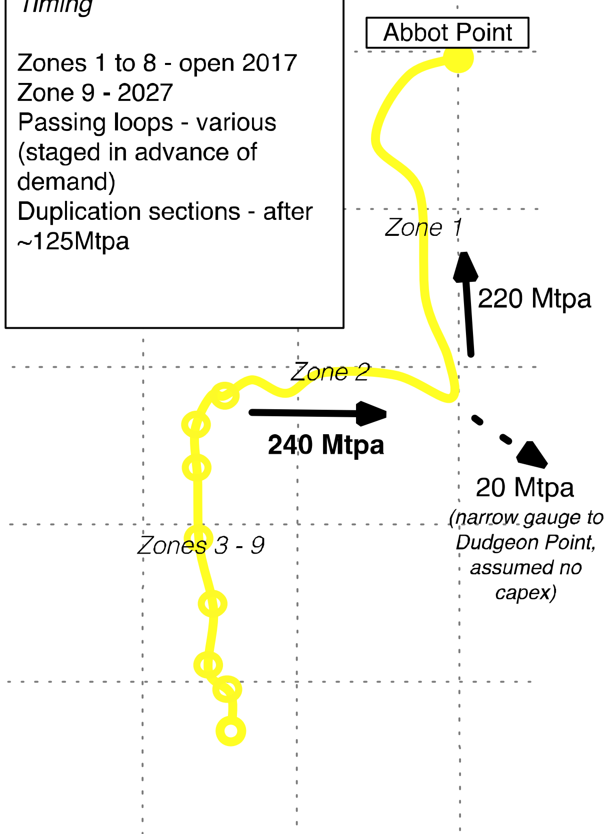

- Loaded ruling grade 1:100
- Unloaded ruling grade 1:50
- Train payload ~ 10,000t

# Capacity Related Differences

**GICP**

*Timing*

Zones 1 to 8 - open 2017
Zone 9 - 2027
Passing loops - various (staged in advance of demand)
Duplication sections - after ~125Mtpa

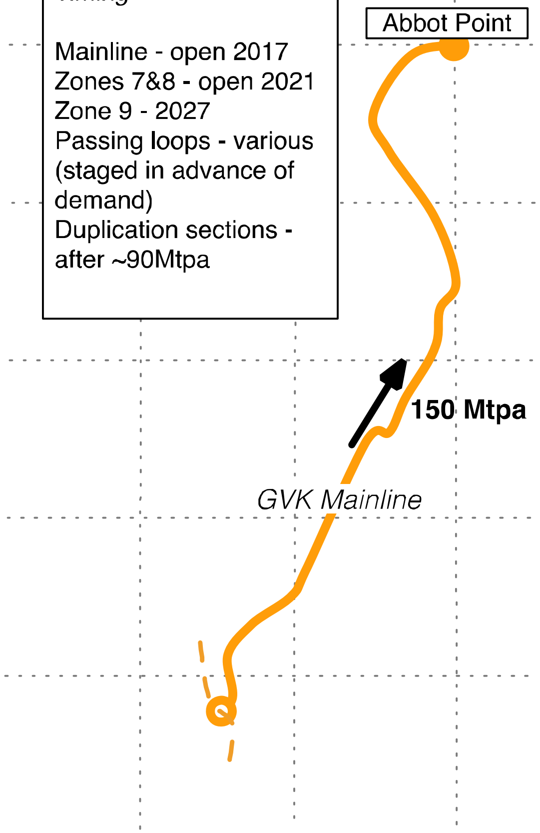



*Track specification (initial build)*
Zone 1 - Single standard guage, 40T
Zones 2 to 4 - Single dual gauge, 40T
Zones 5 - 8 - Single standard gauge, 40T

**GVK**

*Timing*

Mainline - open 2017
Zones 7&8 - open 2021
Zone 9 - 2027
Passing loops - various (staged in advance of demand)
Duplication sections - after ~90Mtpa

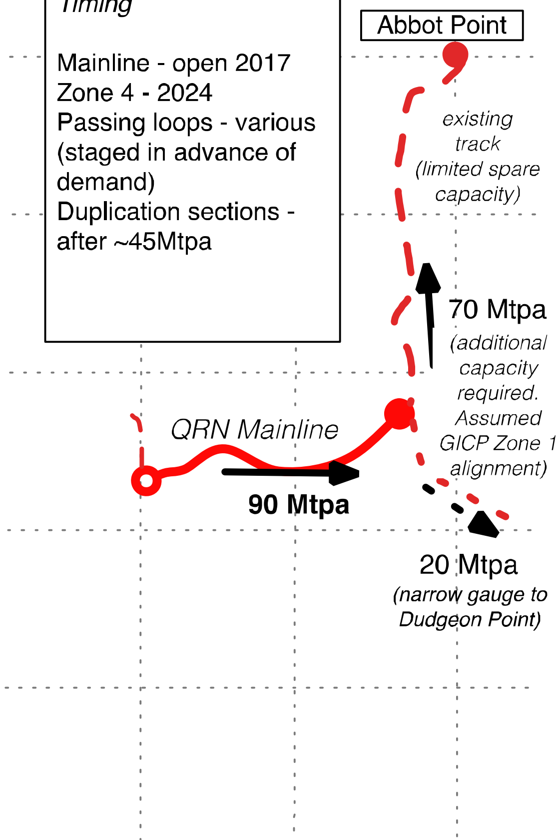



*Track specification (initial build)*
Mainline - Single standard guage, 32.5T

**QRN**

*Timing*

Mainline - open 2017
Zone 4 - 2024
Passing loops - various (staged in advance of demand)
Duplication sections - after ~45Mtpa

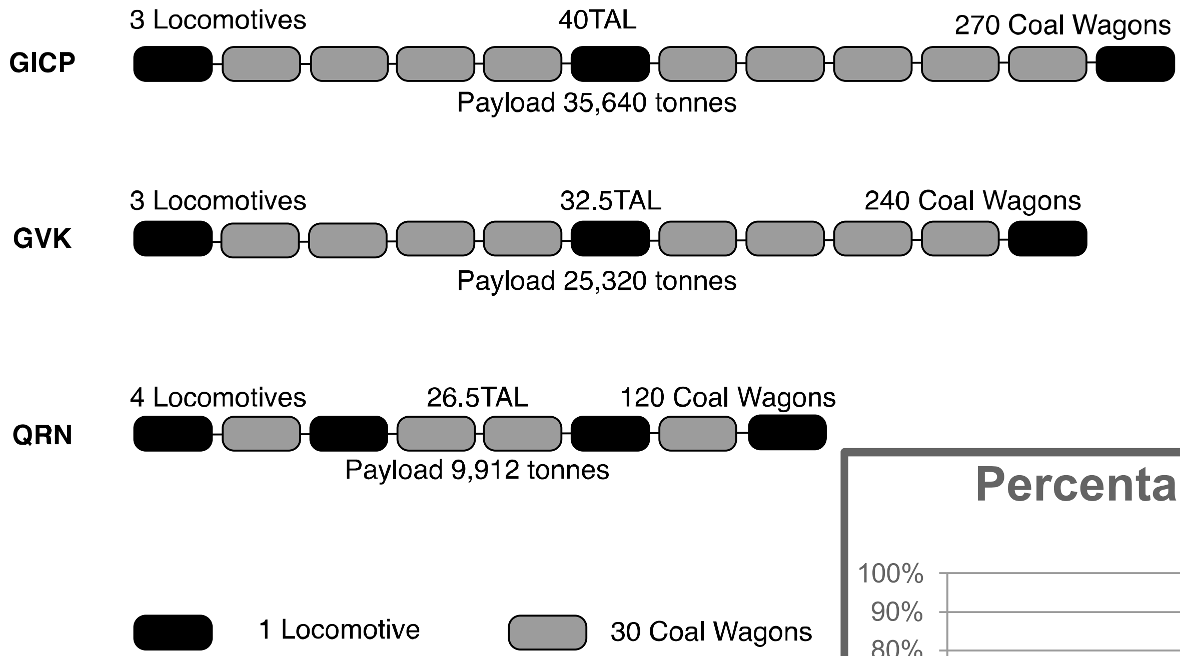


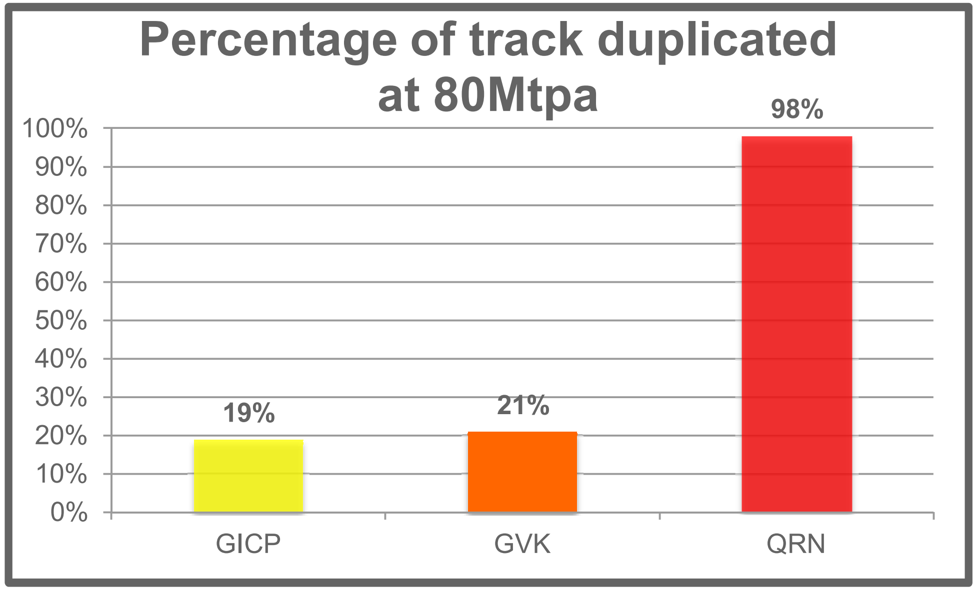

*Track specification (initial build)*
Mainline - Single standard guage, 26.5T



Everything Infrastructure

# Capacity Related Differences




Capacity enhancement steps

a) Single track (greenfield),
b) Passing loops (initial - greenfield),
c) Passing loops (ongoing – brownfield),
d) Duplication sections (brownfield).

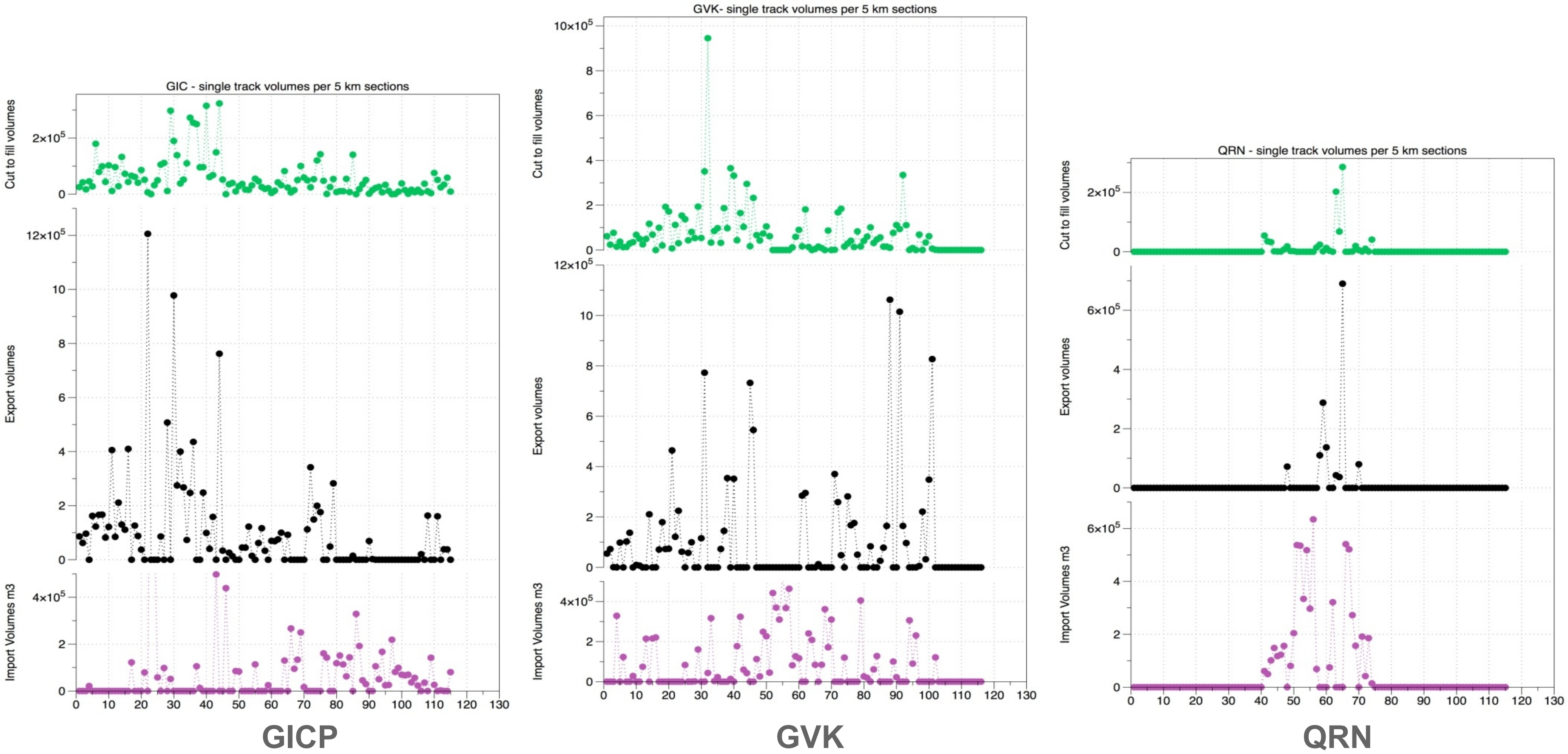
# Below Rail Elemental Cost Differences

| Cost Structure | Differences | |
|---|---|---|
| Direct Costs | | |
| Earthworks | GICP better balance(*) | |
| Capping Layer | Similar | |
| Structures | GICP less drainage (**) | |
| Permanent Way | Standard gauge higher | |
| Environmental works & Fencing | Similar | |
| *Sub total of Direct Costs* | | *100%* |
| Indirect Costs | GICP less exposed to weather | |
| **Total Direct & Indirect Costs** | | |
| Contractors margin | Same % | |
| **Total Contractors Price** | | |
| Client Cost | Same % | |
| Land Costs | GIC lower land cost | |
| Project Contingencies | Same % | |
| **Total Order of Magnitude Estimated Price** | | *~250%* |

(*) - GICP has more balanced cut to fill earthworks profile resulting in minimum haulage of imported and exported materials;
- GICP alignment minimises crossing of floodplains resulting in less imported fill required for large embankments in flood prone areas;

(**) – GICP alignment would have fewer structures as GICP has lower exposure to flood areas.

# Comparative Earthworks: Indicative cut to fill, export and import volumes (by 5km sections)




- GICP has a reasonable spread of balanced cut to fill earthworks (green);
- GICP major cut areas with large export volumes to be optimised (black);
- GICP has lower imported fill volume (pink).

# Below Rail Assumed Terrain Type Distances

Below Rail terrain type kilometres

| GICP | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Zone 1 | 20 | 148 | 15 | 36 | 219 |
| Zone 2 | 128 | | | 23 | 151 |
| Zone 3 | | | 16 | 12 | 28 |
| Zone 4 | | 44 | | | 44 |
| Zone 5 | | | 24 | 10 | 34 |
| Zone 6 | 4 | | | 18 | 22 |
| Zone 7 | 20 | | | 16 | 36 |
| Zone 8 | 21 | | | 2 | 23 |
| Zone 9 | 20 | | | | 20 |
| Totals | 213 | 192 | 55 | 117 | **577** |

GIC

| GVK | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 149 | 136 | 20 | 180 | **485** |

GVK

| QRN | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 75 | | | 99 | **174** |
| | | | | Existing network to Abbot Point +22km | 229 |
| | | | | | **403** |

QRN

- GICP has a longer total distance but has less track in flood prone areas

# Below Rail Comparative Direct Cost by Terrain

Below Rail Weighted Average Direct Cost per terrain type (all values are shown in $2012 $m/km*)

| *GICP(**)* | Flat | Hilly | Rolling | Flood | Average |
|---|---|---|---|---|---|
| Zone 1 | 2.5 | 3.1 | 2.6 | 3 | 3.01 |
| Zone 2 | 2.3 | | | 2.8 | 2.38 |
| Zone 3 | | | 2.4 | 2.9 | 2.58 |
| Zone 4 | | 2.6 | | | 2.62 |
| Zone 5 | | | 2.7 | 2.9 | 2.76 |
| Zone 6 | 2.4 | | | 2.9 | 2.81 |
| Zone 7 | 2.4 | | | 2.9 | 2.61 |
| Zone 8 | 2.4 | | | 2.9 | 2.4 |
| Zone 9 | 2.3 | | | | 2.31 |
| Overall average | | | | | **2.70** |

GIC

| *GVK* | Flat | Hilly | Rolling | Flood | Average |
|---|---|---|---|---|---|
| Mainline | 2.4 | 3.1 | 2.6 | 3.5 | **3.00** |

GVK

| *QRN* | Flat | Hilly | Rolling | Flood | Average |
|---|---|---|---|---|---|
| Mainline | 2.4 | | | 3.5 | **3.00** |

QRN

(*) Includes provision for escalation during the construction period
(**) Based on GICP with standard gauge only

- GICP has a lower weighted average cost per kilometre

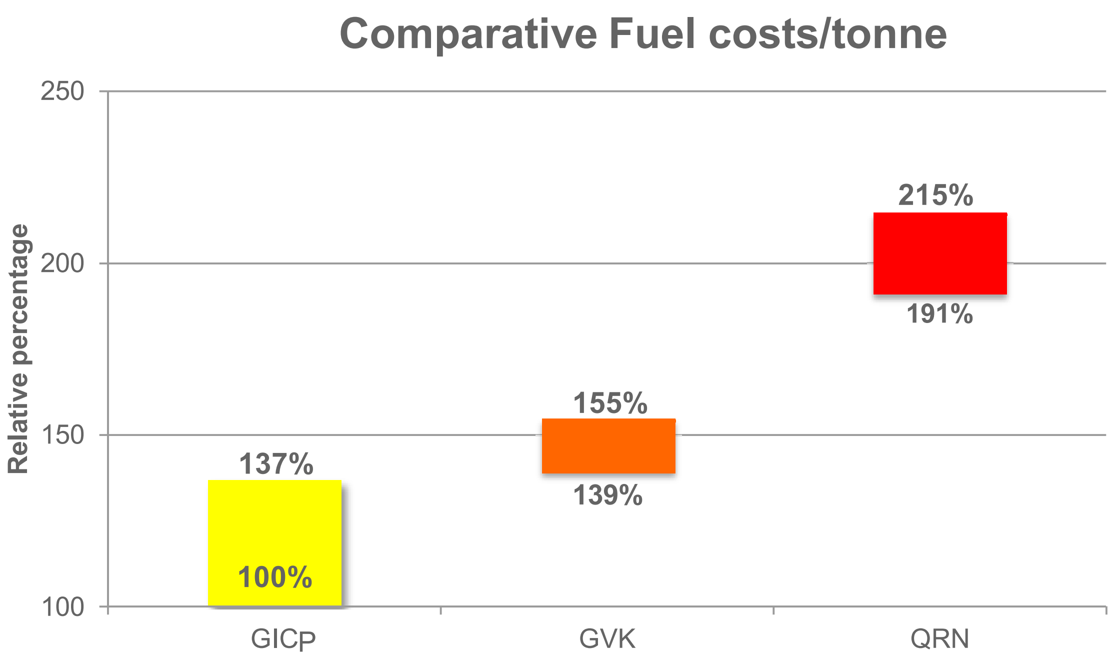
# Operating Efficiencies Differences

| Infrastructure | Train Configuration | Locomotives | Wagon Tare Mass | Train Payload |
|---|---|---|---|---|
| GICP 40TAL | 3 Locos * 270 Wagons | ES44ACi | 26T | 35,640(*) |
| GVK 32.5TAL | 3 Locos * 240 Wagons | ES44Aci | 20.7T | 25,320(**) |
| QRN 26.5TAL | 4 Locos * 120 Wagons | GT42CU AC | 19.4T | 9,912(***) |

Note: (*) :(160 -26 – 2) * 270 = 35,640, (**): (130 -20.7 – 2 - 2) * 240 = 25,320, , (***) : (106 -19.4 – 2 - 2) * 120 = 9,912

Note(1): Assuming the theoretical performance of 40TAL wagon,

Note(2): Assuming GICP 9% fuel saving for lidded wagons,




* Excludes labour & maintenance.

# Comparative Differences Overview

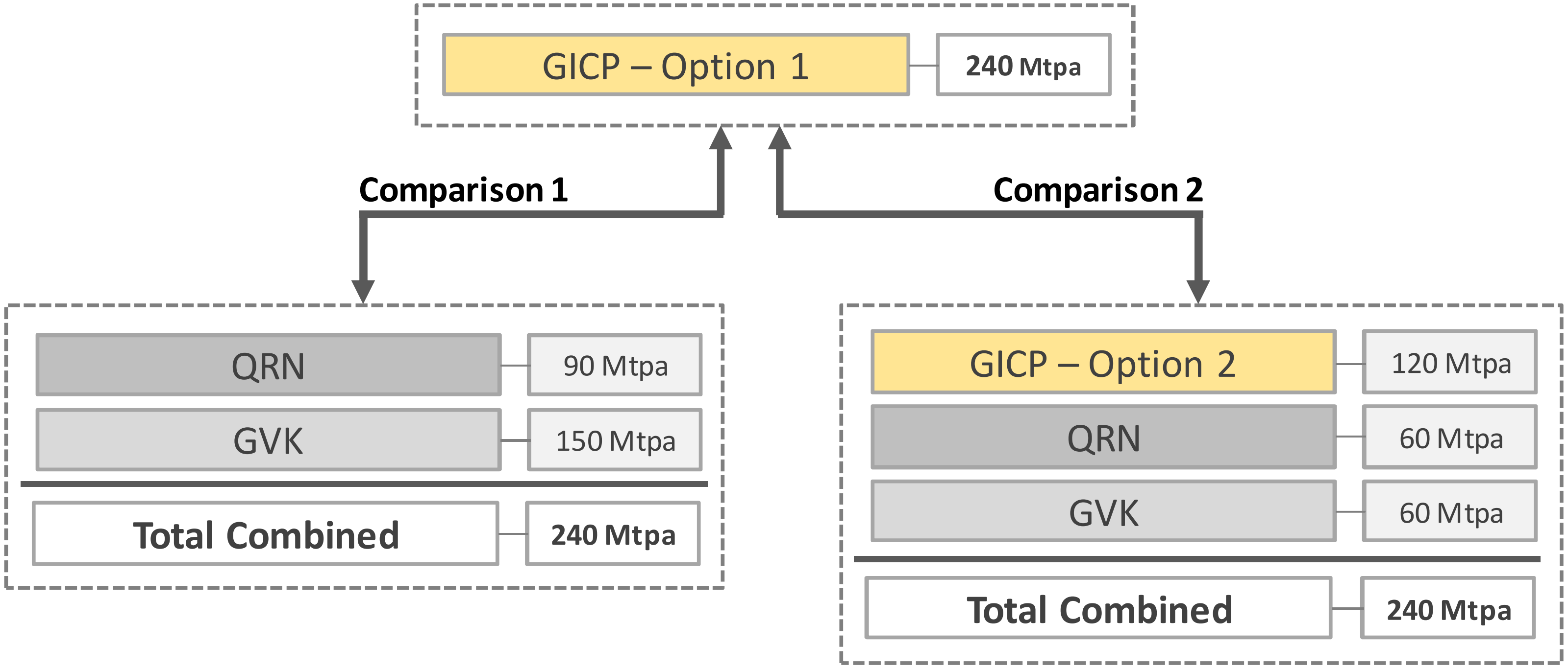
| | GICP | GVK | QRN |
|---|---|---|---|
| Alignment Efficiencies | Balanced Earthworks | Imported Fill, Drainage Structures | Imported Fill, Drainage Structures |
| Capacity Enhancement | Economies of scale with 40TAL wagon, on standard gauge | Similar to GIC but with reduced payload | Restricted by existing QRN network, Require major capacity upgrades to meet demand |
| Access Characteristics | Located to service Galilee North & South | Galilee South focused | Galilee North focused |
| Below Rail Comparative Costs | Less direct cost/km | Additional bridges & culverts in floodplain areas | Additional bridges & culverts in floodplain areas |
| Operating Efficiencies | Opex Cost / Tonne 100% ~ 145% | Opex Cost / Tonne 149% ~ 167% | Opex Cost / Tonne 220% ~ 252% |

# Approach to Financial Assessment

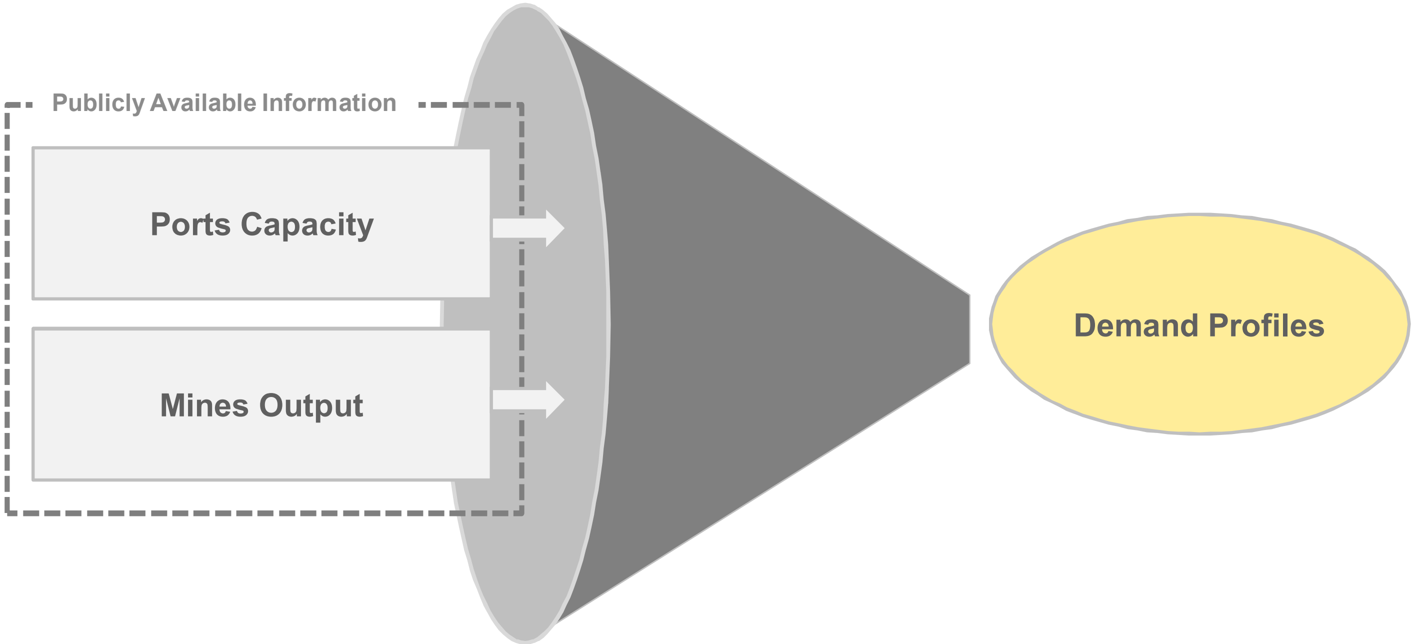
- Government’s announcements on 6 June 2012 supports two rail corridors:
  - QRN East-West corridor
  - GVK North-South corridor

- Focus on comparing GICP solution against alternative multi-alignment solutions:
  - **Comparison 1** - Identify the financial benefits associate with the GICP single alignment solution over a multiple alignment solution serviced by QRN and GVK.
  - **Comparison 2** - Assess the financial benefits available to miners of a smaller scale GICP solution where the solutions proposed for QRN and GVK also exist.

# Definition of Comparisons

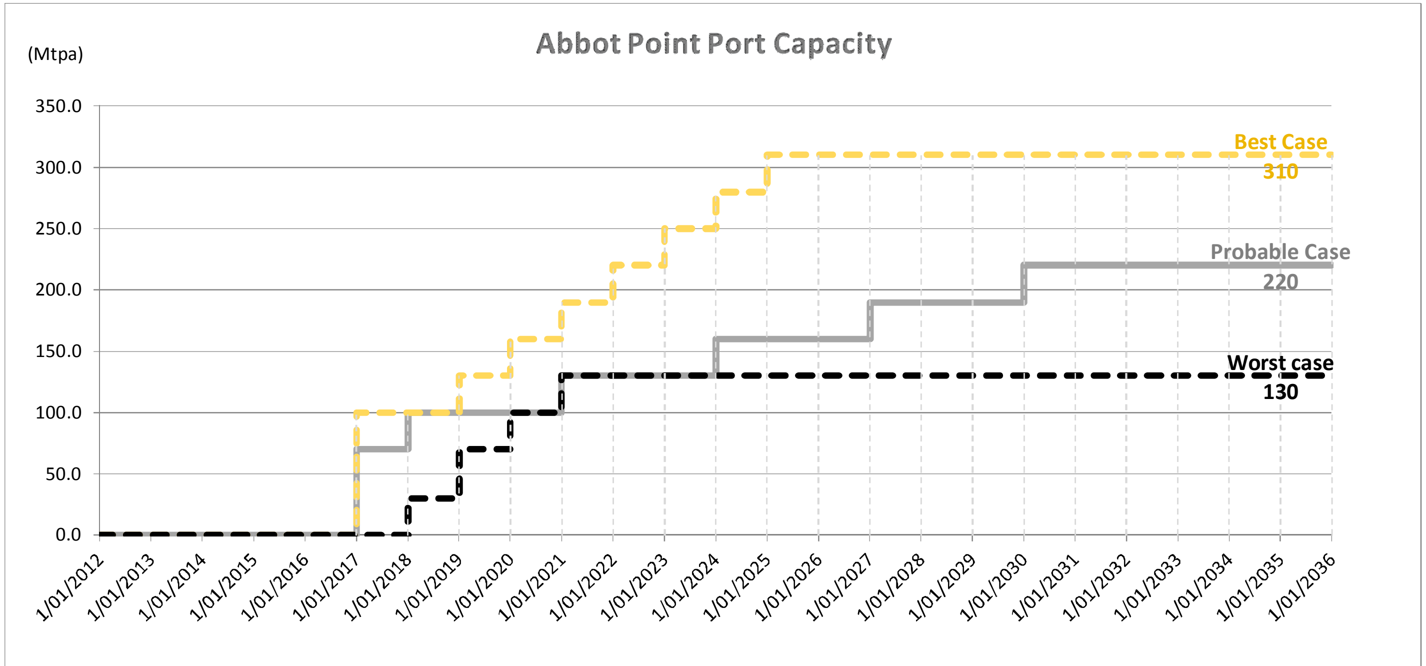


# Demand Profile Methodology



# Port Capacity Assumptions

- Abbot Point Port Capacity (assumed for Galilee coal)

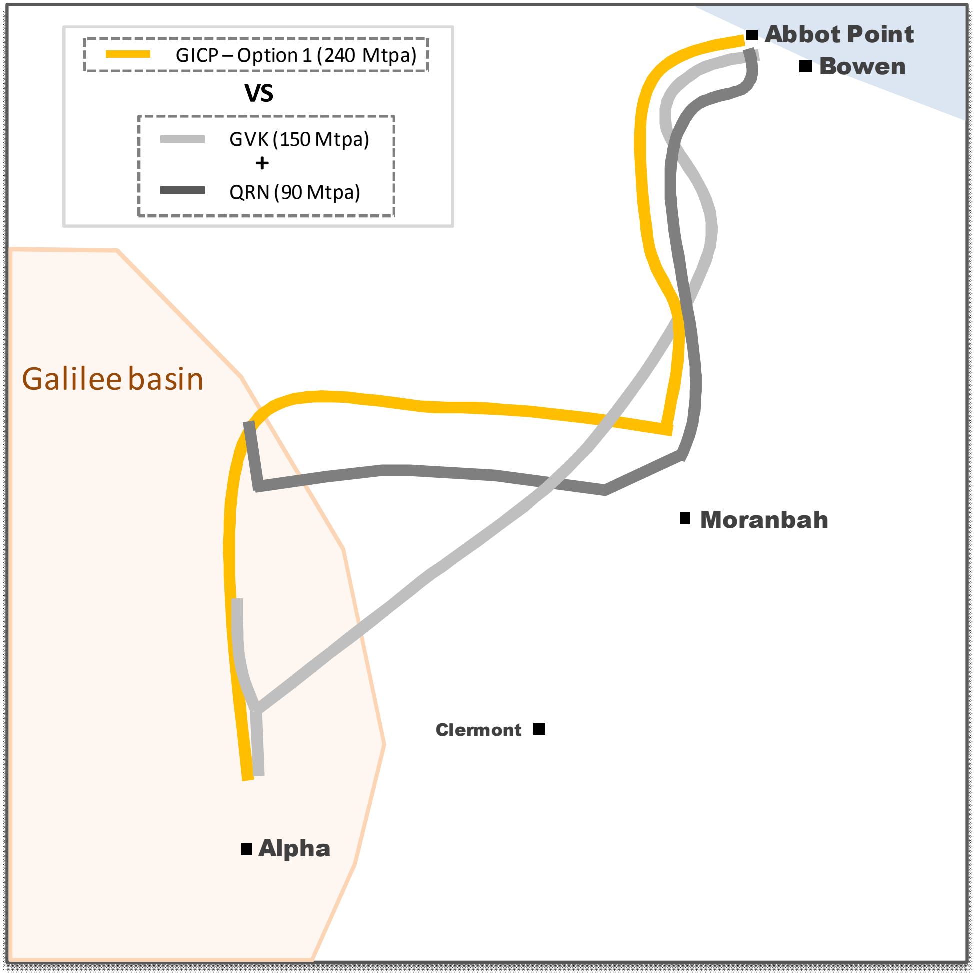


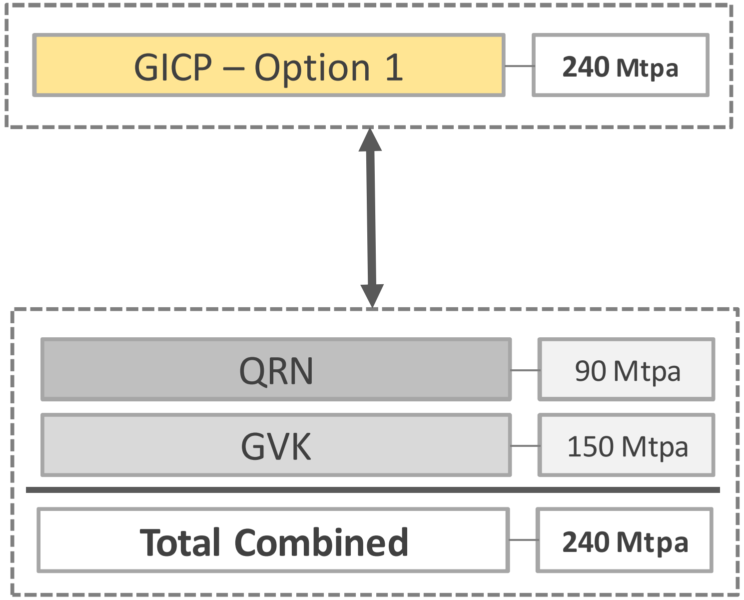

- Dudgeon Point Port Capacity: 20Mtpa for Adani

# Mines Output Assumptions

| Project name | Proponent | Range of publicly available volumes (Mtpa) | Volumes assumed for analysis (Mtpa) | Operational readiness |
|---|---|---|---|---|
| South Galilee Coal Project | AMCI & Bandanna Energy Ltd | 15-20 | 15 | 2015 |
| China First Coal Project | Waratah | 40 | 40 | 2014 |
| Alpha Coal Project | Hancock / GVK | 30 | 30 | Q2 2015 |
| Alpha West Project | Hancock / GVK | 16-24 | 16 | 2016 |
| Kevin's Corner Project | GVK | 30 | 30 | Q4 2015 |
| Alpha North Coal Project | Waratah | 40 | 40 | Q4 2016 |
| Alpha West Coal Project | Waratah | No details | - | No details |
| Degulla Coal Project | Vale | 20-40 | 20 | Unknown<br>2016 assumed for purpose of study |
| Carmichael East Coal Project | Waratah | No details | - | No details |
| Carmichael Coal Project | Adani | 60 (from 2022) | 60 | 2014 |
| China Stone Project - South | Macmines | 30 | 30 | 2016 |
| China Stone Project – North | Macmines | 30 | 30 | No details<br>2016 assumed for purpose of study |
| Total Galilee Basin | | 311-344 | 311 | |

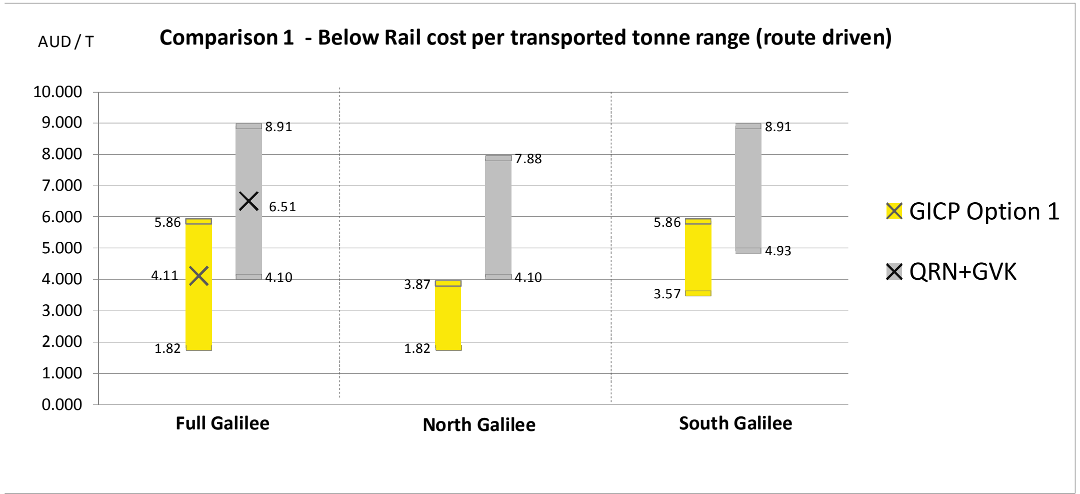
# Comparison 1

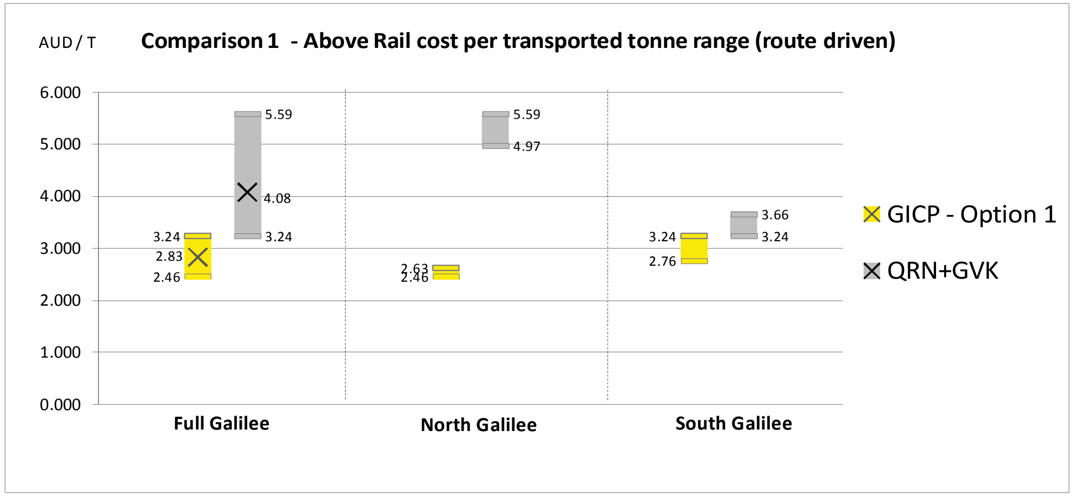



This is an Ernst & Young graphical representation of alignment for information purposes and is not to scale.

# Comparison 1 – Financial Results



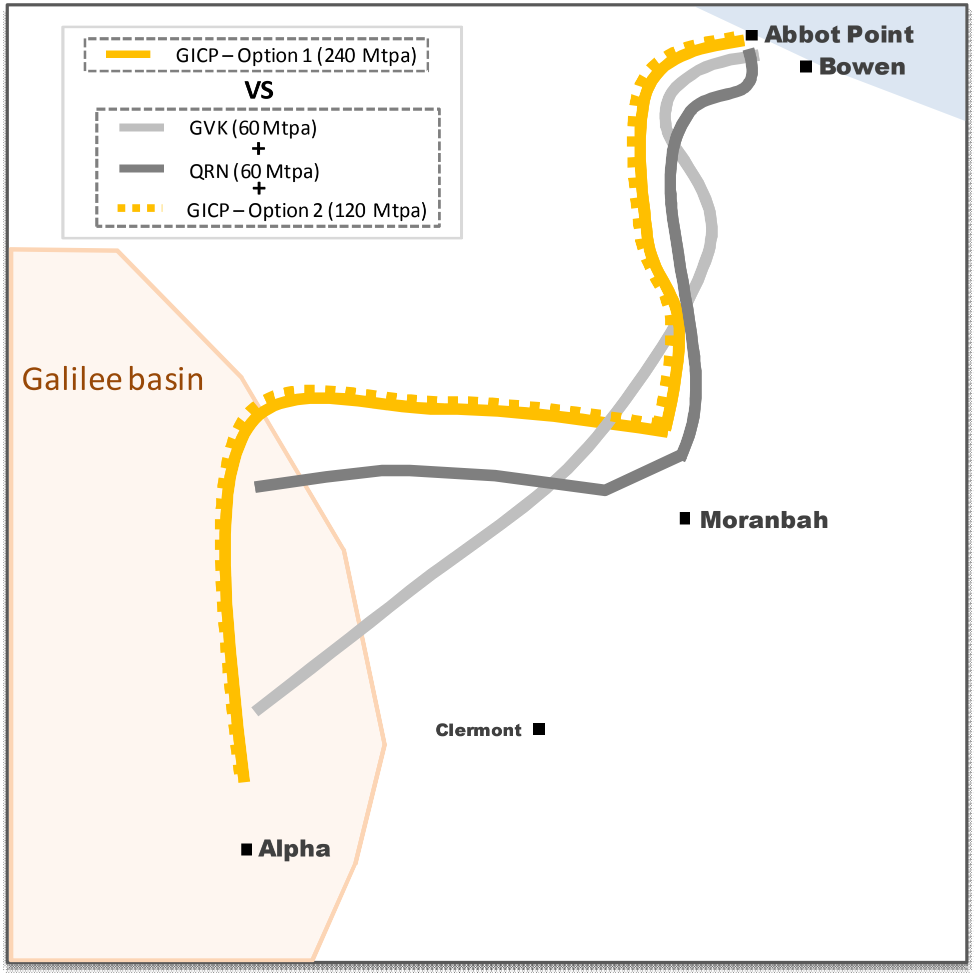
# Comparison 1 – Financial Results

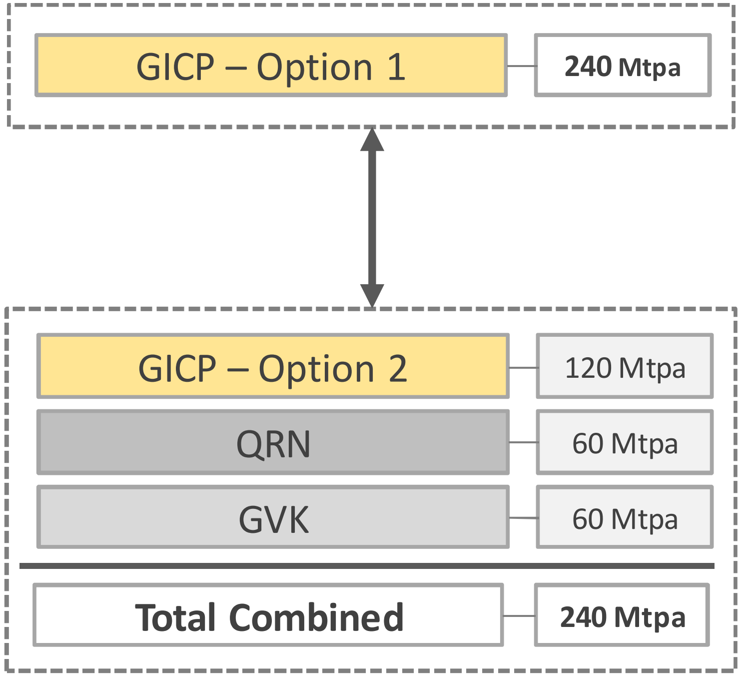
- GICP 240Mtpa single alignment solution appears to offer a 50% to 55% lower cost per tonne, in the region of AUD7.00, than a combined QRN (90Mtpa) and GVK (150Mtpa) solution
- This is driven by efficiencies from:
  - **Below Rail**: The lower cost of building one below rail alignment compared to the cost of building two alignments. The GICP option 1 construction cost is around AUD6.1bn* in 2012 prices, a saving in the region of 70% to 75% over the combined alternative solution.
  - **Above Rail**: The standard gauge, 40 tonne axle load, above rail solution proposed for GICP is estimated to be in the range of 15% to 20% more cost efficient than the proponent GVK, standard gauge, 32.5 tonne axle load solution and approximately 80% more efficient than the proponent QRN, narrow gauge, 26.5 tonne axle load solution

* Construction cost of **AUD6.1bn = (A) - (B) + (C)**

- **(A)** = AUD3.9bn for Below Rail single line and single gauge costs, including provision for inflation during construction (ie. 577km x AUDm2.7/km x 250%)
- **(B)** = AUD0.2bn for removal of provision for indexation during construction
- **(C)** = AUD2.4bn for dual gauge, passing loops and duplication

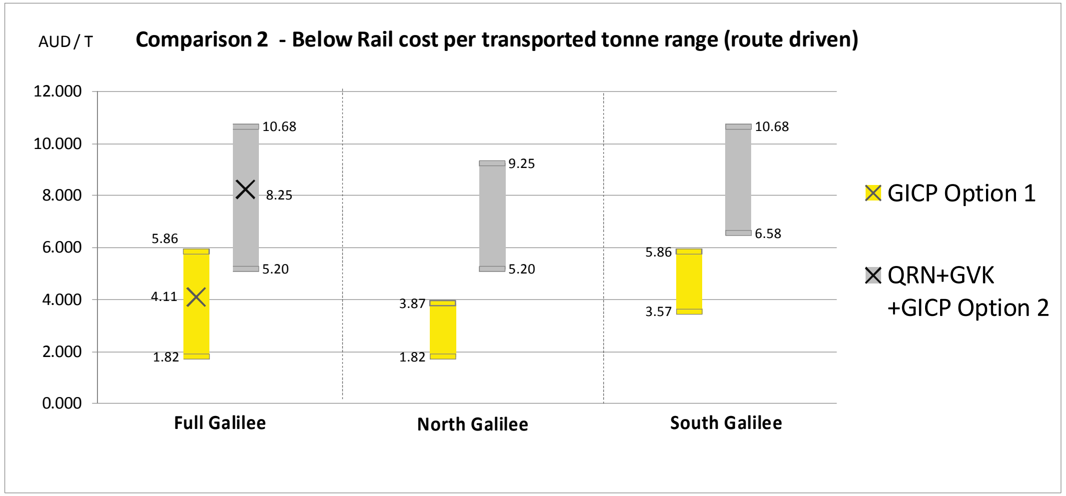
# Comparison 2

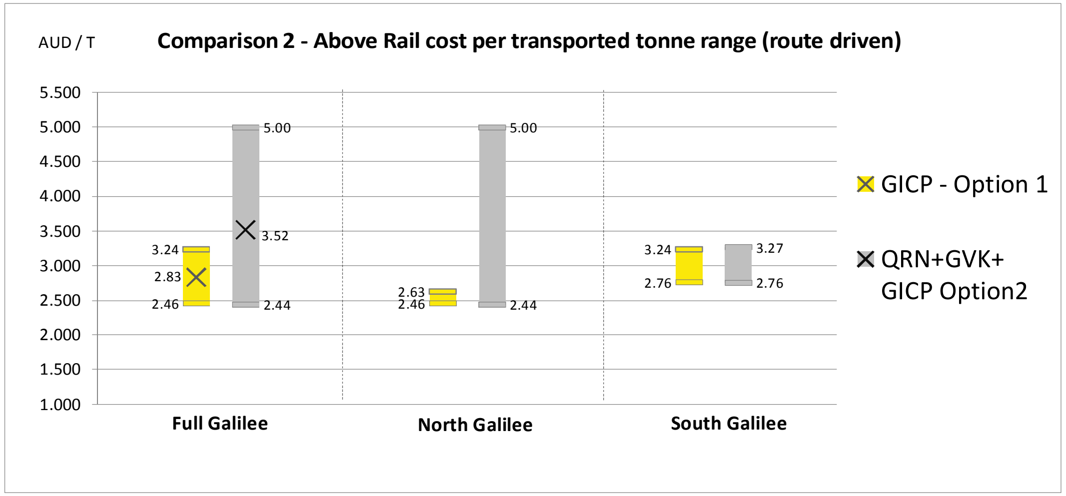



This is an Ernst & Young graphical representation of alignment for information purposes and is not to scale.

# Comparison 2 – Financial Results



# Comparison 2 – Financial Results

- GICP Option 1 (240Mtpa) appears to be in the region of 65% to 70% more efficient, on a cost per tonne basis, than the combined three alignment solution
- At around AUD10.00 the GICP Option 2 (120Mtpa) cost per tonne is in the range of 25% to 40% lower than the QRN (60Mtpa) and GVK (60Mtpa) components of Comparison 2. This is a positive indicator of the potential of the GICP's performance at lower volumes, however, further assessment was required as in this comparison the different alignments service different mines.
- The potential of the GICP Option 2 (120Mtpa) was explored further by assessing the options available to each mine for getting to the port. This involved assessing the GICP Option 2 outputs against the QRN (90Mtpa) and GVK (150Mtpa) solution explored under Comparison 1.
  - At a system level, the cost per tonne of around AUD10.00 for GICP Option 2 (120Mtpa) compares favourably against approximately AUD10.60 for the combined QRN (90Mtpa) and GVK (150Mtpa) solution. Again indicating the potential of the lower volume GICP solution.
  - When assessed at a mine level:
    - Macmines South – The GICP Option 2 solution, at AUD9.80, indicates a cost per tonne benefit of AUD3.70 over the QRN (90Mtpa) alternative. The above rail solution provided AUD3.20 of this benefit, however, the below rail solution also performed favourably.
    - Vale - The GICP Option 2 solution appears to offer a benefit over the GVK (150Mtpa) solutions of around 20% to 25%, AUD0.90 above rail and AUD1.50 below rail.
    - Waratah – The GVK (150Mtpa) solution outperformed the GICP Option 2 (120Mtpa) solution by between 10% and 20% for the various Waratah mines serviced. However, the Waratah mines could also benefit if higher volumes are achieved on the GICP alignment.
  - A consistent message across all mines was the importance of the GICP above rail solution. At a system level, the cost per tonne is 40% to 50% lower than the combined alternative solution.

# Sensitivities

- QCA Regulated return on Below Rail (Comparison 1)
  - Key messages do not change
- Port Capacity – Best + Worst Case (Comparison 1)
  - Range of prices increase in line with expectation
- Port Access (Comparison 2)
  - Cost per tonne falls reflecting better asset utilisation
  - GICP option 1 cost per tonne remains lower by 50% to 60%
- Theoretical Direct Comparison against QRN
  - GICP solution appears to offers lower cost per tonne for Adani mine, driven by above rail (50% of QRN cost). Alignment also likely to benefit Macmines.
- Theoretical Direct Comparison against GVK
  - GICP and GVK solutions appear to offer similar cost per tonne. Alignment of GICP favourable for mines north of GVK alignment.

# Conclusions

On preliminary assessment:

- The single alignment GICP solution, at around AUD 7.00 per tonne, indicates 50% to 55% financial efficiency against the alternative dual alignment solution.
- If more than one alignment is developed:
  - The GICP solution indicated financial benefits, on a cost per tonne basis, for the Vale, Macmines and Adani mines
  - Waratah mines could also benefit if higher volumes are achieved
- The above rail analysis indicates that, on a cost per tonne basis:
  - Standard Gauge performs more efficiently than Narrow Gauge
  - Subject to further validation of wagon design, a 40 tonne axle load wagon outperforms 32.5 and 26.5 tonne axle load wagons
- GICP achieves major environmental and community benefits by:
  - Bypassing community areas
  - Minimising impact on agricultural land
  - Minimising the length of corridor in flood plain areas

# Next Steps

- **Initial Steps**
  - Engage the mining community and testing of demand assumptions
  - Engage NQBP, as the Abbot Point port owner, to market test the port capacity strategy
  - Based on feedback from above steps, validate and/or revise analysis
  - Re-engage the mining community and port owners for support
- **Future Steps**
  - In conjunction with miners, raise the profile and visibility of GICP with the State Government
  - Develop the financing structure and engage the financial market
  - Expand on the community and environmental benefits

# Appendix 20


PROJECT IRON BOOMERANG
east west line parks limited

Galilee Infrastructure Corridor Project
Pre-feasibility Financial and Commercial Report

20 December 2012

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East West Line Parks Limited
16th Floor, 344 Queen Street
Brisbane
QLD, 4000

20 December 2012

*Private and confidential*

# Galilee Infrastructure Corridor Project – Pre-Feasibility Financial and Commercial Report

Dear Tom

In accordance with your instructions, we have performed the work set out in our Professional Services Agreement ('PSA') dated 10 May 2012 (the "Engagement Agreement") in connection with the proposed Galilee Infrastructure Corridor Project, for East West Line Parks Limited ( "you", "EWLP" or the "Client).

The PSA contains important information which should be read for a proper understanding of our work and this draft discussion paper.

**Purpose of our report and restrictions on its use**

The purpose of this report, undertaken in accordance with the scope of the Engagement Agreement, is to assess and document the economic feasibility of the Galilee Infrastructure Corridor Project ('GICP' or the 'Project') in association with Everything Infrastructure Services Pty Ltd, part of the Everything Infrastructure Group, ('EIG' or 'EI') and EWLP.

This report was prepared on your instructions solely for the purpose set out in the Engagement Agreement and should not be relied upon for any other purpose. In carrying out our work and preparing our report, we have worked solely on the instructions of the EWLP and for its purposes.

Our report may not have considered issues relevant to any third parties. Any use such third parties may choose to make of our report is entirely at their own risk and we shall have no responsibility whatsoever in relation to any such use.

We disclaim all responsibility to any other party for any loss or liability that the other party may suffer or incur arising from or relating to or in any way connected with the contents of this report, the provision of this report to the other party or reliance upon this report by the other party. Liability is limited by a scheme approved under professional standards Amendment Act.

Where this report is being disclosed to a third party, the Deed Poll, agreed between Ernst & Young and EWLP, shall be provided to the third party for confirmation.

**Scope of our work**

To perform our analysis we had to:

- ► Develop preliminary access and tariff pricing principles.
- ► Review publicly available information setting out key demand parameters to identify potential demand side constraints.
- ► Utilise capital and operation cost inputs provided by EIG. As such, this report should be read in conjunction with EIG's "Above and below rail comparative cost estimates" report of July 2012 (attached at Appendix H).
- ► Develop a comparative pricing model to assess the economic feasibility of GICP.
- ► Document assumptions and obtain EWLP signoff
- ► Run scenarios as agreed with EWLP.

**Outside of our scope and other Limitations**

We have not:

- ► Validated any of the assumptions provided by EIG and EWLP.
- ► Validated any of the publicly available information used in this report.
- ► Performed an assessment of the ability of EWLP to finance the infrastructure.
- ► Performed an assessment of the environmental or regional community benefits arising from a single corridor solution.
- ► Performed market testing at this stage of the study.
- ► Held discussions with any third party referred to in this report. In particular, we have not engaged with either QR National Limited or GVK Power & Infrastructure Limited to test the assumptions applied in assessing the alternative solutions.

The financial model on which our estimations are based on has not been reviewed or audited at this stage of the study.

Our work in connection with this assignment is of a different nature to that of an audit or a due diligence assignment. Our report to you is based on inquiries of, and discussions with, management. We have not sought to verify the accuracy of the data or the information and explanations provided by management. Our work has been limited in scope and time and we stress that a more detailed review may reveal material issues that this review has not. If you would like to clarify any aspect of this review or discuss other related matters then please do not hesitate to contact us.

Yours sincerely

Mark White
Partner

Contents

# 1. Key terms and definitions

Table 1: List of terms and definitions

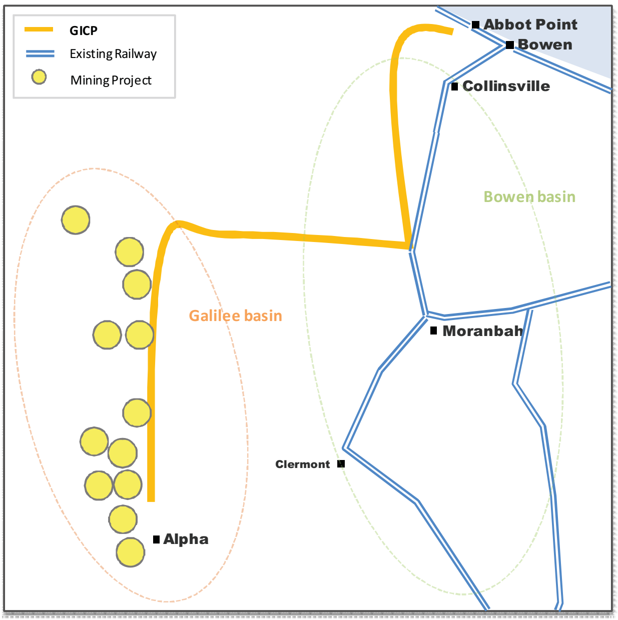
| Term | Definition |
|---|---|
| % | Percentage |
| Adani | Adani Enterprises Limited |
| AMCI | AMCI Capital L.P |
| AUDm | Millions of dollars AUD |
| AUD | Australian Dollars |
| Bandanna | Bandanna Energy Limited |
| BHP | BHP Billiton Limited |
| Bn | Billions |
| CQIRP | Central Queensland Integrated Rail project |
| EIG or EI | Everything Infrastructure Services Pty Ltd (part of Everything Infrastructure Group) |
| EIS | Environmental impact statement |
| EWLP | East West Line Parks Limited |
| EY | Ernst and Young |
| GICP, GIC or the Project | Galilee Infrastructure Corridor Project |
| GVK | Refers to the GVK Group, in particular GVK Power & Infrastructure Limited |
| Hancock | Hancock Coal Pty Ltd |
| INR | Indian Rupees |
| Macmines | Macmines Austasia PTY LTD |
| NPV | Net Present Value at 31 December 2012 |
| NQBP | North Queensland Bulk Port Corporation Limited |
| QCA | Queensland Competition Authority |
| QRN | QR National Limited |
| Vale | Vale S.A |
| Waratah | Waratah Coal Pty Ltd |

# 2. Executive Summary

EWLP has developed its Galilee Infrastructure Corridor Project ('GICP' or the 'Project') with the aim of providing a multi-user solution capable of catering for the future demands of the Galilee Basin and beyond.

GICP is the only single-corridor solution amongst many publicly announced rail proposals to service the whole of the Galilee basin. The following graphic depicts the proposed rail alignment:

Graphic 1: Galilee Infrastructure Corridor Project's alignments[1]




In our role as Economic Infrastructure Consultants of the Project, along with EIG (EIG's report is included in Appendix H), we studied the estimated relative economic freight efficiency of the various Galilee basin rail proposals in the public arena.

The government's announcements on 6 June 2012 in relation to its support for two rail corridors, namely the QRN East-West corridor and the GVK North-South corridor, shaped the direction of this analysis.

The announcement states that Adani is currently developing the QRN alignment with QRN, therefore Adani's own corridor was not considered further within this assessment. The Adani and QRN corridors are, in any event, on a similar east-west alignment.

Waratah's proposed corridor, whilst similar in alignment and length to the corridor proposed by GVK, has been qualitatively assessed by EIG, on the basis of publicly available information, as having a lower operational efficiency factor and, as such, has not been assessed further within this report.

Our assessment is based on capital and operating cost estimations provided by EIG and uses current Queensland Competition Authority's ('QCA') regulatory pricing principles. The demand assumption in Galilee basin is based on publicly available information.

[1] This is an Ernst & Young graphical representation of alignment for information purposes and is not to scale.

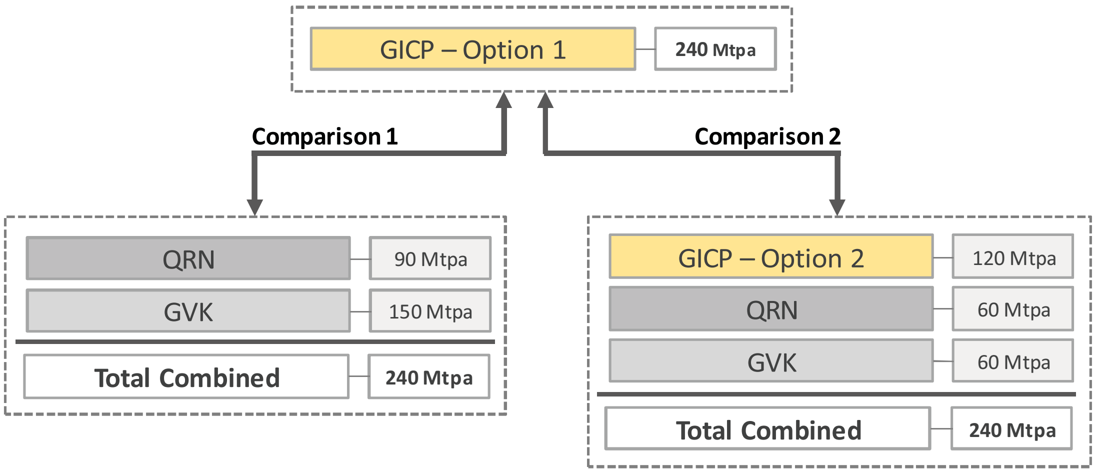
For the purpose of performing the assessment it was assumed that the capacity for Galilee coal was 240Mtpa, reflecting the Probable/Base Case port capacity. The 240Mtpa being reflective of 220Mtpa at port capacity at Abbot Point and 20Mtpa at Dudgeon Point port.

We devised a series of haulage scenarios and comparisons, each delivering this total tonnage, to assess the relative performance of the different Galilee rail proposals on a cost per tonne basis.

This report focuses on comparing EWLP's preferred solution, GICP Option 1, against alternative multi-alignment solutions involving QRN, GVK and smaller scale GICP Options.

The following diagram summarises the key comparisons performed.

Graphic 2: Definition of Comparison 1 and 2




The purpose of each comparison is:

- Comparison 1 seeks to identify the potential financial benefits associated with the GICP single alignment solution over a multiple alignment solution serviced by QRN and GVK.

- Comparison 2 seeks to assess the potential financial benefits available to miners of a smaller scale GICP solution where the alternative solutions proposed for QRN and GVK also exist.

While our assessment did not study the impact of GICP volumes between the 120Mtpa and 240Mtpa considered in Comparisons 1 and 2, the relationship between cost per tonne and volume is such that it allowed us to draw conclusions about the likely performance at intermediate volumes.

The table below lists, based upon information provided by EIG, the key characteristics of each of the rail lines under comparison:

Table 2: Key technical assumptions

| Railway | Gauge | Axle Load | Length |
|---|---|---|---|
| GICP - Option 1 | Standard Gauge | 40 tonnes | 577 km |
| QRN ( 90Mtpa) | Narrow Gauge | 26.5 tonnes | 425 km[2] |
| GVK (150Mtpa) | Standard Gauge | 32.5 tonnes | 564 km |
| GICP - Option 2 | Standard Gauge | 40 tonnes | 577 km |
| QRN (60Mtpa) | Narrow Gauge | 26.5 tonnes | 381 km[3] |
| GVK (60Mtpa) | Standard Gauge | 32.5 tonnes | 485 km |

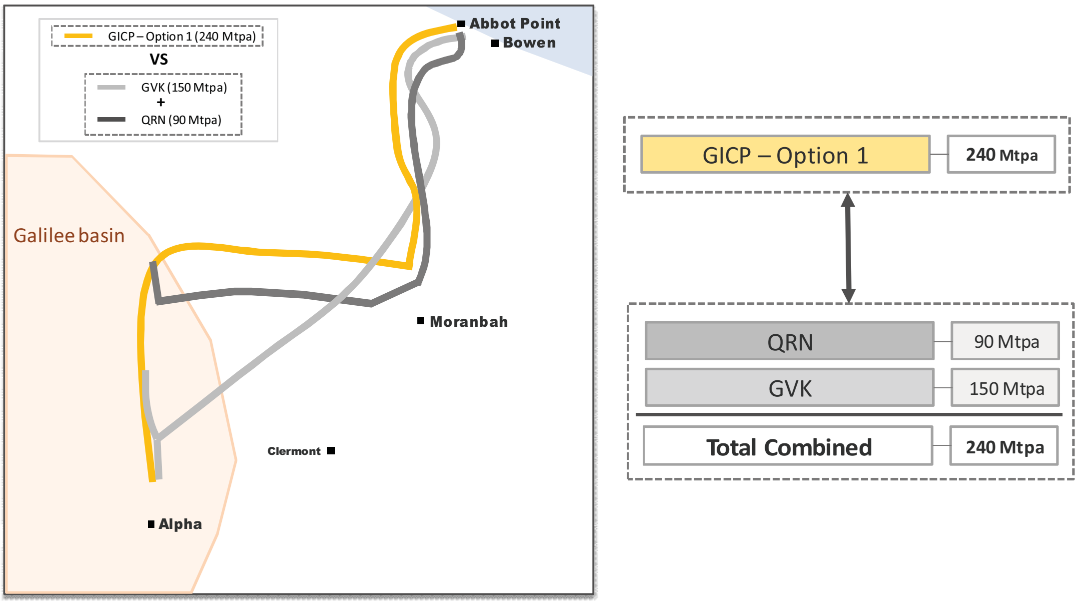
[2] The length of the existing QRN alignment upon which the financial modelling was performed was understated by around 22km, should be 447km. Difference does not impact the key messages and the figures within this report were not updated to reflect this understatement. During phase 2 the alignment length will be updated
[3] Comment as above footnote. Length understated in financial modelling by 22km, should be403km.

At this stage, we have not performed an assessment of the ability of EWLP to finance the infrastructure nor have we performed an assessment of the economic viability of Galilee thermal coal. In addition, we have not performed an assessment of the environmental or regional community benefits arising from a single corridor solution.

The key findings were as follows:

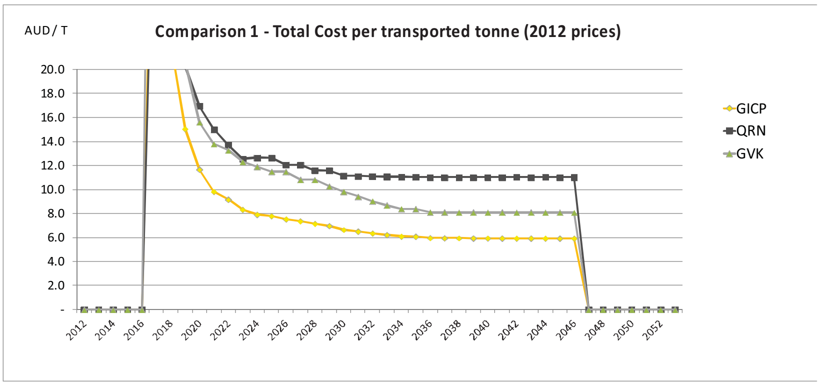
## 2.1 Comparison 1

Graphic 3: Rail alignments assessed in comparison 1[4]




Comparison 1 assesses a single alignment 240Mtpa GICP solution (GICP Option1) against a combined QRN (90Mtpa) and GVK (150Mtpa) alternative solution that would serve the same purpose of servicing all of the mines in the Galilee Basin. For the purpose of this assessment it is assumed that QRN serves the North Galilee mines while GVK serves the South Galilee mines. The following chart depicts the estimated cost per tonne for the system over the life of the concession:

Chart 1: Above and Below Rail combined cost per transported tonne




[4] This is an Ernst & Young graphical representation of alignment for information purposes and is not to scale.

The following tables depict the estimated price ranges, on a cost per tonne basis, for below and above rail resulting from the comparison 1 analysis.  The bars represent the pricing range for the mine routes considered within this comparison while the X represents the estimated weighted average cost per tonne for the system over the life of the concession.  A mine "route" is defined as being the section of the track used by a particular mine for a specified volume of coal.

Chart 2: Comparison 1 - Below Rail cost per transported tonne

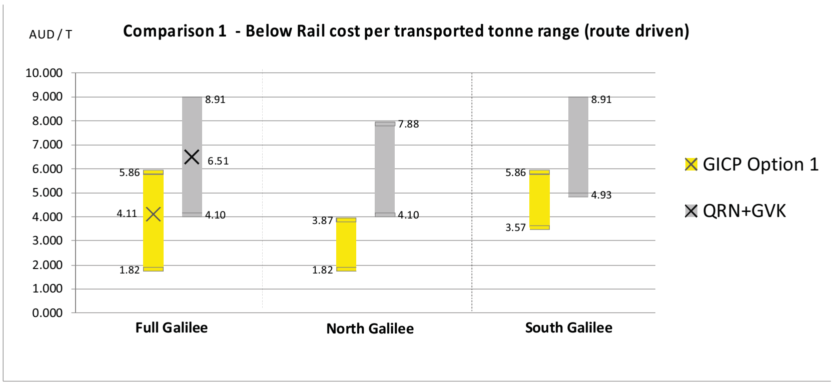
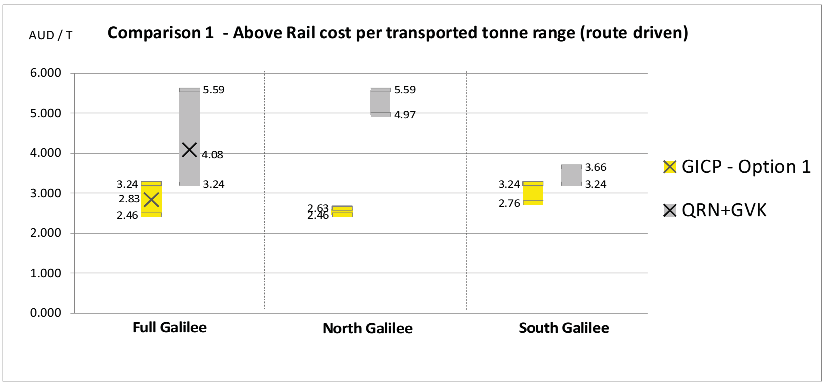



Chart 3: Comparison 1 - Above Rail cost per transported tonne




The key messages resulting from this comparison are:

- GICP 240Mtpa single alignment solution, with an average freight cost from the Galilee basin of around AUD7.00 per tonne, appears to offer a 50% to 55% benefit over a combined QRN (90Mtpa) and GVK (150Mtpa) alternative solution.

- When assessed at a mine level our analysis indicates that all mines included within this comparison benefited from a lower cost per tonne under the GICP Option 1 (240Mtpa). The cost benefit estimates for individual mines range from 10% to 165% with the cost per tonne ranging from approximately AUD4.50 to AUD9.00.

- This is driven by efficiencies from:

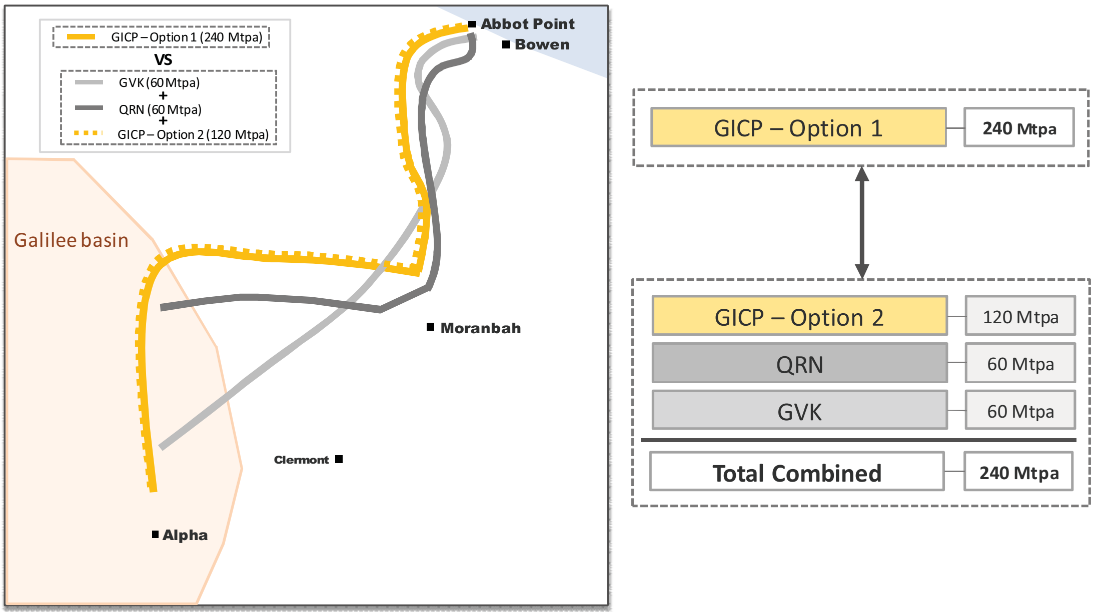
    - The lower cost of building one below rail alignment compared to the cost of building two alignments. The GICP option 1 construction cost (including staged augmentations of passing loops and duplications as required) is around AUD6.1bn in 2012 prices, a saving in the region of 70% to 75% over the combined alternative solution.

- Subject to further validation of the 40 tonne axle load wagon design (as yet not developed for Queensland coal mines although the benchmark for iron ore mines in Western Australia), the standard gauge, 40 tonne axle load, above rail solution proposed for GICP is estimated to be in the range of 15% to 20% more cost efficient than the proponent GVK, standard gauge, 32.5 tonne axle load solution and approximately 80% more efficient than the proponent QRN, narrow gauge, 26.5 tonne axle load solution. These results indicate that a 40 tonne axle load solution is more cost effective than 32.5 tonne axle load and that a narrow gauge above rail solution is less effective than standard gauge.

- Our results are calculated at a vanilla WACC equivalent to QRN's 15% pre-tax price[5]. However, we also performed sensitivity analysis to assess the result of this comparison at the regulated return determined by QCA, a vanilla WACC of 9.96%. The key messages do not change as a result of this sensitivity analysis.

## 2.2 Comparison 2

Graphic 4: Rail alignments assessed in comparison 2[6]

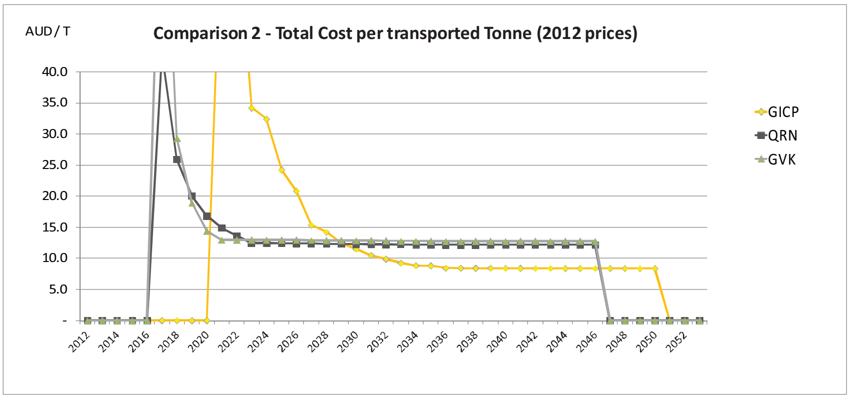



Comparison 2 assesses the same GICP Option 1 (240Mtpa) against a three alignments alternative solution comprising a GICP 120Mtpa solution (GICP Option2), QRN (60Mtpa) and GVK (60Mtpa). For GICP Option 2, due to port capacity restrictions it has been assumed, for the purpose of this study, that operations do not commence until 1 January 2021 as identified in the following chart.

[5] Page 8 of QCA report - Final Decision, QR Network's 2010 DAU, September 2010

[6] This is an Ernst & Young graphical representation of alignment for information purposes and is not to scale.

Chart 4: Above and Below Rail combined cost per transported tonne




The following tables depict the price ranges for below and above rail resulting from the comparison 2 analysis.

Chart 5: Comparison 2 - Below Rail cost per transported tonne

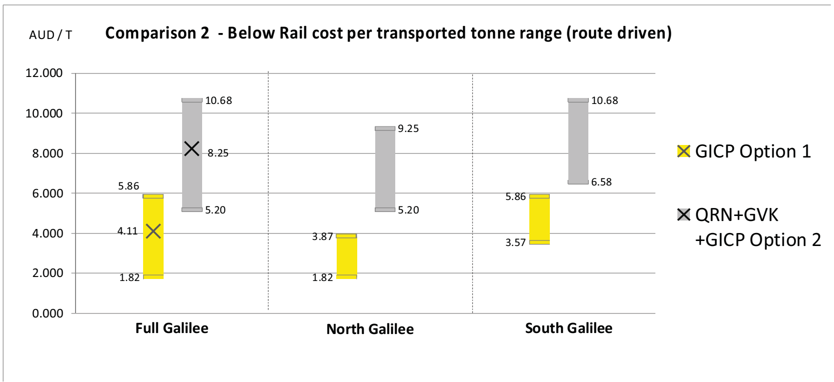
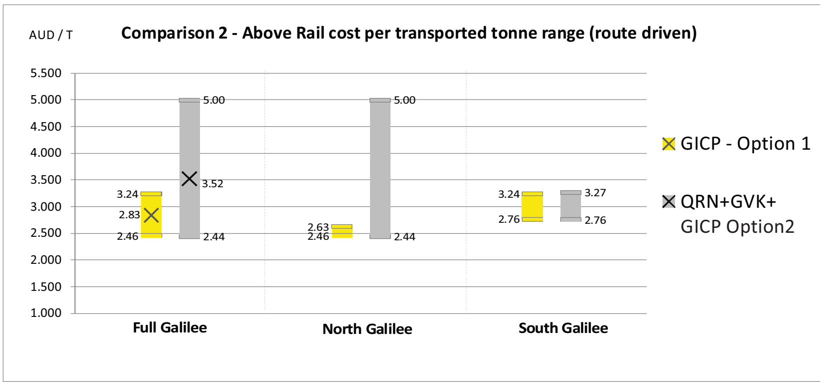



Chart 6: Comparison 2 - Above Rail cost per transported tonne




The key messages resulting from this comparison are:

- GICP Option 1 (240Mtpa) appears to be in the region of 65% to 70% more efficient, on a cost per tonne basis, than the combination of QRN (60Mtpa), GVK (60Mtpa) and GICP option 2 (120Mtpa). This is primarily due to the fact that three separate alignments require three infrastructure spends as well as to other influences such as the more efficient above rail solution.

- At around AUD10.00 the GICP Option 2 (120Mtpa) cost per tonne is estimated to be in the range of 25% to 40% lower than the QRN (60Mtpa) and GVK (60Mtpa) components of Comparison 2. This is a positive indicator of the potential of the GICP's performance at lower volumes. However, in this comparison the different alignments service different mines and therefore further assessment of this performance was required.

The potential of the GICP Option 2 (120Mtpa) was explored further by assessing the alternative routes to port available to each of the mines serviced under this solution. The alternatives assumed for each mine were:

- Macmines' China Stone Project (South) mine – As explored in Comparison 1, Macmines could connect into the proposed QRN alignment, creating the QRN (90Mtpa) alternative solution.

- Vale's Degulla Coal Project mine – Vale could connect into the GVK alignment, forming part of the GVK (150Mtpa) alternative solution explored under Comparison 1.

- Waratah's China First Coal Project and Alpha North Coal Project mines – Both of these Waratah mines could connect into the GVK alignment, forming part of the GVK (150Mtpa) alternative solution explored under Comparison 1.

- The key messages resulting from these comparisons are:

    - Macmines South – The GICP Option 2 solution, at AUD9.80, indicates a cost per tonne benefit of AUD3.70 over the QRN (90Mtpa) alternative. The above rail solution provided AUD3.20 of this benefit, however, the below rail solution also performed favourably.

    - Vale - The GICP Option 2 solution has the potential to offer a benefit over the GVK (150Mtpa) alternative of around 20% to 25%, with benefits of AUD0.90 above rail and AUD1.50 below rail.

    - Waratah – The GVK (150Mtpa) alternative outperformed the GICP Option 2 (120Mtpa) solution by between 10% and 20% for the various Waratah mines serviced. However, as identified in Comparison 1 the GICP Option 1 (240Mtpa) solution outperformed the GVK (150Mtpa) alternative, indicating that the Waratah mines would also benefit if higher volumes are achieved on the GICP alignment.

    - A consistent message across all three comparisons (Macmines South, Vale and Waratah) was the importance of the GICP above rail solution with the estimated above rail cost per tonne benefits for the individual mines ranging from around 5% to 130%.

- From GVK's perspective, certainty around proponents timing and tonnages will be key to any expansion in capacity of this alternative solution above 60Mtpa. The above point indicates that it may be difficult for GVK to achieve commitments from proponents such as Vale, Macmines and Waratah where a GICP alternative exists.

- All of the above points indicate the potential viability, on a cost per tonne basis, of a GICP solution even if both the GVK and QRN alternative solutions are already in operation under long term commercial agreements.

The above results are calculated assuming the 240Mtpa of port capacity is achieved by 1 January 2030. However, we also performed a theoretical port access sensitivity that assessed the impact of accelerating the full 240Mtpa port capacity for delivery by 1 January 2017. The key messages are:

- In line with expectation, the more efficient use of the infrastructure resulted in a reduction in the cost per tonne. For the GICP option 2 component the reduction was in the region of 10% to approximately AUD8.90 per tonne.

- When compared against GICP option 1, the combined solution, at approximately AUD11.10, remains in the region of 50% to 60% less cost effective, on a cost per tonne basis. This reflects the fact that three alignments are required under this comparison. It should also be noted that the costs of GICP option 1 would similarly reduce if the port restrictions were removed.

## 2.3 Other sensitivity comparisons against alternative solutions

To further understand the competitiveness of the GICP solution we performed a number of theoretical sensitivities aimed at identifying the key strengths and weaknesses of the GICP solution when compared directly against the QRN and GVK alternative solutions.

The comparisons performed are:

- QRN (60Mtpa) against GICP (60Mtpa) servicing the same throughput coming from Adani's Carmichael Coal mine.

- GVK (60Mtpa) against GICP (60Mtpa) servicing the same throughput coming from GVK's Alpha and Kevin's Corner mines.

These comparisons assess the efficiency of the QRN and GVK corridors, each directly serving its dedicated mine(s), with that of the GICP corridor which is, for each comparison, restricted to carrying the same limited tonnage. The comparisons therefore ignore the alignment benefits offered by the GICP alignment. The results of these two separate comparisons are reported in 2.3.1.1 and 2.3.1.2 below.

Acknowledging the alignment advantages of the GICP (that it passes by the aforementioned GVK and Adani mines), we also performed the following more direct comparison:

- The combined GVK (60Mtpa) and QRN (60Mtpa) against GICP servicing the same throughput coming from both Adani's Carmichael Coal mine (60Mtpa) and GVK's Alpha and Kevin's Corner mines (60Mtpa).

This comparison sought to identify the efficiency resulting from GICP's favourable alignment over its direct competitors when carrying the same 120Mtpa. This comparison is reported in 2.3.1.3 below.

#### *2.3.1.1 QRN*

By comparing the GICP alignment with the QRN alternative solution under the same limited demand profile, our analysis indicated that even though the GICP corridor is significantly longer and restricted to tonnages significantly below its optimum capacity:

- The GICP solution offers a lower cost per tonne than the QRN alternative solution servicing only the 60Mtpa of Adani, at approximately AUD11.30 versus AUD12.90. This result is largely driven by the above rail solution which appears significantly more efficient for GICP. Based on the cost information provided by EIG, the GICP above rail cost per tonne, at AUD 2.60, is roughly 50% of the QRN cost per tonne which is approximately AUD5.00.

In addition, the alignment of the GICP solution passes closer to the Macmines South mine than the QRN alignment and, as demonstrated by Comparison 2, there appears to be a financial advantage to Macmines South in using the GICP alignment.

#### *2.3.1.2 GVK*

By comparing the GICP alignment with the GVK alternative solution under the same demand profile, our analysis indicated that even though the GICP corridor is significantly longer and restricted to tonnages significantly below its optimum capacity,:

- At approximately AUD 13.50, the overall cost per tonne resulting is broadly the same for both the GICP and GVK alignments. When considered at a below and above rail level, the GVK alternative solution appears around AUD0.20 cheaper for below rail while GICP is around AUD0.20 cheaper for above rail.

In addition, the alignment of the GICP solution means there appears to be a financial advantage to using the GICP alignment rather than the GVK alignment for many of the Galilee mines.

#### *2.3.1.3 GICP as a combined solution servicing QRN (60Mtpa) and GVK (60Mtpa)*

By combining the tonnages of the QRN (60Mtpa) and GVK (60Mtpa), this comparison sought to identify the efficiency resulting from GICP's favourable alignment over its direct competitors. Our analysis indicated that all three of the mines (Adani's Carmichael Coal, GVK's Alpha and GVK's Kevins Corner) considered in this analysis benefit from a lower cost per tonne for their access to the port under the GICP solution. The combined cost per transported tonne for the GICP solution would be approximately AUD8.60, in the region of 50% to 60% lower than the QRN and GVK two-alignment alternative solution.

## 2.4 Conclusions

The key messages resulting from our assessment are:

- For a whole-of Galilee 240 Mtpa scenario, the GICP Option 1 solution, with a combined above and below rail cost per tonne in the region of AUD7.00, appears to offer 50% to 55% more efficient solution, on a cost per tonne basis, than the combined QRN and GVK alternative solution announced by Government. Our analysis indicated that all mines included within this comparison benefited from a lower cost per tonne under the GICP alignment. This demonstrates the comparative financial efficiency of a single alignment solution to the Galilee Basin with the proposed 40 tonne axle load rolling stock.

- Our analysis indicates that Adani would benefit from a lower cost per tonne by using the GICP solution rather than the QRN alignment – even when assessed using just Adani's 60Mtpa. This benefit is largely driven from the efficiency of the GICP above rail solution.

- When operating at a reduced capacity of 120 Mtpa (combining 60 Mtpa from Adani and 60 Mtpa from the Hancock/GVK mines), the GICP solution would cost approximately AUD8.60 per tonne, estimated to be in the region of 50% to 60% lower than the QRN (60Mtpa) and GVK (60Mtpa) two-alignment alternative solution. All three of the mines assessed in the option benefit from a lower cost per tonne from the GICP solution.

- If the GVK alignment is the only alternative solution developed, our analysis indicates that the GICP alignment can be developed to provide an economically efficient solution, measured on a cost per tonne basis, for the Vale, Macmines and Adani mines. Waratah also benefits where higher volumes are achieved.

- Even if the QRN (60Mtpa) and GVK (60Mtpa) corridors are developed and operate with the support of their proponents' dedicated tonnages (Adani and GVK/Hancock respectively), our analysis indicates the GICP can still be developed to provide an economically efficient 120Mtpa solution, measured on a cost per tonne basis, for the Vale and Macmines mines and a competitive alternative for the Waratah mines.

- Our analysis indicates that the economic efficiencies offered by the GICP solution increase broadly proportionately as the volumes using the alignment increase towards the 240Mtpa considered in GICP Option 1.

- The GICP standard gauge 40 tonne axle load wagon solution is estimated to be approximately 80% more efficient than the QRN, narrow gauge, 26.5 tonne axle load solution and in the range of 15% to 20% more cost efficient than the GVK, standard gauge, 32.5 tonne axle load solution. This result is subject to further validation of the 40 tonne axle load wagon design which, although the benchmark for iron ore mines in Western Australia, has yet not been developed for Queensland coal mines.

- Further work needs to be undertaken with individual miners to define the demand and timing assumptions and further refine the cost per tonne analysis.

# 3. Introduction

## 3.1 Background and context

The Project involves "the development of a multi-user, multi-purpose freight and communications corridor, complete with heavy haul freight rail and telecommunications infrastructure", approximately 577 kilometres in total length.

EWLP has developed its Galilee Infrastructure Corridor Project ('GICP' or the 'Project') with the aim of providing a multi-user solution capable of catering for the future demands of the Galilee Basin and beyond.

The Project seeks to provide an alternative solution to those proposed by QR National ('QRN') and the Mining led proponents by providing a single corridor multi-user solution.

EWLP appointed Ernst & Young ('EY') and Everything Infrastructure Services Pty Limited, part of the Everything Infrastructure Group, ('EIG' or 'EI') as Economic Infrastructure Consultants of the Project.

- Our role was to perform a number of tasks related to financial aspects of the GICP (as listed in chapter 3.3.1).
- EIG's role was to perform works related to technical scoping and costing workstream.

## 3.2 Objectives of the GICP

The Initial Advice Statement prepared by EWLP clearly sets out the objectives of the GICP as:

"The Project will facilitate the Proponent's vision for an open access freight Corridor to Abbot Point, which is justified for the compelling economic and community benefits it will provide, including the following:

- Services the doorstep of all Galilee Basin mining tenements and aggregates their freight volumes via a single multi user, infrastructure Corridor containing a standard gauge, heavy haul rail system that delivers optimum economic efficiency to all users;
- Simultaneously introduces a standard gauge, heavy haul freight solution to Abbot Point from an integrated rail location central to the Bowen Basin coalfields;
- Provides the Abbot Point State Development Area and the proposed new port facilities with a high capacity rail connection incorporating state-of-the-art, carrier grade telecommunications to assist the centralised management of all rail traffic entering;
- For the entire Corridor incorporates advanced train control signalling on a common shared platform for optimised freight efficiency in a multi user environment;
- Promotes the State's yet unrealised ambition to connect the minerals region around Mt Isa (the North West Minerals Province) to the east coast via a heavy haul rail corridor of optimum economic efficiency by advancing such an asset nearly half the required distance; and
- Provides for future community utility services to be located within the corridor.

Further, the Corridor is sensitive to the need to preserve valuable cropping land and existing farming and other key established land uses in the parts of regional Queensland that it traverses".

## 3.3 Overview of preliminary financial and commercial feasibility work

### 3.3.1 Scope of Phase 1 works

Our response to the RFP identified a two staged approach to our work. This report focuses on the first of the two phases. In this first phase, working closely with EWLP, we had to:

- Develop preliminary access and tariff pricing principles.
- Review publicly available information setting out key demand parameters to identify potential demand side constraints.
- Utilise capital and operation cost inputs provided by EIG.
- Develop a comparative pricing model to assess the economic feasibility of GICP.
- Document assumptions and obtain EWLP signoff
- Run scenarios as agreed with EWLP.

From an early stage it became apparent that the demand scenarios were best aligned with the financial model. As such, we also developed the demand model which forms part of the financial model and enables real time sensitivity analysis.

In performing our assessment we have applied consistent pricing assumptions to the input costs provided by EIG for the purpose of comparison. However, we have not engaged with either QRN or GVK to test the assumptions applied for the alternative solutions.

### 3.3.2 EIG cost analysis

During Phase 1 EIG has performed "order of magnitude costing analysis", split between below and above rail, for the demand and operating scenarios identified and agreed with EWLP. EIG has provided a separate "Above and below rail comparative cost estimates" report detailing this work.

The outputs of EIG's work form a key input to our financial model and, to ensure an efficient transfer of information from EIG to EY, a number of cost templates were agreed which were used to populate our financial model. We have included the templates in Appendix D to this report to provide a clear audit trail between the two reports, Appendix E also provides a reconciliation from the financial model back to these costs.

Key limitations on risk identified in EIG's report, that are important to understand in the context of our work, include:

- The cost assessments performed by EIG for both above and below rail comparable costs have been prepared as a desktop study only at this stage.
- Key assumptions have been based on preliminary alignment and earthworks volume information provided by EWLP, information available from the public domain and the above and below rail experience of the EIG team.

- It is anticipated that further scope definition including design of specific items such as the standard profile, the vertical and horizontal rail alignment, the sizing of structures and drainage through floodplains, coal wagon technical performance specifications and detailed train system operational modelling will increase the level of project definition and improve the accuracy of the cost estimates for both above and below rail components.

- With the aim of achieving valuable economies of scale, EWLP propose using a 40 tonnes axle load wagon. This theoretical wagon will be based on the characteristics of wagons existing today. Further design and manufacture of a 40 tonnes axle load wagon may impact the preliminary modelling undertaken for this assessment. Further detail modelling will be undertaken at a later stage to test the assumptions related to the 40 tonnes axle load wagons' design.

### 3.3.3 Work to be performed at Phase 2

A number of the activities identified as Phase 1 activities in the Professional Services Agreement will now fall into Phase 2 as residual Phase 1 activities. This reflects the dynamic nature of the Project which has witnessed numerous government announcements since our engagement. The activities are:

Structuring and commercial workstream

- Identify other supply chain risks that impact commercial structure.

- Develop engagement plan for both government and miners.

- Develop entity / governance structure options, workshop these with EWLP and assess the options against EWLP objectives.

- Develop and workshop commercial risk allocation addressing delivery, operations and financing risks.

- Develop key principles supporting a financing package.

- Develop contractual framework for preferred commercial options.

- Facilitate engagement with government and miners.

Financial modelling workstream

- Agree with EWLP on an indicative financing package to be modelled. Consider key parameters including tenor, currency, gearing, margins, target return, etc.

- In the first phase, the length of the existing QRN alignment upon which the financial modelling was performed was understated by around 22 kilometres. In terms of costs, this difference only impacts the track maintenance costs which are driven by kilometres, all other costs provided by EIG are driven by tonnages. As the scale of impact on the costs is small in comparison with the project costs and does not impact the key messages the figures within this report were not updated to reflect this understatement. During Phase 2 the alignment length will be updated.

# 4. Current proposed Galilee rail solutions

This section considers the qualitative characteristics of the alternative rail solutions being proposed for infrastructure to the Galilee Basin.

At the outset of our engagement on this Project there were four proponents seeking approvals to construct railway infrastructure to the Galilee Basin:

- Adani – An East-West corridor seeking access to the existing QRN network near Moranbah.
- GVK / Hancock – A North-South corridor from Abbot Point Port to the GVK / Hancock coal reserves in South Galilee.
- QRN – An extension of QRN's existing capacity with a corridor connecting the North Galilee and another connecting the South Galilee. The existing network would be upgraded.
- Waratah - A North-South corridor from Abbot Point Port to the Waratah coal reserves in South Galilee.

Note – The BHP Billiton proposed rail infrastructure from Abbot Point to near Moranbah is not being assessed for the purposes of this engagement as this line would not service the Galilee Basin.

However, an announcement from the Queensland Government on 6 June 2012 stated its support for " two rail corridors to service new and existing coal mines in both the Galilee and Bowen Basins", namely:

- QRN - "An east-west corridor will see an extension of the existing QR National network from near Moranbah to the central Galilee Basin and will provide links to coal ports of Abbot Point, Dalrymple Bay and Dudgeon Point".
- GVK - "A north-south rail corridor will be defined along the proposed GVK-Hancock Coal alignment to facilitate the construction of new standard gauge rail lines to link the proposed large-scale, vertically integrated mining operations in the southern Galilee Basin to Abbot Point".

The announcement states that Adani is currently developing the QRN alignment with QRN, therefore Adani's own corridor was not considered further within this assessment. The Adani and QRN corridors are, in any event, on a similar east-west alignment.

Waratah's proposed corridor, whilst similar in alignment and length to the corridor proposed by GVK, has been qualitatively assessed by EIG, on the basis of publicly available information, as having a lower operational efficiency factor and, as such, has not been assessed further within this report.

In light of this announcement this section focuses on assessing the QRN and GVK solutions.

The table below details the high level technical characteristics of the proposed solutions, including comparable information for the EWLP Project.

Table 3: Summary of proponents projects against the GICP project

| Project Proponent | Areas Served | Total Length (km) | Gauge system | Axle loading / train payload | Capacity |
|---|---|---|---|---|---|
| EWLP | North and South Galilee | 577 km | Standard Gauge | 40t | With passing loops and duplication capable of in excess of 300Mtpa |
| QRN[7] | North Galilee | 381km from Adani mine to Abbot Point port[8] | Expected to be Narrow Gauge, consistent with existing track | Expected to be 26.5t consistent with existing track | 60Mtpa to 80Mtpa[9] |
| GVK[4] | South Galilee | 495 km[10] | Standard gauge | 32.5t | Initial capacity of 60Mtpa, scalable to 120Mtpa with duplication increasing capacity to 250Mtpa[11] |

## 4.1 Galilee mines serviced by railway solutions

The table below summarises which mining sites have potential, for the purpose of this assessment, to be served by each of the railway projects.

- GICP is a single corridor solution designed to service the whole of the Galilee Basin.
- QRN is a North Galilee solution.
- GVK is primarily a South Galilee solution.

Table 4: Summary of mines serviced by rail infrastructure

| Mine site | Proponent | EWLP | QRN | GVK / Hancock |
|---|---|---|---|---|
| South Galilee Coal Project | AMCI & Bandanna Energy Ltd | Potential with spur | Potential with spur | No |
| China First Coal Project | Waratah | Yes | No | Yes |
| Alpha Coal Project | Hancock/GVK | Yes | No | Yes |
| Alpha West Project | Hancock/GVK | Yes | No | Yes |
| Kevin's Corner Project | Hancock/GVK | Yes | No | Yes |
| Alpha North Coal Project | Waratah | Yes | No | Yes |
| Alpha West Coal Project | Waratah | Yes | No | Yes |
| Degulla Coal Project | Vale | Yes | No | Yes |

[7] QR National IAS - December 5 2011
[8] The length of the existing QRN alignment upon which the financial modelling was performed was understated by around 22km, should be 403km. Difference does not impact the key messages and the figures within this report were not updated to reflect this understatement. During phase 2 the alignment length will be updated
[9] Reuters article of 2 July 2012 http://uk.reuters.com/article/2012/07/02/uk-adani-rail-idUKBRE86104420120702?feedType=RSS&feedName=businessNews
[10] May 2012 presentation from Paul Mulder, MD Coal at GVK length is 495km, 10km longer than information assumed in EIG costing which is 485km
[11] May 2012 presentation from Paul Mulder, MD Coal at GVK

| Mine site | Proponent | EWLP | QRN | GVK / Hancock |
|---|---|---|---|---|
| Carmichael East Coal Project | Waratah | Yes | Yes | No |
| Carmichael Coal Project | Adani | Yes | Yes | No |
| China Stone Project - South | Macmines | Yes | Yes | No |
| China Stone Project - North | Macmines | Potential with spur | No | Potential with spur |

# 5. Capacity and demand parameters

In this section we consider the scale and timing of the railway operation. For the purpose of doing this analysis we had to make assumptions on three key components:

- Proposed port capacity.
- Mining demand and throughput.
- Corridor capacity.

Together, this information has been used to determine the demand for each of the options under consideration.

## 5.1 Abbot Point Port capacity

### 5.1.1 Current port situation

#### *5.1.1.1 Existing terminal (Terminal 1)*

The existing terminal is leased and operated by a subsidiary of the Adani Group. The actual throughput of the terminal is currently in the region of approximately 14Mtpa (2011/12 actuals[12]). However, we understand that the terminal is fully subscribed for its 50Mtpa capacity. As such, we understand that there is no capacity available at the existing terminal.

#### *5.1.1.2 Proposed expansions*

A government press release by the Deputy Premier Jeff Seeney on 31 May 2012 stated that there would be 160Mtpa resulting from the expansion of three terminals at Abbot Point, Terminals 0, 2 and 3. The following table summarises our understanding of the capacities at each and also the availability to service Galilee Basin coal.

Table 5: Abbot Point port capacity

| Terminal | Investor | Expansion Capacity (Mtpa) | Utilised by Bowen Basin Coal | Residual Capacity |
|---|---|---|---|---|
| Terminal 1 expansion (also known as Terminal 0) | Mundra Port Pty Ltd (Adani Group) | 40 | - | 40 |
| Terminal 2 | BHP Billiton Limited | 60 | 60 | - |
| Terminal 3 | GVK-Hancock | 60 | - | 60 |
| **Total proposed expansions** | | **160** | **60** | **100** |

[12] NQBP website

#### *5.1.1.3 Future expansion*

The same government press release (31 May 2012) stated that the government "*will be discussing with industry what additional capacity is needed beyond that*".

It also stated that the "*approach to expansion of infrastructure at Abbot Point is a more practical, more realistic, more sensible and more deliverable plan than the unrealistic and undeliverable proposals from the former, failed Bligh Government*".

This followed a previous press article on 19 May 2012 that effectively cancelled the previously proposed Terminals 4 to 9 expansions and Multi Cargo Facility.

It is therefore clear that the government intends to propose a port solution for parties not catered for under the existing expansion proposals. However, there is uncertainty as to the nature, location and timing of any future expansions.

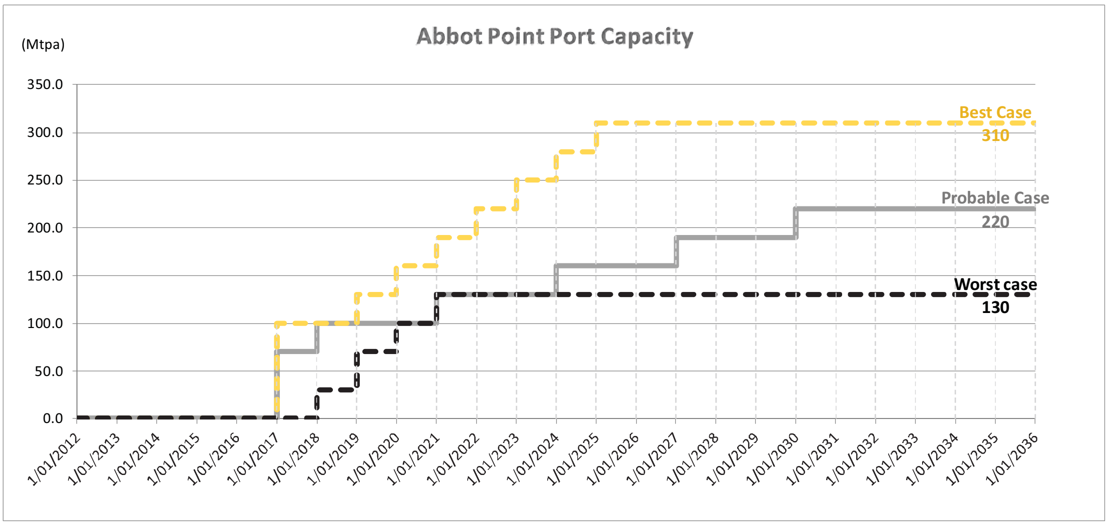
### 5.1.2 Abbot Point Port capacity scenarios

The development of port capacity scenarios is of vital importance for determining the timing and scale of the EWLP rail system, especially in light of the uncertainty surrounding the future expansion of Abbot Point Port. A demand model has been developed utilising the port capacity and publicly available miner volumes to determine the demand of the project.

Abbot Point port capacity scenarios were identified and agreed with EWLP at operational scenario meetings held on 29 May 2012 and 31 May 2012. These scenarios consider the capacity available to service Galilee coal, it is assumed that Bowen Basin coal will be serviced outside of this capacity.

The following chart summarises the agreed port capacity scenarios.

Chart 7: Abbot Point port capacity for Galilee coal




The key assumptions underlying the above chart are as follows:

#### *5.1.2.1 Best case*

- 1 July 2017 delivery of T0 (40Mtpa) and T3 (60Mtpa)
- 1 January 2019 ramp up of capacity at 30Mtpa per year for 7 years

- Ultimate capacity of 310Mtpa achieved at 1 January 2025

#### *5.1.2.2 Probable case (base case)*

- 1 January 2017 delivery of T0 (40Mtpa) and T3 (30Mtpa)
- 1 January 2018 delivery of remaining 30Mtpa at T3
- 1 January 2021 delivery of 30Mtpa additional capacity every 3years for 4 tranches (120Mtpa in total)
- Ultimate capacity of 220Mtpa achieved at 1 January 2030

#### *5.1.2.3 Worst case*

- 1 January 2018 delivery of T3 (first 30Mtpa)
- 1 January 2019 delivery of T0 (40Mtpa)
- 1 January 2020 delivery of remaining 30Mtpa at T3
- 1 January 2021 delivery of 30Mtpa additional capacity once only
- Ultimate capacity of 130Mtpa at 1 January 2021

## 5.2 Dudgeon Point Port capacity

In addition to the capacities available at Abbot Point Port, the GICP Option 1 alignment (considered in section 6.2) includes a link into the QRN network and assumes that Adani will utilise this access to transport 20Mtpa of coal to Dudgeon Point Port where it also has terminal facilties.

This capacity does not exist for GICP Option 2 (considered in Comparisons 2 in sections 11) which does not link into the QRN network.

When considering the alternative solutions:

- The QRN solution is linked to the existing QRN network and therefore has access to this 20 Mtpa of Dudgeon Point Port.
- The GVK solution does not link into the existing QRN network and therefore does not have access to this additional capacity.

When combined with the Abbot Point port capacity this creates capacity of up to:

- Best Case = 330 Mtpa
- Probable Case = 240Mtpa
- Worst Case = 150Mtpa

## 5.3 Mine demand and throughput

### 5.3.1 Galilee Basin Mines

In assessing the miner demand we performed a review of publicly available information. There are currently 12 mines proposed in the Galilee Basin, the following table provides a summary of the key characteristics of each. Details of our study are included in Appendix A.

Table 6: Miner demand assumptions

| | Project Name | Proponent | Type | Range of volume of cleaned coal (Mtpa) | Volumes assumed for analysis (Mtpa)[13] | Operational commencement [14] | Reserve Mine Life |
|---|---|---|---|---|---|---|---|
| 1 | South Galilee Coal Project | AMCI & Bandanna Energy Ltd | open-cut & underground coal | 15-20 | 15 | 2015 | 1 Bn Tonnes<br>43 years |
| 2 | China First Coal Project | Waratah | open-cut & underground coal | 40 | 40 | 2014 | 3.7 Bn Tonnes[15]<br>66 years |
| 3 | Alpha Coal Project | Hancock / GVK | Open-cut coal | 30 | 30 | Q2 2015 | 1.82 Bn tonnes<br>30 years |
| 4 | Alpha West Project | Hancock / GVK | Underground coal | 16-24 | 16 | 2016 | 1.8 Bn tonnes<br>30+ years |
| 5 | Kevin's Corner Project | GVK | open-cut & underground coal | 30 | 30 | Q4 2015 | 4.3 Bn tonnes<br>About 30 years |
| 6 | Alpha North Coal Project | Waratah | coal | 40 | 40 | Q4 2016 | 3.5 Bn tonnes<br>About 62.5 years |
| 7 | Alpha West Coal Project | Waratah | Coal | No details | - | No details | No details |
| 8 | Degulla Coal Project | Vale | coal | 20-40 | 20 | Unknown<br>2016[16] assumed for purpose of study as agreed with EWLP | No details |
| 9 | Carmichael East Coal Project | Waratah | Coal | No details | - | No details | No details |
| 10 | Carmichael Coal Project | Adani | open-cut & underground coal | 60 (from 2022) | 60 | 2014[17] | 7.8 Bn tonnes<br>Over 100 years |
| 11 | China Stone Project - South | Macmines | open-cut & underground coal | 30 | 30 | 2016 | 3.7 Bn tonnes[18]<br>About 46 years |
| 12 | China Stone Project - North | Macmines | open-cut & underground coal | 30 | 30 | No details<br>2016 assumed for purpose of study as agreed with EWLP | No details |
| | Total Galilee Basin | | | 311-344 | 311 | | |

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[13] Assumes the lower figure within the range proposed by miners
[14] Assumes 1 January for modelling purposes where not stated otherwise.
[15] Subject to mining permit extension
[16] Bloomberg article : Australia's $32 Billion Galilee Coal Basin Needs Joint Rail, Vale Says. (http://mobile.bloomberg.com/news/2011-11-23/australia-s-32-billion-galilee-coal-basin-needs-joint-rail-vale-says)
[17] Adani press article of 2 July 2012 suggests July 2013 operational commencement. Original timing retained for purpose of financial modelling (http://in.reuters.com/article/2012/07/02/us-adani-rail-construction-idINBRE86107H20120702)
[18] Could go up to 9.7 Bn depending on permit extension (largest coal resource in the Galilee Basin)

Our analysis has identified that there is a significant degree of uncertainty surrounding the timing of these mines. This appears to be driven by a number of factors including potential constraints imposed by port and rail connectivity.

### 5.3.2 Bowen Basin Mines

The Galilee Basin mines will experience competition for port capacity from the Bowen Basin mines. In particular, this is evidenced by the fact that Rio Tinto, Anglo and NQCT (made up of Peabody, New Hope, Middlemount and Carabella) were all involved in the recently cancelled T4-T9 proposals with 30Mtpa each.
As well as Abbot Point Port, the Bowen Basin miners, serviced by the QRN network, will have the option to go south to Dudgeon Point Port.

For the purpose of our assessment, we have assumed that there will be sufficient port capacity for Bowen Basin miners at Abbot Point port and Dudgeon Point Port.

### 5.3.3 Ability of mines to deliver on time

Most of the mines noted in the above table are expected to deliver between 2014 and 2016. However, the initial tranches of port capacity are owned by Adani and GVK / Hancock and it is not until 1 January 2019 at the earliest (in the Best Case scenario) that the demand of other miners can be satisfied.

These timeframes have been assumed deliverable for the purpose of our study. An important aspect of Phase 2 will be the market testing exercise to be performed with the mining community. This activity will allow refinement of the demand assumptions and provide further confidence in the analysis.

## 5.4 Corridor capacity

It has been assumed for the purpose of this study that the corridor capacity will be increased using passing loops and duplication to meet the modelled demand.

## 5.5 Demand profile assumptions

In assessing the demand profiles applicable for each of the options and comparisons we applied a number of assumptions, they were:

- Mine demand will be delayed until railway and port infrastructure is available to service the demand. The port capacity is treated as the restricting factor.
- Mines can be delivered by the dates stated in Table 6 above, delayed as appropriate to match the port capacity.
- The contracted tonnages may be lower than the ultimate annual demand of a mine where this is necessary for maximising the demand throughput.
- The minimum level of tonnages contracted for is assumed as 15Mtpa for each mine. Where a mine has already contracted the minimum 15Mtpa and has additional demand, no minimum is applied to any subsequent contracted volumes.
- It is assumed that Terminal 0 services the Adani mine only and Terminal 3 services the GVK / Hancock mines only.

- Where Adani and GVK / Hancock mines are not involved in a scenario it is assumed that their port capacity is also not available. All remaining port capacity is assumed to be available to the Project.

- The tonnage volumes proposed by miners will take a number of years to be achieved. For the purpose of the study we have assumed the mines ramp up on the following profiles:

Table 7: Ramp up profiles

| Profile | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Source |
|---|---|---|---|---|---|---|---|---|
| Adani | 14.3% | 28.6% | 42.9% | 57.1% | 71.4% | 85.7% | 100.0% | Adani IAS full capacity by 2022.<br><br>Assumed straight line |
| GVK / Hancock | 25.0% | 50.0% | 75.0% | 100.0% | 100.0% | 100.0% | 100.0% | GVK presentation by Paul Mulder (May 2012) – Kevins Corner 2016 to 2019 ramp up.<br><br>Assumed straight line. |
| All others mines | 25.0% | 25.0% | 50.0% | 50.0% | 75.0% | 75.0% | 100.0% | EWLP agreed |

These assumptions reflect the approach agreed with EWLP at the operational scenario meetings held on 29 May 2012 and 31 May 2012.

# 6. Definition of GICP Options and key comparisons

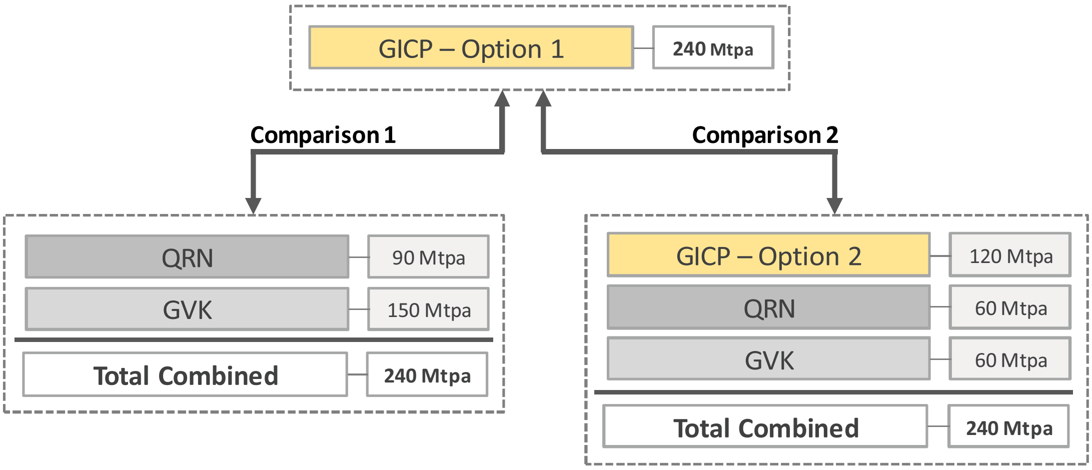
This section defines the GICP Options and comparisons considered within this report.

## 6.1 Options under consideration

The government's announcements on 6 June 2012 in relation to its support for two rail corridors, namely the QRN East-West corridor and the GVK North-South corridor, shaped the direction of this analysis[19].

As a result, this report focuses on comparing EWLP's preferred solution, GICP Option 1, against alternative multi-alignment solutions involving QRN, GVK and smaller scale GICP Options. EWLP's Option 1 and the various comparisons are defined below.

Graphic 5: Definition of Comparison 1 and 2




## 6.2 GICP Option 1 - single alignment solution

GICP Option 1 is a single alignment Galilee Basin solution capable of serving all miners in the Basin. It has the following key characteristics:

- Route from Abbot Point to South Galilee capturing all proposed Galilee mines with the exception of:
  - AMCI – Proposed alignment does not extend as far South as this mine. However, the proposed alignment of the GICP provides the ability for AMCI to connect to the alignment using a spur.
  - Macmines North – Proposed alignment does not currently extend north to this mine. However, the proposed alignment of the GICP provides the ability for Macmines North to connect to the alignment using a spur

[19] On 7 June 2012 EWLP received a letter from Deputy Premier Jeff Seeney dated 6 June 2012 in relation to the government's announcement. A workshop between EWLP, EIG and EY was held on 8 June 2012 to discuss the implications of this letter and agree the direction of the analysis. GICP Options 1, comparison 1 and comparison 2 were defined in this workshop. An unrestricted port access scenario was subsequently agreed at a workshop on 26 June 2012, this is included as a sensitivity to Comparison 2.

- Assumes no competing rail alignments.
- Alignment links to QRN existing network to allow Adani access to Dudgeon Point where 20Mtpa of coal is assumed to flow. The track needs to be Dual Gauge from Adani to North Goonyella where the EWLP track meets the QRN track to accommodate the fact that the QRN track is narrow gauge. It is assumed that no coal hub is required at this connection point and that Adani will separately negotiate access to QRN track.
- Standard gauge for the remainder of the track.
- 40t axle load is assumed for the full alignment.
- Timing and scale is restricted by Abbot Point port capacity which is 220Mtpa in the Probable Case (refer to section 5.1.2.2) with 20Mtpa being assumed for Dudgeon Point port from 2017.

The following table summarises the mines serviced by GICP Option 1.

Table 8: GICP Option 1 mines serviced

| Mine site | Proponent | Mines Serviced |
|---|---|---|
| South Galilee Coal Project | AMCI & Bandanna Energy Ltd | No |
| China First Coal Project | Waratah | Yes |
| Alpha Coal Project | Hancock/GVK | Yes |
| Alpha West Project | Hancock/GVK | Yes |
| Kevin's Corner Project | Hancock/GVK | Yes |
| Alpha North Coal Project | Waratah | Yes |
| Alpha West Coal Project | Waratah | Yes |
| Degulla Coal Project | Vale | Yes |
| Carmichael East Coal Project | Waratah | Yes |
| Carmichael Coal Project | Adani | Yes |
| China Stone Project - South | Macmines | Yes |
| China Stone Project - North | Macmines | No |

### 6.2.1 Assumed demand profile

The chart below depicts the assumed demand profiles for GICP Option 1 under the Probable Case Port scenario. The first summarises the proposed contracted volumes and the second the volume throughput. Appendix C includes tables with the figures supporting the charts.

Chart 8: Option 1 contracted volumes

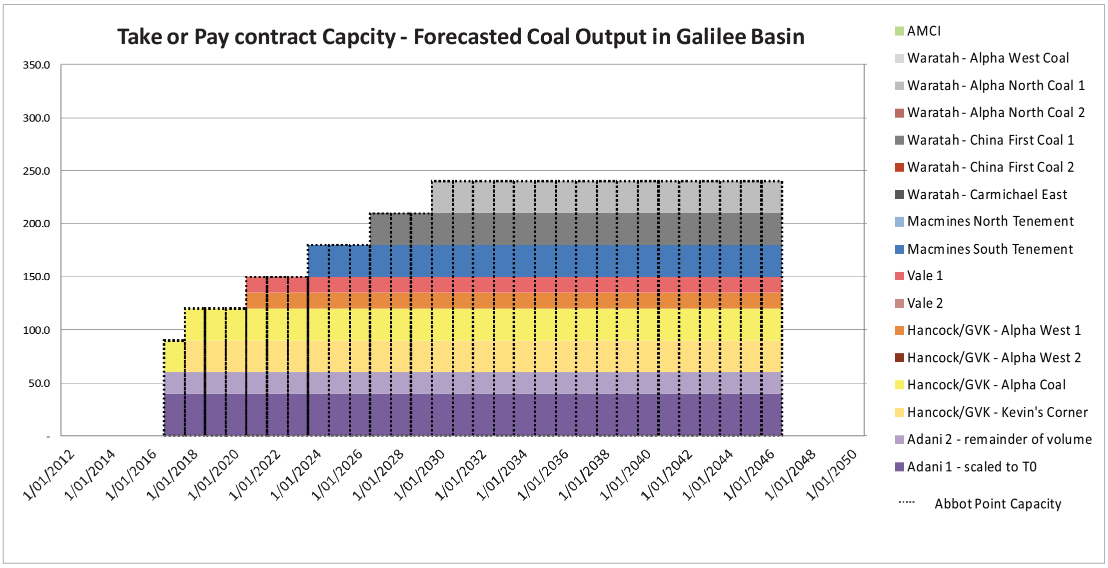
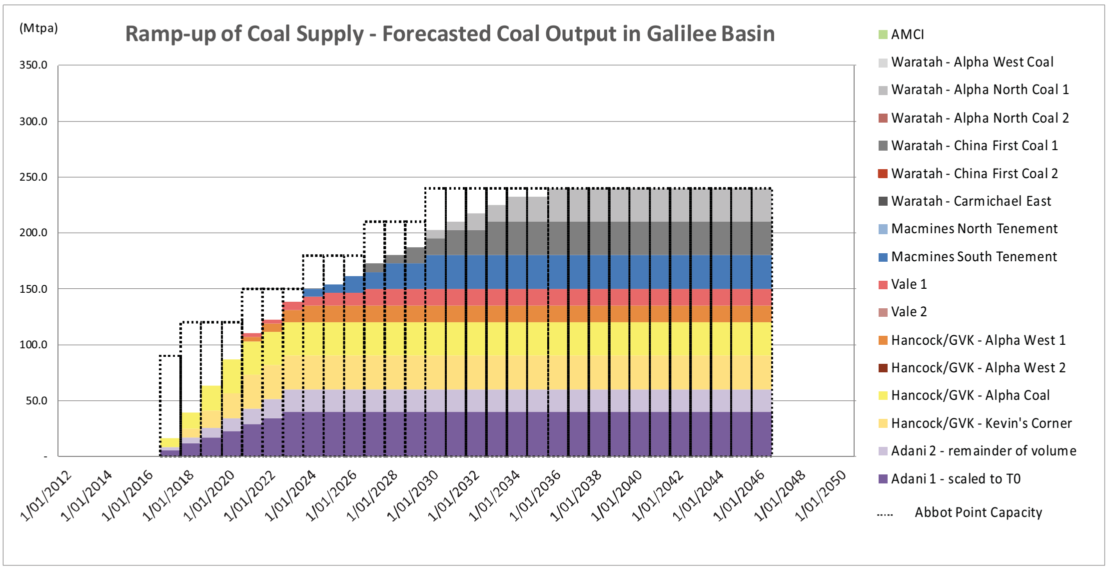



Chart 9: Option 1 volume throughput




## 6.3 Key Comparisons

Two key scenarios were selected for comparison against GICP Option 1, each is detailed below.

The demand profiles specific to each comparison are included within the relevant sections 10 to 12 which assess the comparisons performed. Demand profiles were shared with EWLP and EIG for comment and agreement and used by EIG in its staging and costing exercise.

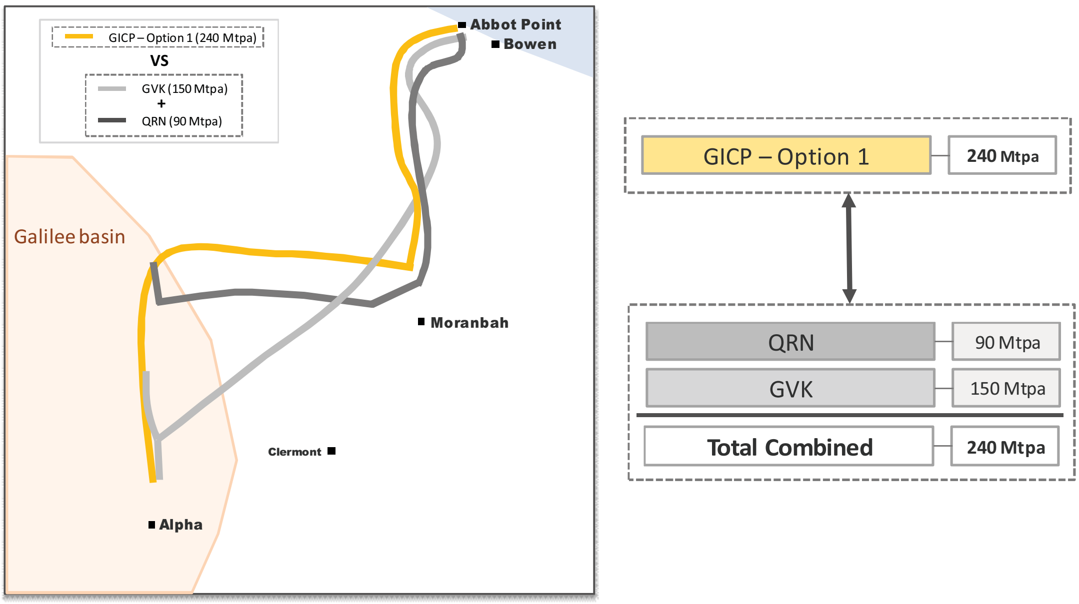
### 6.3.1 Comparison 1

Comparison 1 compares GICP Option 1 against a combined QRN and GVK solution that would serve the same purpose of servicing all of the mines in the Galilee Basin. The comparison is performed on a directly comparable basis using the tonnage profiles proposed for GICP option 1, with:

- QRN servicing North Galilee – 90Mtpa solution of which 20Mtpa (Adani) is transported to Dudgeon Point with the remaining 70Mtpa being transported to Abbot Point.

- GVK servicing South Galilee – 150Mpta solution, all of which is transported to Abbot Point.

Graphic 6: Rail alignments assessed in comparison 1[20]




The following table summarises the assumed split of mines between QRN and GVK for the purpose of Comparison 1.

Table 9: Comparison 1 mines serviced

| Mine site | Proponent | GICP Option 1 | | QRN | GVK |
|---|---|---|---|---|---|
| South Galilee Coal Project | AMCI & Bandanna Energy Ltd | No | | No | No |
| China First Coal Project | Waratah | Yes | | No | Yes |
| Alpha Coal Project | Hancock/GVK | Yes | | No | Yes |
| Alpha West Project | Hancock/GVK | Yes | | No | Yes |
| Kevin's Corner Project | Hancock/GVK | Yes | | No | Yes |
| Alpha North Coal Project | Waratah | Yes | | No | Yes |
| Alpha West Coal Project | Waratah | Yes | | No | Yes |
| Degulla Coal Project | Vale | Yes | | No | Yes |
| Carmichael East Coal Project | Waratah | Yes | | Yes | No |
| Carmichael Coal Project | Adani | Yes | | Yes | No |
| China Stone Project - South | Macmines | Yes | | Yes | No |
| China Stone Project – North | Macmines | No | | No | No |

The characteristics of the alternative solutions are considered further in section 4.

[20] This is an Ernst & Young graphical representation of alignment for information purposes and is not to scale.

## 6.3.2 Comparison 2

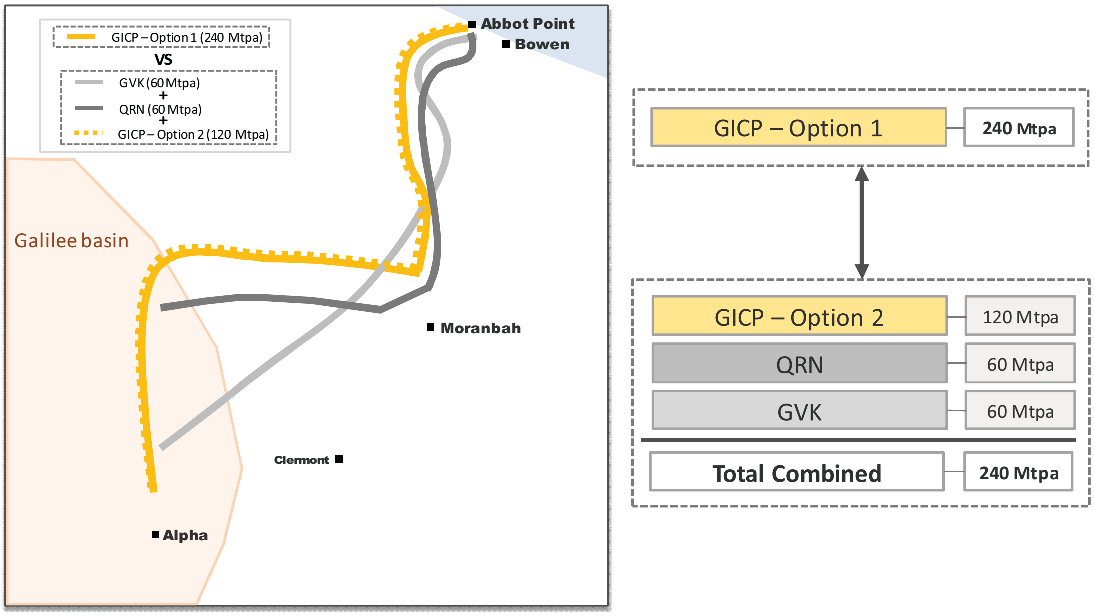
Comparison 2 compares GICP Option 1 against a solution comprising three railways:

- QRN servicing Adani only, assuming Adani services its own port capacity – 60Mtpa solution of which 20Mtpa is transported to Dudgeon Point with the remaining 40Mtpa being transported to Abbot Point. The scale of this railway being restricted by the scale of Abbot Point port capacity that Adani has secured (refer to section 5.1.1.2).

- GVK servicing GVK's first 60Mtpa, assuming GVK services its own port capacity – 60Mpta solution, all of which is transported to Abbot Point. The scale of this railway being restricted by the scale of Abbot Point port capacity that GVK has secured (refer to section 5.1.1.2).

- GICP Option 2 servicing all remaining mines to a maximum of 120Mtpa – 120Mpta solution, all of which is transported to Abbot Point. It is assumed that EWLP will secure all future port capacity and has access to all remaining miner demand. The entire alignment will be a standard gauge track as no access to the QRN network or other ports is assumed. All other characteristics remain consistent with GICP Option 1.

Graphic 7: Rail alignments assessed in comparison 2[21]




The purpose of this comparison is twofold:

- To assess the viability of the EWLP alignment at lower volumes solution.

- To assess the viability of a segregated solution against a single line solution.

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[21] This is an Ernst & Young graphical representation of alignment for information purposes and is not to scale.

The following table summarises the assumed split of mines for the purpose of Comparison 2.

Table 10: Comparison 2 mines serviced

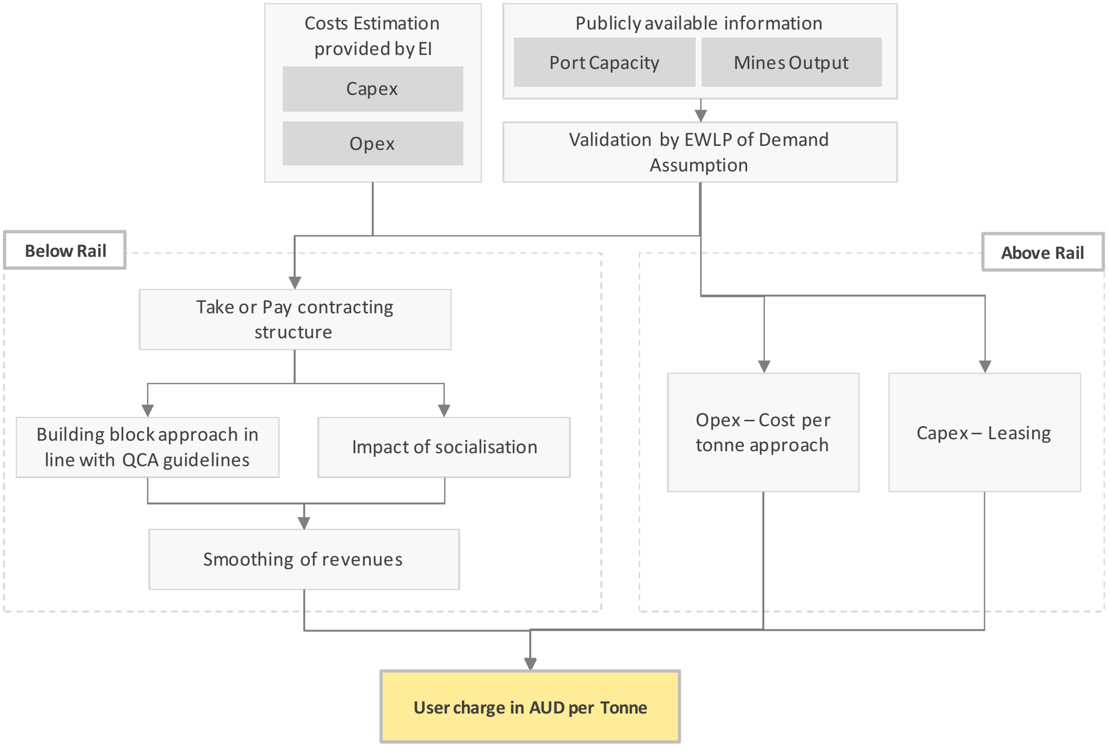
| Mine site | Proponent | GICP Option 1 | | GICP Option 2 | QRN | GVK |
|---|---|---|---|---|---|---|
| South Galilee Coal Project | AMCI & Bandanna Energy Ltd | No | | No | No | No |
| China First Coal Project | Waratah | Yes | | Yes | No | No |
| Alpha Coal Project | Hancock/GVK | Yes | | No | No | Yes |
| Alpha West Project | Hancock/GVK | Yes | | Yes | No | No |
| Kevin's Corner Project | Hancock/GVK | Yes | | No | No | Yes |
| Alpha North Coal Project | Waratah | Yes | | Yes | No | No |
| Alpha West Coal Project | Waratah | Yes | | Yes | No | No |
| Degulla Coal Project | Vale | Yes | | Yes | No | No |
| Carmichael East Coal Project | Waratah | Yes | | Yes | No | No |
| Carmichael Coal Project | Adani | Yes | | No | Yes | No |
| China Stone Project - South | Macmines | Yes | | Yes | No | No |
| China Stone Project - North | Macmines | No | | No | No | No |

The characteristics of the alternative solutions are considered further in section 4.

# 7. Methodology of analysis

The diagram below summarises the methodology employed in our analysis.

Graphic 8: Methodology diagram




The key aspects are considered in detail below.

## 7.1 Take or Pay contracting structure

The EWLP railway is being developed as a multi user solution for the Galilee Basin. As such, it is assumed that the railway will operate Take or Pay when contracting the capacity.

Take or Pay contracts are commonly used by infrastructure companies when transacting with the mining community and are accepted as the market norm.

## 7.2 Tariff structure and socialisation - Below Rail

For the purpose of this assessment we have assumed that the tariff structure for the below rail assets follows a building block approach, an approach is closely associated with regulated industries. The Queensland coal rail infrastructure is currently regulated by QCA and this approach has historically been used to price below rail access and is an acceptable approach to the mining community.

In the public domain there are two levels of return used for price setting:

- QCA regulated return of 9.96% vanilla WACC – This reflects the QCA's determination for QRN.

- Above regulated return of 13.62% vanilla WACC – This reflect the return that QRN secured on its recent GAPE project.

We have assumed that the above regulated return applies for the purpose of our financial modelling. However we have performed sensitivity analysis applying the QCA regulated return within Comparison 1 to provide a range of outcomes.

### 7.2.1 Socialisation

The socialisation of costs between miners is an important component of the tariff structure. In the market, there are a couple of variations on the approach to the socialisation of costs, however, for the purpose of this assessment we have assumed that at any point in time, the costs associated with a zone are shared between users based upon the contracted volumes of each user of the zone.

We will explore socialisation options further at Phase 2 of the project.

### 7.2.2 Building Block approach

The building block approach can be applied using either a post-tax or pre-tax approach. For the purposes of this analysis, a post-tax approach has been used.

Under the post-tax building block approach, there are five building blocks which make up the revenue requirement:

1. Return of Asset - is an allowance for the depreciation of the assets that compensates investors for their loss in value over time. This is calculated based on the value of the Asset Base and the assumed asset lives.

2. Return on Asset - is derived by applying a rate of return (e.g. the WACC) to the value of the Asset Base.

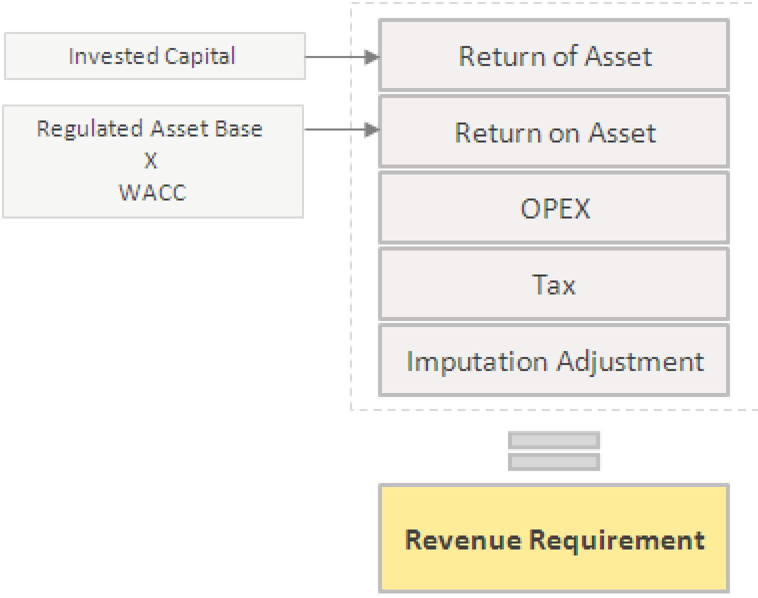
3. An allowance for the efficient operating and administrative costs required to provide the service.

4. An allowance for the expected tax liability arising from the revenue.

5. An adjustment related to Dividend Imputation corporate tax policy in Australia.

The following diagram captures the key components of the building blocks logic.

Graphic 9: Building Bloc Logic – Revenue construction




The calculation methodology associated with each of these building blocks is considered below.

#### 7.2.2.1 Return of Asset

With Return of Asset, the consortium is able to recover its invested capital through regulatory depreciation.

#### 7.2.2.2 Return on Asset

Under the post-tax building block approach, the 'Return on Asset' is derived by applying a rate of return to the RAB. In determining a rate of return on an asset, the building block approach assumes that the consortium:

- Meets benchmark levels of efficiency; and
- Uses a financing structure that meets benchmark standards of gearing and other financial parameters for a going concern and reflects in other respects best practice.

The rate of return under a post-tax framework typically assumes the WACC to be representative of the rate of return. For example, the formula to calculate a "post-tax WACC" (also known as a vanilla WACC) is shown below.

$$WACC = Ke \times \frac{E}{V} + Kd \times \frac{D}{V}$$

Ke is the return on equity (determined using the CAPM) and is calculated as rf + βe × MRP

| | |
|---|---|
| rf | is the nominal risk free rate |
| βe | is the equity beta; and |
| MRP | is the market risk premium; |

Kd is the return on debt and is calculated as rf + DRP, where:

| | |
|---|---|
| DRP | is the debt risk premium |

| | |
|---|---|
| *E/V* | is the value of equity as a proportion of the value of equity and debt, which is 1 - D/V; and |
| *D/V* | is the value of debt as a proportion of the value of equity and debt. |

The WACC used within our financial model is a nominal WACC and therefore must be applied to nominal costs. To ensure that the Return on Asset calculates correctly the Asset was inflated before the WACC was applied to it. It was then necessary to include a negative inflation adjustment to the Return of Asset to ensure that this component was not overstated.

#### *7.2.2.3 OPEX*

Operating expenditure reflects the costs that would be incurred by a prudent service provider, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of service delivery.

#### *7.2.2.4 Tax*

Under a post-tax framework, the cost of tax is calculated explicitly as a separate building block. This requires the WACC to be defined as a nominal Vanilla WACC (i.e. Excluding the impact of tax).

The calculation of taxable income assumes that:

- ► Required revenue qualifies as assessable income;
- ► ►There are three tax deductible expenses –allowed opex, interest expense (which is calculated based on the assumed cost of debt in the allowed WACC and the debt proportion of the capital base) and depreciation of assets using applicable tax depreciation rules and rates.

#### *7.2.2.5 Imputation Adjustment*

The Australian Tax system allows companies to attach franking credits to dividend paid in an attempt to eliminate double taxation upon company profits.

$$\text{Franking credit} = \frac{T}{1-T} \text{x Dividend x Y}$$

T Company Tax Rate

Y Imputation Credit Utilisation Rate

The imputation Adjustment block takes into account the impact of this tax credit on the maximum allowable revenue calculation.

### 7.2.3 Revenue requirement and smoothing

The revenue requirement results from the combination of these components. For the purpose of this assessment we smoothed the revenue requirement over the life of the railway operation. To perform this smoothing we calculated the Net Present Value ('NPV') of the revenue cashflows resulting from the building block model and targeted the same NPV using revenues that remain constant over the operational life in 2012 prices. These figures were used to calculate the cost per tonne charged to the miners.

## 7.3 Above Rail – Lease and Operating Expenditure

Above rail assets are not modelled on the same basis as the below rail assets. It is common for Rolling Stock to be procured via a lease from a Rolling Stock lessor (typically a bank or finance house).

For the purpose of this financial analysis, we have reflected the lease charges associated with the initial investment and overhauls of rolling stock as a constant annuity payable over the useful economic life of the asset.

The operational expenditure of the above rail assets for each mine is directly derived from the tonnages and distance travelled.

The financial model determines the rail haulage charges for routes from each of the mines based upon the tonnage profiles described previously. These charges are provided on both a price per tonne and a price per tonne kilometre basis.

## 7.4 Tariff structure – Above Rail

The structuring and charges associated with the above rail assets can be handled in a number of different manners, including:

- Infrastructure company focused – Infrastructure company acquires or leases rolling stock and operates.
- User focused – The user of the rolling stock acquires or leases the assets and operates.
- Other solutions may include third parties operating the assets or "wet leases" where the lessor is also responsible for the operation of the assets.

For the purpose of our analysis the tariff rates for the above rail assets are set based upon the infrastructure company entering rolling stock leases with a pass through of operating expenditure to the user. We will explore the structuring options further at Phase 2 of the project.

# 8. Financial Model and Key Financial Assumptions

## 8.1 Financial Model

The Financial Model (the "Model") generates the following deliverables:

- Key input assumptions that allow for the calculation of capacity, cost sensitivities and key financial outputs.
- Key outputs that focus on user charges and visual representations of comparisons with alternative proposals.

### 8.1.1 Key modelling assumptions

The following table outlines key generic assumption on which the Pre-feasibility Financial Model has been built

Table 11: Generic input assumptions

| Input | Assumption | Source |
|---|---|---|
| Periodicity of model | ▪ Construction: Monthly<br>▪ Operations: Yearly | EIG and EY |
| General Timeframe | ▪ For the purposes of the model calculations, general timeframe is driven by the level of demand.<br>▪ Financial analysis is performed over a 30 years' time horizon starting from the first operating day of the first mine to open. | EY |
| Timing of construction | All construction commences on 1 January | EY |
| Capitalisation of interest | Interests are calculated and capitalised on a monthly basis during the construction period | EY |

### 8.1.2 Outputs

The financial model delivers the following key outputs

Table 12: Key outputs

| Output | Comments |
|---|---|
| Below Rail User Charge - overall and by mine | $ per tonne ($/t) and $ per tonne kilometre ($tk) on contracted volumes and also on volume throughput |
| Above Rail User Charge -by mine | $ per tonne kilometre ($tk) |
| Graphs | Contracted volumes over 30 years - by mine and by zone<br>Demand throughput over 30 years - by mine and by zone<br>Below Rail User charge over 30 years - by mine and zone on contracted volumes and also on volume throughput<br>Above Rail User charge over 30 years - by mine<br>Port Capacity |

The financial model does not include financial statements at this stage, this is something that will be added when the full Project Finance functionality is added.

### 8.1.3 Scenario capabilities

The financial model is capable of assessing the following scenarios.

| Scenarios | Comments |
|---|---|
| GICP Option 1 | As defined in section 6.2 |
| GICP Option 2 | As defined in section 6.3 |
| Port capacity alternatives for Options 1 and 2 | Utilising the Base Case and Worst Case port capacities as defined by EWLP |
| Alternative solution -GVK | As defined in section 6.3 |
| Alternative solution – QR National | As defined in section 6.3 |

## 8.2 Key Financial Assumptions

The following generic assumptions are used across all the scenarios in our analysis.

### 8.2.1 Pricing assumptions

#### 8.2.1.1 *Key pricing input assumptions – below rail*

Table 13: Generic input assumptions

| Input | Assumption | Source |
|---|---|---|
| Approach to depreciation (for pricing purposes) | 30 year straight line | Consistent with other regulated rail assets |
| Gearing | 55% | Consistent with QCA determination for QRN |
| WACC used for return on capital | Vanilla WACC equivalent to QRN's 15% pre-tax price[22]<br><br>Model is capable of switching to Regulated Vanilla WACC of 9.96% (reflective of QCA determination for QRN). Comprising:<br>Equity at 9.99%<br>Debt at 9.94% (including a margin of 4.75%) | QCA |
| WACC used for capitalised interest | Regulated Vanilla WACC of 9.96% (reflective of QCA determination for QRN). | Reflective of QCA determination for QRN |
| Deprecation of assets (for the purpose of calculating taxable income) – below rail | 30 year straight line | Consistent with other regulated rail assets |
| Corporate Tax | 30% | Consistent with QCA determination for QRN |
| Imputation Tax Adjustment | 0.5 – effectively 50% adjustment to the level of Corporate Tax | Consistent with QCA determination for QRN |

[22] Page 8 of QCA report – Final Decision, QR Network's 2010 DAU, September 2010

#### 8.2.1.2 *Key economic input assumptions – below rail*

All cost inputs are in 2012 prices, a full year's inflation is applied on 1 January each year using the following economic assumptions.

Table 14: Economic assumptions - below rail

| Input | Assumption | Source |
|---|---|---|
| Construction inflation | 4.00% | EIG |
| Maintenance inflation | 2.50% | EIG |
| CPI | 2.50% (applicable to all other inflation calculations) | Mid point of Royal Bank of Australia long term target for inflation |

#### 8.2.1.3 *Key pricing input assumptions – above rail*

Above rail is financed via leasing contracts characterized by the following metrics:

Table 15: Generic input assumptions

| Input | Assumption | Source |
|---|---|---|
| Rolling stock lease | 10 years for Locomotives<br><br>15 years for Wagons | Lease matches economic life provided by EIG |
| Amortisation of lease | Constant annuities | Market approach |
| Base Interest Rate | 5.5% | Australian Government 10yr government bond coupon at 2/7/2012 |
| Interest Credit Spread | 0.3% | Market rate |
| Interest Margin | 2.5% | Market rate |
| Upfront financing fee | 1.5% | Market rate |
| Mark up on asset value | 10% for asset lessor | Market rate |

#### 8.2.1.4 *Key economic input assumptions – above rail*

All costs are in 2012 prices, a full year's inflation is applied on 1 January each year using the key economic assumptions for Above Rail are described in the table below.

Table 16: Economic assumptions - above rail

| Input | Assumption | Source |
|---|---|---|
| Construction inflation - USD elements | 0.40% | EIG |
| Construction inflation - AUD | 3.15% | EIG |

| Input | Assumption | Source |
|---|---|---|
| elements | | |
| Fuel inflation | 2.70% | EIG |
| Maintenance inflation - USD elements | 0.40% | EIG |
| Maintenance inflation - AUD elements | 3.15% | EIG |
| Labour inflation | 3.68% | EIG |
| CPI | 2.50% (applicable to all other inflation calculations) | Mid point of Royal Bank of Australia long term target for inflation |
| FX rate - US$:A$ | 1.00:1.00 | Reflective of recent foreign exchange rates |

### 8.2.2 Other input assumptions

The Special Purpose Vehicle created to develop and operate the Project is assumed to have the following costs.

Table 17: Organisational management structure and costs assumptions

| Input | Assumption (All figures in 1 January 2012 prices) | Source |
|---|---|---|
| Salaries | Chief Executive Officer = $450,000pa<br><br>Chief Operating Officer = $375,000pa<br><br>Financial Director = $300,000pa<br><br>Project Director = $300,000pa<br><br>Project Management Team = $750,000pa ($125,000 each for team of 6)<br><br>Executive Assistant = $50,000<br><br>Total = $2,225,000pa | EWLP agreed |
| Management fee | $500,000 | EWLP agreed |
| Accommodation | $123,750 ($11,250 per employee) | EWLP agreed |
| Accounting, tax and advisor fees | $150,000 | EWLP agreed |
| Overheads | $749,688 (25% of direct management fees) | EWLP agreed |
| Profit margin uplift | $374,844 (10% of direct management fees and overheads) | EWLP agreed |

Whilst these cost assumptions are based on a preliminary assessment of the proposed organisation overheads and will no doubt alter as planning advances, their relatively small scale, in comparison to the scale of Project costs for each of the solutions, means that cost variances in respect of the Special Purpose Vehicle operational management are unlikely to impact the cost per tonne significantly. Also, we would not expect such cost variances to impact the key messages of this assessment.

# 9. Financial Analysis - GICP Option 1

## 9.1 Definition of the GICP Option 1

GICP Option 1 is a single line solution that serves both the North and South Galilee miners as defined in section 6.2. The following table summarises the mines serviced by GICP Option 1.

Table 18: GICP Option 1 mines serviced and allocation between North and South Galilee

| Mine site | Proponent | Mines Serviced | North / South allocation |
|---|---|---|---|
| South Galilee Coal Project | AMCI & Bandanna Energy Ltd | No | South |
| China First Coal Project | Waratah | Yes | South |
| Alpha Coal Project | Hancock/GVK | Yes | South |
| Alpha West Project | Hancock/GVK | Yes | South |
| Kevin's Corner Project | Hancock/GVK | Yes | South |
| Alpha North Coal Project | Waratah | Yes | South |
| Alpha West Coal Project | Waratah | Yes | South |
| Degulla Coal Project | Vale | Yes | South |
| Carmichael East Coal Project | Waratah | Yes | North |
| Carmichael Coal Project | Adani | Yes | North |
| China Stone Project - South | Macmines | Yes | North |
| China Stone Project - North | Macmines | No | North |

The above assumed allocation between North and South Galilee applies throughout this report in all scenarios considered.

## 9.2 Demand assumptions

The charts below depict the demand profiles for GICP Option 1 under the Probable Case Port scenario resulting from the demand and capacity parameters included in section 5. The first summarises the proposed contracted volumes and the second the volume throughput. Appendix C includes tables with the figures supporting the charts.

Chart 10: GICP Option 1 contracted volumes

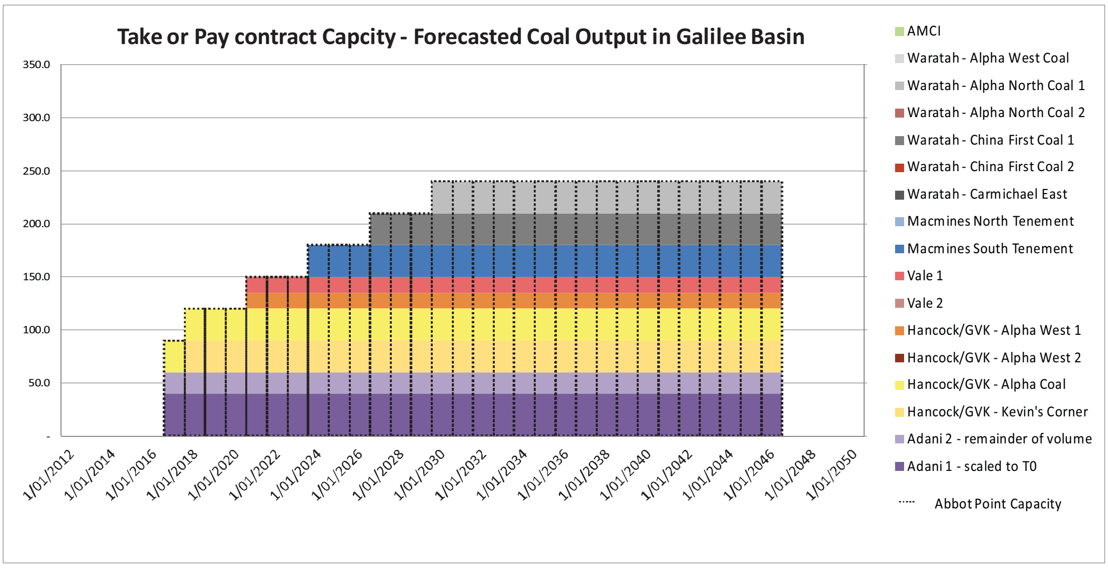
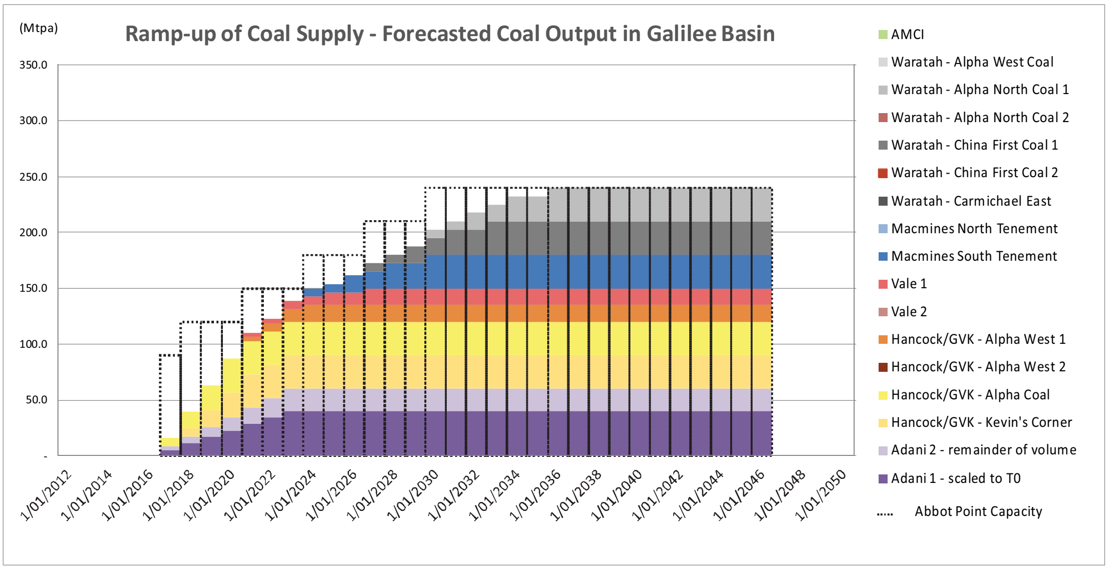


Chart 11: GICP Option 1 volume throughput




The above demand profiles are indicative only and reflective of the demand and capacity parameters assumed. The profiles will be refined at the next stage when EWLP engages the miners and port to test its assumptions.

The above demand profiles result in the following railway construction delivery profile.

Table 19: GICP Option 1 construction delivery profiles

| Zone | First day of delivery | Term of construction |
|---|---|---|
| Zone1 - Abbot Point to North of Moranbah | 1 January 2017 | 36 months |
| Zone2 - North of Moranbah to North Galilee | 1 January 2017 | 36 months |
| Zone3 - North Galilee to Macmines South | 1 January 2017 | 36 months |
| Zone4 - Macmines South to Adani Carmichael | 1 January 2017 | 36 months |
| Zone5 - Adani Carmichael to Waratah Carmichael | 1 January 2017 | 36 months |
| Zone6 - Waratah Carmichael to Vale Degulla | 1 January 2017 | 36 months |
| Zone7 - Vale Degulla to Waratah Alpha West | 1 January 2017 | 36 months |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | 1 January 2017 | 36 months |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | 1 January 2027 | 12 months |

## 9.3 Key technical assumptions

### 9.3.1 Below Rail

#### *9.3.1.1 Capex costs*

The following tables summarise the capital costs associated with GICP option 1.

Table 20: Below Rail Construction Costs (2012 prices)

| AUDm | GICP option 1 |
|---|---|
| Construction Spend | 3,807.0 |
| Passing Loops Capital Expenditure | 833.0 |
| Duplication Capital Expenditure | 1,474.2 |
| Total | 6,114.2 |

Table 21: Below Rail Construction Costs (forecast cashflows)

| AUDm | GICP option 1 |
|---|---|
| Construction Spend | 4,357.9 |
| Passing Loops Capital Expenditure | 1,031.9 |
| Duplication Capital Expenditure | 2,522.5 |
| Total | 7,912.3 |

It is assumed that the construction costs associated with passing loops and duplication are incurred over a 12 month periods as agreed with EIG. Passing loop and duplication cost templates are included within the EIG cost templates.

Refer to Appendix D for EIG cost templates and Appendix E for a reconciliation from the Financial Model to the EIG cost template. The 2012 prices included in the above table reflect the EIG costs with contract pricing escalation / inflation removed.

#### *9.3.1.2 Opex and maintenance costs*

The following tables summarise the annual track maintenance costs associated with GICP option 1.

Table 22: Below Rail Annual track maintenance costs (2012 prices)

| Annual costs per km AUD (2012 prices) | GICP option 1 |
|---|---|
| 0Mtpa to 10Mtpa | 12,000 |
| Greater than 10Mtpa to 30Mtpa | 22,000 |
| Greater than 30Mtpa to 50Mtpa | 30,000 |
| Greater than 50Mtpa to 100Mtpa | 60,000 |
| Greater than 100Mtpa to 400Mtpa | 60,000 |

### 9.3.2 Above Rail

#### *9.3.2.1 Capex costs*

The following table summarise the rolling stock capital costs associated with GICP option 1.

Table 23: Above Rail Construction Costs (2012 prices)

| | GICP option 1 |
|---|---|
| Train capacity range - Mtpa per train | 7.10 - 8.66 |
| No. of Loco's per train | 3.3 |
| Cost per Loco – USD element | 3,570,000 |
| No. of Wagon's per train | 283.5 |
| Cost per Wagon – USD element | 132,600 |
| Loco overhaul every x years | 10 |
| Cost per Loco overhaul – USD element | 1,785,000 |
| Cost per Loco overhaul – AUD element | 892,500 |
| Wagon overhaul every x years | 15 |
| Cost per Wagon overhaul – USD element | 33,150 |
| Cost per Wagon overhaul – AUD element | 33,150 |

#### *9.3.2.2 Opex and maintenance costs*

The following tables summarise the rolling stock operating and maintenance costs associated with each of the rail alignments within this comparison.

Table 24: Above Rail operating and maintenance costs (2012 prices)

| Cost per tonne | GICP option 1 |
|---|---|
| Fuel costs range (AUD) | 1.03 - 1.39 |
| Maintenance costs range – USD element | 0.06 - 0.08 |
| Maintenance costs range – AUD element | 0.54 - 0.66 |
| Labour costs range (AUD) | 0.12 – 0.15 |

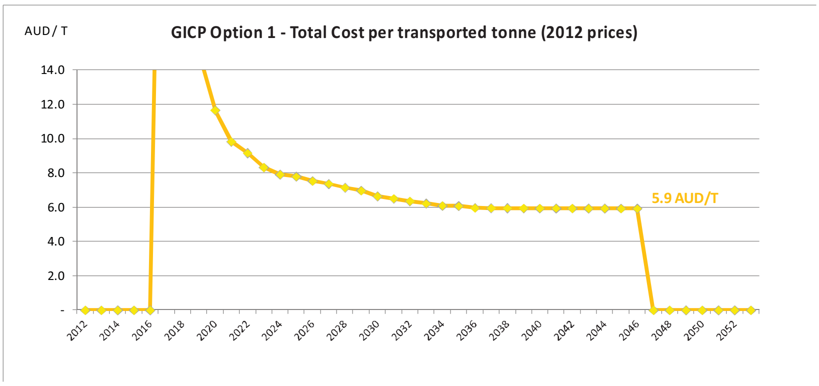
## 9.4 Financial results

The table and charts below depict the key outputs resulting for GICP Option 1.

Table 25: Key outputs

| Comparison 1 | GICP Option 1 |
|---|---|
| | |
| Capex (2012 prices) | 6,114 |
| Alignment Length (Km) | 577 |
| Maximum tonnages | 240 |
| | |
| **Below Rail** (2012 prices) | |
| AUD per Transported Tonne - Weighted average | 4.11 |
| | |
| **Above Rail** (2012 prices) | |
| AUD per Transported Tonne - Weighted average | 2.83 |
| | |
| **Total Cost** (2012 prices) | |
| AUD per Transported Tonne - Weighted average | 6.95 |

Chart 12: Above and Below Rail combined cost per transported tonne




The competitiveness of the results will be assessed in the comparisons and benchmarking sections that follow.

## 9.5 Port Capacity sensitivity analysis

In this sensitivity we assess the impact that port capacity has on the main metrics of the GICP Option 1 solution. Section 5 defines the best and worst case port capacities used for this sensitivity.

The following charts demonstrate the range of outcomes resulting. The bars represent the pricing range for the mine routes considered within this comparison while the X represents the weighted average cost per tonne for the system over the life of the concession. A mine "route" is defined as being the section of the track used by a particular mine for a specified volume of coal.

Chart 13: Below Rail cost per transported tonne range

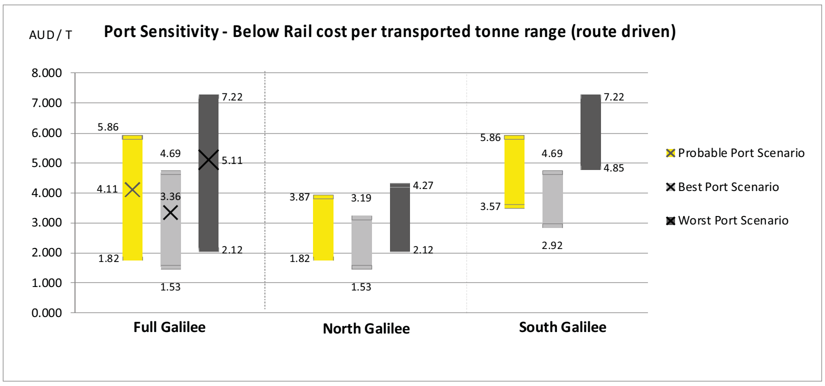
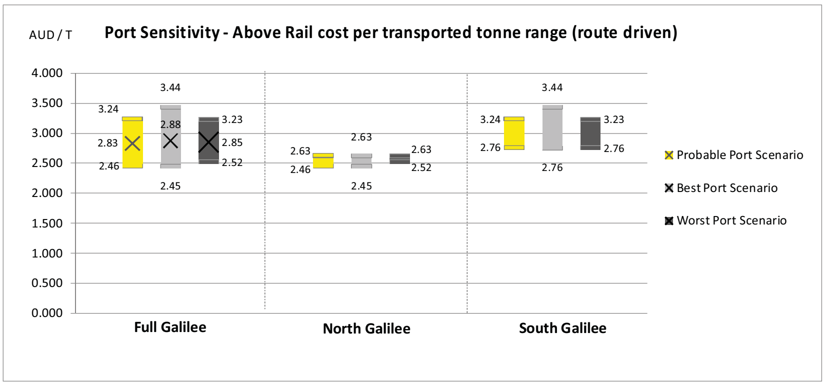



Chart 14: Above Rail cost per transported tonne range




In line with expectation the overall cost per tonne range increases where the Best Case and Worst Case port scenarios are considered.

- Below Rail – As expected the range extends to a lower cost per tonne under the Best Case and a higher cost per tonne under the Worst Case reflecting better and worse utilisation of the asset respectively.
- Above Rail – The movement in cost per tonne above rail are not significant, this reflects the fact that rolling stock is procured on an as needed basis and there is little scope for efficiencies of scale under the current structure. The small movements identified are reflective of the location and scale of the mines served under each scenario.

# 10. Financial Analysis - Comparison 1

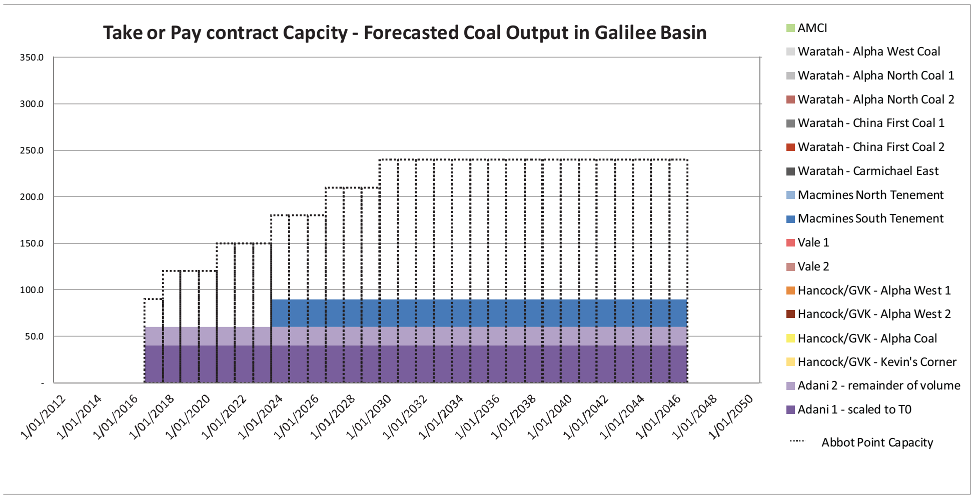
## 10.1 Definition of comparison 1

Comparison 1 assesses GICP Option 1 against a combined QRN (90Mtpa) and GVK (150Mtpa) solution that would serve the same purpose of servicing all of the mines in the Galilee Basin. Comparison 1 is defined in detail in section 6.

## 10.2 Demand assumptions

The charts below depict the comparable demand profiles for QRN and GVK under the Probable Case Port scenario resulting from the demand and capacity parameters included in section 5. Appendix C includes tables with the figures supporting the charts.

Chart 15: Comparison 1 QRN (90Mtpa) contracted and transported throughput (Mtpa)



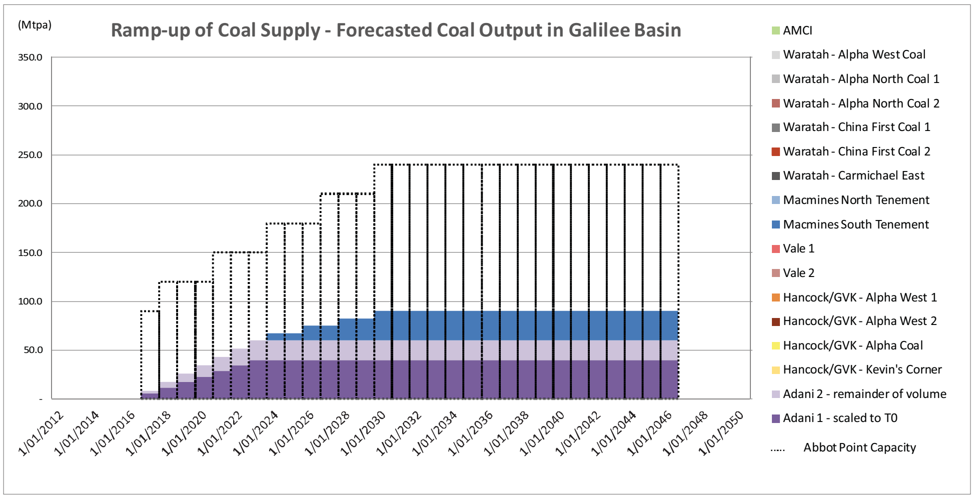
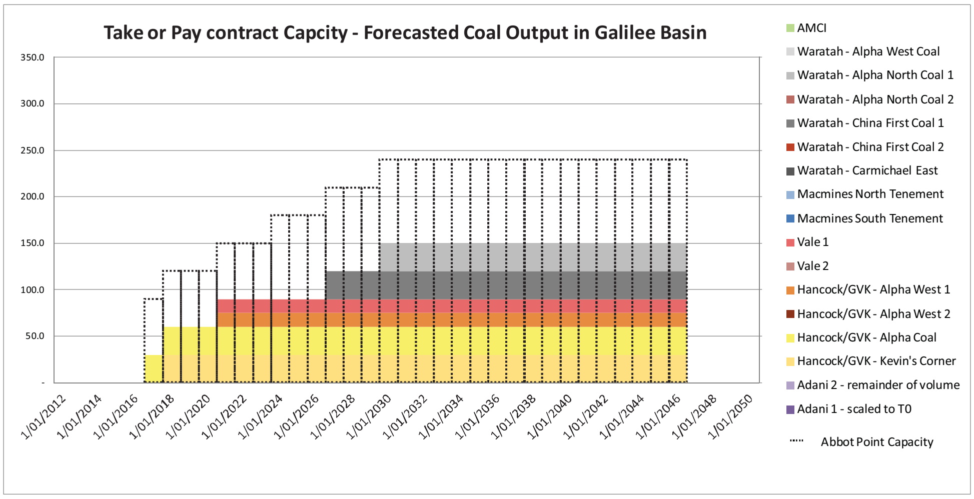
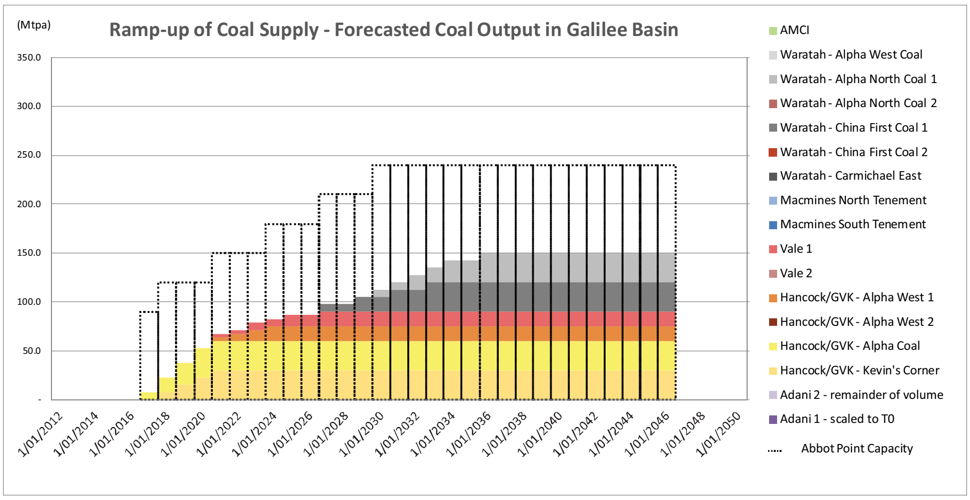



Chart 16: Comparison 1 GVK (150Mtpa) contracted and transported throughput (Mtpa)




The above demand profiles are indicative only and reflective of the demand and capacity parameters assumed. The profiles will be refined at the next stage when EWLP engages the miners and port to test its assumptions.

The above demand profiles result in the following railway construction delivery profiles.

Table 26: Comparison 1 QRN (90Mtpa) construction delivery profiles

| Zone | First day of delivery | Term of construction |
|---|---|---|
| Existing asset – Abbot Point to North Goonyella | 1 January 2017 | N/A |
| QRN Mainline – North Goonyella to Adani Carmichael | 1 January 2017 | 36 months |
| Zone 4 - Macmines South to Adani Carmichael | 1 January 2024 | 12 months |

Table 27: Comparison 1 GVK (150Mtpa) construction delivery profiles

| Zone | First day of delivery | Term of construction |
|---|---|---|
| GVK Mainline – Abbot Point to GVK Kevin's Corner | 1 January 2017 | 36 months |
| Zone 7 - Vale Degulla to Waratah Alpha West | 1 January 2021 | 24 months |
| Zone 8 - Waratah Alpha West to GVK Kevin's Corner | | |
| Zone 9 - GVK Kevin's Corner to Waratah China 1st Coal | 1 January 2027 | 12 months |

# 10.3 Key technical assumptions

## 10.3.1 Below Rail

### *10.3.1.1 Capex costs*

The following tables summarise the capital costs associated with each of the rail alignments within this comparison.

Table 28: Below Rail Construction Costs (2012 prices)

| AUDm | QRN (90Mtpa) | GVK (150Mtpa) | QRN + GVK | GICP option 1 |
|---|---|---|---|---|
| Construction Spend | 2,357.1 | 4,003.9 | 6,361.0 | 3,807.0 |
| Passing Loops Capital Expenditure | 214.5 | 597.5 | 812.0 | 833.0 |
| Duplication Capital Expenditure | 2,371.5 | 990.0 | 3,361.5 | 1,474.2 |
| Total | 4,943.1 | 5,591.4 | 10,534.5 | 6,114.2 |

Table 29: Below Rail Construction Costs (forecast cashflows)

| AUDm | QRN (90Mtpa) | GVK (150Mtpa) | QRN + GVK | GICP option 1 |
|---|---|---|---|---|
| Construction Spend | 2,797.3 | 4,659.6 | 7,456.8 | 4,357.9 |
| Passing Loops Capital Expenditure | 250.9 | 773.0 | 1,024.0 | 1,031.9 |
| Duplication Capital Expenditure | 2,930.8 | 1,785.7 | 4,716.5 | 2,522.5 |
| Total | 5,979.0 | 7,218.3 | 13,197.3 | 7,912.3 |

In assessing the QRN alignment it was necessary to assume an asset value for the elements of the existing QRN alignment that will be used in delivering its solution. For the purpose of this assessment was assumed that $1bn of existing assets is added to the asset base of the QRN solution.

We have also assumed that the existing QRN asset is contracted for and operates at 50Mtpa for the purpose of socialising the costs of the existing asset and the associated upgrades.

It is assumed that the construction costs associated with passing loops and duplication are incurred over a 12 month periods as agreed with EIG. Passing loop and duplication cost templates are included within the EIG cost templates.

Refer to Appendix D for EIG cost templates and Appendix E for a reconciliation from the Financial Model to the EIG cost template. The 2012 prices included in the above table reflect the EIG costs with contract pricing escalation / inflation removed.

### *10.3.1.2 Opex and maintenance costs*

The following tables summarise the annual track maintenance costs associated with each of the rail alignments within this comparison.

Table 30: Below Rail Annual track maintenance costs (2012 prices)

| Annual costs per km AUD (2012 prices) | QRN (90Mtpa) | GVK (150Mtpa) | | GICP option 1 |
|---|---|---|---|---|
| 0Mtpa to 10Mtpa | 12,000 | 12,000 | | 12,000 |
| Greater than 10Mtpa to 30Mtpa | 22,000 | 22,000 | | 22,000 |
| Greater than 30Mtpa to 50Mtpa | 30,000 | 30,000 | | 30,000 |
| Greater than 50Mtpa to 100Mtpa | 45,000 | 50,000 | | 60,000 |
| Greater than 100Mtpa to 400Mtpa | 45,000 | 50,000 | | 60,000 |

## 10.3.2 Above Rail

### *10.3.2.1 Capex costs*

The following table summarise the rolling stock capital costs associated with each of the rail alignments within this comparison.

Table 31: Above Rail Construction Costs (2012 prices)

| | QRN (90Mtpa) | GVK (150Mtpa) | | GICP option 1 |
|---|---|---|---|---|
| Train capacity range - Mtpa per train | 3.07 - 3.36 | 5.91 - 6.34 | | 7.1 - 8.66 |
| No. of Loco's per train | 4.4 | 3.3 | | 3.3 |
| Cost per Loco – USD element | 5,100,000 | 3,570,000 | | 3,570,000 |
| No. of Wagon's per train | 126 | 252 | | 283.5 |
| Cost per Wagon – USD element | 112,200 | 122,400 | | 132,600 |
| Loco overhaul every x years | 10 | 10 | | 10 |
| Cost per Loco overhaul – USD element | 2,550,000 | 1,785,000 | | 1,785,000 |
| Cost per Loco overhaul – AUD element | 1,275,000 | 892,500 | | 892,500 |
| Wagon overhaul every x years | 15 | 15 | | 15 |
| Cost per Wagon overhaul – USD element | 28,050 | 30,600 | | 33,150 |
| Cost per Wagon overhaul – AUD element | 28,050 | 30,600 | | 33,150 |

### *10.3.2.2 Opex and maintenance costs*

The following tables summarise the rolling stock operating and maintenance costs associated with each of the rail alignments within this comparison.

Table 32: Above Rail operating and maintenance costs (2012 prices)

| Cost per tonne | QRN (90Mtpa) | GVK (150 Mtpa) | | GICP option 1 |
|---|---|---|---|---|
| Fuel costs range (AUD) | 2.27 - 2.60 | 1.53 - 1.72 | | 1.03 - 1.39 |
| Maintenance costs range - USD element | 0.20 - 0.22 | 0.08 - 0.09 | | 0.06 - 0.08 |
| Maintenance costs range - AUD element | 0.89 - 0.97 | 0.67 - 0.72 | | 0.54 - 0.66 |
| Labour costs range (AUD) | 0.32 - 0.35 | 0.17 - 0.18 | | 0.12 - 0.15 |

## 10.4 Financial results

The financial results of this comparison have assessed under the following headers:

- Key outputs
- Commentary on the results

### 10.4.1 Key outputs

The table and charts below depict the key outputs resulting from the above inputs, presented on a cost per tonne and cost per tonne kilometre basis.

Table 33: Comparison 1 key outputs

| Comparison 1 | QRN (90Mtpa) | GVK (150Mtpa) | QRN + GVK | GICP Option 1 |
|---|---|---|---|---|
| Capex (2012 prices) | 4,943 | 5,591 | 10,535 | 6,114 |
| Alignment Length (Km) | 425 | 564 | 989 | 577 |
| Maximum tonnages | 90 | 150 | 240 | 240 |
| **Below Rail** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 6.73 | 6.36 | 6.51 | 4.11 |
| **Above Rail** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 5.14 | 3.36 | 4.08 | 2.83 |
| **Total Cost** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 11.87 | 9.72 | 10.58 | 6.95 |

Chart 17: Above and Below Rail combined cost per transported tonne

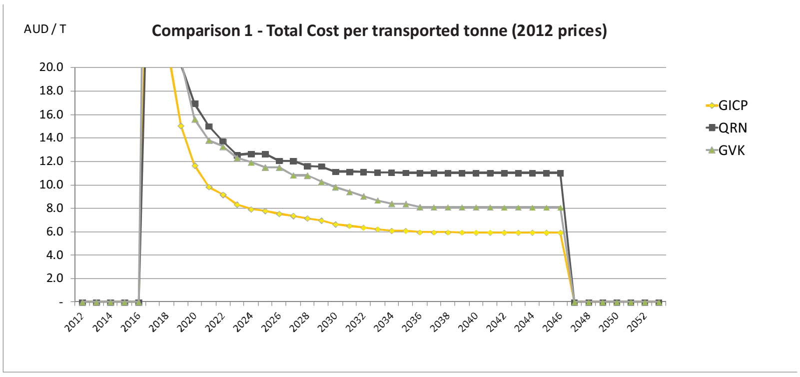


Chart 18: Above and Below Rail combined cost per transported tonne kilometre

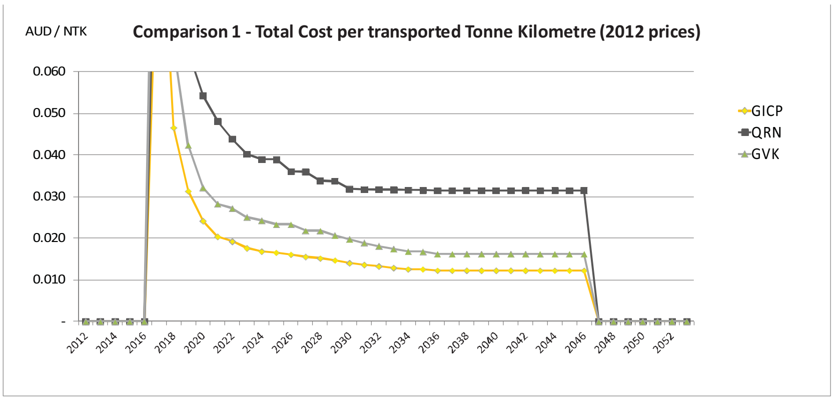



Chart 19: Below Rail cost per transported tonne range

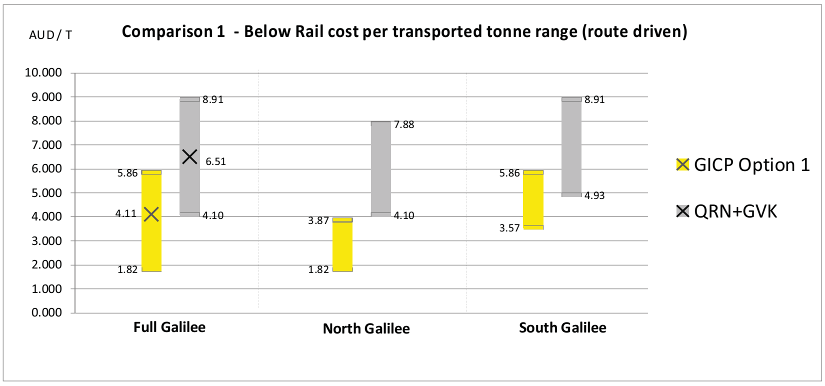
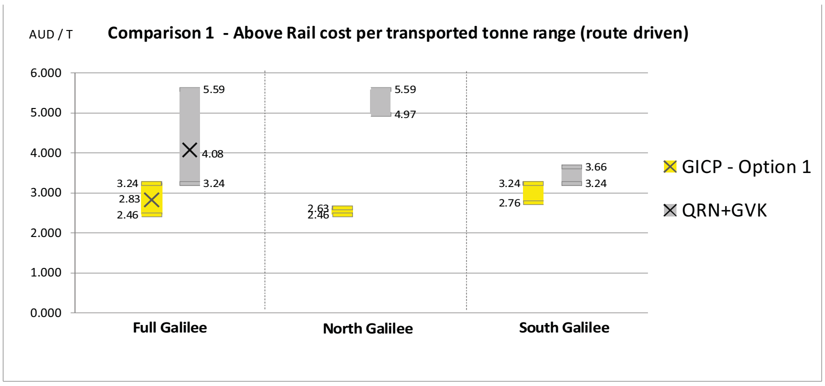



Chart 20: Above Rail cost per transported tonne range




## 10.4.2 Commentary on the financial results

The key results of our analysis are:

- GICP 240Mtpa single alignment solution, with an average freight cost from the Galilee basin of around AUD7.00 per tonne, appears to offer a 50% to 55% benefit over a combined QRN (90Mtpa) and GVK (150Mtpa) solution.

- When assessed at a mine level our analysis indicates that all mines included within this comparison benefited from a lower cost per tonne under the GICP Option 1 (240 Mtpa). The cost benefit estimates for individual mines range from 10% to 165% with the cost per tonne ranging from approximately AUD4.50 to AUD9.00.

- This is  driven by efficiencies from:
    - The lower cost of building one below rail alignment compared to the cost of building two alignments. The GICP option 1 construction cost (including staged augmentations of passing loops and duplications as required) is around AUD6.1bn in 2012 prices, a saving in the region of 70% to 75% over the combined alternative solution.
    - Subject to further validation of the 40 tonne axle load wagon design (as yet not developed for Queensland coal mines although the benchmark for iron ore mines in Western Australia), the standard gauge, 40 tonnes axle load, above rail solution proposed for GICP is estimated to be in the range of 15% to 20% more cost efficient than the proponent GVK, standard gauge, 32.5 tonnes axle load solution and approximately 80% more efficient than the proponent QRN, narrow gauge, 26.5 tonnes axle load solution. These results indicate that a 40 tonne axle load solution is more cost effective than 32.5 tonne axle load and that a narrow gauge above rail solution is less effective than standard gauge.

## 10.5 Sensitivity analysis – below rail regulated return

The above results are calculated using a WACC equivalent to QRN's current pricing structure.  This sensitivity seeks to demonstrate the below rail cost impact of using the regulated return determined by QCA, a vanilla WACC of 9.96%.

The following tables and charts depict the key outputs resulting from this sensitivity analysis.

Table 34: Comparison 1 key outputs for sensitivity

| Comparison 1 with Regulated WACC | QRN (90Mtpa) Reg | GVK (150Mtpa) Reg | QRN + GVK Reg | GICP Option 1 Reg |
|---|---|---|---|---|
| Capex (2012 prices) | 4,943 | 5,591 | 10,535 | 6,114 |
| Alignment Length (Km) | 425 | 564 | 989 | 577 |
| Maximum tonnages | 90 | 150 | 240 | 240 |
| **Below Rail** (2012 prices) | | | | |
| AUD per Transported Tonne - Weighted average | 4.92 | 4.73 | 4.81 | 3.08 |

Chart 21: Above and Below Rail combined cost per transported tonne for sensitivity

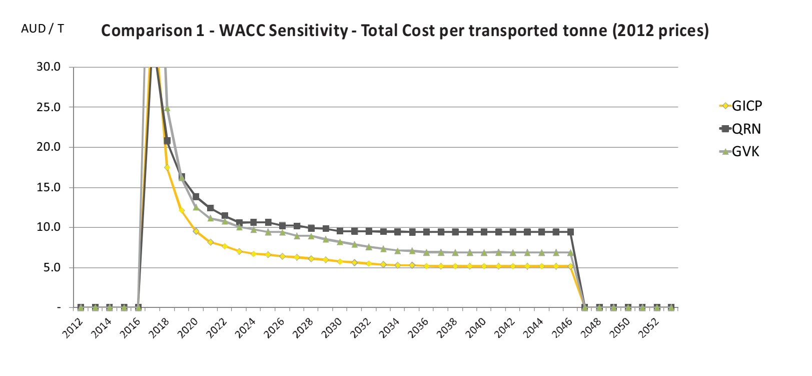
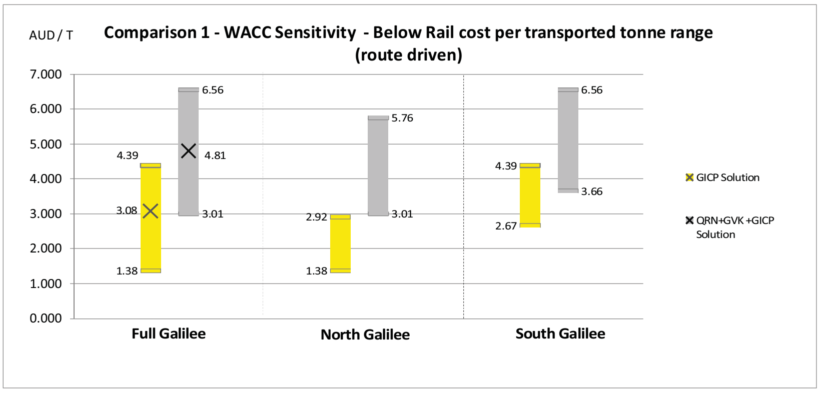


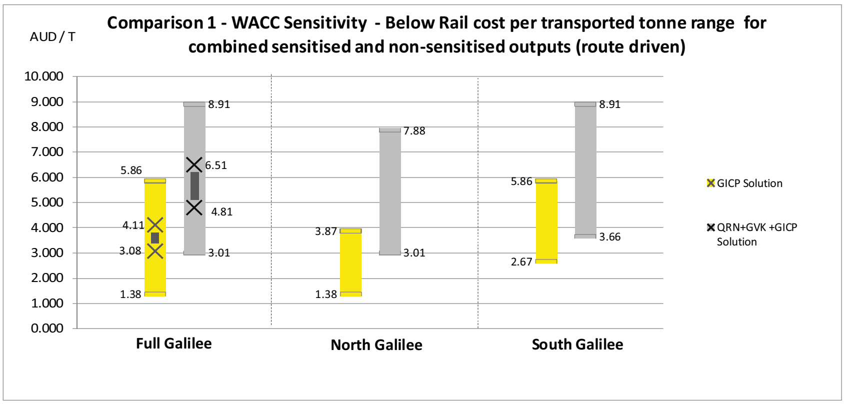
Chart 22: Below Rail cost per transported tonne range for sensitivity




The above results confirm that the key messages identified in section 10.4.2 remain valid at this lower cost of capital.

Combining the results of this sensitivity analysis with the non-sensitised outputs creates the following wider cost per tonne range for the below rail assets.

Chart 23: Below Rail cost per transported tonne range from combined range of sensitised and non-sensitised outputs



# 11. Financial Analysis - Comparison 2

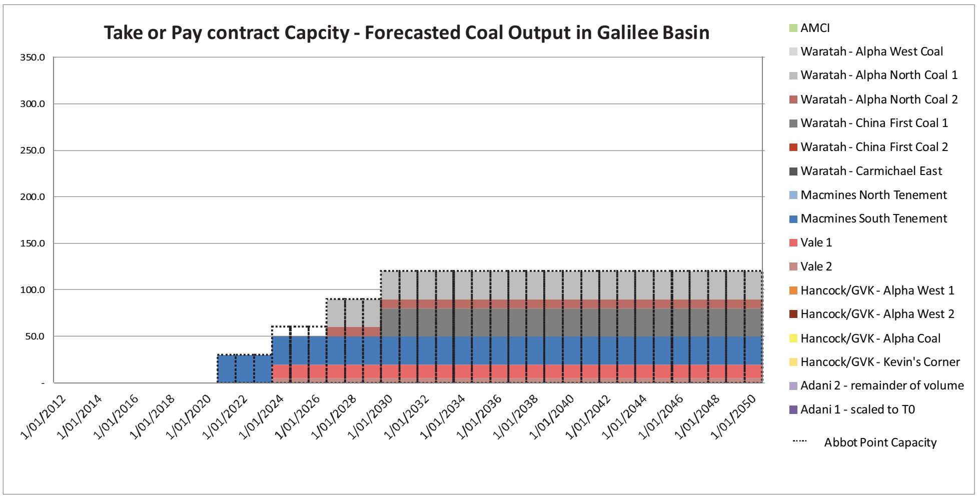
## 11.1 Definition of comparison 2

Comparison 2 assesses GICP Option 1 against a three alignments solution comprising a GICP 120 Mtpa solution (GICP Option2), QRN (60Mtpa) and GVK (60Mtpa). Comparison 2 is defined in detail in section 6.

## 11.2 Demand assumptions

The charts below depict the demand profiles for GICP, QRN and GVK under comparison 2 hypotheses and Probable Case Port scenario resulting from the demand and capacity parameters included in section 5. Appendix C includes tables with the figures supporting the charts.

Chart 24: GICP Option 2 contracted and transported throughput (Mtpa)



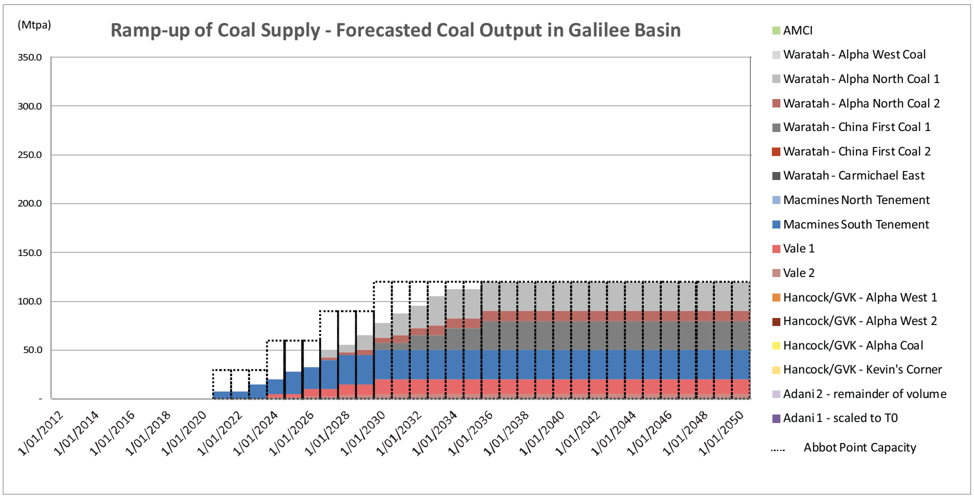
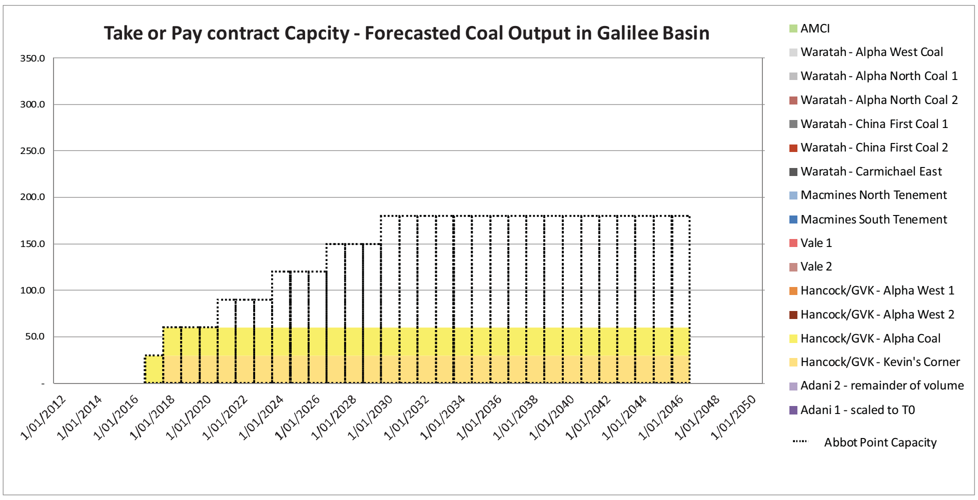
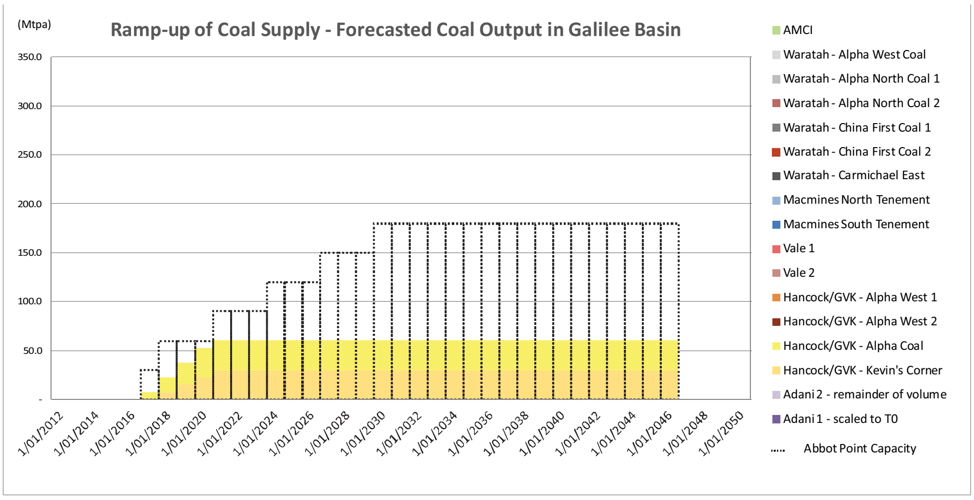



Chart 25: Comparison 2 QRN (60Mtpa) contracted and transported throughput (Mtpa)


Chart 26: Comparison 2 GVK (60Mtpa) contracted and transported throughput (Mtpa)






The above demand profiles are indicative only and reflective of the demand and capacity parameters assumed. The profiles will be refined at the next stage when EWLP engages the miners and port to test its assumptions.

The above demand profiles result in the following railway construction delivery profiles.

Table 35: GICP Option 2 construction delivery profiles

| Zone | First day of delivery | Term of construction |
|---|---|---|
| Zone 1 - Abbot Point to North of Moranbah | 1 January 2021 | 36 months |
| Zone2 - North of Moranbah to North Galilee | | |
| Zone3 - North Galilee to Macmines South | | |
| Zone4 - Macmines South to Adani Carmichael | 1 January 2024 | 24 months |
| Zone5 - Adani Carmichael to Waratah Carmichael | | |
| Zone6 - Waratah Carmichael to Vale Degulla | | |
| Zone7 - Vale Degulla to Waratah Alpha West | 1 January 2027 | 12 months |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | 1 January 2030 | 12 months |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | | |

Table 36: Comparison 2 QRN (60Mtpa) construction delivery profiles

| Zone | First day of delivery | Term of construction |
|---|---|---|
| Existing asset – Abbot Point to North Goonyella | 1 January 2017 | N/A |
| QRN Mainline – North Goonyella to Adani Carmichael | 1 January 2017 | 36 months |

Table 37: Comparison 2 GVK (60Mtpa) construction delivery profiles

| Zone | First day of delivery | Term of construction |
|---|---|---|
| GVK Mainline – Abbot Point to GVK Kevin's Corner | 1 January 2017 | 36 months |

## 11.3 Key technical assumptions

### 11.3.1 Below Rail

#### *11.3.1.1 Capex costs*

The following tables summarise the capital costs associated with each of the rail alignments within this comparison.

Table 38: Below Rail Construction Costs (2012 prices)

| AUDm | GICP option 2 | QRN (60Mtpa) | GVK (60Mtpa) | GICP opt. 2 + QRN + GVK | GICP option 1 |
|---|---|---|---|---|---|
| Construction Spend | 3,658.6 | 2,091.3 | 3,501.4 | 9,251.3 | 3,807.0 |
| Passing Loops Capital Expenditure | 790.1 | 221.8 | 396.7 | 1,408.6 | 833.0 |
| Duplication Capital Expenditure | - | 2,121.6 | - | 2,121.6 | 1,474.2 |
| Total | 4,448.7 | 4,434.7 | 3,898.1 | 12,781.5 | 6,114.2 |

Table 39: Below Rail Construction Costs (forecast cashflows)

| AUDm | GICP option 2 | QRN (60Mtpa) | GVK (60Mtpa) | GICP opt. 2 + QRN + GVK | GICP option 1 |
|---|---|---|---|---|---|
| Construction Spend | 5,190.1 | 2,388.0 | 3,936.8 | 11,514.9 | 4,357.9 |
| Passing Loops Capital Expenditure | 1,304.9 | 259.5 | 474.0 | 2,038.3 | 1,031.9 |
| Duplication Capital Expenditure | - | 2,482.0 | - | 2,482.0 | 2,522.5 |
| Total | 6,494.9 | 5,129.5 | 4,410.8 | 16,035.2 | 7,912.3 |

In assessing the QRN alignment, just as for comparison 1, it was necessary to assume an asset value for the elements of the existing QRN alignment that will be used in delivering its solution. For the purpose of this assessment was assumed that $1bn of existing assets are added to the asset base of the QRN solution.

We have also assumed that the existing QRN asset is contracted for and operates at 50Mtpa for the purpose of socialising the costs of the existing asset and the associated upgrades.

It is assumed that the construction costs associated with passing loops and duplication are incurred over a 12 month periods as agreed with EIG. Passing loop and duplication cost templates are included within the EIG cost templates.

Refer to Appendix D for EIG cost templates and Appendix E for a reconciliation from the Financial Model to the EIG cost template. The 2012 prices included in the above table reflect the EIG costs with contract pricing escalation / inflation removed.

### 11.3.1.2 Opex and maintenance costs

The following tables summarise the annual track maintenance costs associated with each of the rail alignments within this comparison.

Table 40: Below Rail Annual track maintenance costs (2012 prices)

| Annual costs per km AUD (real - 2012 prices) | GICP option 2 | QRN (60Mtpa) | GVK (60Mtpa) | GICP option 1 |
|---|---|---|---|---|
| 0Mtpa to 10Mtpa | 12,000 | 12,000 | 12,000 | 12,000 |
| Greater than 10Mtpa to 30Mtpa | 22,000 | 22,000 | 22,000 | 22,000 |
| Greater than 30Mtpa to 50Mtpa | 30,000 | 30,000 | 30,000 | 30,000 |
| Greater than 50Mtpa to 100Mtpa | 60,000 | 45,000 | 50,000 | 60,000 |
| Greater than 100Mtpa to 400Mtpa | 60,000 | 45,000 | 50,000 | 60,000 |

## 11.3.2 Above Rail

### 11.3.2.1 Capex costs

The following table summarise the rolling stock capital costs associated with each of the rail alignments within this comparison.

Table 41: Above Rail Construction Costs (2012 prices)

| | GICP option 2 | QRN (60Mtpa) | GVK (60Mtpa) | GICP option 1 |
|---|---|---|---|---|
| Train capacity range - Mtpa per train | 6.82 - 8.66 | 3.36 | 6.29 - 6.34 | 7.1 - 8.66 |
| No. of Loco's per train | 3.3 | 4.4 | 3.3 | 3.3 |
| Cost per Loco - USD element | 3,570,000 | 5,100,000 | 3,570,000 | 3,570,000 |
| No. of Wagon's per train | 283.5 | 126 | 252 | 283.5 |
| Cost per Wagon - USD element | 132,600 | 112,200 | 122,400 | 132,600 |
| Loco overhaul every x years | 10 | 10 | 10 | 10 |
| Cost per Loco overhaul - USD element | 1,785,000 | 2,550,000 | 1,785,000 | 1,785,000 |
| Cost per Loco overhaul - AUD element | 892,500 | 1,275,000 | 892,500 | 892,500 |
| Wagon overhaul every x years | 15 | 15 | 15 | 15 |

| | GICP option 2 | QRN (60Mtpa) | GVK (60Mtpa) | GICP option 1 |
|---|---|---|---|---|
| Cost per Wagon overhaul - USD element | 33,150 | 28,050 | 30,600 | 33,150 |
| Cost per Wagon overhaul - AUD element | 33,150 | 28,050 | 30,600 | 33,150 |

#### *11.3.2.2 Opex and maintenance costs*

The following tables summarise the rolling stock operating and maintenance costs associated with each of the rail alignments within this comparison.

Table 42: Above Rail operating and maintenance costs (2012 prices)

| Cost per tonne | GICP option 2 | QRN (60Mtpa) | GVK (60Mtpa) | GICP option 1 |
|---|---|---|---|---|
| Fuel costs range (AUD) | 1.03 - 1.49 | 2.27 | 1.53 - 1.55 | 1.03 - 1.39 |
| Maintenance costs range - USD element | 0.06 - 0.08 | 0.20 | 0.08 | 0.06 - 0.08 |
| Maintenance costs range - AUD element | 0.54 - 0.68 | 0.89 | 0.67 - 0.68 | 0.54 - 0.66 |
| Labour costs range (AUD) | 0.12 - 0.15 | 0.32 | 0.17 | 0.12 - 0.15 |

## 11.4 Financial results

The financial results of this comparison have assessed under the following headers:

- Key outputs
- Commentary on the results

### 11.4.1 Key outputs

The table and charts below depict the key outputs resulting from the above inputs, presented on a cost per tonne and cost per tonne kilometre basis.

Table 43: Comparison 2 key outputs

| Comparison 2 | GICP Option 2 | QRN (60Mtpa) | GVK (60Mtpa) | GICP2 + QRN + GVK | GICP Option 1 |
|---|---|---|---|---|---|
| Capex (2012 prices) | 4,449 | 4,435 | 3,898 | 12,781 | 6,114 |
| Alignment Length (Km) | 577 | 381 | 485 | 1,443 | 577 |
| Maximum tonnages | 120 | 60 | 60 | 240 | 240 |
| **Below Rail** (2012 prices) | | | | | |
| AUD per Transported Tonne - Weighted average | 7.18 | 7.90 | 10.29 | 8.25 | 4.11 |
| **Above Rail** (2012 prices) | | | | | |
| AUD per Transported Tonne - Weighted average | 2.80 | 4.98 | 3.26 | 3.52 | 2.83 |
| **Total Cost** (2012 prices) | | | | | |
| AUD per Transported Tonne - Weighted average | 9.98 | 12.88 | 13.55 | 11.77 | 6.95 |

Chart 27: Above and Below Rail combined cost per transported tonne

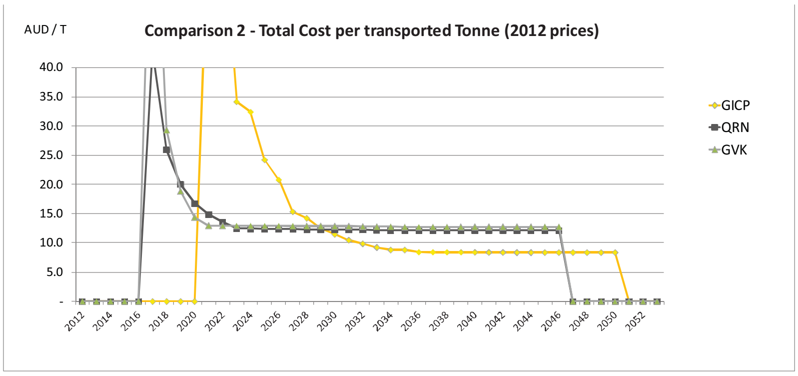



Chart 28: Above and Below Rail combined cost per transported tonne kilometre

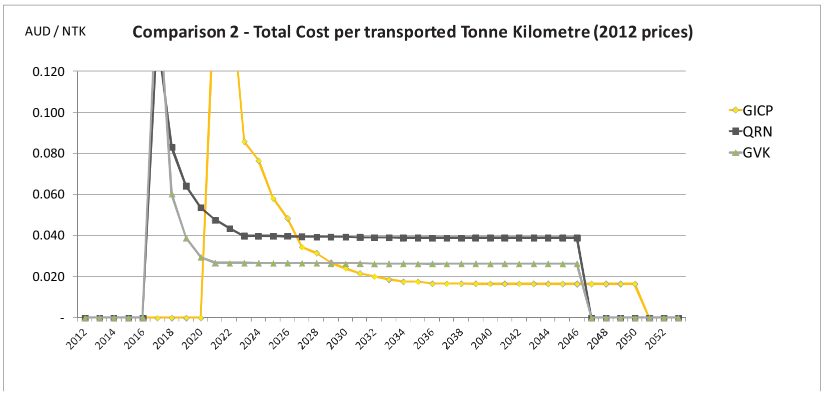



Chart 29: Below Rail cost per transported tonne range

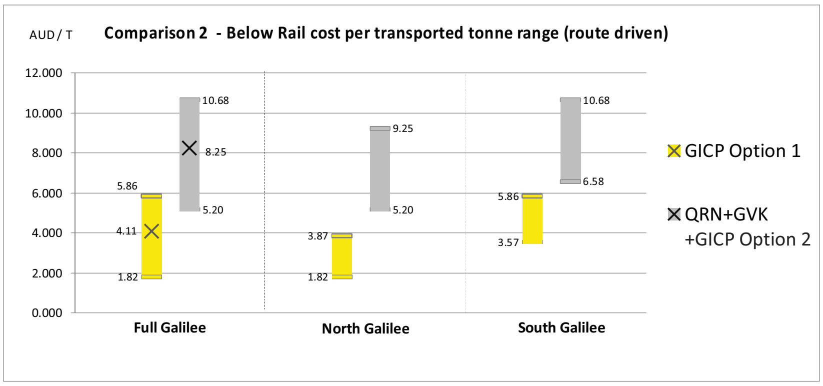
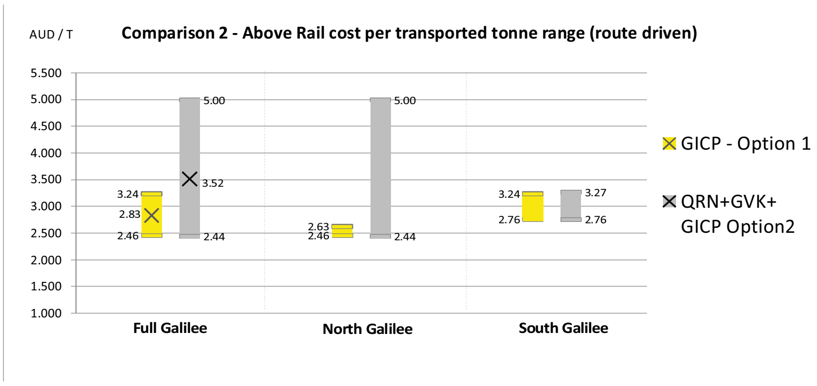


Chart 30: Above Rail cost per transported tonne range




### 11.4.2 Commentary on the financial results

Based on the costs provided by EIG, the key messages resulting from our analysis are:

- GICP Option 1 (240Mtpa) appears to be in the region of 65% to 70% more efficient, on a cost per tonne basis, than the combination of QRN (60Mtpa), GVK (60Mtpa) and GICP option 2 (120Mtpa). This is primarily due to the fact that three separate alignments require three infrastructure spends as well as to other influences such as the more efficient above rail solution.
- At around AUD10.00 the GICP Option 2 (120Mtpa) cost per tonne is estimated to be in the range of 25% to 40% lower than the QRN (60Mtpa) and GVK (60Mtpa) components of Comparison 2. This is a positive indicator of the potential of the GICP's performance at lower volumes. However, in this comparison the different alignments service different mines and therefore further assessment of this performance was required.

The potential of the GICP Option 2 (120Mtpa) was explored further by assessing the alternative routes to port available to each of the mines serviced under this solution. The alternatives assumed for each mine were:

- Macmines' China Stone Project (South) mine – As explored in Comparison 1, Macmines could connect into the proposed QRN alignment, creating the QRN (90Mtpa) solution.
- Vale's Degulla Coal Project mine – Vale could connect into the GVK alignment, forming part of the GVK (150Mtpa) solution explored under Comparison 1.
- Waratah's China First Coal Project and Alpha North Coal Project mines – Both of these Waratah mines could connect into the GVK alignment, forming part of the GVK (150Mtpa) solution explored under Comparison 1.
- The key messages resulting from these comparisons are:
  - Macmines South – The GICP Option 2 solution, at AUD9.80, indicates a cost per tonne benefit of AUD3.70 over the QRN (90Mtpa) alternative. The above rail solution provided AUD3.20 of this benefit, however, the below rail solution also performed favourably.
  - Vale - The GICP Option 2 solution has the potential to offer a benefit over the GVK (150Mtpa) alternative of around 20% to 25%, with benefits of AUD0.90 above rail and AUD1.50 below rail.

   - Waratah – The GVK (150Mtpa) alternative outperformed the GICP Option 2 (120Mtpa) solution by between 10% and 20% for the various Waratah mines serviced. However, as identified in Comparison 1 the GICP Option 1 (240Mtpa) solution outperformed the GVK (150Mtpa) alternative, indicating that the Waratah mines would also benefit if higher volumes are achieved on the GICP alignment.

   - A consistent message across all three comparisons (Macmines South, Vale and Waratah) was the importance of the GICP above rail solution with the estimated above rail cost per tonne benefits for the individual mines ranging from around 5% to 130%.

- From GVK's perspective, certainty around proponents timing and tonnages will be key to any expansion in capacity of this alternative solution above 60Mtpa. The above point indicates that it may be difficult for GVK to achieve commitments from proponents such as Vale, Macmines and Waratah where a GICP alternative exists.

- All of the above points indicate the potential viability, on a cost per tonne basis, of a GICP solution even if both the GVK and QRN solutions are already in operation under long term commercial agreements.

## 11.5 Sensitivity analysis – Port Access Sensitivity

### 11.5.1 Definition

Comparisons 1 and 2 assumed that the Abbot Point port capacity restricted the timing of mining development. This sensitivity compares GICP Option 1 against a solution where the port is not the constraining factor and is effectively a mine demand led variation of Comparison 2. This is a theoretical sensitivity that, whilst unlikely to occur, is used to further assess whether our previous findings hold true.

It assumes that all three railways are constructed in full in preparation for operational commencement on 1 January 2017. For comparison purposes the 240Mtpa applicable for GICP Option 1 is used as the tonnages cap for this sensitivity.

### 11.5.2 Financial results

The table and charts below depict the key outputs resulting from the above inputs, presented on a cost per tonne and cost per tonne kilometre basis.

Table 44: Port Access Sensitivity - key outputs

| Port Access Sensitivity | GICP (120Mtpa) | QRN (60Mtpa) | GVK (60Mtpa) | GICP + QRN + GVK | GICP Option 1 |
|---|---|---|---|---|---|
| Capex (2012 prices) | 4,449 | 4,435 | 3,898 | 12,781 | 6,114 |
| Alignment Length (Km) | 577 | 381 | 485 | 1,443 | 577 |
| Maximum tonnages | 120 | 60 | 60 | 240 | 240 |
| **Below Rail** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 6.08 | 7.90 | 10.16 | 7.59 | 4.11 |
| **Above Rail** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 2.83 | 4.98 | 3.25 | 3.47 | 2.83 |
| **Total Cost** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 8.90 | 12.88 | 13.42 | 11.06 | 6.95 |

Chart 31: Above and Below Rail combined cost per transported tonne

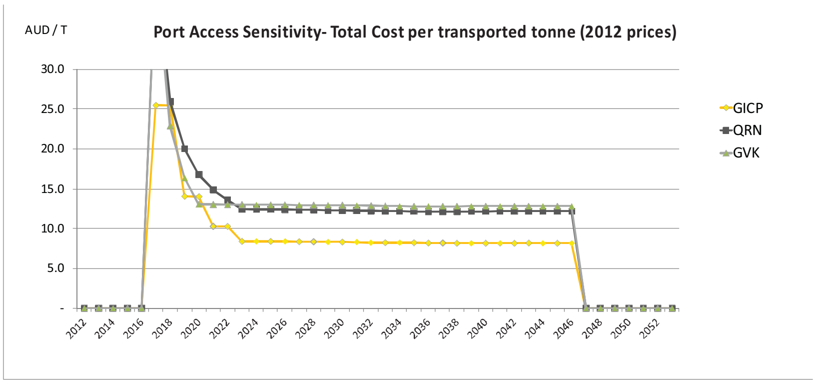



Chart 32: Above and Below Rail combined cost per transported tonne kilometre

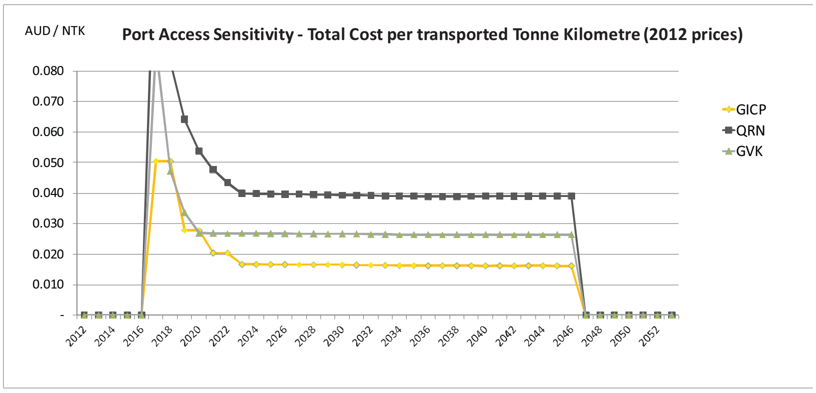



Chart 33: Below Rail cost per transported tonne range

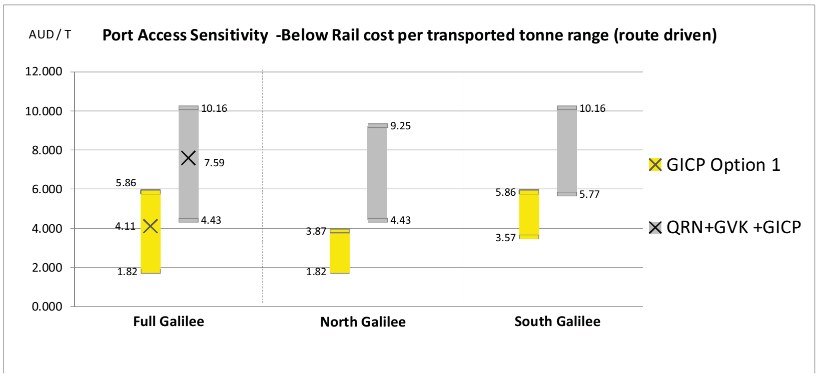
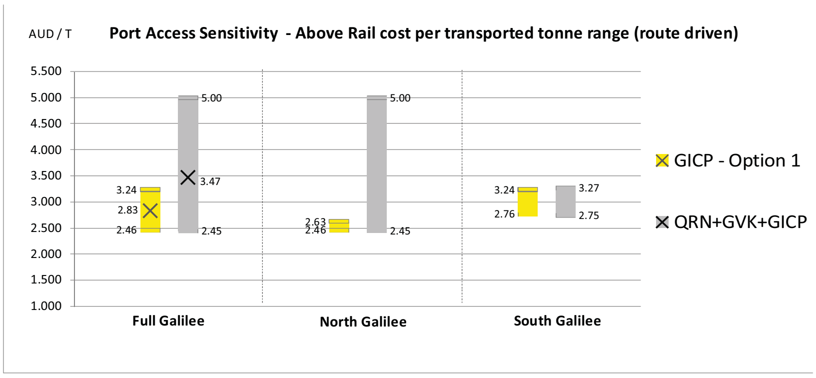


Chart 34: Above Rail cost per transported tonne range




## 11.5.3 Commentary on Port Access Sensitivity

The key messages resulting from our analysis are:

- This theoretical scenario indicates a reduction in cost per tonne from approximately AUD10.00 under GICP option 2 to approximately AUD8.90 reflecting more efficient use of the infrastructure. Overall, the combined solution (QRN + GVK + GICP) is approximately AUD0.70 cheaper than in Comparison 2.

When compared against GICP option 1, the combined solution, at approximately AUD11.10, remains in the region of 50% to 60% less cost effective, on a cost per tonne basis. This reflects the fact that three alignments are required under this comparison. It should also be noted that the costs of GICP option 1 would similarly reduce if the port restrictions were removed.

# 12. Financial Analysis – Other sensitivity comparisons against alternative solutions

To further understand the competitiveness of the GICP solution we performed a number of theoretical sensitivities aimed at identifying the strengths and weaknesses of the GICP solution when compared directly against the QRN and GVK alternative solutions at 60 Mtpa. In this analysis the level of user charge forecasted by our financial model are compared for:

- A QRN line servicing 60 Mtpa of Adani coal in north Galilee and a GICP line servicing the exact same 60 Mtpa throughput under the same condition of demand.
- A GVK line servicing 60 Mtpa of GVK / Hancock coal in south Galilee and a GICP line servicing the exact same 60 Mtpa throughput under the same condition of demand.

These comparisons assess the efficiency of the QRN and GVK corridors, each directly serving its dedicated mine(s), with that of the GICP corridor which is, for each comparison, restricted to carrying the same limited tonnage. The comparisons therefore ignore the alignment benefits offered by the GICP alignment.

Acknowledging the alignment advantages of the GICP (that it passes by the aforementioned GVK and Adani mines), we also performed the following more direct comparison:

- The combined GVK (60Mtpa) and QRN (60Mtpa) against GICP servicing the same throughput coming from both Adani's Carmichael Coal mine (60Mtpa) and GVK's Alpha and Kevin's Corner mines (60Mtpa).

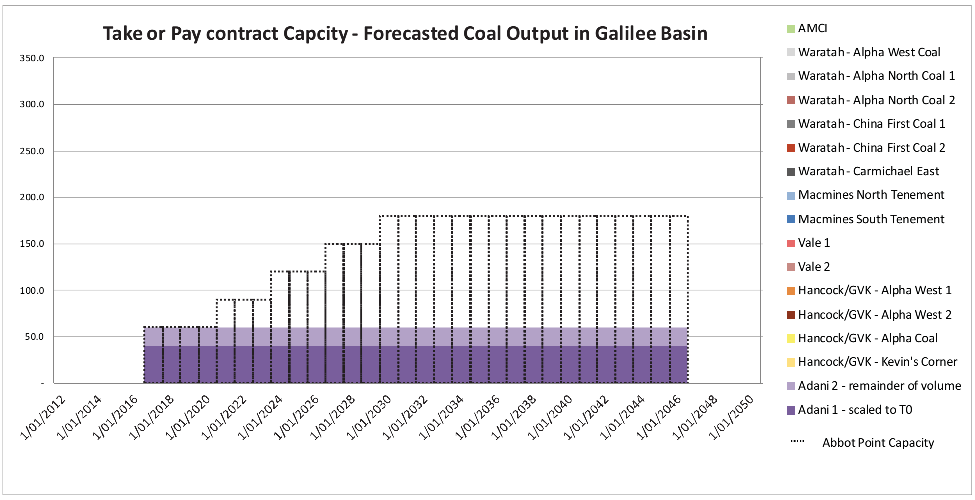
This comparison sought to identify the efficiency resulting from GICP's favourable alignment over its direct competitors when carrying the same 120Mtpa. This comparison is reported in section 12.3.2.3 below

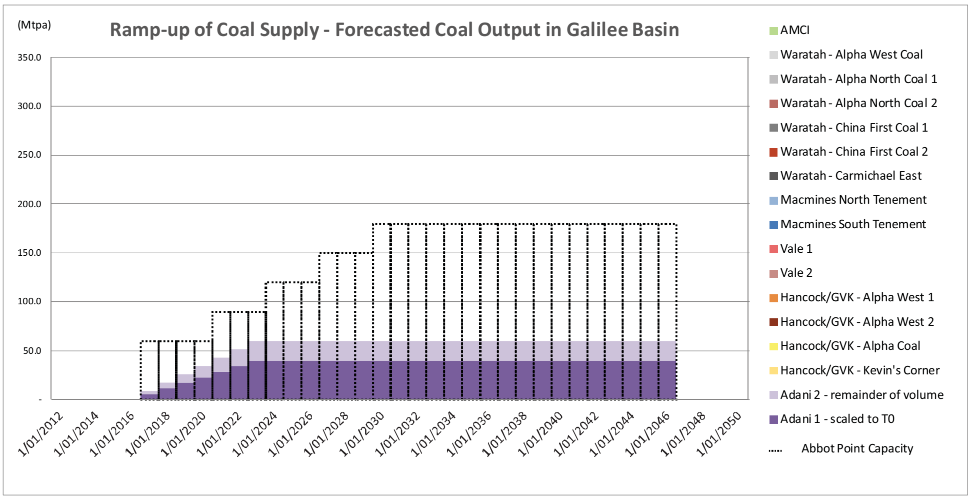
## 12.1 Demand assumptions

The charts below depict the demand profiles used for direct comparison of the QRN (60Mtpa) and GVK (60Mtpa) alternatives against GICP. The profiles were extracted from Comparison 2.

## 12.1.1 QRN (60Mtpa)

Chart 35: QRN (60 Mtpa) Direct Comparison contracted and transported throughput (Mtpa)



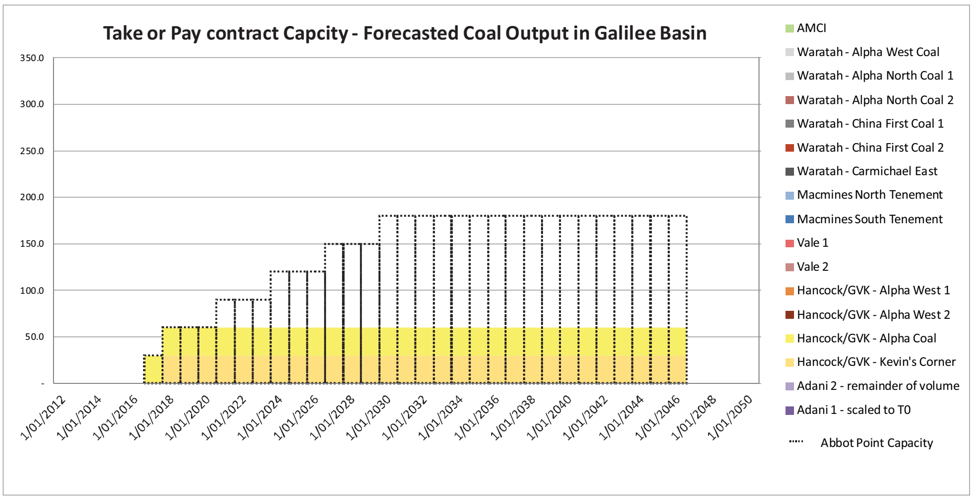



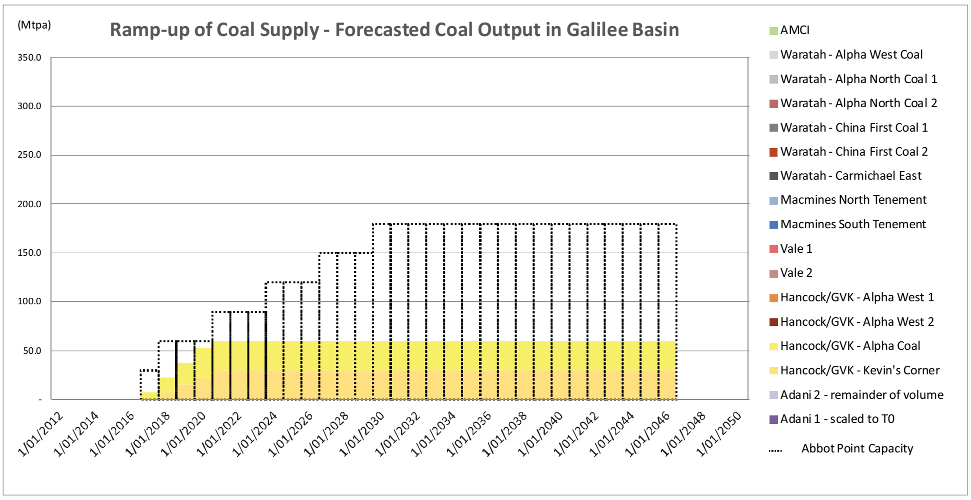

For the purpose of assessing GICP against the QRN (60Mtpa) solution, we made the following key construction assumptions:

- GICP option 1 costs were used as basis as they include a dual gauge track element for Adani's delivery to Dudgeon Point port.
- Alignment built from Abbot Point port as far as Adani (zone 4).

## 12.1.2 GVK (60Mtpa)

Chart 36: GVK (60Mtpa) Direct Comparison contracted and transported throughput (Mtpa)




For the purpose of assessing GICP against the GVK (60Mtpa) solution, we made the following key construction assumptions:

- GICP option 3 costs were used as basis as they exclude dual gauge which is not required for the GVK solution.
- Alignment built from Abbot Point port as far as GVK Kevin's Corner (zone 8).

The above demand profiles are indicative only and reflective of the demand and capacity parameters assumed. The profiles will be refined at the next stage when EWLP engages the miners and port to test its assumptions.

## 12.2 Key technical assumptions

### 12.2.1 Below Rail

#### *12.2.1.1 Capex costs*

The following tables summarise the capital costs associated with each of the rail alignments within this comparison.

Table 45: Below Rail Construction Costs (real – 2012 prices)

| AUDm | QRN (60Mtpa) | GICP (QRN 60) | | GVK (60Mtpa) | GICP (GVK 60) |
|---|---|---|---|---|---|
| Construction Spend | 2,091.3 | 2,960.5 | | 3,501.4 | 3,531.0 |
| Passing Loops Capital Expenditure | 221.8 | 223.1 | | 396.7 | 433.1 |
| Duplication Capital Expenditure | 2,121.6 | - | | - | - |
| Total | 4,434.7 | 3,183.6 | | 3,898.1 | 3,964.1 |

Table 46: Below Rail Construction Costs (nominal)

| AUDm | QRN (60Mtpa) | GICP (QRN 60) | | GVK (60Mtpa) | GICP (GVK 60) |
|---|---|---|---|---|---|
| Construction Spend | 2,388.0 | 3,328.6 | | 3,936.8 | 4,000.4 |
| Passing Loops Capital Expenditure | 259.5 | 261.0 | | 474.0 | 517.1 |
| Duplication Capital Expenditure | 2,482.0 | - | | - | - |
| Total | 5,129.5 | 3,589.6 | | 4,410.8 | 4,517.5 |

In assessing the QRN alignment, just as for comparison 1, it was necessary to assume an asset value for the elements of the existing QRN alignment that will be used in delivering its solution. For the purpose of this assessment was assumed that $1bn of existing assets are added to the asset base of the QRN solution.

We have also assumed that the existing QRN asset is contracted for and operates at 50Mtpa for the purpose of socialising the costs of the existing asset and the associated upgrades.

### 12.2.1.2 Opex and maintenance costs

The following tables summarise the annual track maintenance costs associated with each of the rail alignments within this comparison.

Table 47: Below Rail Annual track maintenance costs (real - 2012 prices)

| Annual costs per km AUD (real - 2012 prices) | QRN (60Mtpa) | GICP (QRN 60) | | GVK (60Mtpa) | GICP (GVK 60) |
|---|---|---|---|---|---|
| 0Mtpa to 10Mtpa | 12,000 | 12,000 | | 12,000 | 12,000 |
| Greater than 10Mtpa to 30Mtpa | 22,000 | 22,000 | | 22,000 | 22,000 |
| Greater than 30Mtpa to 50Mtpa | 30,000 | 30,000 | | 30,000 | 30,000 |
| Greater than 50Mtpa to 100Mtpa | 45,000 | 60,000 | | 50,000 | 60,000 |
| Greater than 100Mtpa to 400Mtpa | 45,000 | 60,000 | | 50,000 | 60,000 |

## 12.2.2 Above Rail

### 12.2.2.1 Capex costs

The following table summarise the rolling stock capital costs associated with each of the rail alignments within this comparison.

Table 48: Above Rail Construction Costs (real - 2012 prices)

| | QRN (60Mtpa) | GICP (QRN 60) | | GVK (60Mtpa) | GICP (GVK 60) |
|---|---|---|---|---|---|
| Train capacity range - Mtpa per train | 3.36 | 8.35 | | 6.29 - 6.34 | 7.22 - 7.30 |
| No. of Loco's per train | 4.4 | 3.3 | | 3.3 | 3.3 |
| Cost per Loco - USD element | 5,100,000 | 3,570,000 | | 3,570,000 | 3,570,000 |
| No. of Wagon's per train | 126 | 283.5 | | 252 | 283.5 |
| Cost per Wagon - USD element | 112,200 | 132,600 | | 122,400 | 132,600 |
| Loco overhaul every x years | 10 | 10 | | 10 | 10 |
| Cost per Loco overhaul - USD element | 2,550,000 | 1,785,000 | | 1,785,000 | 1,785,000 |
| Cost per Loco overhaul - AUD element | 1,275,000 | 892,500 | | 892,500 | 892,500 |
| Wagon overhaul every x years | 15 | 15 | | 15 | 15 |
| Cost per Wagon overhaul - USD element | 28,050 | 33,150 | | 30,600 | 33,150 |
| Cost per Wagon overhaul - AUD element | 28,050 | 33,150 | | 30,600 | 33,150 |

#### 12.2.2.2 Opex and maintenance costs

The following tables summarise the rolling stock operating and maintenance costs associated with each of the rail alignments within this comparison.

Table 49: Above Rail operating and maintenance costs (real – 2012 prices)

| Cost per tonne | QRN (60Mtpa) | GICP (QRN 60) | | GVK (60Mtpa) | GICP (GVK 60) |
|---|---|---|---|---|---|
| Fuel costs range (AUD) | 2.27 | 1.10 | | 1.53 - 1.55 | 1.33 - 1.35 |
| Maintenance costs range – USD element | 0.20 | 0.06 | | 0.08 | 0.07 |
| Maintenance costs range – AUD element | 0.89 | 0.56 | | 0.67 - 0.68 | 0.64 |
| Labour costs range (AUD) | 0.32 | 0.13 | | 0.17 | 0.15 |

## 12.3 Financial results

The financial results of this comparison have assessed under the following headers:

- Key outputs
- Commentary on the results

### 12.3.1 Key outputs

The table and charts below depict the key outputs resulting from the above inputs, presented on a cost per tonne and cost per tonne kilometre basis.

Table 50: Direct Comparison against QRN (60Mtpa) – Key outputs

| Direct Comparison against QRN (60 Mtpa) | GICP (60 QRN) | QRN (60Mtpa) |
|---|---|---|
| | | |
| Capex (2012 prices) | 3,184 | 4,435 |
| Alignment Length (Km) | 442 | 381 |
| Maximum tonnages | 60 | 60 |
| | | |
| **Below Rail** (2012 prices) | | |
| AUD per Transported Tonne - Weighted average | 8.76 | 7.90 |
| | | |
| **Above Rail** (2012 prices) | | |
| AUD per Transported Tonne - Weighted average | 2.56 | 4.98 |
| | | |
| **Total Cost** (2012 prices) | | |
| AUD per Transported Tonne - Weighted average | 11.32 | 12.88 |

Note – The lower below rail cost per tonne resulting for QRN is reflective of the socialisation of costs on the existing track.

Chart 37: QRN (60Mtpa) Direct Comparison - Above and Below Rail combined cost per transported tonne

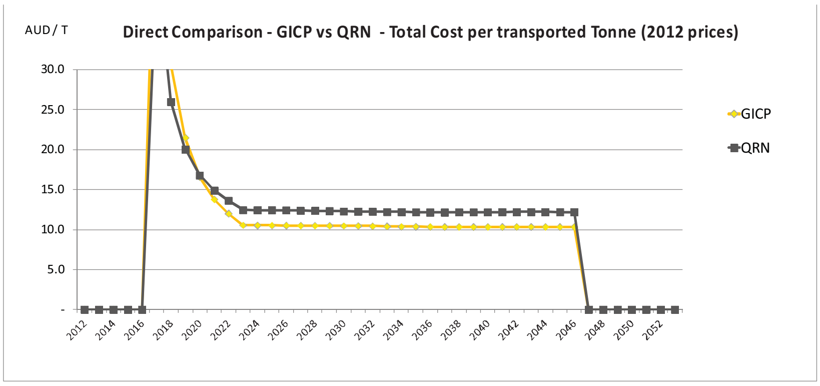
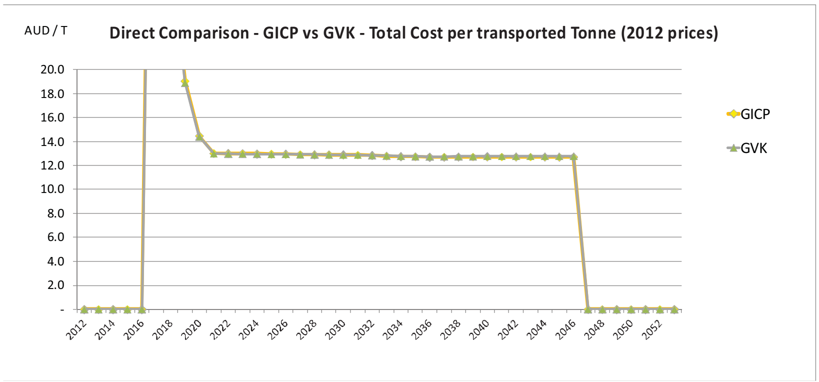



Table 51: Direct Comparison against GVK (60Mtpa) – Key outputs

| Direct Comparison against GVK (60 Mtpa) | GICP (60 GVK) | GVK (60 Mtpa) |
|---|---|---|
| | | |
| Capex (2012 prices)<br>Alignment Length (Km)<br>Maximum tonnages | 3,964<br>557<br>60 | 3,898<br>485<br>60 |
| | | |
| **Below Rail** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 10.48 | 10.29 |
| | | |
| **Above Rail** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 3.06 | 3.26 |
| | | |
| **Total Cost** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 13.54 | 13.55 |

Chart 38: GVK (60Mtpa) Direct Comparison - Above and Below Rail combined cost per transported tonne




## 12.3.2 Commentary on the financial results

The key messages resulting from our analysis are:

### *12.3.2.1 QRN*

- Despite the GICP corridor being significantly longer and restricted to tonnages significantly below its optimum capacity, the GICP solution offers a lower cost per tonne than the QRN solution servicing only the 60Mtpa of Adani, at approximately AUD11.30 versus AUD12.90. This result is largely driven by the above rail solution which appears significantly more efficient for GICP. Based on the cost information provided by EIG, the GICP above rail cost per tonne, at AUD2.60, is roughly 50% of the QRN cost per tonne which is approximately AUD5.00.

- In addition, the alignment of the GICP solution passes closer to the Macmines South mine than the QRN alignment and, as demonstrated by Comparison 2, there appears to be a financial advantage to Macmines South in using the GICP alignment.

#### *12.3.2.2 GVK*

- Despite the GICP corridor being significantly longer and restricted to tonnages significantly below its optimum capacity, at approximately AUD13.50, the overall cost per tonne resulting is broadly the same for both the GICP and GVK alignments. When considered at a below and above rail level, the GVK solution appears around AUD0.20 cheaper for below rail while GICP is around AUD0.20 cheaper for above rail.

- In addition, the alignment of the GICP solution means there appears to be a financial advantage to using the GICP alignment rather than the GVK alignment for many of the Galilee mines.

#### *12.3.2.3 GICP as a combined solution servicing QRN (60) and GVK (60) only*

- By combining the tonnages of the QRN (60Mtpa) and GVK (60Mtpa), this comparison sought to identify the efficiency resulting from GICP's favourable alignment over its direct competitors. Our analysis indicates that all three of the mines (Adani's Carmichael Coal, GVK's Alpha and GVK's Kevins Corner) considered in this analysis benefit from a lower cost per tonne for their access to the port under the GICP solution. The combined cost per transported tonne for the GICP solution would be approximately AUD8.60, in the region of 50% to 60% lower than the QRN and GVK two-alignment solution.

Table 52: GICP combined solution – Key output

| GICP - combined solution QRN and GVK (120) | QRN (60Mtpa) | GVK (60Mtpa) | QRN + GVK | GICP (120Mtpa) |
|---|---|---|---|---|
| Capex (2012 prices) | 4,435 | 3,898 | 8,333 | 4,245 |
| Alignment Length (Km) | 381 | 485 | 866 | 557 |
| Maximum tonnages | 60 | 60 | 120 | 120 |
| **Below Rail** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 7.90 | 10.29 | 9.33 | 5.77 |
| **Above Rail** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 4.98 | 3.26 | 3.95 | 2.81 |
| **Total Cost** (2012 prices)<br>AUD per Transported Tonne - Weighted average | 12.88 | 13.55 | 13.28 | 8.59 |

# 13. Preliminary key issues

At this stage we have sought to identify the key issues applicable to the EWLP project. At Phase 2 of the Project we will explore these key issues and the project risks in more detail.

## 13.1 Supply chain considerations

Table 53: Supply chain considerations

| Item | Description |
|---|---|
| Port capacity insufficient | Insufficient capacity at Abbot Point Port is a significant risk for the Project which requires close attention.<br><br>Not only are the Bowen Basin coal companies competing for use of the Port, the ultimate scale of the Port is unknown following the government announcements on 6 June effectively cancelling the Terminal 4 to 9 expansion.<br><br>This risk can be managed by, for example:<br><br>► Proactive engagement of government to ensure an alignment in objectives.<br><br>► Developing the railway is scalable manner based upon known capacity.<br><br>► Contracting with users in advance of construction.<br><br>► Ensuring access to the QRN network from the EWLP corridor to allow access to other Ports on that network, in particular Dudgeon Point Port. |
| Mine investment delays | Mining companies may delay planned investments in the tenements for a number of reasons including, for example, lack of port capacity, low coal prices, financing / balance sheet constraints and lower global demand.<br><br>Such delays in mine investment may impact the ability of EWLP to fully contract the rail capacity.<br><br>This risk can be managed by, for example:<br><br>► Proactive engagement of miners.<br><br>► Developing the railway is scalable manner and ensuring that competition exists for the railway capacity.<br><br>► Contracting with users in advance of construction.<br><br>► Engaging miners as potential investors in the infrastructure company. |

## 13.2 Commercial and financial considerations

Table 54: Commercial and financial considerations

| Item | Description |
|---|---|
| Political support for EWLP corridor and process delays | As we have seen already on this project the government's priorities and objectives can substantially impact the timing and direction of projects with significant announcements on Abbot Point and the two rail corridors following Queensland's election of a new government.<br><br>The government is currently supporting the GVK and QRN/Adani corridors and it is unknown whethere the government will move from its current position to support the GICP solution.<br><br>In addition, the uncertainty surrounding the future scale of Abbot Point port may lead to further process delays as miners and EWLP lobby the government for greater certainty in this regard. |
| Environment approvals | Government approvals, in particularly EIS, will play a significant role in the speed at which EWLP can progress its Project. The Project is currently behind the other alternative solution that are both well advanced in their EIS approvals process (refer to section Appendix B) and it will therefore be important to actively manage the government through the EIS approvals process. |
| Coal price | The global thermal coal price is fundamental to the Project, if the thermal coal price falls below the threshold at which it is financially viable miners will not sign up to Take or Pay contracts and the Project will not progress in the current timescales. |
| Delivery risks | There are numerous delivery risks that require further exploration at Phase 2, some of the key considerations include:<br><br>► Construction delays.<br>► Construction overruns.<br>► Train and track delivery alignment.<br>► Integration with Port.<br>► Integration with QRN asset (where appropriate). |
| Operational risks | There are numerous operational risks that require further exploration at Phase 2, some of the key considerations include:<br><br>► Track availability.<br>► Train operation performance.<br>► Health & Safety.<br>► Management of train routes (to avoid bottlenecks)<br>► Operational costs higher than expected.<br>► Wagon to Port transfer risks.<br>► Integration issues with QRN asset impacts performance on EWLP track (where appropriate). |
| Financing risks | There are numerous financial risks that require further exploration at Phase 2, some of the key considerations include:<br><br>► Availability of finance - The global financial crisis significantly impacted the availability of debt and the project bond market all but disappeared.<br>► Scale of Project – The capacity of the financial markets to fund a project of this scale requires testing.<br>► Cost of finance – The cost of long term financing increase substantially following the global financial crisis. |

| Item | Description |
|---|---|
| | ► Stranded asset risk – The risk that the asset may not be fully utilised for its economic life is something that can be considered as part of the Take or Pay contract process.<br>► Technology risk - The 40t axle load wagons are not a proven in the coal industry and represent a technology risk that requires mitigation.<br>► Foreign exchange risk – Explored further below. |
| Foreign exchange risk | Foreign exchange rate risk can be considered in the following key components:<br><br>► Infrastructure spend - Many of the assets associated with the railway infrastructure are likely to be supplied from outside of Australia, in particular the Locomotives (USA) and the Wagons (China). Most likely, suppliers outside of Australia will transact in US$.<br>► Financing – Parity of the AUD and US$ presents an opportunity to achieve lower cost of funding by raising finance in the US. However, access to this lower cost of financing exposes the Project to exchange rate risk in the event that the AUD weakens.<br>► Operational & maintenance costs – Costs will be transacted in AUD as well as other currencies, most likely US$ (for example where considering Rolling Stock maintenance).<br>► Revenue contracts – The currency used to contract with the mining companies will be a key tool for managing foreign exchange risk.<br><br>The transfer and management of foreign exchange risk will present a number of challenges that require exploring in Phase 2. |

## 13.3 Risk workshop

We recommend that a risk workshop is held during Phase 2 to explore each of these issues further, identify Project risks, their impact and an appropriate action for managing and mitigate them.

# 14. Next steps

The analysis in this report provides a number of positive messages about the GICP. The next phase should seek to build on these positive messages by engaging stakeholders and performing market testing of the assumptions.

We propose the following approach:

- Engage the mining community and testing of demand assumptions.
- Engage NQBP, as the Abbot Point port owner, to market test the port capacity strategy.
- Using the feedback from miners and the port, reassess the financial viability, on a cost per tonne basis, of the Project.
- Assuming the Project remains financially viable, on a cost per tonne basis, re-engage the mining community and port for support.
- Raise the profile and visibility of the Project with the state government by performing presentations and workshops on the status, miner support and benefits of the project.
- Develop the financing structure and engage the financial market.

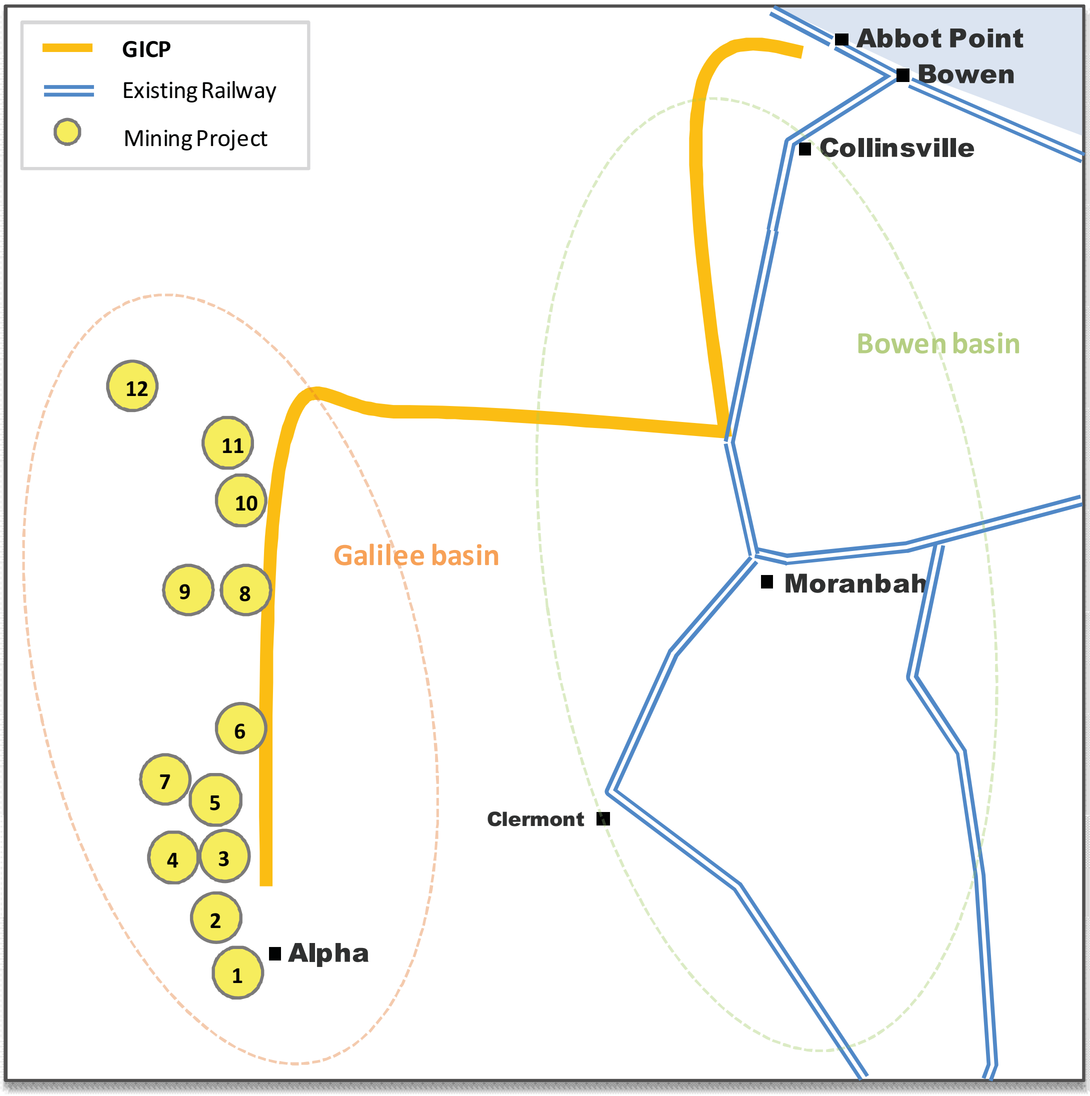
# Appendix A Mine demand

## Purpose

The purpose of this appendix is to list and compile publically available information about mining sites (completed and in progress) located along Galilee Infrastructure Corridor Project (GICP).

## GICP Overview

The following diagram is provides a simplified summary of the corridor proposed by EWLP and the alignment of the various potential users (mines) along this route.[23]




[23] This is an Ernst & Young graphical representation of alignment for information purposes and is not to scale

The following table provides a summary of the mines currently proposed for the Galilee Basin area. Further details on each are provided below the table.

| | Project Name | Proponent | Type | Range of volume of cleaned coal (Mtpa) | Volumes assumed for analysis (Mtpa)[24] | Operational commencement [25] | Reserve<br>Mine Life |
|---|---|---|---|---|---|---|---|
| 1 | South Galilee Coal Project | AMCI & Bandanna Energy Ltd | open-cut & underground coal | 15-20 | 15 | 2015 | 1 Bn Tonnes<br>43 years |
| 2 | China First Coal Project | Waratah | open-cut & underground coal | 40 | 40 | 2014 | 3.7 Bn Tonnes[26]<br>66 years |
| 3 | Alpha Coal Project | Hancock / GVK | Open-cut coal | 30 | 30 | Q2 2015 | 1.82 Bn tonnes<br>30 years |
| 4 | Alpha West Project | Hancock / GVK | Underground coal | 16-24 | 16 | 2016 | 1.8 Bn tonnes<br>30+ years |
| 5 | Kevin's Corner Project | GVK | open-cut & underground coal | 30 | 30 | Q4 2015 | 4.3 Bn tonnes<br>About 30 years |
| 6 | Alpha North Coal Project | Waratah | coal | 40 | 40 | Q4 2016 | 3.5 Bn tonnes<br>About 62.5 years |
| 7 | Alpha West Coal Project | Waratah | Coal | No details | - | No details | No details |
| 8 | Degulla Coal Project | Vale | coal | 20-40 | 20 | Unknown<br>EY Estimate: 2016[27] | No details |
| 9 | Carmichael East Coal Project | Waratah | Coal | No details | - | No details | No details |
| 10 | Carmichael Coal Project | Adani | open-cut & underground coal | 60 (from 2022) | 60 | 2014[28] | 7.8 Bn tonnes<br>Over 100 years |
| 11 | China Stone Project - South | Macmines | open-cut & underground coal | 30 | 30 | 2016 | 3.7 Bn tonnes[29]<br>About 46 years |
| 12 | China Stone Project - North | Macmines | open-cut & underground coal | 30 | 30 | No details<br>EY Model assumes: 2016 | No details |
| | Total Galilee Basin | | | 311-344 | 311 | | |

[24] Assumes the lower figure within the range proposed by miners
[25] Assumes 1 January for modelling purposes where not stated otherwise.
[26] Subject to mining permit extension
[27] Bloomberg article : Australia's $32 Billion Galilee Coal Basin Needs Joint Rail, Vale Says. (http://mobile.bloomberg.com/news/2011-11-23/australia-s-32-billion-galilee-coal-basin-needs-joint-rail-vale-says)
[28] Adani press article of 2 July 2012 suggests July 2013 operational commencement. Original timing retained for purpose of financial modelling (http://in.reuters.com/article/2012/07/02/us-adani-rail-construction-idINBRE86107H20120702)
[29] Could go up to 9.7 Bn depending on permit extension (largest coal resource in the Galilee Basin)

# Detailed Projects Description

## Mine 1 - South Galilee Coal Mine

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | AMCI & Bandanna Energy Ltd | Deedi |
| Type | open-cut & underground coal | Deedi |
| Volume cleaned coal (mtpa) | 15-20 | Deedi |
| Completion | 2015 | Deedi |
| Reserve / Mine Life | 1 Bn Tonnes<br>*43 years* | EY Estimate<br>*Proponents website (http://www.southgalilee.com.au/Default.aspx)* |
| Investment (Billion AUD) | 1.5 (mining only) | Deedi |
| Volume ramp up | No details | N/A |

## Mine 2 - China First Coal Project

Note: This project is also known as Galilee Coal Northern Export Facility Project)
The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Waratah Coal Pty Ltd | Deedi |
| Type | open-cut & underground coal | Deedi |
| Volume cleaned coal (mtpa) | 40 | Deedi |
| Completion | 2014 | Deedi |
| Reserve / Mine Life | 3.7 Bn Tonnes (1)<br>*66 years* | Proponent website<br>*EY Estimate* |
| Investment (Billion AUD) | 7.63 (include rail) | Deedi |
| Volume ramp up | No details | N/A |

(1) Subject to mining permit extension (see JORC reserves = 1.1 Bn)

## Mines 3 - Alpha Coal Project

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Hancock/GVK | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Type | Open-cut coal | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Volume cleaned coal (mtpa) | 30 | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Completion | Q2 2015<br>2016 | GVK Presentation by Paul Mulder MG - Coal (May 2012)<br>Deedi |
| Reserve / Mine Life | 1.82 Bn tonnes resources<br>*30 years* | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Investment (Billion AUD) | 7<br>(include rail) | Deedi |
| Volume ramp up | 2015 to 2019 | GVK Presentation by Paul Mulder MG - Coal (May 2012) |

## Mines 4 - Alpha West Project

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Hancock/GVK | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Type | Underground coal | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Volume cleaned coal (mtpa) | 16-24 | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Completion | 2016 | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Reserve / Mine Life | 1.8 Bn tonnes resources<br>*30+ years* | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Investment (Billion AUD) | No details | N/A |
| Volume ramp up | No details | N/A |

# Mines 5 - Kevin's Corner Project

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | GVK | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Type | open-cut & underground coal | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Volume cleaned coal (mtpa) | 30 | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Completion | Q4 2015 | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Reserve / Mine Life | 4.3 Bn tonnes resources<br>*About 30 years* | GVK Presentation by Paul Mulder MG - Coal (May 2012) |
| Investment (Billion AUD) | 6.6<br>(include rail) | Deedi |
| Volume ramp up | 2016 to 2019 | GVK Presentation by Paul Mulder MG - Coal (May 2012) |

# Mines 6 - Alpha North Coal Project

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Waratah | Proponent website |
| Type | coal | Proponent website |
| Volume cleaned coal (mtpa) | 40 | Proponent website |
| Completion | Q4 2016 | Proponent website |
| Reserve / Mine Life | 3.5 Bn tonnes resource<br>*About 62.5 years* | Proponent website<br>*EY Calculation* |
| Investment (Billion AUD) | No details | N/A |
| Volume ramp up | No details | N/A |

## Mines 7 - Alpha West Coal Project (Waratah)

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Waratah | Proponent website and EWLP Map |
| Type | coal | Proponent website and EWLP Map |
| Volume cleaned coal (mtpa) | No details | N/A |
| Completion | No details | N/A |
| Reserve / Mine Life | No details | N/A |
| Investment (Billion AUD) | No details | N/A |
| Volume ramp up | No details | N/A |

## Mines 8 - Degulla Coal Project (Vale)

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Vale | Proponent website and EWLP Map |
| Type | coal | Proponent website and EWLP Map |
| Volume cleaned coal (mtpa) | 20-40 | Aquilaresources.com: http://www.aquilaresources.com.au/files/International%20Longwall%2024062011.pdf |
| Completion | Unknown EY Guess : 2016 | Bloomberg article: - http://mobile.bloomberg.com/news/2011-11-23/australia-s-32-billion-galilee-coal-basin-needs-joint-rail-vale-says |
| Reserve / Mine Life | No details | N/A |
| Investment (Billion AUD) | 8 | Bloomberg article: - http://mobile.bloomberg.com/news/2011-11-23/australia-s-32-billion-galilee-coal-basin-needs-joint-rail-vale-says |
| Volume ramp up | No details | N/A |

# Mines 9 - Carmichael East Coal Project (Waratah)

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Waratah | Proponent website and EWLP Map |
| Type | coal | Proponent website and EWLP Map |
| Volume cleaned coal (mtpa) | No details | N/A |
| Completion | No details | N/A |
| Reserve / Mine Life | No details | N/A |
| Investment (Billion AUD) | No details | N/A |
| Volume ramp up | No details | N/A |

# Mines 10 - Carmichael Coal Project (Adani)

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Adani | Deedi |
| Type | Open-cut and underground | Deedi |
| Volume cleaned coal (mtpa) | 60 (from 2022) | Deedi |
| Completion | 2014 | Deedi |
| Reserve / Mine Life | 7.8 Bn tonnes<br>*Over 100 years* | Adani Overview for Marketing: http://www.ichca.com/about_us/Conference%20Sponsors/Adani%20overview%20for%20marketing.pdf<br>*Mine Life: 90 years per proponent website and 150 years per IAS (p8)* |
| Investment (Billion AUD) | 4.1<br>(mining only) | Deedi |
| Volume ramp up | Initial input of 2 Mtpa in 2014 will increase to deliver a max of 60 Mtpa from 2022 | Carmichael Coal Mine and Rail Project – Initial Advice Statement – 22 October 2010 |

## Mines 11 and 12 - China Stone Project (Macmines)

The following table summarises the findings of our research and the source of our findings.

| Description | Findings | Source |
|---|---|---|
| Proponent | Macmines | Proponent website |
| Type | Open-cut and underground | Proponent website |
| Volume cleaned coal (mtpa) | 60<br>30 North mine and 30 South mine | Proponent website |
| Completion | 2016 (south mine) | Proponent website |
| Reserve / Mine Life | 3.7 Bn tonnes (JORC resource)<br>*About 46 years* | Proponent website |
| Investment (Billion AUD) | No details | N/A |
| Volume ramp up | No details | N/A |

# Appendix B Status of alternative proposals

The following table explores the progress to date and proposed timing of the alternative proposals.

Table 2: Summary of the major steps and administrative authorizations

| Steps / characteristic | QRN | GVK |
|---|---|---|
| Initial advice statement released | 5 December 2011 | 18 September 2008 |
| Declared project of significance | 27 January 2012 | 24 October 2008 |
| Public consultation on the Draft Terms of Reference of the EIS | 7 February 2009 to 9 March 2009 | 5 May 2012 to 4 June 2012 |
| Terms of Reference of EIS released | Pending | 1 June 2009 |
| Public consultation on EIS | No | 5 November to 20 December 2010 |
| Coordinator-General's report on EIS released | No | 29 May 2012 |
| Federal Validation | No | Pending |
| Proposed Delivery | 2015 | 2016 |
| Bankable Feasibility Studies | Seeking agreement with miners to conduct joint Feasibility studies | Bankable Feasibility Studies in progress[30] |
| Approx. Corridor Investment | $2 Bn (at least) noted in IAS[31] while other information indicates $6 Bn[32] | $3 Bn[33] |

The above table identifies that GVK is more advanced with its proposal than QRN. However, QRN's proposed delivery date is in 2015, one year before GVK's.

[30] GVK presentation to Macquarie – May 2012
[31] QR National IAS – December 5 2011
[32] Reuters article of 2 July 2012 http://uk.reuters.com/article/2012/07/02/uk-adani-rail-idUKBRE86104420120702?feedType=RSS&feedName=businessNews
[33] 1.5Bn included within Kevin's Corner Project investment and 1.5Bn included within Alpha Coal Project investment

# Appendix C Demand Tables

## GICP Option 1

**Coal Output with Ramp-up**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 30 | - | - | - | - | - | - | 7.5 | 15.0 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 30 | - | - | - | - | - | 7.5 | 15.0 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 15 | - | - | - | - | - | - | - | - | - | 3.8 | 7.5 | 11.3 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - | - | - | - | - |
| Vale 1 | 15 | - | - | - | - | - | - | - | - | - | 3.8 | 3.8 | 7.5 | 7.5 | 11.3 | 11.3 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 40 | - | - | - | - | - | 5.7 | 11.4 | 17.1 | 22.9 | 28.6 | 34.3 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 20 | - | - | - | - | - | 2.9 | 5.7 | 8.6 | 11.4 | 14.3 | 17.1 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 30 | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **240.0** | - | - | - | - | - | **16.1** | **39.6** | **63.2** | **86.8** | **110.4** | **122.7** | **138.8** | **150.0** | **153.8** | **161.3** | **172.5** | **180.0** | **187.5** | **202.5** | **210.0** | **217.5** | **225.0** | **232.5** | **232.5** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | - | - | - | - | - | - | - |

**Contracted Take or Pay Capacity**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 30 | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 30 | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 15 | - | - | - | - | - | - | - | - | - | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - | - | - | - | - |
| Vale 1 | 15 | - | - | - | - | - | - | - | - | - | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 40 | - | - | - | - | - | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 20 | - | - | - | - | - | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 30 | - | - | - | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **240.0** | - | - | - | - | - | **90.0** | **120.0** | **120.0** | **120.0** | **150.0** | **150.0** | **150.0** | **180.0** | **180.0** | **180.0** | **210.0** | **210.0** | **210.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | **240.0** | - | - | - | - | - | - | - |

## QRN (90Mtpa)

**Coal Output with Ramp-up**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 40 | - | - | - | - | - | 5.7 | 11.4 | 17.1 | 22.9 | 28.6 | 34.3 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 20 | - | - | - | - | - | 2.9 | 5.7 | 8.6 | 11.4 | 14.3 | 17.1 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 30 | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **90.0** | - | - | - | - | - | **8.6** | **17.1** | **25.7** | **34.3** | **42.9** | **51.4** | **60.0** | **67.5** | **67.5** | **75.0** | **75.0** | **82.5** | **82.5** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | - | - | - | - | - | - | - |

**Contracted Take or Pay Capacity**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 40 | - | - | - | - | - | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 20 | - | - | - | - | - | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 30 | - | - | - | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **90.0** | - | - | - | - | - | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | - | - | - | - | - | - | - |

# GVK (150Mtpa)

**Coal Output with Ramp-up**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 30 | - | - | - | - | - | - | 7.5 | 15.0 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 30 | - | - | - | - | - | 7.5 | 15.0 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 15 | - | - | - | - | - | - | - | - | - | 3.8 | 7.5 | 11.3 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - | - | - | - | - |
| Vale 1 | 15 | - | - | - | - | - | - | - | - | - | 3.8 | 3.8 | 7.5 | 7.5 | 11.3 | 11.3 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **150.0** | - | - | - | - | - | **7.5** | **22.5** | **37.5** | **52.5** | **67.5** | **71.3** | **78.8** | **82.5** | **86.3** | **86.3** | **97.5** | **97.5** | **105.0** | **112.5** | **120.0** | **127.5** | **135.0** | **142.5** | **142.5** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | - | - | - | - | - | - | - |

**Contracted Take or Pay Capacity**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 30 | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 30 | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 15 | - | - | - | - | - | - | - | - | - | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - | - | - | - | - |
| Vale 1 | 15 | - | - | - | - | - | - | - | - | - | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **150.0** | - | - | - | - | - | **30.0** | **60.0** | **60.0** | **60.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **90.0** | **120.0** | **120.0** | **120.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | **150.0** | - | - | - | - | - | - | - |

## GICP Option 2

**Coal Output with Ramp-up**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - |
| Waratah - Alpha North Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | 15 | - | - | - | - | - | - | - | - | - | - | - | - | 3.8 | 3.8 | 7.5 | 7.5 | 11.3 | 11.3 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - |
| Adani 1 - scaled to T0 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.5 | 2.5 | 5.0 | 5.0 | 7.5 | 7.5 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | - | - | - |
| Vale 2 | 5 | - | - | - | - | - | - | - | - | - | - | - | - | 1.3 | 1.3 | 2.5 | 2.5 | 3.8 | 3.8 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | - | - | - |
| Macmines South Tenement | 30 | - | - | - | - | - | - | - | - | - | 7.5 | 7.5 | 15.0 | 15.0 | 22.5 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **120.0** | - | - | - | - | - | - | - | - | - | **7.5** | **7.5** | **15.0** | **20.0** | **27.5** | **32.5** | **50.0** | **55.0** | **65.0** | **77.5** | **87.5** | **95.0** | **105.0** | **112.5** | **112.5** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | - | - | - |

**Contracted Take or Pay Capacity**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - |
| Waratah - Alpha North Coal 1 | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | 15 | - | - | - | - | - | - | - | - | - | - | - | - | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | - | - | - |
| Adani 1 - scaled to T0 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | - | - | - |
| Vale 2 | 5 | - | - | - | - | - | - | - | - | - | - | - | - | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | - | - | - |
| Macmines South Tenement | 30 | - | - | - | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **120.0** | - | - | - | - | - | - | - | - | - | **30.0** | **30.0** | **30.0** | **50.0** | **50.0** | **50.0** | **90.0** | **90.0** | **90.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | **120.0** | - | - | - |

## QRN (60Mtpa)

**Coal Output with Ramp-up**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 40 | - | - | - | - | - | 5.7 | 11.4 | 17.1 | 22.9 | 28.6 | 34.3 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 20 | - | - | - | - | - | 2.9 | 5.7 | 8.6 | 11.4 | 14.3 | 17.1 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **60.0** | - | - | - | - | - | **8.6** | **17.1** | **25.7** | **34.3** | **42.9** | **51.4** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | - | - | - | - | - | - | - |

**Contracted Take or Pay Capacity**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 40 | - | - | - | - | - | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 20 | - | - | - | - | - | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **60.0** | - | - | - | - | - | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | - | - | - | - | - | - | - |

GVK (60Mtpa)

**Coal Output with Ramp-up**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 30 | - | - | - | - | - | - | 7.5 | 15.0 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 |
| Hancock/GVK - Alpha Coal | 30 | - | - | - | - | - | 7.5 | 15.0 | 22.5 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 |
| Hancock/GVK - Alpha West 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **60.0** | **-** | **-** | **-** | **-** | **-** | **7.5** | **22.5** | **37.5** | **52.5** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** |

| | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines North Tenement | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

**Contracted Take or Pay Capacity**

| | Max contracted | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | 0.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 30 | - | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 |
| Hancock/GVK - Alpha Coal | 30 | - | - | - | - | - | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 |
| Hancock/GVK - Alpha West 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 1 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines North Tenement | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **60.0** | **-** | **-** | **-** | **-** | **-** | **30.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** |

| | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha West Coal | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Carmichael East | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Kevin's Corner | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha Coal | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 1 - scaled to T0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Adani 2 - remainder of volume | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bowen 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Hancock/GVK - Alpha West 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - China First Coal 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Waratah - Alpha North Coal 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vale 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines South Tenement | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Macmines North Tenement | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **60.0** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

## Direct Comparison

- Comparison against QRN (60 Mtpa) - same demand scenario as QRN (60Mtpa) in Comparison 2
- Comparison against GVK (60 Mtpa) - same demand scenario as GVK (60Mtpa) in Comparison 2

# Appendix D Everything Infrastructure Cost templates

## Below Rail - GICP Option 1 – Zone 1

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| **ZONE 1 - BELOW RAIL - Capex** | | **20 km** | **148 km** | **15 km** | **36 km** | **219 km** |
| Start of Construction | **1/01/2014** | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction contract | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 1,002,065,375** | | | | | |
| **Contractors Mark Up +10%** | $ 100,206,538 | | | | | |
| **Total Contractor's Price** | $ 1,102,271,913 | | | | | |
| **Client Costs (PM, Planning & Approvals) +10%** | $ 110,227,191 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 32,900,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 1,245,399,104** | | | | | |
| **Contingencies** | $ 373,619,731 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 1,619,018,835** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Zone 2

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| ZONE 2 - BELOW RAIL - Capex | | 128 km | 0 km | 0 km | 23 km | 151 km |
| Start of Construction | 1/01/2014 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction contrac | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **595,043,648** | | | | | |
| **Contractors Mark Up** +10% | $ 59,504,365 | | | | | |
| **Total Contractor's Price** | $ 654,548,013 | | | | | |
| **Client Costs (PM, Planning & Approvals)** +10% | $ 65,454,801 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 15,100,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 735,102,814** | | | | | |
| **Contingencies** | $ 220,530,844 | **(30%)** | | | | |
| **Total Zone 2 Construction Costs** | **$ 955,633,659** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Zone 3

| ZONE 3 - BELOW RAIL - Capex | | Flat<br>0 km | Hilly<br>0 km | Rolling<br>16 km | Flood<br>12 km | Total<br>28 km |
|---|---|---|---|---|---|---|
| Start of Construction | 1/01/2014 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction contract | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | 120,555,986 | | | | | |
| Contractors Mark Up +10% | $ 12,055,599 | | | | | |
| Total Contractor's Price | $ 132,611,584 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 13,261,158 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,400,000 | | | | | |
| Project Costs (excluding contingencies) | $ 147,272,743 | | | | | |
| Contingencies | $ 44,181,823 | (30%) | | | | |
| Total Zone 2 Construction Costs | $ 191,454,566 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Zone 4

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| **ZONE 4 - BELOW RAIL - Capex** | | **0 km** | **44 km** | **0 km** | **0 km** | **44 km** |
| **Start of Construction** | **1/01/2014** | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| **Construction pricing inflation rate** | **4%** | | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |
| **<u>Spend required in this zone</u>** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructio | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 196,124,278** | | | | | |
| **Contractors Mark Up** **+10%** | $ 19,612,428 | | | | | |
| **Total Contractor's Price** | $ 215,736,706 | | | | | |
| **Client Costs (PM, Planning & Approvals)** **+10%** | $ 21,573,671 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 2,200,000.00 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 239,510,377** | | | | | |
| **Contingencies** | $ 71,853,113 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 311,363,489** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Zone 5

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| ZONE 5 - BELOW RAIL - Capex | | 0 km | 0 km | 24 km | 10 km | 34 km |
| Start of Construction | 1/01/2014 | NB: For start of construction date later than 1st Jan 2014, suggest inflation | | | | |
| Construction pricing inflation rate | 4% | rate of 4%pa for construction pricing increases | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 135,127,161 | | | | | |
| Contractors Mark Up +10% | $ 13,512,716 | | | | | |
| Total Contractor's Price | $ 148,639,877 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 14,863,988 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,700,000 | | | | | |
| Project Costs (excluding contingencies) | $ 165,203,865 | | | | | |
| Contingencies | $ 49,561,159 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 214,765,024 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Zone 6

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| ZONE 6 - BELOW RAIL - Capex | | 4 km | 0 km | 0 km | 18 km | 22 km |
| Start of Construction | 1/01/2014 | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructior | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 119,776,147 | | | | | |
| Contractors Mark Up +10% | $ 11,977,615 | | | | | |
| Total Contractor's Price | $ 131,753,762 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 13,175,376 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,100,000 | | | | | |
| Project Costs (excluding contingencies) | $ 146,029,138 | | | | | |
| Contingencies | $ 43,808,741 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 189,837,880 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Zone 7

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| **ZONE 7 - BELOW RAIL - Capex** | | **36 km** | **0 km** | **0 km** | **0 km** | **36 km** |
| **Start of Construction** | **1/01/2014** | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| **Construction pricing inflation rate** | **4%** | | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructic | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 135,698,470** | | | | | |
| **Contractors Mark Up** **+10%** | $ 13,569,847 | | | | | |
| **Total Contractor's Price** | $ 149,268,317 | | | | | |
| **Client Costs (PM, Planning & Approvals)** **+10%** | $ 14,926,832 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 1,800,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 165,995,149** | | | | | |
| **Contingencies** | $ 49,798,545 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 215,793,693** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Zone 8

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| ZONE 8 - BELOW RAIL - Capex | | 21 km | 0 km | 0 km | 2 km | 23 km |
| Start of Construction | 1/01/2014 | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructi | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 79,724,674 | | | | | |
| Contractors Mark Up +10% | $ 7,972,467 | | | | | |
| Total Contractor's Price | $ 87,697,142 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 8,769,714 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,200,000 | | | | | |
| Project Costs (excluding contingencies) | $ 97,666,856 | | | | | |
| Contingencies | $ 29,300,057 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 126,966,913 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Zone 9

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| **ZONE 9 - BELOW RAIL - Capex** | | **20 km** | **0 km** | **0 km** | **0 km** | **20 km** |
| **Start of Construction** | **1/01/2026** | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| **Construction pricing inflation rate** | 4% | | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 100% | 0% | 0% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construc | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 80,274,714** | | | | | |
| **Contractors Mark Up +10%** | $ 8,027,471 | | | | | |
| **Total Contractor's Price** | $ 88,302,185 | | | | | |
| **Client Costs (PM, Planning & Approvals) +10%** | $ 8,830,218 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 1,000,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 98,132,403** | | | | | |
| **Contingencies** | $ 29,439,721 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 127,572,124** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 1 – Opex

**ZONE 9 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

| | | |
|---|---|---|
| Maintenance Cost Escalation Factor : | 2.5% | Assumed annual inflation rate based on CPI (mainly labour) |
| Maintenance Cost Base Date : | 1st Jul 2012 | |

## Below Rail - GICP Option 1 – Passing Loops

**PASSING LOOPS - GENERAL**

| | | | |
|---|---|---|---|
| As a rule of thumb each of train can carry | 7.5 Mtpa | Total Construction Cost [Brownfield] of Typical Passing Loop | $5,250,000 /km |
| No passing loops have been included in the Total Construction Costs. | Passing Loop escalation Factor : | 4.0% | Assumed annual inflation rate based on construction costs |
| For each additional train a new passing loop will be required. | Cost Base Date : | 1st Jul 2012 | |

| | Passing Loop Spend Factor (Equivelant kms) | | | | | | |
|---|---|---|---|---|---|---|---|
| **Volume (Mtpa in total system)** | **Zone 1** | **Zone 2** | **Zone 3** | **Zone 4** | **Zone 5** | **Zone 6** | **Zone 7** |
| 0.0 | 5.67 | 11.33 | 0 | 0 | 0 | 5.67 | 0 |
| 7.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 37.5 | 8.5 | 8.5 | 0 | 8.5 | 0 | 8.5 | 0 |
| 45.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60.0 | 8.5 | 8.5 | 0 | 8.5 | 0 | 0 | 8.5 |
| 67.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82.5 | 8.5 | 8.5 | 0 | 0 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 105.0 | 8.5 | 8.5 | 8.5 | 0 | 8.5 | 0 | 0 |
| 112.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 120.0 | 8.5 | 8.5 | 0 | 0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NB(1) : precise locations of passing loops not yet determined, assumed Flat terrrain used first.

NB(2 ): a 50% reduction factor has been applied to intial quantities to allow for greenfield build.

# Below Rail - GICP Option 1 – Duplication

**DUPLICATION - GENERAL**

| | | | |
|---|---|---|---|
| | | **Total Construction Cost [Brownfield]** | |
| As a rule of thumb each of train can carry | **7.5 Mtpa** | **of Duplicated section** | **$5,400,000** /km |
| Duplication is adopted upon the total passing loop length reaching 30% of total line length. | Passing Loop escalation Factor : | **4.0%** | Assumed annual inflation rate based on construction costs |
| | Cost Base Date : | 1st Jul 2012 | |

| | Duplication Cost Factors (Equivelant kms) | | | | | | |
|---|---|---|---|---|---|---|---|
| **Volume (Mtpa in total system)** | **Zone 1** | **Zone 2** | **Zone 3** | **Zone 4** | **Zone 5** | **Zone 6** | **Zone 7** |
| 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 37.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 45.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 67.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 105.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 120.0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 150.0 | 21 | 42 | 0 | 0 | 0 | 0 | 0 |
| 157.5 | 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 172.5 | 21 | 21 | 0 | 0 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 | 21 | 0 | 0 | 0 |
| 187.5 | 0 | 21 | 0 | 0 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 21 | 0 | 21 | 0 | 0 |
| 210.0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| 217.5 | 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| 225.0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 |
| 232.5 | 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| 240.0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NB(1) : precise locations of duplicated sections not yet determined, assumed Flat terrrain ussed first.

Note: for the purpose of modelling passing loops and duplication, the system throughput was assumed as the zone 1 throughput volumes as agreed with EIG.

## Below Rail – QRN (90Mtpa) – Mainline

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| **QRN/Adani - BELOW RAIL - Capex** | | **75 km** | **0 km** | **0 km** | **99 km** | **174 km** |
| Start of Construction | **1/01/2014** | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| **Spend curve (Year)** | 1 | 2 | 3 | 4 | 5 | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction contract | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 828,092,800** | | | | | |
| **Contractors Mark Up** **+10%** | $ 82,809,280 | | | | | |
| **Total Contractor's Price** | $ 910,902,080 | | | | | |
| **Client Costs (PM, Planning & Approvals)** **+10%** | $ 91,090,208 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 26,100,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 1,028,092,287** | | | | | |
| **Contingencies** | $ 308,427,686 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 1,336,519,974** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail – QRN (90Mtpa) – Zone4

| QRN ZONE 4 - BELOW RAIL - Capex | | Flat 0 km | Hilly 44 km | Rolling 0 km | Flood 0 km | Total Km 44 km |
|---|---|---|---|---|---|---|
| Start of Construction | 1/01/2023 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 100% | 0% | 0% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructio | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 167,184,080 | | | | | |
| Contractors Mark Up +10% | $ 16,718,408 | | | | | |
| Total Contractor's Price | $ 183,902,488 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 18,390,249 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 2,200,000 | | | | | |
| Project Costs (excluding contingencies) | $ 204,492,736 | | | | | |
| Contingencies | $ 61,347,821 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 265,840,557 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail – QRN (90Mtpa) – Opex

**QRN - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $45,000 | $45,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

| | | |
|---|---|---|
| Maintenance Cost Escalation Factor : | 2.5% | Assumed annual inflation rate based on CPI (mainly labour) |
| Maintenance Cost Base Date : | 1st Jul 2012 | |

## Below Rail – QRN (90Mtpa) – Passing Loops

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 3.2 Mtpa

Total Construction Cost [Brownfield] of Typical Passing Loop $4,875,000 /km

No passing loops have been included in the Total Construction Costs.

For each additional train a new passing loop will be required.

Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs

Cost Base Date : 1st Jul 2012

| | Passing Loop Cost Factors | | EWLP |
|---|---|---|---|
| Volume (Mtpa in total system) | Main Line | Upgrade North/South | Zone 1 |
| 0.0 | 5.5 | 0 | 0 |
| 7.5 | 0 | 0 | 0 |
| 15.0 | 7 | 3.5 | 0 |
| 22.5 | 3.5 | 7 | 0 |
| 30.0 | 7 | 0 | 0 |
| 37.5 | 3.5 | 7 | 0 |
| 45.0 | 0 | 0 | 0 |
| 52.5 | 0 | 0 | 0 |
| 60.0 | 0 | 0 | 0 |
| 67.5 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 |
| 82.5 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 |
| 105.0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 |
| 120.0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 |

NB(1) : precise locations of passing loops not yet determined, assumed Flat terrrain ussed first.

NB(2 ): a 50% reduction factor has been applied to intial quantities to allow for greenfield build.

## Below Rail – QRN (90Mtpa) – Duplication

**DUPLICATION - GENERAL**

| | | | | |
|---|---|---|---|---|
| | | | | **Total Construction Cost [Brownfield]** |
| As a rule of thumb each of train can carry | **3.2 Mtpa** | | | **of Duplicated section** **$5,100,000** /km |
| Duplication is adopted upon the total passing loop length reaching | | Passing Loop escalation Factor : | **4.0%** | Assumed annual inflation rate based on |
| 30% of total line length. | | Cost Base Date : | 1st Jul 2012 | construction costs |
| Assumed 1 duplication link / every 2 new train sets. | | | | |

| | Duplication Cost Factors | | EWLP | |
|---|---|---|---|---|
| **Volume (Mtpa in total system)** | **Main Line** | **Upgrade North/South** | **Zone 1** | |
| 0.0 | 0 | 0 | 0 | |
| 7.5 | 0 | 0 | 0 | |
| 15.0 | 0 | 0 | 0 | |
| 22.5 | 0 | 0 | 0 | |
| 30.0 | 0 | 0 | 0 | |
| 37.5 | 0 | 0 | 0 | **Total Construction Cost** |
| 45.0 | 45 | 0 | 314 | **for building entire single line Greenfield line 219km** |
| 52.5 | 0 | 0 | 0 | |
| 60.0 | 23 | 0 | 0 | |
| 67.5 | 69 | 0 | 0 | |
| 75.0 | 14 | 0 | 0 | |
| 82.5 | 0 | 0 | 0 | |
| 90.0 | 0 | 0 | 0 | |
| 97.5 | 0 | 0 | 0 | |
| 105.0 | 0 | 0 | 0 | |
| 112.5 | 0 | 0 | 0 | |
| 120.0 | 0 | 0 | 0 | |
| 127.5 | 0 | 0 | 0 | |
| 135.0 | 0 | 0 | 0 | |
| 142.5 | 0 | 0 | 0 | |
| 150.0 | 0 | 0 | 0 | |
| 157.5 | 0 | 0 | 0 | |
| 165.0 | 0 | 0 | 0 | |
| 172.5 | 0 | 0 | 0 | |
| 180.0 | 0 | 0 | 0 | |
| 187.5 | 0 | 0 | 0 | |
| 195.0 | 0 | 0 | 0 | |
| 202.5 | 0 | 0 | 0 | |
| 210.0 | 0 | 0 | 0 | |
| 217.5 | 0 | 0 | 0 | |
| 225.0 | 0 | 0 | 0 | |
| 232.5 | 0 | 0 | 0 | |
| 240.0 | 0 | 0 | 0 | |
| 247.5 | 0 | 0 | 0 | |
| 255.0 | 0 | 0 | 0 | |
| 262.5 | 0 | 0 | 0 | |
| 270.0 | 0 | 0 | 0 | |
| 277.5 | 0 | 0 | 0 | |
| 285.0 | 0 | 0 | 0 | |
| 292.5 | 0 | 0 | 0 | |
| 300.0 | 0 | 0 | 0 | |
| 307.5 | 0 | 0 | 0 | |
| 315.0 | 0 | 0 | 0 | |
| 322.5 | 0 | 0 | 0 | |
| 330.0 | 0 | 0 | 0 | |
| 337.5 | 0 | 0 | 0 | |
| 345.0 | 0 | 0 | 0 | |
| 352.5 | 0 | 0 | 0 | |

NB(1) : precise locations of duplicated sections not yet determined, assumed Flat terrrain ussed first.

Note: for the purpose of modelling passing loops and duplication, the system throughput was assumed as the main line throughput volumes as agreed with EIG.

## Below Rail – GVK (150Mtpa) – Mainline

| GVK Main Line - BELOW RAIL - Capex | | Flat<br>149 km | Hilly<br>136 km | Rolling<br>20 km | Flood<br>180 km | Total<br>485 km |
|---|---|---|---|---|---|---|
| Start of Construction | 1/01/2014 | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction contract | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 2,251,006,719** | | | | | |
| **Contractors Mark Up** +10% | $ 225,100,672 | | | | | |
| **Total Contractor's Price** | $ 2,476,107,390 | | | | | |
| **Client Costs (PM, Planning & Approvals)** +10% | $ 247,610,739 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 76,100,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 2,799,818,129** | | | | | |
| **Contingencies** | $ 839,945,439 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 3,639,763,568** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail – GVK (150Mtpa) – Zone 7

| | | Flat | Hilly | Rolling | Flood | Total km |
|---|---|---|---|---|---|---|
| GVK - ZONE 7 - BELOW RAIL - Capex | | 20 km | 0 km | 0 km | 16 km | 36 km |
| Start of Construction | 1/01/2019 | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 50% | 50% | 0% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construct | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 148,474,060 | | | | | |
| Contractors Mark Up +10% | $ 14,847,406 | | | | | |
| Total Contractor's Price | $ 163,321,466 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 16,332,147 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,800,000 | | | | | |
| Project Costs (excluding contingencies) | $ 181,453,612 | | | | | |
| Contingencies | $ 54,436,084 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 235,889,696 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail – GVK (150Mtpa) – Zone 8

| | | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|---|
| GVK - ZONE 8 - BELOW RAIL - Capex | | | 21 km | 0 km | 0 km | 2 km | 23 km |
| Start of Construction | 1/01/2019 | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | | |
| Construction pricing inflation rate | 4% | | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total | |
| Spend profile / curve - applied to all zone spend | 50% | 50% | 0% | 0% | 0% | 100% | |
| Spend required in this zone | | | | | | | |
| Categories | | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constru | | | | |
| Earthworks | | | | | | | |
| Capping Layer | | | | | | | |
| Structures | | | | | | | |
| Permanent Way | | | | | | | |
| Incidental & Environmental Works | | | | | | | |
| Fencing | | | | | | | |
| Total Construction Costs | $ 93,960,267 | | | | | | |
| Contractors Mark Up +10% | $ 9,396,027 | | | | | | |
| Total Contractor's Price | $ 103,356,294 | | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 10,335,629 | | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | | |
| Land Acquisition (provided by EWLP) | $ 1,200,000 | | | | | | |
| Project Costs (excluding contingencies) | $ 114,891,923 | | | | | | |
| Contingencies | $ 34,467,577 | (30%) | | | | | |
| Total Zone 1 Construction Costs | $ 149,359,500 | | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | | |

Below Rail – GVK (150Mtpa) – Zone 9

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| **GVK - ZONE 9 - BELOW RAIL - Capex** | | **20 km** | **0 km** | **0 km** | **0 km** | **20 km** |
| Start of Construction | 1/01/2026 | NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| **Spend curve (Year)** | 1 | 2 | 3 | 4 | 5 | **Total** |
| **Spend profile / curve - applied to all zone spend** | 100% | 0% | 0% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for const | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 78,415,674** | | | | | |
| **Contractors Mark Up** +10% | $ 7,841,567 | | | | | |
| **Total Contractor's Price** | $ 86,257,241 | | | | | |
| **Client Costs (PM, Planning & Approvals)** +10% | $ 8,625,724 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 1,000,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 95,882,965** | | | | | |
| **Contingencies** | $ 28,764,890 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 124,647,855** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail – GVK (150Mtpa) – Opex

**Option 1 - GVK - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $50,000 | $50,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)

Maintenance Cost Base Date : 1st Jul 2012

## Below Rail – GVK (150Mtpa) – Passing Loops

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **6.0 Mtpa**

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,000,000** /km

No passing loops have been included in the Total Construction Costs.

Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs

For each additional train a new passing loop will be required.

Cost Base Date : 1st Jul 2012

| | Passing Loop Cost Factors | | | |
|---|---|---|---|---|
| **Volume (Mtpa in total system)** | **Main Line** | **Zone 7** | **Zone 8** | **Zone 9** |
| 0.0 | 8.5 | 0 | 0 | 0 |
| 7.5 | 0 | 0 | 0 | 0 |
| 15.0 | 0 | 0 | 0 | 0 |
| 22.5 | 26 | 0 | 0 | 0 |
| 30.0 | 0 | 0 | 0 | 0 |
| 37.5 | 17 | 0 | 0 | 0 |
| 45.0 | 0 | 0 | 0 | 0 |
| 52.5 | 17 | 0 | 0 | 0 |
| 60.0 | 0 | 0 | 0 | 0 |
| 67.5 | 34 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 | 0 |
| 82.5 | 8.5 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 | 0 |
| 97.5 | 8.5 | 0 | 0 | 0 |
| 105.0 | 0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 | 0 |
| 120.0 | 0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 | 0 |

## Below Rail – GVK (150Mtpa) – Duplication

**DUPLICATION - GENERAL**

| | | | |
|---|---|---|---|
| | | **Total Construction Cost [Brownfield]** | |
| As a rule of thumb each of train can carry | **6.0 Mtpa** | **of Duplicated section** | **$5,000,000** /km |
| Duplication is adopted upon the total passing loop length reaching 30% of total line length. | Passing Loop escalation Factor : | **4.0%** | Assumed annual inflation rate based on construction costs |
| | Cost Base Date : | 1st Jul 2012 | |
| Assumed 1 duplication link / every 2 new train sets. | | | |

| | Duplication Cost Factor | | | |
|---|---|---|---|---|
| **Volume (Mtpa in total system)** | **Main Line** | **Zone 7** | **Zone 8** | **Zone 9** |
| 0.0 | 0 | 0 | 0 | 0 |
| 7.5 | 0 | 0 | 0 | 0 |
| 15.0 | 0 | 0 | 0 | 0 |
| 22.5 | 0 | 0 | 0 | 0 |
| 30.0 | 0 | 0 | 0 | 0 |
| 37.5 | 0 | 0 | 0 | 0 |
| 45.0 | 0 | 0 | 0 | 0 |
| 52.5 | 0 | 0 | 0 | 0 |
| 60.0 | 0 | 0 | 0 | 0 |
| 67.5 | 0 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 | 0 |
| 82.5 | 0 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 | 0 |
| 97.5 | 45 | 0 | 0 | 0 |
| 105.0 | 22 | 0 | 0 | 0 |
| 112.5 | 43 | 0 | 0 | 0 |
| 120.0 | 22 | 0 | 0 | 0 |
| 127.5 | 22 | 0 | 0 | 0 |
| 135.0 | 22 | 0 | 0 | 0 |
| 142.5 | 22 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 | 0 |
| 157.5 | 22 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 | 0 |

Note: for the purpose of modelling passing loops and duplication, the system throughput was assumed as the main line throughput volumes as agreed with EIG.

## Below Rail - GICP Option 2 – Zone 1

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| ZONE 1 - BELOW RAIL - Capex | | 20 km | 148 km | 15 km | 36 km | 219 km |
| Start of Construction | 1/01/2018 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction contract | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 1,002,065,375 | | | | | |
| Contractors Mark Up +10% | $ 100,206,538 | | | | | |
| Total Contractor's Price | $ 1,102,271,913 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 110,227,191 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 32,900,000 | | | | | |
| Project Costs (excluding contingencies) | $ 1,245,399,104 | | | | | |
| Contingencies | $ 373,619,731 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 1,619,018,835 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 2 – Zone 2

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| **ZONE 2 - BELOW RAIL - Capex** | | **128 km** | **0 km** | **0 km** | **23 km** | **151 km** |
| **Start of Construction** | **1/01/2018** | NB: For start of construction date later than 1st Jan 2013, suggest | | | | |
| **Construction pricing inflation rate** | **4%** | inflation rate of 4%pa for construction pricing increases | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construct | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **543,290,117** | | | | | |
| **Contractors Mark Up** **+10%** | $ 54,329,012 | | | | | |
| **Total Contractor's Price** | $ 597,619,128 | | | | | |
| **Client Costs (PM, Planning & Approvals)** **+10%** | $ 59,761,913 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 15,100,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 672,481,041** | | | | | |
| **Contingencies** | $ 201,744,312 | **(30%)** | | | | |
| **Total Zone 2 Construction Costs** | **$ 874,225,354** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 2 – Zone 3

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| ZONE 3 - BELOW RAIL - Capex | | 0 km | 0 km | 16 km | 12 km | 28 km |
| Start of Construction | 1/01/2018 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | 104,171,483 | | | | | |
| Contractors Mark Up +10% | $ 10,417,148 | | | | | |
| Total Contractor's Price | $ 114,588,632 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 11,458,863 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,400,000 | | | | | |
| Project Costs (excluding contingencies) | $ 127,447,495 | | | | | |
| Contingencies | $ 38,234,248 | (30%) | | | | |
| Total Zone 2 Construction Costs | $ 165,681,743 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 2 – Zone 4

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| ZONE 4 - BELOW RAIL - Capex | | 0 km | 44 km | 0 km | 0 km | 44 km |
| Start of Construction | 1/01/2022 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| **Spend curve (Year)** | 1 | 2 | 3 | 4 | 5 | Total |
| **Spend profile / curve - applied to all zone spend** | 50% | 50% | 0% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructio | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 166,224,278** | | | | | |
| **Contractors Mark Up** +10% | $ 16,622,428 | | | | | |
| **Total Contractor's Price** | $ 182,846,706 | | | | | |
| **Client Costs (PM, Planning & Approvals)** +10% | $ 18,284,671 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 2,200,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 203,331,377** | | | | | |
| **Contingencies** | $ 60,999,413 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 264,330,789** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 2 – Zone 5

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| ZONE 5 - BELOW RAIL - Capex | | 0 km | 0 km | 24 km | 10 km | 34 km |
| Start of Construction | 1/01/2022 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 50% | 50% | 0% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 152,418,900 | | | | | |
| Contractors Mark Up +10% | $ 15,241,890 | | | | | |
| Total Contractor's Price | $ 167,660,790 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 16,766,079 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,700,000 | | | | | |
| Project Costs (excluding contingencies) | $ 186,126,869 | | | | | |
| Contingencies | $ 55,838,061 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 241,964,930 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 2 – Zone 6

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| **ZONE 6 - BELOW RAIL - Capex** | | **4 km** | **0 km** | **0 km** | **18 km** | **22 km** |
| **Start of Construction** | **1/01/2022** | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| **Construction pricing inflation rate** | **4%** | | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 50% | 50% | 0% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructior | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 72,016,407** | | | | | |
| **Contractors Mark Up** **+10%** | $ 7,201,641 | | | | | |
| **Total Contractor's Price** | $ 79,218,048 | | | | | |
| **Client Costs (PM, Planning & Approvals)** **+10%** | $ 7,921,805 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 1,100,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 88,239,853** | | | | | |
| **Contingencies** | $ 26,471,956 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 114,711,809** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 2 – Zone 7

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| ZONE 7 - BELOW RAIL - Capex | | 20 km | 0 km | 0 km | 16 km | 36 km |
| Start of Construction | 1/01/2026 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 100% | 0% | | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructi | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 149,265,487 | | | | | |
| Contractors Mark Up +10% | $ 14,926,549 | | | | | |
| Total Contractor's Price | $ 164,192,035 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 16,419,204 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,800,000 | | | | | |
| Project Costs (excluding contingencies) | $ 182,411,239 | | | | | |
| Contingencies | $ 54,723,372 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 237,134,611 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 2 – Zone 8

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| **ZONE 8 - BELOW RAIL - Capex** | | **21 km** | **0 km** | **0 km** | **2 km** | **23 km** |
| Start of Construction | **1/01/2029** | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| **Spend curve (Year)** | 1 | 2 | 3 | 4 | 5 | **Total** |
| **Spend profile / curve - applied to all zone spend** | 100% | 0% | | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for constructi | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 79,724,674** | | | | | |
| **Contractors Mark Up** **+10%** | $ 7,972,467 | | | | | |
| **Total Contractor's Price** | $ 87,697,142 | | | | | |
| **Client Costs (PM, Planning & Approvals)** **+10%** | $ 8,769,714 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 1,200,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 97,666,856** | | | | | |
| **Contingencies** | $ 29,300,057 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 126,966,913** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

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## Below Rail - GICP Option 2 – Zone 9

| | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| ZONE 9 - BELOW RAIL - Capex | | 20 km | 0 km | 0 km | 0 km | 20 km |
| Start of Construction | 1/01/2029 | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| Construction pricing inflation rate | 4% | | | | | |
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 100% | 0% | 0% | 0% | 0% | 100% |
| Spend required in this zone | | | | | | |
| Categories | | | | | | |
| Construction (Third Party Costs) | Costs $ | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construc | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| Total Construction Costs | $ 80,274,714 | | | | | |
| Contractors Mark Up +10% | $ 8,027,471 | | | | | |
| Total Contractor's Price | $ 88,302,185 | | | | | |
| Client Costs (PM, Planning & Approvals) +10% | $ 8,830,218 | | | | | |
| Defect liability period | $ - | | Not included : assumed covered by maintenance contractors | | | |
| Land Acquisition (provided by EWLP) | $ 1,000,000 | | | | | |
| Project Costs (excluding contingencies) | $ 98,132,403 | | | | | |
| Contingencies | $ 29,439,721 | (30%) | | | | |
| Total Zone 1 Construction Costs | $ 127,572,124 | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GICP Option 2 – Opex

**GICP Option 2 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

| | | |
|---|---|---|
| Maintenance Cost Escalation Factor : | 2.5% | Assumed annual inflation rate based on CPI (mainly labour) |
| Maintenance Cost Base Date : | 1st Jul 2012 | |

## Below Rail - GICP Option 2 – Passing Loops

**PASSING LOOPS - GENERAL**

| | | | | |
|---|---|---|---|---|
| | | | Total Construction Cost [Brownfield] | |
| As a rule of thumb each of train can carry | 7.5 Mtpa | | of Typical Passing Loop | $5,250,000 /km |
| No passing loops have been included in the Total Construction Costs. | | Passing Loop escalation Factor : | 4.0% | Assumed annual inflation rate based on |
| For each additional train a new passing loop will be required. | | Cost Base Date : | 1st Jul 2012 | construction costs |

| | Passing Loop Spend Factor (Equivelant kms) | | | | | | |
|---|---|---|---|---|---|---|---|
| **Volume (Mtpa in total system)** | **Zone 1** | **Zone 2** | **Zone 3** | **Zone 4** | **Zone 5** | **Zone 6** | **Zone 7** |
| 0.0 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 7.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 15.0 | 8.5 | 17.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 22.5 | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 30.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 37.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 45.0 | 8.5 | 17.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 52.5 | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 60.0 | 0.0 | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 67.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 75.0 | 8.5 | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 82.5 | 0.0 | 0.0 | 0.0 | 8.5 | 0.0 | 0.0 | 0 |
| 90.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.5 | 0 |
| 97.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 105.0 | 8.5 | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 112.5 | 0.0 | 0.0 | 0.0 | 0.0 | 8.5 | 0.0 | 0 |
| 120.0 | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 127.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 135.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 142.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 150.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 157.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 165.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 172.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 180.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 187.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 195.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 202.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 210.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 217.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 225.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 232.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 240.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 247.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 255.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 262.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 270.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 277.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 285.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 292.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 300.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 307.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 315.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 322.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 330.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 337.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 345.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 352.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |

NB(1) : precise locations of passing loops not yet determined, assumed Flat terrrain ussed first.
NB(2 ): a 50% reduction factor has been applied to intial quantities to allow for greenfield build.

## Below Rail - GICP Option 2 – Duplication

**DUPLICATION - GENERAL**

| | | | |
|---|---|---|---|
| | | Total Construction Cost [Brownfield] | |
| As a rule of thumb each of train can carry | 7.5 Mtpa | of Duplicated section | $5,400,000 /km |
| Duplication is adopted upon the total passing loop length reaching 30% of total line length. | Passing Loop escalation Factor : | 4.0% | Assumed annual inflation rate based on construction costs |
| | Cost Base Date : | 1st Jul 2012 | |
| Assumed 1 duplication link / every 2 new train sets. | | | |

| | Duplication Cost Factors (Equivelant kms) | | | | | | |
|---|---|---|---|---|---|---|---|
| Volume (Mtpa in total system) | Zone 1 | Zone 2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 | Zone 7 |
| 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 37.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 45.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 67.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 105.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 120.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

NB(1) : precise locations of duplicated sections not yet determined, assumed Flat terrrain ussed first.

Note: for the purpose of modelling passing loops and duplication, the system throughput was assumed as the zone 1 throughput volumes as agreed with EIG.

## Below Rail - QRN (60Mtpa) – Main Line

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| **QRN Mainline - BELOW RAIL - Capex** | | **75 km** | **0 km** | **0 km** | **99 km** | **174 km** |
| **Start of Construction** | **1/01/2014** | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| **Construction pricing inflation rate** | **4%** | | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction contract | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 828,092,800** | | | | | |
| **Contractors Mark Up** **+10%** | $ 82,809,280 | | | | | |
| **Total Contractor's Price** | $ 910,902,080 | | | | | |
| **Client Costs (PM, Planning & Approvals)** **+10%** | $ 91,090,208 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 26,100,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 1,028,092,287** | | | | | |
| **Contingencies** | $ 308,427,686 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 1,336,519,974** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - QRN (60Mtpa) – Opex

**Option 2 - QRN - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $45,000 | $45,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

Maintenance Cost escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)

Maintenance Cost Base Date : 1st Jul 2012

## Below Rail - QRN (60Mtpa) – Passing Loops

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **3.2 Mtpa**

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$4,875,000** /km

No passing loops have been included in the Total Construction Costs.

For each additional train a new passing loop will be required.

It is assumed passing loops are build every 3 years

Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs

Cost Base Date : 1st Jul 2012

| | Passing Loop Cost Factors | | EWLP |
|---|---|---|---|
| **Volume (Mtpa in total system)** | **Main Line** | **Upgrade North/South** | **Zone 1** |
| 0.0 | 7 | 0 | 0 |
| 7.5 | 0 | 0 | 0 |
| 15.0 | 7 | 3.5 | 0 |
| 22.5 | 3.5 | 7 | 0 |
| 30.0 | 3.5 | 3.5 | 0 |
| 37.5 | 7 | 3.5 | 0 |
| 45.0 | 0 | 0 | 0 |
| 52.5 | 0 | 0 | 0 |
| 60.0 | 0 | 0 | 0 |
| 67.5 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 |
| 82.5 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 |
| 105.0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 |
| 120.0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 |

NB(1) : precise locations of passing loops not yet determined, assumed Flat terrrain ussed first.

NB(2 ): a 50% reduction factor has been applied to intial quantities to allow for greenfield build.

## Below Rail - QRN (60Mtpa) – Duplication

**DUPLICATION - GENERAL**

| | | | | | |
|---|---|---|---|---|---|
| | | | **Total Construction Cost [Brownfield]** | | |
| As a rule of thumb each of train can carry | **3.2 Mtpa** | | **of Duplicated section** | **$5,100,000** | /km |
| Duplication is adopted upon the total passing loop length reaching | | Passing Loop escalation Factor : | **4.0%** | Assumed annual inflation rate based on | |
| 30% of total line length. | | Cost Base Date : | 1st Jul 2012 | construction costs | |
| Assumed 1 duplication link / every 2 new train sets. | | | | | |

| | Duplication Cost Factors | | EWLP |
|---|---|---|---|
| **Volume (Mtpa in total system)** | **Main Line** | **Upgrade North/South** | **Zone 1** |
| 0.0 | 0 | 0 | 0 |
| 7.5 | 0 | 0 | 0 |
| 15.0 | 0 | 0 | 0 |
| 22.5 | 0 | 0 | 0 |
| 30.0 | 0 | 0 | 0 |
| 37.5 | 0 | 0 | 0 |
| 45.0 | 40 | 0 | 314 |
| 52.5 | 62 | 0 | 0 |
| 60.0 | 0 | 0 | 0 |
| 67.5 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 |
| 82.5 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 |
| 105.0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 |
| 120.0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 |

**Total Construction Cost**
**for building entire single line Greenfield line 219km**

NB(1) : precise locations of duplicated sections not yet determined, assumed Flat terrrain ussed first.

Note: for the purpose of modelling passing loops and duplication, the system throughput was assumed as the main line throughput volumes as agreed with EIG.

# Below Rail - GVK (60Mtpa) – Mainline

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| **GVK Mainline - BELOW RAIL - Capex** | | **149 km** | **136 km** | **20 km** | **180 km** | **485 km** |
| **Start of Construction** | **1/01/2014** | NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases | | | | |
| **Construction pricing inflation rate** | **4%** | | | | | |
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |
| **Spend required in this zone** | | | | | | |
| **Categories** | | | | | | |
| **Construction (Third Party Costs)** | **Costs $** | | | | | |
| Establishment of construction offices, camps & environmental surveys | | | | | | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | | | NB: Includes allowance to fix price and time for construction contract | | | |
| Earthworks | | | | | | |
| Capping Layer | | | | | | |
| Structures | | | | | | |
| Permanent Way | | | | | | |
| Incidental & Environmental Works | | | | | | |
| Fencing | | | | | | |
| **Total Construction Costs** | **$ 2,251,006,719** | | | | | |
| **Contractors Mark Up** **+10%** | $ 225,100,672 | | | | | |
| **Total Contractor's Price** | $ 2,476,107,390 | | | | | |
| **Client Costs (PM, Planning & Approvals)** **+10%** | $ 247,610,739 | | | | | |
| **Defect liability period** | $ - | | Not included : assumed covered by maintenance contractors | | | |
| **Land Acquisition** (provided by EWLP) | $ 76,100,000 | | | | | |
| **Project Costs (excluding contingencies)** | **$ 2,799,818,129** | | | | | |
| **Contingencies** | $ 839,945,439 | **(30%)** | | | | |
| **Total Zone 1 Construction Costs** | **$ 3,639,763,568** | | | | | |
| Cost Base Date : | 1st Jul 2012 | | | | | |

## Below Rail - GVK (60Mtpa) – Opex

**Option 2 - GVK/Hancock - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $50,000 | $50,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

Maintenance Cost escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)

Maintenance Cost Base Date : 1st Jul 2012

## Below Rail - GVK (60Mtpa) – Passing Loops

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 6.0 Mtpa

Total Construction Cost [Brownfield] of Typical Passing Loop $5,000,000 /km

No passing loops have been included in the Total Construction Costs.

For each additional train a new passing loop will be required.

Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs

Cost Base Date : 1st Jul 2012

| | Passing Loop Cost Factors | | | |
|---|---|---|---|---|
| Volume (Mtpa in total system) | Main Line | Zone 7 | Zone 8 | Zone 9 |
| 0.0 | 11.3 | 0 | 0 | 0 |
| 7.5 | 0 | 0 | 0 | 0 |
| 15.0 | 0 | 0 | 0 | 0 |
| 22.5 | 25.5 | 0 | 0 | 0 |
| 30.0 | 0 | 0 | 0 | 0 |
| 37.5 | 17 | 0 | 0 | 0 |
| 45.0 | 0 | 0 | 0 | 0 |
| 52.5 | 17 | 0 | 0 | 0 |
| 60.0 | 8.5 | 0 | 0 | 0 |
| 67.5 | 0 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 | 0 |
| 82.5 | 0 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 | 0 |
| 105.0 | 0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 | 0 |
| 120.0 | 0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 | 0 |

NB(1) : precise locations of passing loops not yet determined, assumed Flat terrrain ussed first.

NB(2 ): a 50% reduction factor has been applied to intial quantities to allow for greenfield build.

## Below Rail - GVK (60Mtpa) – Duplication

| | | | | |
|---|---|---|---|---|
| | | | Total Construction Cost [Brownfield] | |
| As a rule of thumb each of train can carry | 6.0 Mtpa | | of Duplicated section | $5,000,000 /km |
| Duplication is adopted upon the total passing loop length reaching 30% of total line length. | | Passing Loop escalation Factor : | 4.0% | Assumed annual inflation rate based on construction costs |
| | | Cost Base Date : | 1st Jul 2012 | |
| Assumed 1 duplication link / every 2 new train sets. | | | | |

| | Duplication Cost Factor | | | |
|---|---|---|---|---|
| Volume (Mtpa in total system) | Main Line | Zone 7 | Zone 8 | Zone 9 |
| 0.0 | 0 | 0 | 0 | 0 |
| 7.5 | 0 | 0 | 0 | 0 |
| 15.0 | 0 | 0 | 0 | 0 |
| 22.5 | 0 | 0 | 0 | 0 |
| 30.0 | 0 | 0 | 0 | 0 |
| 37.5 | 0 | 0 | 0 | 0 |
| 45.0 | 0 | 0 | 0 | 0 |
| 52.5 | 0 | 0 | 0 | 0 |
| 60.0 | 0 | 0 | 0 | 0 |
| 67.5 | 0 | 0 | 0 | 0 |
| 75.0 | 0 | 0 | 0 | 0 |
| 82.5 | 0 | 0 | 0 | 0 |
| 90.0 | 0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 | 0 |
| 105.0 | 0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 | 0 |
| 120.0 | 0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 | 0 |
| 135.0 | 0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 | 0 |
| 150.0 | 0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 | 0 |
| 165.0 | 0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 | 0 |
| 180.0 | 0 | 0 | 0 | 0 |
| 187.5 | 0 | 0 | 0 | 0 |
| 195.0 | 0 | 0 | 0 | 0 |
| 202.5 | 0 | 0 | 0 | 0 |
| 210.0 | 0 | 0 | 0 | 0 |
| 217.5 | 0 | 0 | 0 | 0 |
| 225.0 | 0 | 0 | 0 | 0 |
| 232.5 | 0 | 0 | 0 | 0 |
| 240.0 | 0 | 0 | 0 | 0 |
| 247.5 | 0 | 0 | 0 | 0 |
| 255.0 | 0 | 0 | 0 | 0 |
| 262.5 | 0 | 0 | 0 | 0 |
| 270.0 | 0 | 0 | 0 | 0 |
| 277.5 | 0 | 0 | 0 | 0 |
| 285.0 | 0 | 0 | 0 | 0 |
| 292.5 | 0 | 0 | 0 | 0 |
| 300.0 | 0 | 0 | 0 | 0 |
| 307.5 | 0 | 0 | 0 | 0 |
| 315.0 | 0 | 0 | 0 | 0 |
| 322.5 | 0 | 0 | 0 | 0 |
| 330.0 | 0 | 0 | 0 | 0 |
| 337.5 | 0 | 0 | 0 | 0 |
| 345.0 | 0 | 0 | 0 | 0 |
| 352.5 | 0 | 0 | 0 | 0 |

NB(1) : precise locations of duplicated sections not yet determined, assumed Flat terrrain ussed first.

Note: for the purpose of modelling passing loops and duplication, the system throughput was assumed as the main line throughput volumes as agreed with EIG.

## Above Rail – GICP – 40 tonnes axle load

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EWLP** | **EWLP Above Rail Model 40TAL V2.0** | | | | | | | | | | | | | | | | | | | |
| **Galilee Infrastructure Corridor Project (GICP)** | | | | | | | | | | | | | | | | | | | | |
| **Above Rail Costings** | | | | | | | | | | | | | | | | | | | | |
| **Output template - for use in EY financial model** | | | | | | | | | | | | | | | | | | | | |
| **Mine** | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 19 | 20 |
| **Mine Name** | | | | | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Waratah - Carmichael East | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match T0 | Adani 2 - remainder of Adani coal | Bowen 1 | Bowen 2 | Bowen 3 | Macmines South Tenement | Macmines North Tenement |
| **Route to** | | | | | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point |
| | **Inflation rate (%)** | | **Inflation Base Date** | **Units** | | | | | | | | | | | | | | | | |
| **Rolling Stock CAPEX** | | | 1/07/2012 | | | | | | | | | | | | | | | | | |
| Route distance - return | | | | km | 1,276.00 | 1,188.00 | 1,080.00 | 1,100.00 | - | 1,126.00 | 1,148.00 | 1,162.00 | 1,014.00 | 880.00 | 880.00 | 490.00 | 490.00 | 490.00 | 846.00 | 970.00 |
| Train capacity | | | | Mtpa per train | 6.82 | 7.10 | 7.63 | 7.51 | | 7.30 | 7.22 | 7.18 | 7.79 | 8.35 | 8.35 | 11.41 | 11.41 | 11.41 | 8.66 | 8.19 |
| **Locos (including Spares)** | | | | | | | | | | | | | | | | | | | | |
| Number of Locos per train | | | | No. | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 | 3.30 |
| Cost per Loco | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 | 3.57 |
| **Wagons (including Spares)** | | | | | | | | | | | | | | | | | | | | |
| Number of Wagons per train | | | | No. | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 | 283.50 |
| Cost per Wagon | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| **Locos overhauls** | | | | | | | | | | | | | | | | | | | | |
| Every x years | | | | Years | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| Cost per Loco per overhaul - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 | 1.79 |
| Cost per Loco per overhaul - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 |
| **Wagons overhauls** | | | | | | | | | | | | | | | | | | | | |
| Every x years | | | | | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 |
| Cost per Wagon per overhaul - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Cost per Wagon per overhaul - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| **Rolling Stock OPEX** | | | | | | | | | | | | | | | | | | | | |
| **Fuel** | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | | | 1/07/2012 | US$ | | | | | | | | | | | | | | | | |
| Cost per tonne - A$ element | 2.70% | ABS 6401 (3 year avg | 1/07/2012 | A$ | 1.49 | 1.39 | 1.26 | 1.29 | - | 1.33 | 1.35 | 1.36 | 1.21 | 1.10 | 1.10 | 0.67 | 0.67 | 0.67 | 1.03 | 1.14 |
| **Maintenance** | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | 0.08 | 0.08 | 0.07 | 0.07 | - | 0.07 | 0.07 | 0.07 | 0.07 | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 | 0.06 | 0.07 |
| Cost per tonne - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | 0.68 | 0.66 | 0.61 | 0.62 | - | 0.64 | 0.64 | 0.65 | 0.60 | 0.56 | 0.56 | 0.41 | 0.41 | 0.41 | 0.54 | 0.57 |
| **Labour** | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | | | 1/07/2012 | US$ | | | | | | | | | | | | | | | | |
| Cost per tonne - A$ element | 3.68% | ABS 6345 (3 year avg | 1/07/2012 | A$ | 0.16 | 0.15 | 0.14 | 0.14 | - | 0.15 | 0.15 | 0.15 | 0.14 | 0.13 | 0.13 | 0.09 | 0.09 | 0.09 | 0.12 | 0.13 |

# Above Rail – QRN

| EWLP | QRN Above Rail Model V1.0 | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Galilee Infrastructure Corridor Project (GICP) | | | | | | | | | | | | | | | | | | | | | | | | |
| Above Rail Costings | | | | | | | | | | | | | | | | | | | | | | | | |
| Output template - for use in EY financial model | | | | | | | | | | | | | | | | | | | | | | | | |
| Mine | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Mine Name | | | | | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Waratah - Carmichael East | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match T0 | Adani 2 - remainder of Adani coal | Bowen 1 | Bowen 2 | Bowen 3 | Spare 1 | Spare 2 | Spare 3 | Spare 4 | Macmines South Tenement | Macmines North Tenement |
| Route to | | | | | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point |
| | Inflation rate (%) | | Inflation Base Date | Units | | | | | | | | | | | | | | | | | | | | |
| **Rolling Stock CAPEX** | | | 1/07/2012 | | | | | | | | | | | | | | | | | | | | | |
| Route distance - return | | | | km | - | - | - | - | - | - | - | - | - | 806.00 | 806.00 | - | - | - | - | - | - | - | 944.00 | - |
| Train capacity | | | | Mtpa per train | | | | | | | | | | 3.36 | 3.36 | | | | | | | | 3.07 | |
| **Locos (including Spares)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Number of Locos per train | | | | No. | | | | | | | | | | 4.40 | 4.40 | | | | | | | | 4.40 | |
| Cost per Loco | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | | | | | | | | | | 5.10 | 5.10 | | | | | | | | 5.10 | |
| **Wagons (including Spares)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Number of Wagons per train | | | | No. | | | | | | | | | | 126.00 | 126.00 | | | | | | | | 126.00 | |
| Cost per Wagon | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | | | | | | | | | | 0.11 | 0.11 | | | | | | | | 0.11 | |
| **Locos overhauls** | | | | | | | | | | | | | | | | | | | | | | | | |
| Every x years | | | | Years | | | | | | | | | | 10.00 | 10.00 | | | | | | | | 10.00 | |
| Cost per Loco per overhaul - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | - | - | - | - | - | - | - | - | - | 2.55 | 2.55 | - | - | - | - | - | - | - | 2.55 | - |
| Cost per Loco per overhaul - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | - | - | - | - | - | - | - | - | - | 1.28 | 1.28 | - | - | - | - | - | - | - | 1.28 | - |
| **Wagons overhauls** | | | | | | | | | | | | | | | | | | | | | | | | |
| Every x years | | | | | | | | | | | | | | 15.00 | 15.00 | | | | | | | | 15.00 | |
| Cost per Wagon per overhaul - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | - | - | - | - | - | - | - | - | - | 0.03 | 0.03 | - | - | - | - | - | - | - | 0.03 | - |
| Cost per Wagon per overhaul - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | - | - | - | - | - | - | - | - | - | 0.03 | 0.03 | - | - | - | - | - | - | - | 0.03 | - |
| **Rolling Stock OPEX** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Fuel** | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | | | 1/07/2012 | US$ | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - A$ element | 2.70% | ABS 6401 (3 year avg | 1/07/2012 | A$ | | | | | | | | | | 2.27 | 2.27 | | | | | | | | 2.60 | |
| **Maintenance** | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | | | | | | | | | | 0.20 | 0.20 | | | | | | | | 0.22 | |
| Cost per tonne - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | | | | | | | | | | 0.89 | 0.89 | | | | | | | | 0.97 | |
| **Labour** | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | | | 1/07/2012 | US$ | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - A$ element | 3.68% | ABS 6345 (3 year avg | 1/07/2012 | A$ | | | | | | | | | | 0.32 | 0.32 | | | | | | | | 0.35 | |

## Above Rail – GVK

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EWLP** | **GVK Above Rail Model V2.0** | | | | | | | | | | | | | | | | | | | | | | | |
| **Galilee Infrastructure Corridor Project (GICP)** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Above Rail Costings** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Output template - for use in EY financial model** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Mine** | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Mine Name** | | | | | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Waratah - Carmichael East | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match TO | Adani 2 - remainder of Adani coal | Bowen 1 | Bowen 2 | Bowen 3 | Spare 1 | Spare 2 | Spare 3 | Spare 4 | Macmines South Tenement | Macmines North Tenement |
| **Route to** | | | | | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point | Abbot Point |
| | **Inflation rate (%)** | | **Inflation Base Date** | **Units** | | | | | | | | | | | | | | | | | | | | |
| **Rolling Stock CAPEX** | | | 1/07/2012 | | | | | | | | | | | | | | | | | | | | | |
| Route distance - return | | | | km | | 1,072.00 | 1,068.00 | - | - | 996.00 | 1,010.00 | 1,016.00 | 1,138.00 | - | - | - | - | - | - | - | - | - | - | - |
| Train capacity | | | | Mtpa per train | | 6.10 | 6.11 | 0.00 | 0.00 | 6.34 | 6.29 | 6.28 | 5.91 | | | | | | | | | | | |
| **Locos (including Spares)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Number of Locos per train | | | | No. | | 3.30 | 3.30 | | | 3.30 | 3.30 | 3.30 | 3.30 | | | | | | | | | | | |
| Cost per Loco | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | | 3.57 | 3.57 | | | 3.57 | 3.57 | 3.57 | 3.57 | | | | | | | | | | | |
| **Wagons (including Spares)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Number of Wagons per train | | | | No. | | 252.00 | 252.00 | | | 252.00 | 252.00 | 252.00 | 252.00 | | | | | | | | | | | |
| Cost per Wagon | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | | 0.12 | 0.12 | | | 0.12 | 0.12 | 0.12 | 0.12 | | | | | | | | | | | |
| **Locos overhauls** | | | | | | | | | | | | | | | | | | | | | | | | |
| Every x years | | | | Years | | 10.00 | 10.00 | | | 10.00 | 10.00 | 10.00 | 10.00 | | | | | | | | | | | |
| Cost per Loco per overhaul - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | - | 1.79 | 1.79 | - | - | 1.79 | 1.79 | 1.79 | 1.79 | - | - | - | - | - | - | - | - | - | - | - |
| Cost per Loco per overhaul - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | - | 0.89 | 0.89 | - | - | 0.89 | 0.89 | 0.89 | 0.89 | - | - | - | - | - | - | - | - | - | - | - |
| **Wagons overhauls** | | | | | | | | | | | | | | | | | | | | | | | | |
| Every x years | | | | | | 15.00 | 15.00 | | | 15.00 | 15.00 | 15.00 | 15.00 | | | | | | | | | | | |
| Cost per Wagon per overhaul - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | - | 0.03 | 0.03 | - | - | 0.03 | 0.03 | 0.03 | 0.03 | - | - | - | - | - | - | - | - | - | - | - |
| Cost per Wagon per overhaul - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | - | 0.03 | 0.03 | - | - | 0.03 | 0.03 | 0.03 | 0.03 | - | - | - | - | - | - | - | - | - | - | - |
| **Rolling Stock OPEX** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Fuel** | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | | | 1/07/2012 | US$ | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - A$ element | 2.70% | ABS 6401 (3 year avg | 1/07/2012 | A$ | | 1.63 | 1.63 | | | 1.53 | 1.55 | 1.55 | 1.72 | | | | | | | | | | | |
| **Maintenance** | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | 0.40% | ABS 6457 (2 year avg | 1/07/2012 | US$ | | 0.09 | 0.09 | | | 0.08 | 0.08 | 0.08 | 0.09 | | | | | | | | | | | |
| Cost per tonne - A$ element | 3.15% | 50% - ABS 6427 (3 yea | 1/07/2012 | A$ | | 0.70 | 0.70 | | | 0.67 | 0.68 | 0.68 | 0.72 | | | | | | | | | | | |
| **Labour** | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - US$ element | | | 1/07/2012 | US$ | | | | | | | | | | | | | | | | | | | | |
| Cost per tonne - A$ element | 3.68% | ABS 6345 (3 year avg | 1/07/2012 | A$ | | 0.18 | 0.18 | | | 0.17 | 0.17 | 0.17 | 0.18 | | | | | | | | | | | |

# Appendix E Reconciliation with EIG Costs

## GICP Option 1

| Construction Spend | Kilometrage | EI Cost (A$m) | Real Cost (A$m) | Nominal Cost (A$m) | Nominal Cost (A$m) including capitalised interest |
|---|---|---|---|---|---|
| Zone1 - Abbot to North of Moranbah | 219.0 | 1,619 | 1,557 | 1,751.1 | 2,017.8 |
| Zone2 - North of Moranbah to North Galilee | 151.0 | 956 | 919 | 1,033.6 | 1,191.0 |
| Zone3 - North Galilee to Macmines South | 28.0 | 191 | 184 | 207.1 | 238.6 |
| Zone4 - Macmines South to Adani Carmichael | 44.0 | 311 | 300 | 336.8 | 388.1 |
| Zone5 - Adani Carmichael to Waratah Carmichael | 34.0 | 215 | 207 | 232.3 | 267.7 |
| Zone6 - Waratah Carmichael to Vale Degulla | 22.0 | 190 | 183 | 205.3 | 236.6 |
| Zone7 - Vale Degulla to Waratah Alpha West | 35.5 | 216 | 208 | 233.4 | 268.9 |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | 23.0 | 127 | 122 | 137.3 | 158.2 |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | 20.0 | 128 | 128 | 220.9 | 230.9 |
| Spare Segment 1 | - | - | - | - | - |
| Spare Segment 2 | - | - | - | - | - |
| Spare Segment 3 | - | - | - | - | - |
| Spare Segment 4 | - | - | - | - | - |
| Spare Segment 5 | - | - | - | - | - |
| **Sub-Total** | **576.5** | **3,952.4** | **3,807.0** | **4,357.9** | **4,997.8** |
| | | | | | |
| **Passing Loops Capital Expenditure** | | | | | |
| Zone1 - Abbot to North of Moranbah | | | 252.9 | 315.7 | 331.0 |
| Zone2 - North of Moranbah to North Galilee | | | 282.6 | 350.5 | 367.5 |
| Zone3 - North Galilee to Macmines South | | | 44.6 | 61.1 | 64.0 |
| Zone4 - Macmines South to Adani Carmichael | | | 89.3 | 104.4 | 109.5 |
| Zone5 - Adani Carmichael to Waratah Carmichael | | | 44.6 | 61.1 | 64.0 |
| Zone6 - Waratah Carmichael to Vale Degulla | | | 74.4 | 87.0 | 91.2 |
| Zone7 - Vale Degulla to Waratah Alpha West | | | 44.6 | 52.2 | 54.7 |
| **Sub-Total** | | | **833.0** | **1,031.9** | **1,082.1** |
| | | | | | |
| **Duplication Capital Expenditure** | | | | | |
| Zone1 - Abbot to North of Moranbah | | | 680.4 | 1,142.5 | 1,198.1 |
| Zone2 - North of Moranbah to North Galilee | | | 453.6 | 741.9 | 778.0 |
| Zone3 - North Galilee to Macmines South | | | 113.4 | 220.9 | 231.6 |
| Zone4 - Macmines South to Adani Carmichael | | | 113.4 | 196.4 | 205.9 |
| Zone5 - Adani Carmichael to Waratah Carmichael | | | 113.4 | 220.9 | 231.6 |
| Zone6 - Waratah Carmichael to Vale Degulla | | | - | - | - |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| **Sub-Total** | | | **1,474.2** | **2,522.5** | **2,645.2** |
| | | | | | |
| **Total** | | | **6,114.2** | **7,912.3** | **8,725.1** |
| Existing assets included in above figures | | | - | - | - |

## QRN (90Mtpa)

| Construction Spend | Kilometrage | EI Cost (A$m) | Real Cost (A$m) | Nominal Cost (A$m) | Nominal Cost (A$m) including capitalised interest |
|---|---|---|---|---|---|
| QRN Mainline | 174.0 | 1,337 | 1,286 | 1,445.6 | 1,665.7 |
| ARN Zone 4 | 44.0 | 266 | 266 | 409.2 | 427.7 |
| Existing QRN asset | 207.0 | - | 806 | 942.4 | 984.8 |
| Spare Segment 1 | - | - | - | - | - |
| Spare Segment 2 | - | - | - | - | - |
| Spare Segment 3 | - | - | - | - | - |
| Spare Segment 4 | - | - | - | - | - |
| Spare Segment 5 | - | - | - | - | - |
| Spare Segment 6 | - | - | - | - | - |
| Spare Segment 7 | - | - | - | - | - |
| Spare Segment 8 | - | - | - | - | - |
| Spare Segment 9 | - | - | - | - | - |
| Spare Segment 10 | - | - | - | - | - |
| Spare Segment 11 | - | - | - | - | - |
| **Sub-Total** | **425.0** | **1,602.4** | **2,357.1** | **2,797.3** | **3,078.3** |
| | | | | | |
| **Passing Loops Capital Expenditure** | | | | | |
| QRN Mainline | | | 129.2 | 151.1 | 158.5 |
| ARN Zone 4 | | | - | - | - |
| Existing QRN asset | | | 85.3 | 99.8 | 104.7 |
| Spare Segment 1 | | | - | - | - |
| Spare Segment 2 | | | - | - | - |
| Spare Segment 3 | | | - | - | - |
| Spare Segment 4 | | | - | - | - |
| **Sub-Total** | | | **214.5** | **250.9** | **263.1** |
| | | | | | |
| **Duplication Capital Expenditure** | | | | | |
| QRN Mainline | | | 770.1 | 1,057.4 | 1,108.8 |
| ARN Zone 4 | | | - | - | - |
| Existing QRN asset | | | 1,601.4 | 1,873.4 | 1,964.5 |
| Spare Segment 1 | | | - | - | - |
| Spare Segment 2 | | | - | - | - |
| Spare Segment 3 | | | - | - | - |
| Spare Segment 4 | | | - | - | - |
| **Sub-Total** | | | **2,371.5** | **2,930.8** | **3,073.3** |
| | | | | | |
| **Total** | | | **4,943.1** | **5,979.0** | **6,414.7** |
| Existing assets included in above figures | | | 805.6 | 942.4 | 984.8 |

## GVK (150Mtpa)

| Construction Spend | Kilometrage | EI Cost (A$m) | Real Cost (A$m) | Nominal Cost (A$m) | Nominal Cost (A$m) including capitalised interest |
|---|---|---|---|---|---|
| Main Line GVK - Hancock | 485.0 | 3,640 | 3,501 | 3,936.8 | 4,536.3 |
| Zone7 - Vale Degulla to Waratah Alpha West | 36.0 | 236 | 231 | 310.4 | 340.6 |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | 23.0 | 149 | 146 | 196.5 | 215.6 |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | 20.0 | 125 | 125 | 215.8 | 225.6 |
| Spare Segment 1 | | - | - | - | - |
| Spare Segment 2 | - | - | - | - | - |
| Spare Segment 3 | - | - | - | - | - |
| Spare Segment 4 | - | - | - | - | - |
| Spare Segment 5 | - | - | - | - | - |
| Spare Segment 6 | - | - | - | - | - |
| Spare Segment 7 | - | - | - | - | - |
| Spare Segment 8 | - | - | - | - | - |
| Spare Segment 9 | - | - | - | - | - |
| Spare Segment 10 | | - | - | - | - |
| **Sub-Total** | **564.0** | **4,149.7** | **4,003.9** | **4,659.6** | **5,318.1** |
| | | | | | |
| **Passing Loops Capital Expenditure** | | | | | |
| Main Line GVK - Hancock | | | 597.5 | 773.0 | 810.6 |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | | | - | - | - |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | | | - | - | - |
| Spare Segment 1 | | | - | - | - |
| Spare Segment 2 | | | - | - | - |
| Spare Segment 3 | | | - | - | - |
| **Sub-Total** | | | **597.5** | **773.0** | **810.6** |
| | | | | | |
| **Duplication Capital Expenditure** | | | | | |
| Main Line GVK - Hancock | | | 990.0 | 1,785.7 | 1,872.6 |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | | | - | - | - |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | | | - | - | - |
| Spare Segment 1 | | | - | - | - |
| Spare Segment 2 | | | - | - | - |
| Spare Segment 3 | | | - | - | - |
| **Sub-Total** | | | **990.0** | **1,785.7** | **1,872.6** |
| | | | | | |
| **Total** | | | **5,591.4** | **7,218.3** | **8,001.3** |
| Existing assets included in above figures | | | - | - | - |

## GICP Option 2

| Construction Spend | Kilometrage | EI Cost (A$m) | Real Cost (A$m) | Nominal Cost (A$m) | Nominal Cost (A$m) including capitalised interest |
|---|---|---|---|---|---|
| Zone1 - Abbot to North of Moranbah | 219.0 | 1,619 | 1,557 | 2,048.6 | 2,360.6 |
| Zone2 - North of Moranbah to North Galilee | 151.0 | 874 | 841 | 1,106.2 | 1,274.6 |
| Zone3 - North Galilee to Macmines South | 28.0 | 166 | 159 | 209.6 | 241.6 |
| Zone4 - Macmines South to Adani Carmichael | 44.0 | 264 | 259 | 391.3 | 429.3 |
| Zone5 - Adani Carmichael to Waratah Carmichael | 34.0 | 242 | 237 | 358.2 | 393.0 |
| Zone6 - Waratah Carmichael to Vale Degulla | 22.0 | 115 | 113 | 169.8 | 186.3 |
| Zone7 - Vale Degulla to Waratah Alpha West | 36.0 | 237 | 237 | 410.6 | 429.2 |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | 23.0 | 127 | 127 | 247.3 | 258.5 |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | 20.0 | 128 | 128 | 248.5 | 259.7 |
| Spare Segment 1 | - | - | - | - | - |
| Spare Segment 2 | | - | - | - | - |
| Spare Segment 3 | - | - | - | - | - |
| Spare Segment 4 | - | - | - | - | - |
| Spare Segment 5 | - | - | - | - | - |
| **Sub-Total** | **577.0** | **3,771.6** | **3,658.6** | **5,190.1** | **5,832.7** |
| | | | | | |
| **Passing Loops Capital Expenditure** | | | | | |
| Zone1 - Abbot to North of Moranbah | | | 343.9 | 562.4 | 589.7 |
| Zone2 - North of Moranbah to North Galilee | | | 312.4 | 501.0 | 525.4 |
| Zone3 - North Galilee to Macmines South | | | - | - | - |
| Zone4 - Macmines South to Adani Carmichael | | | 44.6 | 77.3 | 81.0 |
| Zone5 - Adani Carmichael to Waratah Carmichael | | | 44.6 | 86.9 | 91.2 |
| Zone6 - Waratah Carmichael to Vale Degulla | | | 44.6 | 77.3 | 81.0 |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| **Sub-Total** | | | **790.1** | **1,304.9** | **1,368.3** |
| | | | | | |
| **Duplication Capital Expenditure** | | | | | |
| Zone1 - Abbot to North of Moranbah | | | - | - | - |
| Zone2 - North of Moranbah to North Galilee | | | - | - | - |
| Zone3 - North Galilee to Macmines South | | | - | - | - |
| Zone4 - Macmines South to Adani Carmichael | | | - | - | - |
| Zone5 - Adani Carmichael to Waratah Carmichael | | | - | - | - |
| Zone6 - Waratah Carmichael to Vale Degulla | | | - | - | - |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| **Sub-Total** | | | **-** | **-** | **-** |
| | | | | | |
| **Total** | | | **4,448.7** | **6,494.9** | **7,201.0** |
| Existing assets included in above figures | | | - | - | - |

## QRN (60Mtpa)

| Construction Spend | Kilometrage | EI Cost (A$m) | Real Cost (A$m) | Nominal Cost (A$m) | Nominal Cost (A$m) including capitalised interest |
|---|---|---|---|---|---|
| QRN Mainline | 174.0 | 1,337 | 1,286 | 1,445.6 | 1,665.7 |
| ARN Zone 4 | - | - | - | - | - |
| Existing QRN asset | 207.0 | - | 806 | 942.4 | 984.8 |
| Spare Segment 1 | - | - | - | - | - |
| Spare Segment 2 | - | - | - | - | - |
| Spare Segment 3 | - | - | - | - | - |
| Spare Segment 4 | - | - | - | - | - |
| Spare Segment 5 | - | - | - | - | - |
| Spare Segment 6 | - | - | - | - | - |
| Spare Segment 7 | - | - | - | - | - |
| Spare Segment 8 | - | - | - | - | - |
| Spare Segment 9 | - | - | - | - | - |
| Spare Segment 10 | - | - | - | - | - |
| Spare Segment 11 | - | - | - | - | - |
| **Sub-Total** | **381.0** | **1,336.5** | **2,091.3** | **2,388.0** | **2,650.6** |
| | | | | | |
| **Passing Loops Capital Expenditure** | | | | | |
| QRN Mainline | | | 136.5 | 159.7 | 167.5 |
| ARN Zone 4 | | | - | - | - |
| Existing QRN asset | | | 85.3 | 99.8 | 104.7 |
| Spare Segment 1 | | | - | - | - |
| Spare Segment 2 | | | - | - | - |
| Spare Segment 3 | | | - | - | - |
| Spare Segment 4 | | | - | - | - |
| **Sub-Total** | | | **221.8** | **259.5** | **272.1** |
| | | | | | |
| **Duplication Capital Expenditure** | | | | | |
| QRN Mainline | | | 520.2 | 608.6 | 638.2 |
| ARN Zone 4 | | | - | - | - |
| Existing QRN asset | | | 1,601.4 | 1,873.4 | 1,964.5 |
| Spare Segment 1 | | | - | - | - |
| Spare Segment 2 | | | - | - | - |
| Spare Segment 3 | | | - | - | - |
| Spare Segment 4 | | | - | - | - |
| **Sub-Total** | | | **2,121.6** | **2,482.0** | **2,602.7** |
| | | | | | |
| **Total** | | | **4,434.7** | **5,129.5** | **5,525.3** |
| Existing assets included in above figures | | | 805.6 | 942.4 | 984.8 |

## GVK (60Mtpa)

| Construction Spend | Kilometrage | EI Cost (A$m) | Real Cost (A$m) | Nominal Cost (A$m) | Nominal Cost (A$m) including capitalised interest |
|---|---|---|---|---|---|
| Main Line GVK - Hancock | 485.0 | 3,640 | 3,501 | 3,936.8 | 4,536.3 |
| Zone7 - Vale Degulla to Waratah Alpha West | - | - | - | - | - |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | - | - | - | - | - |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | - | - | - | - | - |
| Spare Segment 1 | - | - | - | - | - |
| Spare Segment 2 | - | - | - | - | - |
| Spare Segment 3 | - | - | - | - | - |
| Spare Segment 4 | - | - | - | - | - |
| Spare Segment 5 | - | - | - | - | - |
| Spare Segment 6 | - | - | - | - | - |
| Spare Segment 7 | - | - | - | - | - |
| Spare Segment 8 | - | - | - | - | - |
| Spare Segment 9 | - | - | - | - | - |
| Spare Segment 10 | - | - | - | - | - |
| **Sub-Total** | **485.0** | **3,639.8** | **3,501.4** | **3,936.8** | **4,536.3** |
| | | | | | |
| **Passing Loops Capital Expenditure** | | | | | |
| Main Line GVK - Hancock | | | 396.7 | 474.0 | 497.0 |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | | | - | - | - |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | | | - | - | - |
| Spare Segment 1 | | | - | - | - |
| Spare Segment 2 | | | - | - | - |
| Spare Segment 3 | | | - | - | - |
| **Sub-Total** | | | **396.7** | **474.0** | **497.0** |
| | | | | | |
| **Duplication Capital Expenditure** | | | | | |
| Main Line GVK - Hancock | | | - | - | - |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | | | - | - | - |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | | | - | - | - |
| Spare Segment 1 | | | - | - | - |
| Spare Segment 2 | | | - | - | - |
| Spare Segment 3 | | | - | - | - |
| **Sub-Total** | | | **-** | **-** | **-** |
| | | | | | |
| **Total** | | | **3,898.1** | **4,410.8** | **5,033.4** |
| Existing assets included in above figures | | | - | - | - |

## GICP - Direct Comparison against QRN (60 Mtpa)

| Construction Spend | Kilometrage | EI Cost (A$m) | Real Cost (A$m) | Nominal Cost (A$m) | Nominal Cost (A$m) including capitalised interest |
|---|---|---|---|---|---|
| Zone1 - Abbot to North of Moranbah | 219.0 | 1,619 | 1,557 | 1,751.1 | 2,017.8 |
| Zone2 - North of Moranbah to North Galilee | 151.0 | 956 | 919 | 1,033.6 | 1,191.0 |
| Zone3 - North Galilee to Macmines South | 28.0 | 191 | 184 | 207.1 | 238.6 |
| Zone4 - Macmines South to Adani Carmichael | 44.0 | 311 | 300 | 336.8 | 388.1 |
| Zone5 - Adani Carmichael to Waratah Carmichael | - | - | - | - | - |
| Zone6 - Waratah Carmichael to Vale Degulla | - | - | - | - | - |
| Zone7 - Vale Degulla to Waratah Alpha West | - | - | - | - | - |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | - | - | - | - | - |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | - | - | - | - | - |
| Spare Segment 1 | - | - | - | - | - |
| Spare Segment 2 | - | - | - | - | - |
| Spare Segment 3 | - | - | - | - | - |
| Spare Segment 4 | - | - | - | - | - |
| Spare Segment 5 | - | - | - | - | - |
| **Sub-Total** | **442.0** | **3,077.5** | **2,960.5** | **3,328.6** | **3,835.5** |
| | | | | | |
| **Passing Loops Capital Expenditure** | | | | | |
| Zone1 - Abbot to North of Moranbah | | | 74.4 | 87.0 | 91.2 |
| Zone2 - North of Moranbah to North Galilee | | | 104.1 | 121.8 | 127.7 |
| Zone3 - North Galilee to Macmines South | | | - | - | - |
| Zone4 - Macmines South to Adani Carmichael | | | 44.6 | 52.2 | 54.7 |
| Zone5 - Adani Carmichael to Waratah Carmichael | | | - | - | - |
| Zone6 - Waratah Carmichael to Vale Degulla | | | - | - | - |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| **Sub-Total** | | | **223.1** | **261.0** | **273.7** |
| | | | | | |
| **Duplication Capital Expenditure** | | | | | |
| Zone1 - Abbot to North of Moranbah | | | - | - | - |
| Zone2 - North of Moranbah to North Galilee | | | - | - | - |
| Zone3 - North Galilee to Macmines South | | | - | - | - |
| Zone4 - Macmines South to Adani Carmichael | | | - | - | - |
| Zone5 - Adani Carmichael to Waratah Carmichael | | | - | - | - |
| Zone6 - Waratah Carmichael to Vale Degulla | | | - | - | - |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| **Sub-Total** | | | **-** | **-** | **-** |
| | | | | | |
| **Total** | | | **3,183.6** | **3,589.6** | **4,109.2** |
| Existing assets included in above figures | | | - | - | - |

## QRN - Direct Comparison against QRN (60 Mtpa)

- Same costs as QRN in Comparison 2

## GICP - Direct Comparison against GVK (60 Mtpa)

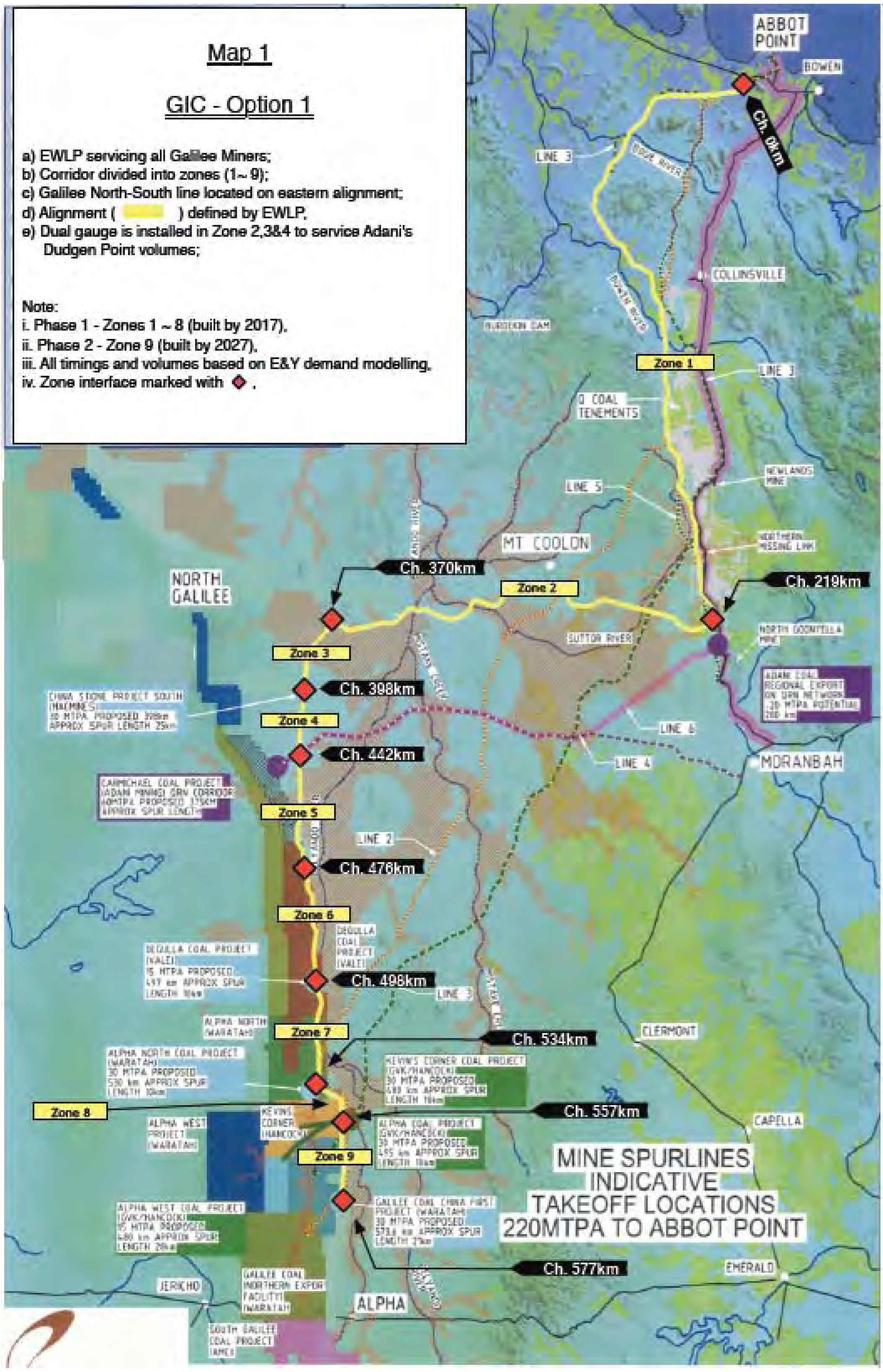
| Construction Spend | Kilometrage | EI Cost (A$m) | Real Cost (A$m) | Nominal Cost (A$m) | Nominal Cost (A$m) including capitalised interest |
|---|---|---|---|---|---|
| Zone1 - Abbot to North of Moranbah | 219.0 | 1,619 | 1,557 | 1,751.1 | 2,017.8 |
| Zone2 - North of Moranbah to North Galilee | 151.0 | 874 | 841 | 945.6 | 1,089.6 |
| Zone3 - North Galilee to Macmines South | 28.0 | 166 | 159 | 179.2 | 206.5 |
| Zone4 - Macmines South to Adani Carmichael | 44.0 | 264 | 259 | 297.3 | 326.2 |
| Zone5 - Adani Carmichael to Waratah Carmichael | 34.0 | 242 | 237 | 272.2 | 298.6 |
| Zone6 - Waratah Carmichael to Vale Degulla | 22.0 | 115 | 113 | 129.0 | 141.6 |
| Zone7 - Vale Degulla to Waratah Alpha West | 36.0 | 237 | 237 | 277.4 | 289.9 |
| Zone8 - Waratah Alpha West to GVK Kevin's Corner | 23.0 | 127 | 127 | 148.5 | 155.2 |
| Zone9 - GVK Kevin's Corner to Waratah China 1st Coal | - | - | - | - | - |
| Spare Segment 1 | - | - | - | - | - |
| Spare Segment 2 | - | - | - | - | - |
| Spare Segment 3 | - | - | - | - | - |
| Spare Segment 4 | - | - | - | - | - |
| Spare Segment 5 | - | - | - | - | - |
| **Sub-Total** | **557.0** | **3,644.0** | **3,531.0** | **4,000.4** | **4,525.4** |
| | | | | | |
| **Passing Loops Capital Expenditure** | | | | | |
| Zone1 - Abbot to North of Moranbah | | | 210.0 | 249.8 | 262.0 |
| Zone2 - North of Moranbah to North Galilee | | | 223.1 | 267.3 | 280.3 |
| Zone3 - North Galilee to Macmines South | | | - | - | - |
| Zone4 - Macmines South to Adani Carmichael | | | - | - | - |
| Zone5 - Adani Carmichael to Waratah Carmichael | | | - | - | - |
| Zone6 - Waratah Carmichael to Vale Degulla | | | - | - | - |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| **Sub-Total** | | | **433.1** | **517.1** | **542.3** |
| | | | | | |
| **Duplication Capital Expenditure** | | | | | |
| Zone1 - Abbot to North of Moranbah | | | - | - | - |
| Zone2 - North of Moranbah to North Galilee | | | - | - | - |
| Zone3 - North Galilee to Macmines South | | | - | - | - |
| Zone4 - Macmines South to Adani Carmichael | | | - | - | - |
| Zone5 - Adani Carmichael to Waratah Carmichael | | | - | - | - |
| Zone6 - Waratah Carmichael to Vale Degulla | | | - | - | - |
| Zone7 - Vale Degulla to Waratah Alpha West | | | - | - | - |
| **Sub-Total** | | | **-** | **-** | **-** |
| | | | | | |
| **Total** | | | **3,964.1** | **4,517.5** | **5,067.7** |
| Existing assets included in above figures | | | - | - | - |

## GVK - Direct Comparison against GVK (60 Mtpa)

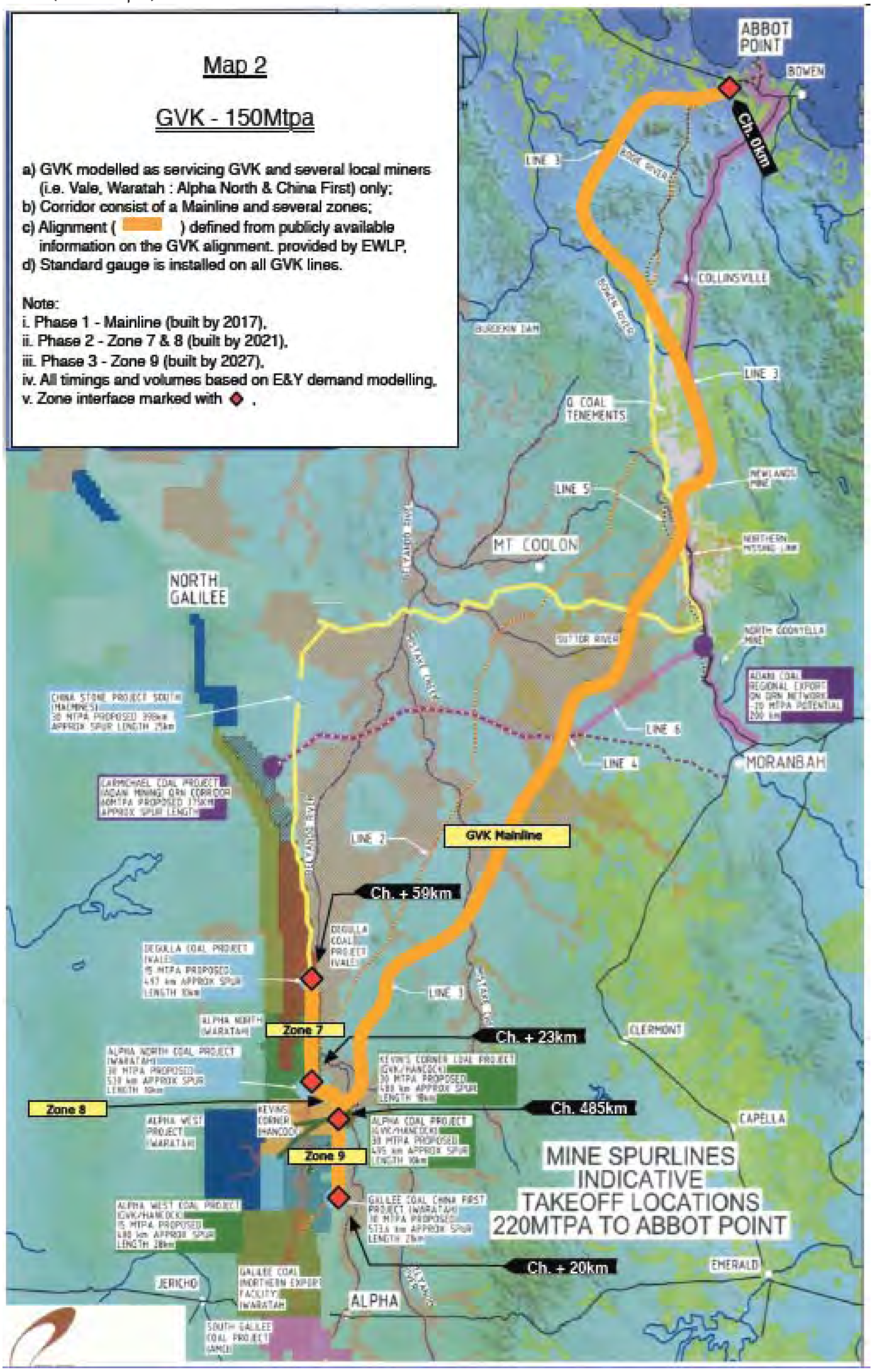
- Same costs as GVK in Comparison 2

# Appendix F Maps of alignments

GICP Option 1

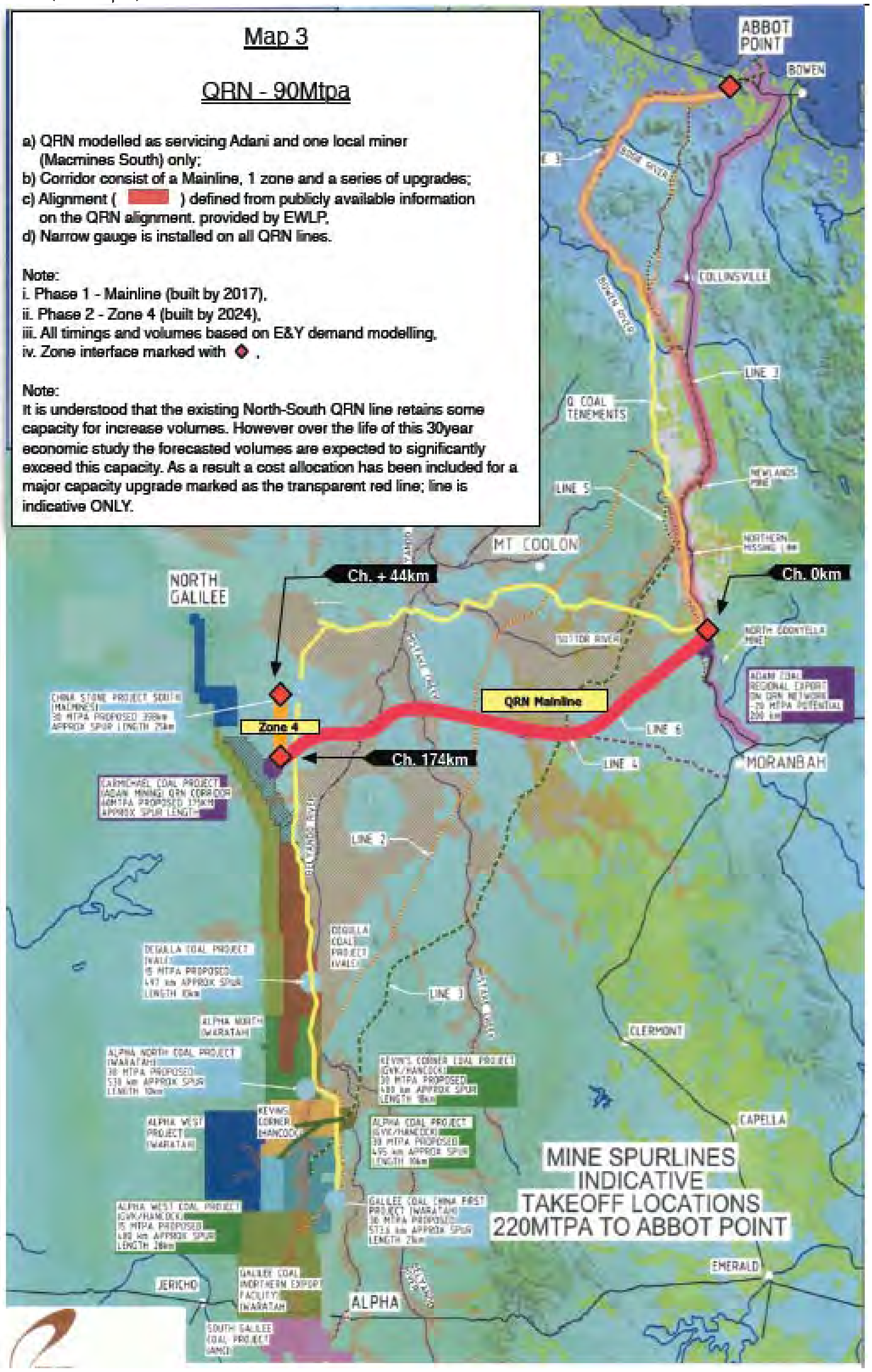

Map 1
GIC - Option 1
a) EWLP servicing all Galilee Miners;
b) Corridor divided into zones (1~ 9);
c) Galilee North-South line located on eastern alignment;
d) Alignment ( ) defined by EWLP,
e) Dual gauge is installed in Zone 2,3&4 to service Adani's Dudgen Point volumes;
Note:
i. Phase 1 - Zones 1 ~ 8 (built by 2017),
ii. Phase 2 - Zone 9 (built by 2027),
iii. All timings and volumes based on E&Y demand modelling,
iv. Zone interface marked with ◆ .
ABBOT POINT
BOWEN
Ch. 0km
LINE 3
COLLINSVILLE
BURDEKIN DAM
Zone 1
LINE 3
COAL TENEMENTS
LINE 5
NEWLANDS MINE
MT COOLON
Ch. 370km
Zone 2
Ch. 219km
NORTH GALILEE
SUTTOR RIVER
Zone 3
Ch. 398km
Zone 4
LINE 6
Ch. 442km
LINE 4
MORANBAH
Zone 5
LINE 2
Ch. 476km
Zone 6
Ch. 498km
LINE 3
Zone 7
Ch. 534km
CLERMONT
Zone 8
Ch. 557km
Zone 9
CAPELLA
MINE SPURLINES
INDICATIVE
TAKEOFF LOCATIONS
220MTPA TO ABBOT POINT
Ch. 577km
EMERALD
JERICHO
ALPHA

GVK (150Mtpa)

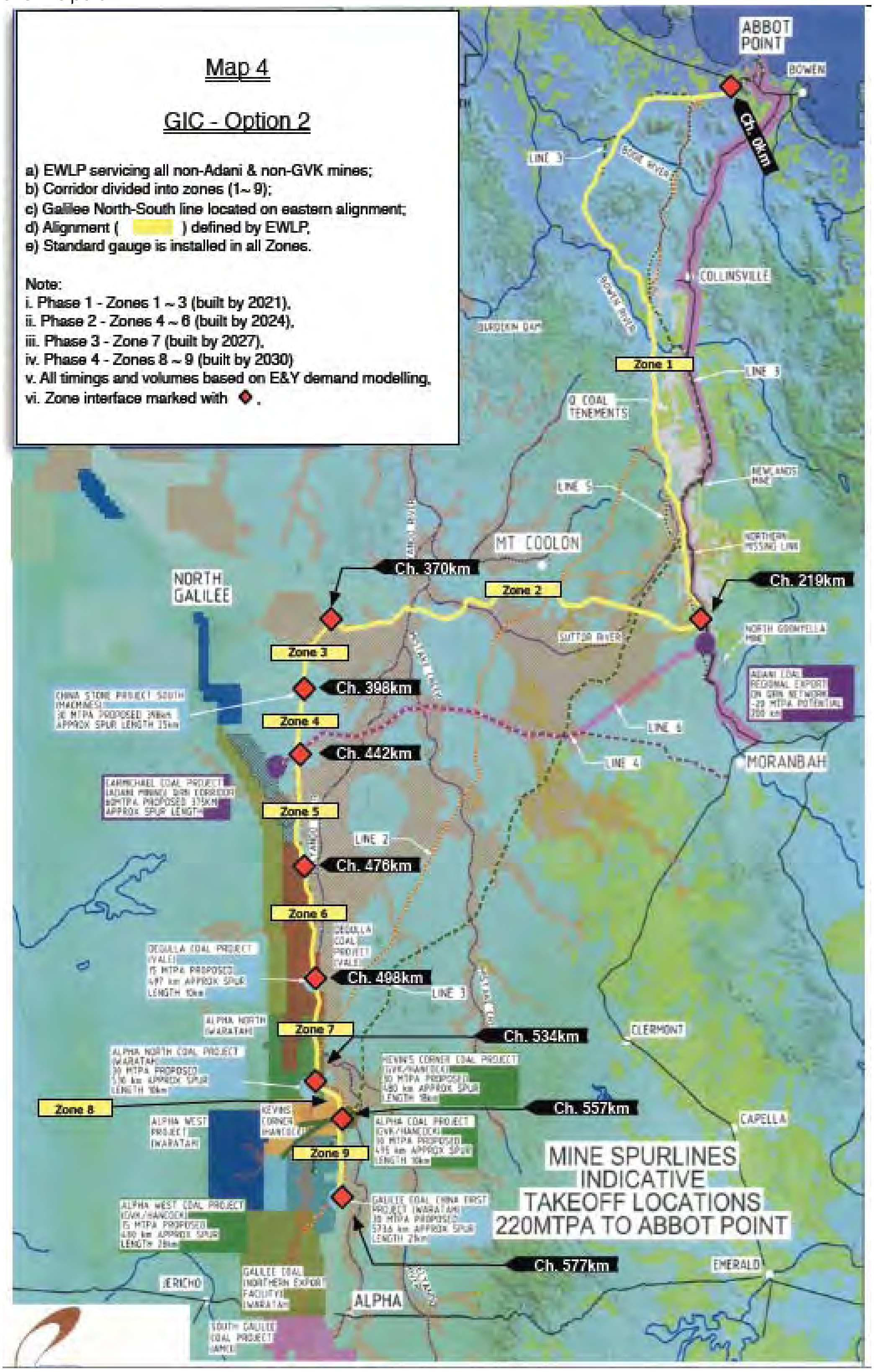


Map 2
GVK - 150Mtpa
a) GVK modelled as servicing GVK and several local miners (i.e. Vale, Waratah : Alpha North & China First) only;
b) Corridor consist of a Mainline and several zones;
c) Alignment ( ) defined from publicly available information on the GVK alignment. provided by EWLP,
d) Standard gauge is installed on all GVK lines.
Note:
i. Phase 1 - Mainline (built by 2017),
ii. Phase 2 - Zone 7 & 8 (built by 2021),
iii. Phase 3 - Zone 9 (built by 2027),
iv. All timings and volumes based on E&Y demand modelling,
v. Zone interface marked with ◆ .
ABBOT POINT
BOWEN
Ch. 0km
LINE 3
COLLINSVILLE
BURDEKIN DAM
LINE 3
Q COAL TENEMENTS
NEWLANDS MINE
LINE 5
MT COOLON
NORTHERN MISSING LINK
NORTH GALILEE
SUTTOR RIVER
NORTH GOONYELLA MINE
LINE 6
LINE 4
MORANBAH
GVK Mainline
LINE 2
Ch. + 59km
LINE 1
Zone 7
Ch. + 23km
CLERMONT
Zone 8
Ch. 485km
CAPELLA
Zone 9
MINE SPURLINES INDICATIVE TAKEOFF LOCATIONS 220MTPA TO ABBOT POINT
Ch. + 20km
EMERALD
JERICHO
ALPHA

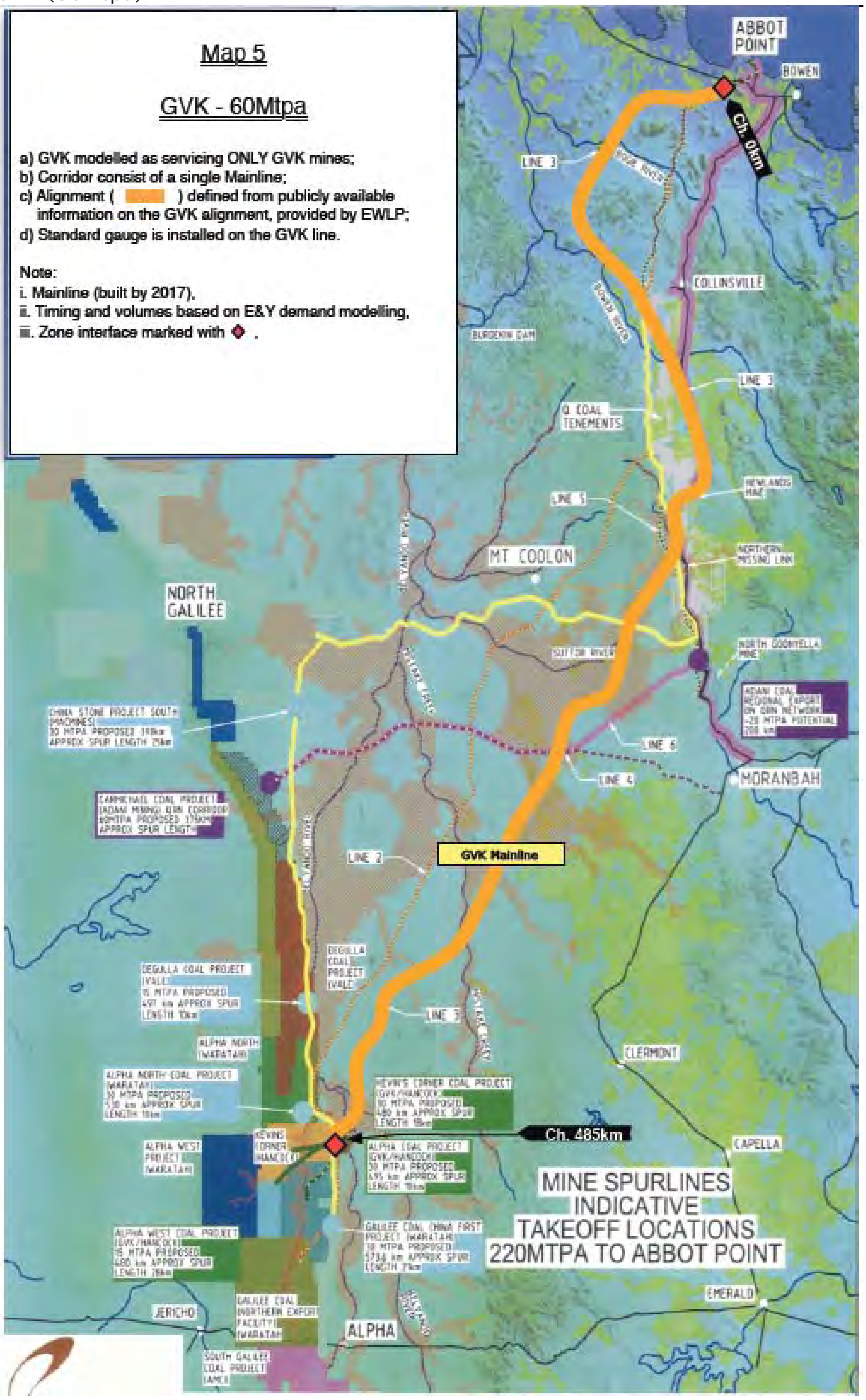
QRN (90Mtpa)


Map 3
QRN - 90Mtpa
a) QRN modelled as servicing Adani and one local miner (Macmines South) only;
b) Corridor consist of a Mainline, 1 zone and a series of upgrades;
c) Alignment ( ) defined from publicly available information on the QRN alignment. provided by EWLP.
d) Narrow gauge is installed on all QRN lines.
Note:
i. Phase 1 - Mainline (built by 2017).
ii. Phase 2 - Zone 4 (built by 2024).
iii. All timings and volumes based on E&Y demand modelling.
iv. Zone interface marked with ◆ .
Note:
It is understood that the existing North-South QRN line retains some capacity for increase volumes. However over the life of this 30year economic study the forecasted volumes are expected to significantly exceed this capacity. As a result a cost allocation has been included for a major capacity upgrade marked as the transparent red line; line is indicative ONLY.
ABBOT POINT
BOWEN
COLLINSVILLE
LINE 3
Q COAL TENEMENTS
LINE 5
MT COOLON
NORTH GALILEE
Ch. + 44km
Ch. 0km
QRN Mainline
Zone 4
Ch. 174km
LINE 6
LINE 4
MORANBAH
LINE 2
LINE 1
CLERMONT
CAPELLA
MINE SPURLINES
INDICATIVE
TAKEOFF LOCATIONS
220MTPA TO ABBOT POINT
EMERALD
JERICHO
ALPHA

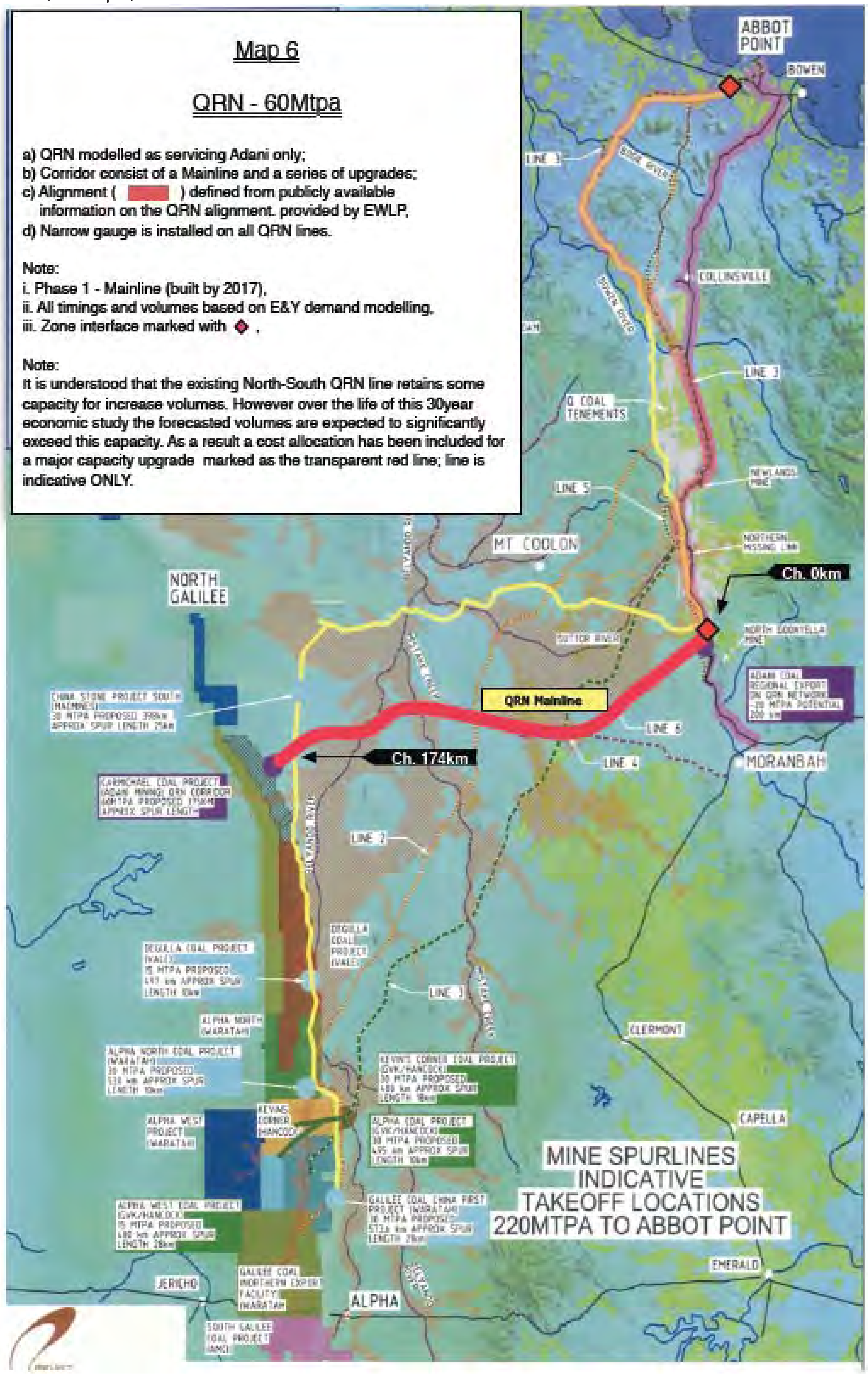
GICP Option 2



GVK (60Mtpa)


Map 5
GVK - 60Mtpa
a) GVK modelled as servicing ONLY GVK mines;
b) Corridor consist of a single Mainline;
c) Alignment ( ) defined from publicly available information on the GVK alignment, provided by EWLP;
d) Standard gauge is installed on the GVK line.
Note:
i. Mainline (built by 2017).
ii. Timing and volumes based on E&Y demand modelling.
iii. Zone interface marked with ◆ .
ABBOT POINT
BOWEN
Ch. 0km
LINE 3
COLLINSVILLE
BURDEKIN DAM
Q COAL TENEMENTS
NEWLANDS MINE
LINE 5
MT COOLON
NORTHERN MISSING LINK
NORTH GALILEE
NORTH GOONYELLA MINE
SUTTOR RIVER
ADANI COAL REGIONAL EXPORT ON QRN NETWORK ~20 MTPA POTENTIAL 200 km
LINE 6
LINE 4
MORANBAH
GVK Mainline
LINE 2
LINE 3
CLERMONT
Ch. 485km
CAPELLA
MINE SPURLINES INDICATIVE TAKEOFF LOCATIONS 220MTPA TO ABBOT POINT
EMERALD
JERICHO
ALPHA

QRN (60Mtpa)



Map 6
QRN - 60Mtpa
a) QRN modelled as servicing Adani only;
b) Corridor consist of a Mainline and a series of upgrades;
c) Alignment ( ) defined from publicly available information on the QRN alignment. provided by EWLP,
d) Narrow gauge is installed on all QRN lines.
Note:
i. Phase 1 - Mainline (built by 2017),
ii. All timings and volumes based on E&Y demand modelling,
iii. Zone interface marked with ,
Note:
It is understood that the existing North-South QRN line retains some capacity for increase volumes. However over the life of this 30year economic study the forecasted volumes are expected to significantly exceed this capacity. As a result a cost allocation has been included for a major capacity upgrade marked as the transparent red line; line is indicative ONLY.
ABBOT POINT
BOWEN
COLLINSVILLE
MT COOLON
NORTH GALILEE
Ch. 0km
QRN Mainline
Ch. 174km
MORANBAH
CLERMONT
CAPELLA
EMERALD
JERICHO
ALPHA
MINE SPURLINES
INDICATIVE
TAKEOFF LOCATIONS
220MTPA TO ABBOT POINT

# Appendix G Key Outputs

## Comparison 1

| Comparison 1 | QRN (90Mtpa) | GVK (150Mtpa) | QRN + GVK | GICP Option 1 | Cheapest Option |
|---|---|---|---|---|---|
| Real Cost (A$m) | 4,943 | 5,591 | 10,535 | 6,114 | |
| Alignment Length (Km) | 425 | 564 | 989 | 577 | |
| Maximum tonnages | 90 | 150 | 240 | 240 | |
| **AUD per Transported NTK - Below Rail (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0170 | 0.0096 | 0.0119 | 0.0066 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 0.0196 | 0.0128 | 0.0150 | 0.0086 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0186 | / | 0.0186 | 0.0066 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0235 | / | 0.0235 | 0.0088 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | / | 0.0097 | 0.0097 | 0.0067 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | / | 0.0164 | 0.0164 | 0.0105 | GICP Option 1 |
| **AUD per Transported NTK - Above Rail (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0145 | 0.0066 | 0.0091 | 0.0056 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 0.0150 | 0.0068 | 0.0094 | 0.0059 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0131 | / | 0.0131 | 0.0057 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0287 | / | 0.0287 | 0.0118 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | / | 0.0067 | 0.0067 | 0.0053 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | / | 0.0070 | 0.0070 | 0.0058 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Below Rail (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 5.94 | 4.79 | 5.25 | 3.20 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 6.73 | 6.36 | 6.51 | 4.11 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 4.10 | / | 4.10 | 1.82 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 7.88 | / | 7.88 | 3.87 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | / | 4.93 | 4.93 | 3.57 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | / | 8.91 | 8.91 | 5.86 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Above Rail (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 5.07 | 3.30 | 4.01 | 2.73 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 5.14 | 3.36 | 4.08 | 2.83 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 4.97 | / | 4.97 | 2.46 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 5.59 | / | 5.59 | 2.63 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | / | 3.24 | 3.24 | 2.76 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | / | 3.66 | 3.66 | 3.24 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Total (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 11.01 | 8.10 | 9.27 | 5.93 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 11.87 | 9.72 | 10.58 | 6.95 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 9.07 | / | 9.07 | 4.28 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 13.47 | / | 13.47 | 6.50 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | / | 8.17 | 8.17 | 6.33 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | / | 12.57 | 12.57 | 9.10 | GICP Option 1 |

## Comparison 2

| Comparison 2 | GICP Option 2 | QRN (60Mtpa) | GVK (60Mtpa) | GICP2 + QRN + GVK | GICP Option 1 | Cheapest Option |
|---|---|---|---|---|---|---|
| Real Cost (A$m) | 4,449 | 4,435 | 3,898 | 12,781 | 6,114 | |
| Alignment Length (Km) | 577 | 381 | 485 | 1,443 | 577 | |
| Maximum tonnages | 120 | 60 | 60 | 240 | 240 | |
| **AUD per Transported NTK - Below Rail (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0111 | 0.0234 | 0.0198 | 0.0161 | 0.0066 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 0.0145 | 0.0253 | 0.0212 | 0.0187 | 0.0086 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0184 | 0.0243 | / | 0.0184 | 0.0066 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0184 | 0.0299 | / | 0.0299 | 0.0088 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 0.0123 | / | 0.0204 | 0.0123 | 0.0067 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | 0.0149 | / | 0.0220 | 0.0220 | 0.0105 | GICP Option 1 |
| **AUD per Transported NTK - Above Rail (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0055 | 0.0155 | 0.0065 | 0.0077 | 0.0056 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 0.0057 | 0.0160 | 0.0067 | 0.0080 | 0.0059 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0061 | 0.0131 | / | 0.0061 | 0.0057 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0061 | 0.0287 | / | 0.0287 | 0.0118 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 0.0053 | / | 0.0067 | 0.0053 | 0.0053 | GICP2 + QRN + GVK |
| South Galilee - Maximum route charge (weighted average over life) | 0.0063 | / | 0.0067 | 0.0067 | 0.0058 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Below Rail (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 5.60 | 7.31 | 9.61 | 7.19 | 3.20 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 7.18 | 7.90 | 10.29 | 8.25 | 4.11 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 7.31 | 5.20 | / | 5.20 | 1.82 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 7.31 | 9.25 | / | 9.25 | 3.87 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 6.58 | / | 9.89 | 6.58 | 3.57 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | 7.72 | / | 10.68 | 10.68 | 5.86 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Above Rail (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 2.57 | 4.83 | 3.14 | 3.34 | 2.73 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 2.80 | 4.98 | 3.26 | 3.52 | 2.83 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 2.44 | 4.97 | / | 2.44 | 2.46 | GICP2 + QRN + GVK |
| North Galilee - Maximum route charge (weighted average over life) | 2.44 | 5.00 | / | 5.00 | 2.63 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 2.76 | / | 3.24 | 2.76 | 2.76 | GICP2 + QRN + GVK |
| South Galilee - Maximum route charge (weighted average over life) | 3.17 | / | 3.27 | 3.27 | 3.24 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Total (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 8.17 | 12.14 | 12.75 | 10.54 | 5.93 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 9.98 | 12.88 | 13.55 | 11.77 | 6.95 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 9.75 | 10.17 | / | 7.64 | 4.28 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 9.75 | 14.25 | / | 14.25 | 6.50 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 9.34 | / | 13.13 | 9.34 | 6.33 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | 10.89 | / | 13.94 | 13.94 | 9.10 | GICP Option 1 |

## Direct Comparison GICP vs QRN (60 Mtpa)

| Direct Comparison against QRN ( 60 Mtpa ) | GICP (60 QRN) | QRN (60Mtpa) | Cheapest Option |
|---|---|---|---|
| Real Cost (A$m) | 3,184 | 4,435 | |
| Alignment Length (Km) | 442 | 381 | |
| Maximum tonnages | 60 | 60 | |
| **AUD per Transported NTK - Below Rail (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0214 | 0.0234 | GICP (60 QRN) |
| Full Galilee - Weighted average of all routes combined over life | 0.0237 | 0.0253 | GICP (60 QRN) |
| North Galilee - Minimum route charge (weighted average over life) | 0.0193 | 0.0243 | GICP (60 QRN) |
| North Galilee - Maximum route charge (weighted average over life) | 0.0249 | 0.0299 | GICP (60 QRN) |
| South Galilee - Minimum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| **AUD per Transported NTK - Above Rail (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0066 | 0.0155 | GICP (60 QRN) |
| Full Galilee - Weighted average of all routes combined over life | 0.0069 | 0.0160 | GICP (60 QRN) |
| North Galilee - Minimum route charge (weighted average over life) | 0.0057 | 0.0131 | GICP (60 QRN) |
| North Galilee - Maximum route charge (weighted average over life) | 0.0118 | 0.0287 | GICP (60 QRN) |
| South Galilee - Minimum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| **AUD Cost per Transported Tonne - Below Rail (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 7.89 | 7.31 | QRN (60Mtpa) |
| Full Galilee - Weighted average of all routes combined over life | 8.76 | 7.90 | QRN (60Mtpa) |
| North Galilee - Minimum route charge (weighted average over life) | 4.31 | 5.20 | GICP (60 QRN) |
| North Galilee - Maximum route charge (weighted average over life) | 10.99 | 9.25 | QRN (60Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| **AUD Cost per Transported Tonne - Above Rail (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 2.45 | 4.83 | GICP (60 QRN) |
| Full Galilee - Weighted average of all routes combined over life | 2.56 | 4.98 | GICP (60 QRN) |
| North Galilee - Minimum route charge (weighted average over life) | 2.52 | 4.97 | GICP (60 QRN) |
| North Galilee - Maximum route charge (weighted average over life) | 2.63 | 5.00 | GICP (60 QRN) |
| South Galilee - Minimum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| **AUD Cost per Transported Tonne - Total (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 10.33 | 12.14 | GICP (60 QRN) |
| Full Galilee - Weighted average of all routes combined over life | 11.32 | 12.88 | GICP (60 QRN) |
| North Galilee - Minimum route charge (weighted average over life) | 6.83 | 10.17 | GICP (60 QRN) |
| North Galilee - Maximum route charge (weighted average over life) | 13.62 | 14.25 | GICP (60 QRN) |
| South Galilee - Minimum route charge (weighted average over life) | / | / | QRN (60Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | / | QRN (60Mtpa) |

## Direct Comparison GICP vs GVK (60 Mtpa)

| Direct Comparison against GVK ( 60 Mtpa ) | GICP (60 GVK) | GVK (60 Mtpa) | Cheapest Option |
|---|---|---|---|
| Real Cost (A$m) | 3,964 | 3,898 | |
| Alignment Length (Km) | 557 | 485 | |
| Maximum tonnages | 60 | 60 | |
| **AUD per Transported NTK - Below Rail (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0176 | 0.0198 | GICP (60 GVK) |
| Full Galilee - Weighted average of all routes combined over life | 0.0188 | 0.0212 | GICP (60 GVK) |
| North Galilee - Minimum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | 0.0181 | 0.0204 | GICP (60 GVK) |
| South Galilee - Maximum route charge (weighted average over life) | 0.0195 | 0.0220 | GICP (60 GVK) |
| **AUD per Transported NTK - Above Rail (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0052 | 0.0065 | GICP (60 GVK) |
| Full Galilee - Weighted average of all routes combined over life | 0.0055 | 0.0067 | GICP (60 GVK) |
| North Galilee - Minimum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | 0.0055 | 0.0067 | GICP (60 GVK) |
| South Galilee - Maximum route charge (weighted average over life) | 0.0055 | 0.0067 | GICP (60 GVK) |
| **AUD Cost per Transported Tonne - Below Rail (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 9.78 | 9.61 | GVK (60 Mtpa) |
| Full Galilee - Weighted average of all routes combined over life | 10.48 | 10.29 | GVK (60 Mtpa) |
| North Galilee - Minimum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | 10.08 | 9.89 | GVK (60 Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | 10.87 | 10.68 | GVK (60 Mtpa) |
| **AUD Cost per Transported Tonne - Above Rail (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 2.92 | 3.14 | GICP (60 GVK) |
| Full Galilee - Weighted average of all routes combined over life | 3.06 | 3.26 | GICP (60 GVK) |
| North Galilee - Minimum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | 3.04 | 3.24 | GICP (60 GVK) |
| South Galilee - Maximum route charge (weighted average over life) | 3.07 | 3.27 | GICP (60 GVK) |
| **AUD Cost per Transported Tonne - Total (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 12.70 | 12.75 | GICP (60 GVK) |
| Full Galilee - Weighted average of all routes combined over life | 13.54 | 13.55 | GICP (60 GVK) |
| North Galilee - Minimum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | / | / | GVK (60 Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | 13.12 | 13.13 | GICP (60 GVK) |
| South Galilee - Maximum route charge (weighted average over life) | 13.95 | 13.94 | GVK (60 Mtpa) |

# Direct Comparison - combined solution servicing QRN and GVK (120Mtpa)

| GICP - combined solution servicing QRN and GVK (120) | QRN (60Mtpa) | GVK (60Mtpa) | QRN + GVK | GICP (120Mtpa) | Cheapest Option |
|---|---|---|---|---|---|
| Real Cost (A$m) | 4,435 | 3,898 | 8,333 | 4,245 | |
| Alignment Length (Km) | 381 | 485 | 866 | 557 | |
| Maximum tonnages | 60 | 60 | 120 | 120 | |
| **AUD per Transported NTK - Below Rail (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0234 | 0.0198 | 0.0209 | 0.0114 | GICP (120Mtpa) |
| Full Galilee - Weighted average of all routes combined over life | 0.0253 | 0.0212 | 0.0225 | 0.0124 | GICP (120Mtpa) |
| North Galilee - Minimum route charge (weighted average over life) | 0.0243 | / | 0.0243 | 0.0102 | GICP (120Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | 0.0299 | / | 0.0299 | 0.0115 | GICP (120Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | / | 0.0204 | 0.0204 | 0.0127 | GICP (120Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | 0.0220 | 0.0220 | 0.0137 | GICP (120Mtpa) |
| **AUD per Transported NTK - Above Rail (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0155 | 0.0065 | 0.0093 | 0.0058 | GICP (120Mtpa) |
| Full Galilee - Weighted average of all routes combined over life | 0.0160 | 0.0067 | 0.0096 | 0.0061 | GICP (120Mtpa) |
| North Galilee - Minimum route charge (weighted average over life) | 0.0131 | / | 0.0131 | 0.0057 | GICP (120Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | 0.0287 | / | 0.0287 | 0.0118 | GICP (120Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | / | 0.0067 | 0.0067 | 0.0055 | GICP (120Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | 0.0067 | 0.0067 | 0.0055 | GICP (120Mtpa) |
| **AUD Cost per Transported Tonne - Below Rail (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 7.31 | 9.61 | 8.69 | 5.29 | GICP (120Mtpa) |
| Full Galilee - Weighted average of all routes combined over life | 7.90 | 10.29 | 9.33 | 5.77 | GICP (120Mtpa) |
| North Galilee - Minimum route charge (weighted average over life) | 5.20 | / | 5.20 | 2.28 | GICP (120Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | 9.25 | / | 9.25 | 5.06 | GICP (120Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | / | 9.89 | 9.89 | 7.07 | GICP (120Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | 10.68 | 10.68 | 7.63 | GICP (120Mtpa) |
| **AUD Cost per Transported Tonne - Above Rail (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 4.83 | 3.14 | 3.82 | 2.68 | GICP (120Mtpa) |
| Full Galilee - Weighted average of all routes combined over life | 4.98 | 3.26 | 3.95 | 2.81 | GICP (120Mtpa) |
| North Galilee - Minimum route charge (weighted average over life) | 4.97 | / | 4.97 | 2.52 | GICP (120Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | 5.00 | / | 5.00 | 2.63 | GICP (120Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | / | 3.24 | 3.24 | 3.04 | GICP (120Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | 3.27 | 3.27 | 3.07 | GICP (120Mtpa) |
| **AUD Cost per Transported Tonne - Total (Real)** | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 12.14 | 12.75 | 12.50 | 7.98 | GICP (120Mtpa) |
| Full Galilee - Weighted average of all routes combined over life | 12.88 | 13.55 | 13.28 | 8.59 | GICP (120Mtpa) |
| North Galilee - Minimum route charge (weighted average over life) | 10.17 | / | 10.17 | 4.80 | GICP (120Mtpa) |
| North Galilee - Maximum route charge (weighted average over life) | 14.25 | / | 14.25 | 7.69 | GICP (120Mtpa) |
| South Galilee - Minimum route charge (weighted average over life) | / | 13.13 | 13.13 | 10.11 | GICP (120Mtpa) |
| South Galilee - Maximum route charge (weighted average over life) | / | 13.94 | 13.94 | 10.70 | GICP (120Mtpa) |

## GICP Option 1 – Sensitivity on Port Capacity

| GICP Option 1 Sensitivity on Port Scenario | Best | Worst | Probable |
|---|---|---|---|
| Real Cost (A$m) | 6,454 | 4,626 | 6,114 |
| Alignment Length (Km) | 577 | 557 | 577 |
| Maximum tonnages | 311 | 150 | 240 |
| **AUD per Transported NTK - Below Rail (Real)** | | | 0.000 |
| Full Galilee - Full capacity steady state for all routes combined | 0.0057 | 0.0095 | 0.0066 |
| Full Galilee - Weighted average of all routes combined over life | 0.0069 | 0.0107 | 0.0086 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0054 | 0.0095 | 0.0066 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0072 | 0.0097 | 0.0088 |
| South Galilee - Minimum route charge (weighted average over life) | 0.0059 | 0.0097 | 0.0067 |
| South Galilee - Maximum route charge (weighted average over life) | 0.0084 | 0.0130 | 0.0105 |
| **AUD per Transported NTK - Above Rail (Real)** | | | 0.000 |
| Full Galilee - Full capacity steady state for all routes combined | 0.0057 | 0.0057 | 0.0056 |
| Full Galilee - Weighted average of all routes combined over life | 0.0059 | 0.0060 | 0.0059 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0057 | 0.0057 | 0.0057 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0118 | 0.0118 | 0.0118 |
| South Galilee - Minimum route charge (weighted average over life) | 0.0053 | 0.0055 | 0.0053 |
| South Galilee - Maximum route charge (weighted average over life) | 0.0133 | 0.0058 | 0.0058 |
| **AUD Cost per Transported Tonne - Below Rail (Real)** | | | 0.000 |
| Full Galilee - Full capacity steady state for all routes combined | 2.75 | 4.51 | 3.20 |
| Full Galilee - Weighted average of all routes combined over life | 3.36 | 5.11 | 4.11 |
| North Galilee - Minimum route charge (weighted average over life) | 1.53 | 2.12 | 1.82 |
| North Galilee - Maximum route charge (weighted average over life) | 3.19 | 4.27 | 3.87 |
| South Galilee - Minimum route charge (weighted average over life) | 2.92 | 4.85 | 3.57 |
| South Galilee - Maximum route charge (weighted average over life) | 4.69 | 7.22 | 5.86 |
| **AUD Cost per Transported Tonne - Above Rail (Real)** | | | 0.000 |
| Full Galilee - Full capacity steady state for all routes combined | 2.76 | 2.73 | 2.73 |
| Full Galilee - Weighted average of all routes combined over life | 2.88 | 2.85 | 2.83 |
| North Galilee - Minimum route charge (weighted average over life) | 2.45 | 2.52 | 2.46 |
| North Galilee - Maximum route charge (weighted average over life) | 2.63 | 2.63 | 2.63 |
| South Galilee - Minimum route charge (weighted average over life) | 2.76 | 2.76 | 2.76 |
| South Galilee - Maximum route charge (weighted average over life) | 3.44 | 3.23 | 3.24 |
| **AUD Cost per Transported Tonne - Total (Real)** | | | |
| Full Galilee - Full capacity steady state for all routes combined | 5.51 | 7.24 | 5.93 |
| Full Galilee - Weighted average of all routes combined over life | 6.24 | 7.96 | 6.95 |
| North Galilee - Minimum route charge (weighted average over life) | 3.98 | 4.65 | 4.28 |
| North Galilee - Maximum route charge (weighted average over life) | 5.82 | 6.89 | 6.50 |
| South Galilee - Minimum route charge (weighted average over life) | 5.67 | 7.61 | 6.3287 |
| South Galilee - Maximum route charge (weighted average over life) | 8.13 | 10.45 | 9.0988 |

## GICP Option 1 – Sensitivity on WACC (Regulated)

| Comparison 1 with Regulated WACC | QRN (90) Reg | GVK (150) Reg | QRN + GVK Reg | GICP Option 1 Reg |
|---|---|---|---|---|
| Real Cost (A$m) | 4,943 | 5,591 | 10,535 | 6,114 |
| Alignment Length (Km) | 425 | 564 | 989 | 577 |
| Maximum tonnages | 90 | 150 | 240 | 240 |
| **AUD per Transported NTK - Below Rail (Real)** | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0124 | 0.0071 | 0.0088 | 0.0049 |
| Full Galilee - Weighted average of all routes combined over life | 0.0144 | 0.0095 | 0.0110 | 0.0064 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0135 | / | 0.0135 | 0.0050 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0173 | / | 0.0173 | 0.0066 |
| South Galilee - Minimum route charge (weighted average over life) | / | 0.0072 | 0.0072 | 0.0050 |
| South Galilee - Maximum route charge (weighted average over life) | / | 0.0121 | 0.0121 | 0.0079 |
| **AUD Cost per Transported Tonne - Below Rail (Real)** | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 4.35 | 3.56 | 3.88 | 2.40 |
| Full Galilee - Weighted average of all routes combined over life | 4.92 | 4.73 | 4.81 | 3.08 |
| North Galilee - Minimum route charge (weighted average over life) | 3.01 | / | 3.01 | 1.38 |
| North Galilee - Maximum route charge (weighted average over life) | 5.76 | / | 5.76 | 2.92 |
| South Galilee - Minimum route charge (weighted average over life) | / | 3.66 | 3.66 | 2.67 |
| South Galilee - Maximum route charge (weighted average over life) | / | 6.56 | 6.56 | 4.39 |

## GICP Option 2 – Port Access Sensitivity

| Port Access Sensitivity | GICP (120Mtpa) | QRN (60Mtpa) | GVK (60Mtpa) | GICP + QRN + GVK | GICP Option 1 | Cheapest Option |
|---|---|---|---|---|---|---|
| Real Cost (A$m) | 4,449 | 4,435 | 3,898 | 12,781 | 6,114 | |
| Alignment Length (Km) | 577 | 381 | 485 | 1,443 | 577 | |
| Maximum tonnages | 120 | 60 | 60 | 240 | 240 | |
| **AUD per Transported NTK - Below Rail (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0108 | 0.0234 | 0.0199 | 0.0155 | 0.0066 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 0.0120 | 0.0253 | 0.0210 | 0.0168 | 0.0086 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0111 | 0.0243 | / | 0.0111 | 0.0066 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0111 | 0.0299 | / | 0.0299 | 0.0088 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 0.0116 | / | 0.0210 | 0.0116 | 0.0067 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | 0.0132 | / | 0.0210 | 0.0210 | 0.0105 | GICP Option 1 |
| **AUD per Transported NTK - Above Rail (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 0.0054 | 0.0155 | 0.0065 | 0.0074 | 0.0056 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 0.0056 | 0.0160 | 0.0067 | 0.0077 | 0.0059 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 0.0061 | 0.0131 | / | 0.0061 | 0.0057 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 0.0061 | 0.0287 | / | 0.0287 | 0.0118 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 0.0052 | / | 0.0067 | 0.0052 | 0.0053 | GICP + QRN + GVK |
| South Galilee - Maximum route charge (weighted average over life) | 0.0063 | / | 0.0067 | 0.0067 | 0.0058 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Below Rail (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 5.47 | 7.31 | 9.65 | 7.01 | 3.20 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 6.08 | 7.90 | 10.16 | 7.59 | 4.11 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 4.430 | 5.20 | / | 4.43 | 1.82 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 4.430 | 9.25 | / | 9.25 | 3.87 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 5.766 | / | 10.16 | 5.77 | 3.57 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | 7.623 | / | 10.16 | 10.16 | 5.86 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Above Rail (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 2.70 | 4.83 | 3.14 | 3.34 | 2.73 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 2.83 | 4.98 | 3.25 | 3.47 | 2.83 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 2.445 | 4.97 | / | 2.45 | 2.46 | GICP + QRN + GVK |
| North Galilee - Maximum route charge (weighted average over life) | 2.445 | 5.00 | / | 5.00 | 2.63 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 2.749 | / | 3.24 | 2.75 | 2.76 | GICP + QRN + GVK |
| South Galilee - Maximum route charge (weighted average over life) | 3.146 | / | 3.27 | 3.27 | 3.24 | GICP Option 1 |
| **AUD Cost per Transported Tonne - Total (Real)** | | | | | | |
| Full Galilee - Full capacity steady state for all routes combined | 8.17 | 12.14 | 12.79 | 10.35 | 5.93 | GICP Option 1 |
| Full Galilee - Weighted average of all routes combined over life | 8.90 | 12.88 | 13.42 | 11.06 | 6.95 | GICP Option 1 |
| North Galilee - Minimum route charge (weighted average over life) | 6.875 | 10.17 | / | 6.88 | 4.28 | GICP Option 1 |
| North Galilee - Maximum route charge (weighted average over life) | 6.875 | 14.25 | / | 14.25 | 6.50 | GICP Option 1 |
| South Galilee - Minimum route charge (weighted average over life) | 8.515 | / | 13.40 | 8.52 | 6.33 | GICP Option 1 |
| South Galilee - Maximum route charge (weighted average over life) | 10.768 | / | 13.43 | 13.43 | 9.10 | GICP Option 1 |

# Appendix H Everything Infrastructure Report

Attached is the 125 page “Above and below rail comparative cost estimates” report of July 2012. In total, the report is 125 pages in length (including the front page and appendices).

East West Line Parks Limited

Galilee Infrastructure Corridor Project

# Above and below rail comparative cost estimates

July 2012

Final version

# Table of Contents

# EXECUTIVE SUMMARY

1. East West Line Parks Ltd ("EWLP") are proposing to develop an open access, multi user, multipurpose infrastructure corridor from the Port of Abbot Point to the coal mining region of the Galilee Basin. The EWLP corridor is referred to as the Galilee Infrastructure Corridor ("GICP").

2. EWLP has engaged Everything Infrastructure (EI) and Ernst & Young (EY) as Economic Infrastructure Consultants of the Project to jointly study the relative economic freight efficiency of the various Galilee basin rail proposals in the public arena.

3. This report is to be read in conjunction with the EY report "Galilee Infrastructure Corridor Project Pre-feasibility Financial and Commercial Report".

4. EI and EY compared the GICP against other Galilee Basin rail lines. The analysis was shaped by the Government's announcements on 6 June 2012 in relation to its support for two rail corridors, namely the QRN "East-West" corridor and the GVK "North-South" corridor.

5. EI's particular part of the study was to assess the above and below rail comparative cost estimates for input into the economic modelling by EY.

6. The cost assessments for both above and below rail comparable costs have been prepared as a desktop study. Key assumptions have been based on preliminary alignment and earthworks volume information provided by EWLP, information available from the public domain and the above and below rail experience of the EI team.

7. The above and below rail cost assessments are only to be used as inputs into the economic modelling of the proposed GICP corridor and this report should be read in conjunction with the report prepared by EY.

**Cost estimate structure**

8. The above and below rail comparative costs estimates have been prepared on a elemental basis to enable modelling on a whole system and mine by mine basis. The estimates included:

    i. Below rail capital cost estimates estimated on a per kilometre basis and including assessments of:

        A. direct costs (including, but not limited to, earthworks, capping layer, structures and permanent way);

        B. indirect costs (including, but not limited to, camps, recurring overheads, design and contractor's mark-up);

        C. land acquisition costs;

        D. client project management costs; and

        E. project contingency.

    ii. Above rail operating and maintenance cost estimates developed on a per tonnage and on a mine by mine basis and including assessments of:

        A. rolling stock costs;

        B. lifecycle maintenance costs for locomotives and wagons; and

        C. rail service operating costs including labour and fuel consumption.

**Comparative options**

9. The major options being assessed for the above and below rail comparative estimates, as shown in Figure 1, were based on 240Mtpa being carried on either:

    i. A single corridor only (referred to as "***GICP–240Mtpa–Option 1***");

ii. Two other corridors (referred to as "***GVK–150Mtpa***" and "***QRN-90Mtpa***"); or

iii. All three corridors (referred to as "***GICP–120Mtpa–Option 2***" and "***GVK-60Mtpa***" and "***QRN-60Mtpa***").

10. The comparisons in the economic modelling, using *GICP–240Mtpa–Option 1* as the base case, are:

i. Comparison 1 – *GICP–240Mtpa–Option 1*, servicing all Galilee mines, **versus** *GVK–150Mtpa*, servicing Galilee South mines **and** *QRN-90Mtpa*, servicing Galilee North mines; and

ii. Comparison 2 – *GICP–240Mtpa–Option 1* " **versus** *GVK-60Mtpa*, servicing only GVK mines, **and** *QRN-60Mtpa*, servicing only Adani mines, **and** *GICP–120Mtpa–Option 2*, servicing all the remaining Galilee mines".

**Comparative differences**

11. There major differences between the cost estimates for the GICP, GVK and QRN corridors were driven by differences in:

i. alignment;

ii. capacity;

iii. access;

iv. below rail cost elements; and

v. operating efficiency.

12. The proposed GICP alignment:

i. minimises exposure to major flood plain areas, resulting in:

A. lower earthworks costs from better earthworks balance of cut and fill materials during construction compared to other corridors. The other corridors, with long sections through flood plain areas, require the importing of large quantities of fill material over long distances;

B. a lower cost of embankment construction due to lower provision for bridge structures and drainage;

C. greater certainty of construction delivery during the wet seasons; and

D. greater certainty of uninterrupted operating service due to flooding events.

ii. provides environmental and community benefits by:

A. avoiding the Collinsville area and the need for noise mitigation treatments; and

B. minimising the impact on agricultural areas resulting in lower land acquisition costs.

13. The proposed GICP has a greater capacity than other corridors as it:

i. is designed to carry 40TAL wagons;

ii. requires fewer trains to carry equivalent loads;

iii. defers capital expenditure for capacity enhancements; and

iv. is capable of connecting to the existing narrow gauge network, if a dual gauge section is included.

14. In terms of accessibility for mines, the proposed GICP provides greater access to the entire Galilee Basin than other corridors as it:

i. does not rely on train paths along existing rail networks; and

ii. subject to a change to existing port constraints, provides access to the entire basin at the same time.

15. Whilst the proposed GICP is longer than other corridors, it has:

i. a lower below rail cost/ tonne capital cost due to its ability to carry higher loads from all parts of the Galilee Basin; and

ii. similar below rail maintenance costs on a per tonne km basis.

16. The proposed GICP has operating efficiency benefits due to:

i. requiring fewer trains as each can carry greater loads when compared to trains on other corridors; and

ii. a lower fuel cost/ tonne operating cost as a result of greater payload trains and minimum ruling grades.

**Further assessment**

17. It is anticipated that further scope definition, including design of specific items such as the standard profile, the vertical and horizontal rail alignment, the sizing of structures and drainage through floodplains, coal wagon technical performance specifications and detailed train system operational modelling would increase the level of project definition and improve the accuracy of the cost estimates for both above and below rail components.

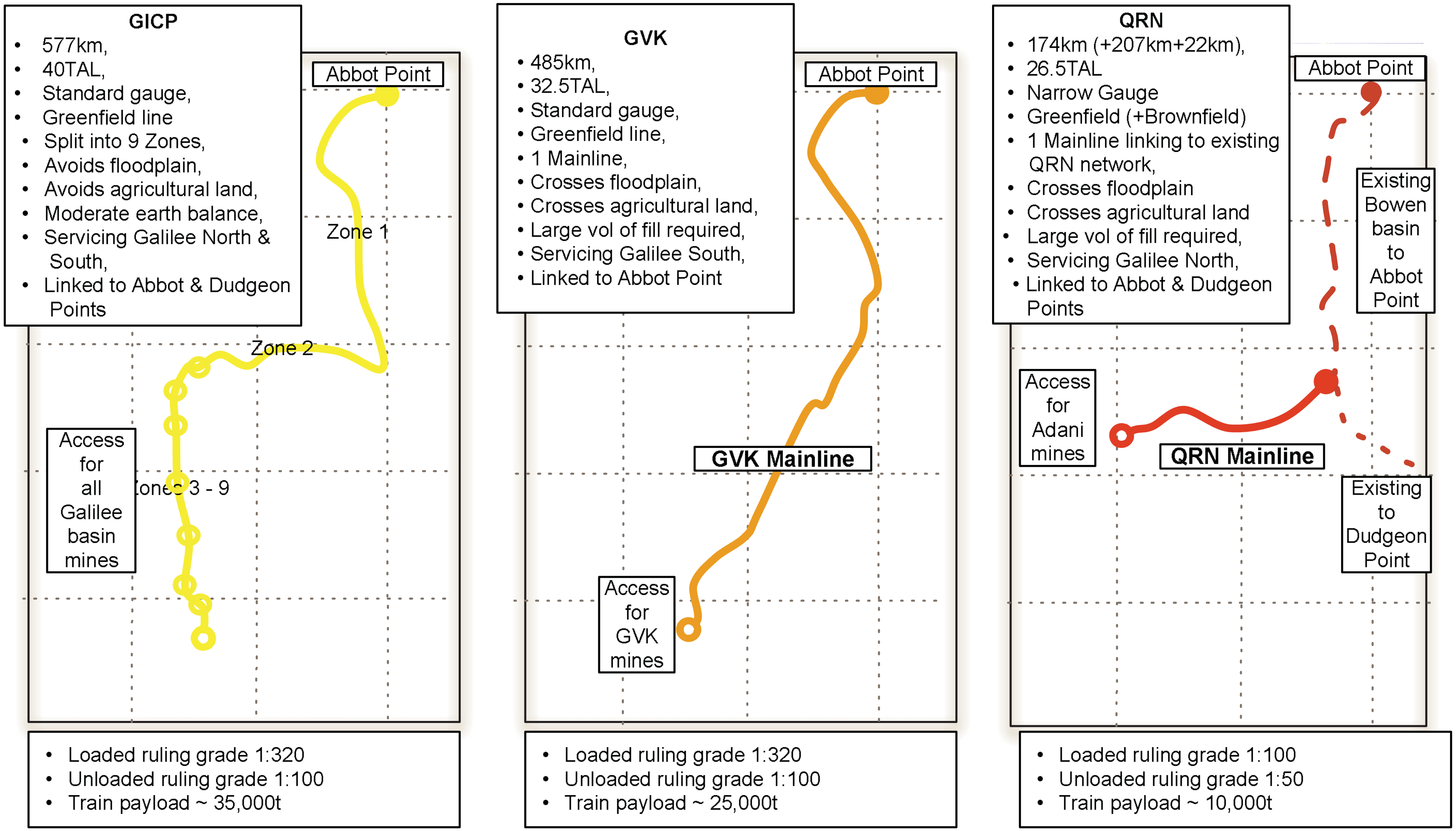



**Figure 1 – Physical comparisons of proposed GICP corridor against assumed proposed GVK and QRN corridors**

# 1. INTRODUCTION

East West Line Parks Ltd (EWLP) proposes to develop an open access, multi user, multipurpose infrastructure corridor from the Port of Abbot Point to the coal mining regions of the Bowen and Galilee Basins. EWLP's Galilee Infrastructure Corridor (GICP) is approximately 600km in length and serves proposed mines in both the Galilee North and Galilee South regions.

EWLP is seeking to demonstrate the economic advantages of the proposed GICP over the other currently proposed rail corridors from the Galilee. The direction of this study was shaped by the Government's announcements on 6 June 2012 in relation to its preliminary support for two rail corridors, namely the QRN East-West corridor and the GVK 'North-South' corridor. The QRN proposed line seeks to utilise the existing narrow gauge network currently connecting the Bowen basin to both Dudgeon Point and Abbot Point and includes a greenfields section extending from near Moranbah to the Galilee North region. The GVK proposed line is a fully greenfields, standard gauge rail line extending approximately 500km directly from Abbot Point to the Galilee South area.

There were a number of other corridors that were not included in our comparative assessment. These included the corridors proposed by Adani directly and the corridor proposed by Warratah. According to the Government announcement, Adani is currently developing the QRN alignment with QRN, therefore Adani's own corridor was not considered further within this assessment. The Adani and QRN corridors are, in any event, on a similar east-west alignment. For Waratah's proposed corridor, it was considered to be similar in alignment and length to the corridor proposed by GVK, however the Waratah corridor was purportedly based on a 25 tonne axle load which was lower than the axle loading for GVK, so the Warratah corridor was not assessed as part of this comparative assessment.

Everything Infrastructure (EI) has assessed the GICP's above and below rail comparative costs for various demand levels and compared costs to the proposed competing GVK and QRN corridors. EI's analysis was used as inputs into the economic modelling being undertaken by Ernst and Young (EY), who have prepared an economic analysis of the GICP for various demand scenarios.

EI's comparative cost estimate report includes:

- a brief background description of the various proposed rail projects giving context to the comparative cost assessment;
- a list of key assumptions underpinning the EIG analysis undertaken for the above and below rail cost estimates;
- a review of the below rail cost estimate outputs;
- a comparison of below cost estimate with those estimated for the other Galilee rail corridors;
- a comment on methods for achieving improved capital cost efficiency;
- a review of the above rail equipment capital costs;
- a determination on the most efficient GICP railway system;
- a summary of EI's findings highlighting the major differences between GICP and the other projects.

A road map outlining the key features of this report is shown in Figure 1.

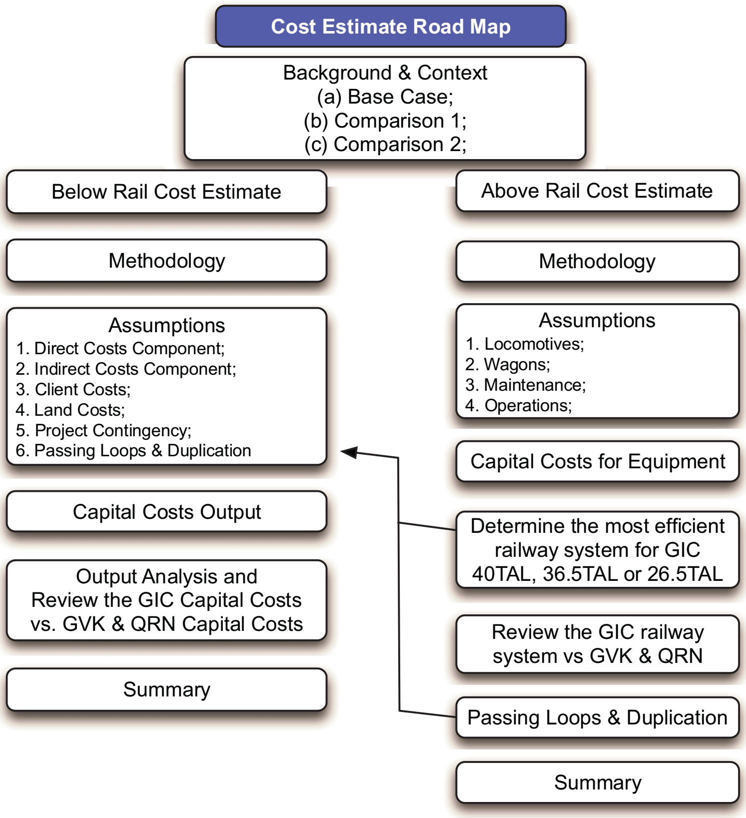



**Figure 2: Road map for the GICP Comparative Cost Estimate**

# 2. BACKGROUND AND CONTEXT

Prior to March 2012, EWLP, as the proponent of the GICP project, together with their technical advisors, undertook preliminary analysis to select a preferred alignment for a rail corridor extending from Abbot Point to both Galilee north and Galilee south regions.

The preferred concept for the GICP, as indicated in EWLP's Initial Advice Statement dated March 2012, has the following characteristics:

- the GICP connects Galilee mines, in both north and south regions, to Abbot Point with a dedicated, multi-user, heavy haul freight line;
- the selected GICP alignment seeks to minimise the length of line traversing flood prone areas and minimise the impact on valuable cropping land; and
- the GICP concept potentially captures significant economies of scale by enabling larger volumes of freight to be carried on a dedicated 40 tonne axle load track.

The aim of EWLP's economic study is to quantify and demonstrate the differentiating characteristics of the GICP from other lines proposed to connect the Galilee Basin to Abbot Point.

The two other rail corridor concepts being compared are the proposed GVK line connecting Abbot Point directly with GVK mines in the Galilee south area and the proposed QRN line extending the existing Goonyella network currently servicing the Bowen Basin to the Adani mines in the Galilee north area. The proposed GICP corridor and the assumed GVK and QRN corridors are depicted in diagrams included in Appendix 1 of this report.

A number of different demand scenarios have been prepared to enable the economic comparison of the GICP against GVK and QRN proposals on a mine by mine basis. For further details on the specific demand scenarios and the various constraints on Abbot Point capacity, refer to the aforementioned associated report prepared by EY.

In terms of the below and above rail comparative cost assessment, there are two major comparisons being considered against a base case, those are;

- Base case - "GICP, servicing all the Galilee mines at up to 240Mtpa" referred to as "***GICP–240Mtpa–Option 1***"
- Comparison 1 – "*GICP–240Mtpa–Option 1*" ***versus*** "GVK servicing the Galilee South mines at up to 150Mtpa" referred to as "***GVK–150Mtpa***" ***and*** "QRN servicing the Galilee North mines at up to 90Mtpa" referred to as "***QRN-90Mtpa***".
- Comparison 2 – "*GICP–240Mtpa–Option 1*" **versus** "GVK servicing only GVK mines at up to 60Mtpa" referred to as "***GVK-60Mtpa***" ***and*** "QRN servicing only Adani mines at up to 60Mtpa" referred to as "***QRN-60Mtpa" and*** "GICP, servicing all the remaining Galilee mines at up to 120Mtpa" referred to as "*GICP–240Mtpa–Option 2*"

# 3. BELOW RAIL COMPARATIVE COST ASSESSMENT

## 3.1. Methodology

EI has adopted a building blocks approach for the development of the below rail comparative cost assessments to enable comparative economic value to be assessed for a range of demand scenarios. The building blocks included assessment of:

- Total below rail construction costs based on a single track configuration for each of the GICP, GVK and QRN rail alignments;
- Greenfield and brownfield construction costs for the addition of passing loops to increase capacity along each line as demand increases; and
- Duplication costs for sections of each line to enhance track capacity.

The total below rail costs were prepared based on physical zones with each of the zones in the Galilee Basin servicing different mines. This zonal approach added to the complexity of preparing comparable cost estimates, however, it provided the flexibility to be able to model different economic outcomes for a range of demand scenarios. Diagrams showing the various alignments and staging of the below rail works have been included in Appendix 1 as:

- Part A – *GICP–240Mtpa–Option 1;*
- Part B – *GVK–150Mtpa* and *QRN-90Mtpa; and*
- Part C – *GICP–120Mtpa–Option 2*, *GVK-60Mtpa* and *QRN-60Mtpa.*

A standard structure for the below rail cost estimates was adopted to enable benchmark comparisons of costs and prices against known market prices for similar work. The total cost structure included:

- Direct costs (including earthworks, capping layer, structures, permanent way, incidental and environmental works and fencing);
- Indirect costs (including mobilisation and demobilisation, camps, recurring overheads, design and design verification, environmental monitoring, site investigations, contractors risk and opportunities, contractor's allowance to fix price and time over the contract period);
- Contractor's mark-up (including offsite overhead recovery and profit);
- Client costs (including development costs and project management during construction);
- Land costs (including allowance for acquisition and land adjustment works); and
- Project contingencies (allowing for the uncertainty at the early stage of project definition).

For this pre-feasibility phase, the direct costs were determined for four different terrain types, broadly defined as:

- Flat - generally flat, small cuts, minimum formation depths, good ground conditions;
- Hilly – major hills requiring larger excavations and deeper gullies to fill, significant earthworks volumes;
- Rolling – low hills and valleys with an opportunity for balanced cut to fill earthworks operation; and
- Flood – generally flat, minimal cuts, poor ground conditions, wider embankments, flatter batters.

The assumed extent of each terrain type for each corridor has been summarised in tables included in Appendix 2.

The direct costs for the typical terrain types were compared for each of the GICP, GVK and QRN lines on a $ per km basis.

## 3.2. SOURCE OF INFORMATION USED IN THE BELOW RAIL COST ASSESSMENTS

The main sources of the information used in the below rail comparative cost assessments were:

- EWLP technical advisors providing details of the comparable corridors for the proposed GICP, and assumed GVK and QRN lines (these have been represented in Appendix 1 of this report);
- Preliminary cut and fill volumes for single track sections of the GICP, GVK and QRN lines as provided by EWLP's technical advisors (summary of earthworks volumes have been included in Appendix 3), and
- Publicly available information relating to technical aspects of the proposed GVK and QRN lines.

## 3.3. KEY ASSUMPTIONS

### 3.3.1. Direct Cost Component Assumptions

*General*

i. Direct cost estimates are based on greenfield construction of single track profiles for each of the preferred GICP, GVK and QRN corridors;

ii. Capacity enhancements, including passing loops and sections of duplicated track, have been estimated on a generic basis for each corridor and include an uplift factor for brownfield construction where applicable;

iii. Below rail cost estimates for each corridor exclude:

    A. rail infrastructure at Abbot Point port area;

    B. spur line connections from the mainline to each mine; and

    C. any upgrades to existing QRN networks;

iv. The assumed lengths of track along each corridor have been defined by EWLP and are based on previous corridor studies undertaken by EWLP for the GICP and on public information for GVK and QRN.

v. The extent of different terrain types along each corridor for GICP, GVK and QRN was based on an assessment of each alignment as depicted on aerial photography. A summary of the assumed terrain types is shown in Tables 1 ~ 6 in Appendix 2;

vi. Indirect costs, contractor's contingency, land acquisition, client and project contingency costs are not included in direct costs and have been estimated separately;

vii. All direct costs are estimated in $2012;

viii. The timing of construction has been based on an opening of rail service for each of the GICP, GVK and QRN at the start of 2017.

ix. For sections of track being staged in accordance with the assumed demand profiles, the inflation factor used has been based on current market estimates for rail construction cost escalation of 4% p.a.

x. Assumed construction methodologies used to build up the rates has been included in Appendix 6 of this report.

*Earthworks*

i. The estimate for major earthworks items has been based on maximising the use of scrapers and includes the following main earthworks construction activities - "common cut to fill", "export to waste" and "borrow to fill";

ii. It is assumed that an earthworks contractor will try to balance earthworks volumes over an economical operating distance for their earthmoving equipment. Taking this into consideration, we have assumed 5 km sections for the earthworks. The "common cut to fill" earthworks activities would be performed by scraper operation moving material from cuts to fills within each 5km section. The "export to waste" and "borrow to fill" operations are also to be undertaken by scrapers using local waste and borrow sites;

iii. Where net "export to waste" and net imports of "borrow to fill" volumes for 5 km sections are contiguous, volumes of "export to waste" materials have been adjusted to avoid double counting of materials "exported to waste" and "borrowed to fill";

iv. Clearing & grubbing has assumed to be over a 15m width (formation + 1.5m either side);

v. Stripping and stockpiling of subsoil has been assumed for a topsoil layer 150mm thick;

vi. Assumed that scrapers would be used on terrain defined as "flat" for cut and fill operations and occasional excavation and trucking required on parts of the terrain defined as "hilly";

vii. There has been no allowance for rock in the general cut and fill rates, however separate rock allowances have been applied to each section;

viii. There has been no allowance for treatment for Acid Sulphate soils;

ix. Other than the long distance importing of material for the GVK and QRN embankments in the flood prone areas, all earthworks rates have been based on short-haul (less than 3000m) earthworks;

x. Assumed Borrow Pits adjacent to alignment when imported fill required;

xi. For excess cut volumes from each section assumed on-site disposal within 5km;

xii. Allowed 3 x 3m rock mattresses for headwalls;

xiii. An access road, 5m wide with 200mm thick crushed rock, is assumed to be installed within the rail corridor;

*Capping layer*

i. Capping layer includes capping and structural layers;

ii. Capping layer assumed to be 200mm thick by 7m wide with materials imported from unidentified quarries within 20km;

iii. Structural layer materials assumed to be processed on site from locally available materials;

*Structures/Drainage*

i. The structures/ drainage section of the below rail cost estimates includes bridges, culverts, level and grade separated crossings;

ii. Structures includes bridges of various assumed lengths ranging from 12m to 300m;

iii. The length of bridges assumed for each line has been estimated using selected alignments shown on high level topographic material, supplemented by Google Earth;

iv. Drainage includes either 1,2 or 3 box culverts, battery culverts or standard pipe culverts;

v. The extent of drainage is based on ARTC standard drawings and depends on the type of terrain for particular sections of the track;

vi. Extensive earthworks upstream of culverts has not been considered;

vii. Allowance has been made for small pipe culverts every 200m;

viii. Supply and installation of fibre optic cable along each of the lines has not been included;

ix. The level crossings required are either active or passive;

x. The extent of crossings has been estimated from a high level map of the rural roads in the area;

xi. For active level crossings, allowed 100m approach road works, gates + warning signalling;

xii. For passive level crossings, allowed 60m approach road works;

xiii. For grade separation of major intersections, allowance include 400m approaches, approximately 80,000 m3 fill with a bridge 50m x 11.5m;

xiv. For grade separation, minor roads assumed with 300m approaches, approximately 80,000m3 fill with a bridge 50m x 9m;

*Permanent Way*

i. Permanent way costs includes the supply and installation of rail, sleeper and ballast materials;

ii. The amount of ballast required depends on the standards chosen for each of the lines. For the purposes of the comparable below rail cost estimate, an amount of 1625m3/km has been used for both the standard gauge and narrow gauge tracks. Once track standards, such as ARTC (QR have no standard gauge standards), are finalised for the standard gauge lines, consideration should be given to adjusting the amount of ballast up to 2600m3/km. For narrow gauge track, QR standards currently use additional ballast, in excess of the standard profile, on shoulders and between tracks resulting in an amount of 2290m3/km. The refinement of ballast quantities should be considered after further definition of the intended track standards for both single and double standard gauge tracks;

iii. Rail supply costs have been based on budget information provided by existing rail suppliers. Assumed that 68kg rail used for standard gauge rail for both GICP 40TAL and GVK 32.5 TAL;

iv. Sleeper supply costs are based on information provided by existing sleeper manufacturers both within Australia and overseas;

v. Installation costs are based on similar installations in the Queensland network for 26.5 TAL narrow gauge rail track and similar heavy haul installations in Western Australia for 32.5 TAL standard gauge. There are no directly comparable installation costs available for 40 TAL in Australia. The assumed installation rates are:

   A. $190,000/km for 26.5 TAL

   B. $220,000/km for 32.5 TAL

   C. $260,000/km for 40TAL

*Incidentals and Environmental Monitoring*

i. For silt fencing, an allowance has been made to install them for both sides of formation. Rate for silt fencing includes maintaining fences;

ii. Sedimentation Basins have been allowed with basins 20m x 20m and low level overflows. Rates include maintenance for 6 months each basin. No allowance has been made to demolish basins;

iii. No allocation for power has been included

*Fencing*

i. Rural fencing has been allowed for on both sides of the track.

### 3.3.2. Indirect Cost components

The following indirect assumptions are based on standard cost estimates used within the construction industry. These include:

i. Estimates for recurring and non-recurring overheads and mobilisation and demobilisation of camp facilities;

ii. Overheads breakdown, as a percentage of direct costs, based on typical major projects included:

| | | |
|---|---|---|
| A. | Staff and salaries | 14% |
| B. | Accommodation and Vehicles | 2% |
| C. | Wet Weather | 2% (GICP) to 4% (GVK & QRN) |
| D. | Site Services | 1.5% |
| E. | Plant/Equipment and Small Tools | 1.5% |
| F. | Safety and Testing | 1.5% |
| G. | Training | 0.5% |
| H. | LSL, Insurances, Legal | 1.0% |
| I. | TOTAL | 24% (GICP) to 26% (GVK & GRN) |

iii. The allowance for overheads differed for the GICP, compared to the other two projects, as the GVK and QRN alignments are likely to result in higher exposure to potential wet weather delays as a larger proportion of their alignments traversed floodplain areas; and

iv. An allowance was made to mobilise and demobilise for four 200-bed construction camps and it was assumed that the camps would be required for the full 3-year period. The costing for provision of the construction camps includes operation and maintenance of the camps.

### 3.3.3. Client Cost Component

i. An allowance of 10% on total contractor prices has been included to cover project management, development and procurement costs.

### 3.3.4. Land Cost Component

i. A nominal per km rate has been allowed for dealing with land acquisition / lease / use related issues based on estimates of land costs provided by EWLP;

ii. Three rates were applied - $150K/km for agricultural or land close to populated areas, $100K/km for non – agricultural land extending west of Moranbah and $50K/km for land extending north south adjacent Galilee mine tenements;

iii. GICP land costs were assumed to be Zone 1 ($150K/km), Zone 2 ($100K/km) and Zones 3 to 9 ($50K/km), GVK land costs were assumed to be $150K/km for their mainline and QRN land costs were assumed to be $150K/km for their mainline.

### 3.3.5. Project Contingency Component

i. A project contingency amount of 30% has been included in the Total Project Costs.

### 3.3.6. Passing Loops and Duplication Component

i. Cost estimates for passing loops have been calculated based on the length of trains, the timing of construction (i.e. greenfield versus brownfield construction) and the type of materials required;

ii. In general, passing loops have been estimated to include earthworks (approximately 50% of single track volumes), material supply (track, ballast & turnouts), the installation of materials and an allocation for interlocking, points machines, huts, power supply etc;

iii. The length of the passing loop is based on the length on the train (I.e. for GICP – Option 1 & 2 = 3 loco and 270 wagons), a theoretical stopping distance (1/2 the length of the train when using Electronic Pneumatic Controlled Breaking and an allocation for float (length of train x 10%). The length of train is estimated to be approximately 5300m, the stopping distance 2700m and float of 530m. A total length of each passing loop for GICP Option 1&2 is approximately 8.5km;

iv. For passing loops built after the first train movement, a brownfield construction factor, of 1.5, has been applied to the earthworks and installation costs. This factor is allocated on the basis that construction will be inhibited due to the regular movement of trains through the working areas and therefore construction will require more time and restricted construction practices.

v. In addition to the costs discussed above, for both greenfield and brownfield estimates, an indirect factor has been included to achieve a Total Construction Cost (incl. mark-up, contingency, etc);

vi. It is assumed that a 3rd party operates the full fleet of trains required to serve all mines. The total number of trains required could therefore be estimated using the total network demand divided by the annual capacity of a typical train (on a mine by mine allocation). On this basis, passing loop numbers were determined on the principle that one additional passing loop for every one new train joining the network. In the case of GICP – Option 1&2, a single train set can haul approximately 7.5Mtpa. Therefore for every increment of 7.5Mtpa, a new train and subsequent passing loop will be required.

vii. It has been assumed that the passing loops are theoretically placed evenly along the entire alignment and that headway between trains will determines the limiting number of passing loops that can be installed. To increase the throughput beyond this point requires duplication of various sections between the passing loops. A standard duplication length has been assumed based on the theoretical spacing between passing loops.

viii. A summary of the assumed below rail capacity curves are shown for each of the corridors in Appendix 5.

### 3.3.7. Below Rail Maintenance Costs

i. Estimates for below rail maintenance costs have been based on publicly available historical data for rail maintenance costs;

ii. Minimal maintenance effort is assumed to be required during the initial years of the operating term with increasing maintenance effort required as the load ramps up;

iii. Maintenance costs are assumed to reach a level approximately equivalent to full replacement of rail along each entire corridor after each 7 to 10 years.

## 3.4. Output Analysis

### 3.4.1. Below Rail comparative cost estimated amounts

A summary of the assessed comparable costs for each of the corridors by their relevant regional zone has been included in Appendix 9. The amounts shown in Appendix 9 have been used an inputs into the economic model prepared by Ernst & Young.

### 3.4.2. Comparable Direct Costs on per Kilometre Basis

The direct costs, on a per kilometre basis, are shown for each of the terrain types for *GICP–240Mtpa–Option 1* in Table 1. The assessment indicated that:

- The direct costs for *GICP–240Mtpa–Option 1* ranged from 2.3 $M/km for the flat area in the Galilee south area to 3.3 $M/km for the flood areas where a dual gauge track is proposed;
- Overall, on an average weighted by distance, the direct costs for *GICP–240Mtpa–Option 1*, was 2.77 $M/km.

**Table 1: GICP–240Mtpa–Option 1 Direct costs ($M/km)**

| ***GICP - Option 1*** | **Flat** | **Hilly** | **Rolling** | **Flood** | **Weighted Average (by distance)** |
|---|---|---|---|---|---|
| Zone 1 | 2.5 | 3.1 | 2.6 | 3.0 | 3.01 |
| Zone 2 | 2.5 | | | 3.3 | 2.59 |
| Zone 3 | | | 2.7 | 3.3 | 2.99 |
| Zone 4 | | 2.6 | | | 2.62 |
| Zone 5 | | | 2.7 | 2.9 | 2.76 |
| Zone 6 | 2.4 | | | 2.9 | 2.81 |
| Zone 7 | 2.4 | | | 2.9 | 2.61 |
| Zone 8 | 2.4 | | | 2.9 | 2.40 |
| Zone 9 | 2.3 | | | | 2.31 |
| Overall average | | | | | **2.77** |

For *GVK-150Mtpa*, the direct costs on per kilometre rates are as shown in Table 2. The assessment indicated that:

- The direct costs for *GVK-150Mtpa* ranged from 2.3 $M/km for the flat area in the Galilee south area to 3.5 $M/km for the flood areas; and
- Overall, on an average weighted by distance, the direct costs for *GVK-150Mtpa*, was 2.93 $M/km.

Table 2: GVK-150Mtpa Direct costs ($M/km)

| *GVK-150Mtpa* | Flat | Hilly | Rolling | Flood | Weighted Average (by distance) |
|---|---|---|---|---|---|
| Mainline | 2.4 | 3.1 | 2.6 | 3.5 | 3.00 |
| Zone 7 | 2.3 | | | 3.5 | 2.80 |
| Zone 8 | 2.3 | | | 3.5 | 2.37 |
| Zone 9 | 2.3 | | | | 2.25 |
| Overall average | | | | | **2.93** |

For *QRN-90Mtpa*, the direct costs on per kilometre rates are as shown in Table 3. The assessment indicated that:

- The direct costs for *QRN-90Mtpa* ranged from 2.4 $M/km for the flat area in the mainline between the existing network and the Galilee basin to 3.5 $M/km for the flood areas; and
- Overall, on an average weighted by distance, the direct costs for *QRN-90Mtpa*, was 2.92 $M/km.

Table 3 - QRN-90Mtpa Direct costs ($M/km)

| *QRN-90Mtpa* | Flat | Hilly | Rolling | Flood | Weighted Average (by distance) |
|---|---|---|---|---|---|
| Mainline | 2.4 | | | 3.5 | 3.00 |
| Zone 4 | | 2.6 | | | 2.58 |
| Overall average | | | | | **2.92** |

The direct costs, on a per kilometre basis, are shown for each of the terrain types for *GICP–120Mtpa–Option 2* in Table 4. The assessment indicated that:

- The direct costs for *GICP–120Mtpa–Option 2* ranged from 2.3 $M/km for the flats area to 3.1 $M/km for the hilly areas, predominantly in Zone 1;
- A large component of the direct costs relate to earthworks costs (a summary of the direct costs rates per kilometre for earthworks has been included in Appendix 4 of this report);
- Overall, on an average weighted by distance, the direct costs for *GICP–120Mtpa–Option 2*, was 2.70 $M/km.

Table 4 - GICP–120Mtpa–Option 2 Direct costs ($M/km)

| *GICP–120Mtpa–Option 2* | Flat | Hilly | Rolling | Flood | Average |
|---|---|---|---|---|---|
| Zone 1 | 2.5 | 3.1 | 2.6 | 3.0 | 3.01 |
| Zone 2 | 2.3 | | | 2.8 | 2.38 |
| Zone 3 | | | 2.4 | 2.9 | 2.58 |
| Zone 4 | | 2.6 | | | 2.62 |
| Zone 5 | | | 2.7 | 2.9 | 2.76 |
| Zone 6 | 2.4 | | | 2.9 | 2.81 |
| Zone 7 | 2.4 | | | 2.9 | 2.61 |
| Zone 8 | 2.4 | | | 2.9 | 2.40 |
| Zone 9 | 2.3 | | | | 2.31 |
| Overall average | | | | | **2.70** |

For *GVK-60Mtpa*, the direct costs on per kilometre rates are as shown in Table 5. The assessment indicated that:

- The direct costs for *GVK-60Mtpa* ranged from 2.4 $M/km for the flat terrain to 3.5 $M/km for the flood areas; and
- Overall, on a weighted average by distance, the direct costs for *GVK-60Mtpa*, was 3.00 $M/km.

**Table 5 - GVK-60Mtpa Direct costs ($M/km)**

| ***GVK-60Mtpa*** | **Flat** | **Hilly** | **Rolling** | **Flood** | **Average** |
|---|---|---|---|---|---|
| Mainline | 2.4 | 3.1 | 2.6 | 3.5 | **3.00** |

For *QRN-60Mtpa*, the direct costs on per kilometre rates are as shown in Table 6. The assessment indicated that:

- the direct costs for *QRN-60Mtpa* ranged from 2.4 $M/km for the flat area in the mainline between the existing network and the Galilee Basis to 3.5 $M/km for the flood areas; and
- overall, on an average weighted by distance, the direct costs for *QRN-60Mtpa*, was 3.00 $M/km.

**Table 6 - QRN-60Mtpa Direct Costs ($M/km)**

| ***QRN-60Mtpa*** | **Flat** | **Hilly** | **Rolling** | **Flood** | **Average** |
|---|---|---|---|---|---|
| Mainline | 2.4 | | | 3.5 | **3.00** |

### 3.4.3. Below Rail Comparative Cost Summary

The following observations are noted:

- *GICP–120Mtpa–Option 2*, with a single standard gauge track over the entire 577km, from this early stage assessment appears more economical to construct on a per kilometre basis than all other options.
- By avoiding the majority of the flood plain area, *GICP–240Mtpa–Option 1* and *GICP–120Mtpa–Option 2* have an overall cost advantage over the GVK and QRN alignments due mainly to:
  - The GICP alignment having a better cut to fill earthworks balance compared to the GVK and QRN flood prone alignments; and
  - Reduced exposure to delays due to flooding during construction.
- The GICP earthworks and flood exposure cost advantages more than offsets the higher 40TAL standard gauge permanent way costs for the GICP track compared to the GVK (32.5TAL) and QRN (26.5TAL) tracks.

Other comments:

- Further refinement of the alignment and the profile design has the opportunity to optimize earthworks cost for the below rail portion of the GICP. Examples can be seen at Ch.110km, Ch.150km and Ch.220km where large cuts may be able to be avoided with further design modelling.
- Passing loops and duplication costs have been included on an average km basis without specific locations being set for each passing loop. There is potential for more balanced earthworks if passing loop locations are taken in consideration in further designs. Considering the above comment in relation to balancing of earth works, there is potential for developing additional cuts were fills are required, coordinating the location with that of near-term passing loop requirements would also avoid double handling of materials etc. Example of such areas includes Ch.425km, Ch.240km etc.

# 4. ABOVE RAIL COMPARATIVE COST ASSESSMENT

## 4.1. METHODOLOGY

The above rail methodology for the GICP is based around the assessment of existing information provided by EWLP and it's consultants. This is also developed with publicly available information and industry knowledge. Generally, the above rail analysis was based on a report provided by Calibre Global ("**Calibre**") on train simulations along the EWLP Alignment (HA200VA1). This report formed the basis of the above rail assumptions going forward.

Using the Calibre report, EI developed a series of further assumptions to assess the various railway systems (i.e. 40TAL, 32.5TAL and 26.5TAL). Upon determining that the 40TAL system has the greatest efficiency a comparison was undertaken with the preferred GICP railway systems against the GVK and QRN rail corridors.

The key assumptions associated with the above rail analysis are included in section 4.2.

## 4.2. KEY ASSUMPTIONS

The key assumptions that have been made for the train simulation modelling fall under several major categories, those being:

1. Rolling Stock;
2. Locomotives;
3. Wagons;
4. Maintenance; and
5. Operations.

A description of each is following.

### 4.2.1. Rolling Stock Component

The above rail comparison has been developed around train simulations run by Calibre Global ("**Calibre**") at the request of EWLP. The train simulations were performed to define the optimal train for each of the rail configurations for the mines in the Galilee Basin. The main driver of long-term operational cost is the cost of fuel, which is generally the largest portion of the whole-of-life cost for a train. Therefore the optimal train was determined purely based around the fuel consumed per tonne of coal.

The Calibre train simulations are only indicative of the fuel consumption and are based on a crude methodology of energy conversion into fuel consumption. A more accurate methodology would be to use a train simulation package that uses notch-by-notch fuel consumption approach to determine the fuel used on a round trip. There are many locomotive fuel saving systems (such as Trip Optimiser, Leader, Consist Manager, Automatic Engine Start Stop etc) that can be purchased to minimise the overall fuel consumption. The efficiencies that potentially could be achieved by using these systems have not been modelled in this analysis.

The train simulation was run on the proponents mainlines only, with interpolation used to determine the times and fuel consumption. By extrapolating these results it was possible to determine the time and fuel consumption for trains servicing specific mines. This interpolation and extrapolation is appropriate and reasonably accurate for prefeasibility assessments. To confirm and further develop operating cost certainty individual simulations should be run for each mine, and its associated spur line, to accurately determine the trip / cycle time and fuel consumption.

Below is a list of the key rolling stock and operational assumptions that have been used to develop the operating cost model for the GICP, GVK and QRN options:

*Note: many of these assumptions are based on Calibre simulation outputs*

i. Time for loaded trip;
ii. Time for empty trip;
iii. Distance for the return trip;
iv. Fuel consumed on loaded trip based on a conversion of energy into fuel consumption;
v. Fuel consumed on empty trip based on a conversion of energy into fuel consumption;
vi. Fuel consumed during loading and unloading based on notch operation for 10 hours;
vii. Lidded wagon fuel saving;
viii. Lidded wagon payload saving (no loss of coal on journey from the mine to the port);
ix. Type and number of locomotives including capital spares and fleet spares;
x. Type and number of wagons including capital spares and fleet spares;
xi. Tare weight of the wagon;
xii. Average payload per wagon;
xiii. Train payload;
xiv. Loading and unloading time;
xv. Operational days per year;
xvi. Inefficiency factor of the operations on the network;
xvii. Locomotive crew changes;
xviii. Provisioning time of the locomotive.

Using the parameters listed above, EI developed a preliminary and simplified Train System Model that estimates key outputs for this economic study based on information provided in the Calibre train simulation model. This Train System Model provided data on rail configurations for each of the mines identified (by E&Y) as potential throughput producing mines. Individual mine characteristics, such as distance from mine to port, spur line length and anticipated throughput were used in this model. The Train System model included the following variables:

i. Annual train capacity measured in Mtpa (million tonnes per annum);
ii. Annual fuel cost measured in $/T (dollars per tonne);
iii. Capital cost per train including fleet spares in 2012 dollars;
iv. Overhaul cost per locomotive and per wagon in 2012 dollars;
v. Capital spares cost per locomotive and per wagon in 2012 dollars;
vi. Maintenance cost (locomotives, wagons, facility charge) in $/T; and
vii. Labour cost (train crew and network controllers) in $/T.

The detailed variables used for the various demand scenarios are shown in Appendix 7B.

### 4.2.2. Locomotive Component

The Calibre train simulation report used the GE ES44ACi Locomotive as the representative locomotive that would perform the train haulage task on greater than a 32.5TAL line within the Galilee Basin. This doesn't restrict the operator or miner from procuring other equivalent locomotives. Many manufacturers have similar locomotives with subtle differences.

Details of the train characteristics assumed for the simulations are shown below.

1. 32.5TAL or greater (i.e. 40TAL) train simulation (GICP & GVK line):
   i. ES44ACi – GE Evolution Series Locomotive:
   ii. Standard Gauge;
   iii. 32.5 tonne axle load (196T);
   iv. 4400 HP Emission standard compliant locomotives;
   v. Modified to meet noise standards in Queensland;
   vi. Includes in-cab signalling system;
   vii. Two driver crews;
   viii. Major overhaul on the locomotive will occur at 10 and 20 years;
   ix. Capital spares will be purchased with the locomotive; and
   x. Spare locomotives will be purchase for maintenance scheduling.
2. 26.5TAL train simulation (QRN line):
   i. GT42CU AC – Downer EDI Locomotive
   ii. Narrow Gauge;
   iii. 20 tonne axle load (120T);
   iv. 3300 GHP;
   v. Meets noise standards;
   vi. Includes in-cab signalling system;
   vii. Two driver crews;
   viii. Major overhaul on the locomotive will occur at 10 and 20 years;
   ix. Capital spares will be purchased with the locomotive;
   x. Spare wagons will be purchased for maintenance scheduling.

### 4.2.3. Wagon Component

With the aim of achieving valuable economies of scale, EWLP propose using a 40TAL wagon. This theoretical wagon will be based on the characteristics of wagons existing today.

A 26.5 tonne axle load wagon exists in Queensland today and several wagon configurations are in operation that were manufactured by QRN, Bradken and Chinese manufacturers. These are typically manufactured from chromium steel and do not include a lidded design.

A 32.5 tonne axle load wagon exists in USA today and is manufactured by FreightCar America. It has been manufactured from aluminium to reduce the tare weight of the wagon. There are many in operation today but none include a lidded design, other than Australian wheat wagons which have an automatic lid system.

By using the design characteristics of these wagons and extrapolating the optimal tare to payload ratio of lighter wagons that exist today, a tare weight of the theoretical 40TAL wagon can be determined. On this basis, and assuming a lidded design, a tare weight of 26tonne has been adopted for this analysis. We note that, changes in tare weight, as result of further design and manufacture of a 40TAL wagon would impact the preliminary modelling undertaken for this assessment and that further detail modelling be undertaken at a later stage to test the following assumptions. The assumptions for the wagon characteristics include:

1. 40 tonne axle load – 160 tonne gross
   i. 26 tonne tare weight
   ii. 2 tonne short loading
   iii. Payload per wagon is 132T
   iv. Lidded wagon (no loss of coal between mine and port)
   v. 19.3m length
   vi. Major overhaul on the wagon will occur at 15 years
   vii. Capital spares will be purchased with the wagons
2. 32.5 tonne axle load – 130 tonne gross
   i. 20.5 tonne tare weight
   ii. 2 tonne short loading
   iii. Payload per wagon is 107.5T for GICP and 105.5T for other proponents
   iv. Lidded wagon for GICP and unlidded wagon for other proponents (unlidded wagon losses 2T of coal per journey from mine to port)
   v. 17.3m length
   vi. Major overhaul on the wagon will occur at 15 years
   vii. Capital spares will be purchased with the wagon
3. 26.5 tonne axle load – 106 tonne gross
   i. 19.4 tonne tare weight
   ii. 2 tonne short loading
   iii. Payload per wagon is 84.6T for GICP and 82.6T for other proponents
   iv. Lidded wagon for GICP and unlidded wagon for other proponents (unlidded wagon losses 2T of coal per journey from mine to port)
   v. 17.3m length
   vi. Major overhaul on the wagon will occur at 15 years
   vii. Spares will be purchased with the wagon

### 4.2.4. Maintenance Component

Key elements of the operational cost of the rolling stock are the maintenance of the locomotive and wagons. It is assumed that a 3rd party will provide the maintenance for the rolling stock at a facility owned by the 3$^{rd}$ party provider. The maintenance cost allows for the labour and material costs for all the scheduled services, unscheduled services, wheel turning and component change out on the locomotives and wagons. An additional cost has been included into the model to cover a charge for the maintenance facility that would include the building, track infrastructure to the site, utilities on the site and site management.

1. Locomotive Maintenance
   i. Schedule services (engine oil, air filters, fuel filters, oil filters, O-rings, fire extinguishers, brake blocks, flange lubricators, compressor oil, gear case oil, air compressor gaskets, dampers etc.);
   ii. Unscheduled services (component failures, collision repairs);
   iii. Wheel turning; and
   iv. Component change out (engine, alternator, traction motors, compressors, couplers, draft gear etc.).
2. Wagon Maintenance
   i. Schedule services (door inspections, brakes);
   ii. Unscheduled services (component failures, collision repairs);
   iii. Wheel turning; and
   iv. Component change out (brake valves, couplers, draft gear etc.).

### 4.2.5. Operations Component

Loading and unloading times become less significant as the travel times increase. For the Galilee mines, the mines to port distances travelled are large (approximately 500kms each way) for most mines. The assumption is that it takes approximately 1 minute to load each wagon and 1 min to unload each wagon. Therefore a 300 wagon train will take 5 hours to load and 5 hours to unload the entire train.

The provisioning of the trains is expected to occur at the mine site. An allowance of 2 hours per train has been made for fuel the locomotives and conducting the pre departure inspection of the train.

The operations of the railway are critical to overall efficiency. It has been assumed that the train will operate 320 days per year which allows for 45 days down time as listed below:

- 20 days – track/mine/port maintenance shutdowns;
- 15 days – unplanned network delays; and
- 10 days – rolling stock reliability issues that cause delays on the network.

Note: Maintenance of the rolling stock will be managed by the fact that there is 10% spare capacity for the locomotives in the fleet and 5% spare capacity for the wagons in the fleet. There is an allowance for capital spare parts to the value of 2% of the price of the locomotives and the wagons.

Another 8% allowance has been made when calculating the million tonnes per annum per train for the delays for the trains when they sit in passing loops, additional delays at the unloader and mines for loading.

### 4.2.6. Above Rail Capital & Operational Price Component

Prices for the rolling stock and prices for operations are based on 2012 market prices. Quotations have not been obtained specifically for the purpose of this assessment. The price list is developed from knowledge for contract prices for the listed rolling stock and associated operations for other clients in 2012, see appendix 8.

## 4.3. COMPARISON OF ALTERNATIVE RAILWAY SYSTEMS FOR GICP (40TAL VS. 32.5TAL VS. 26.5TAL)

In addition to providing inputs into the economic modelling, EIG was asked by EWLP to undertake a high level assessment of the efficiency of different axle loadings for the proposed GICP system using the same Train System Model developed for comparing the GICP with GVK and QRN operating systems.

The Train System model is based on the results for Calibre's train simulations. The Train System Model compared the three alternative GICP railway systems by calculating the annual haulage cost comparison, based on:

- The payload per train per year, and;
- The annual haulage cost;
- Fuel cost per year on a mine by mine basis;
- Rolling stock capital cost (locomotives, wagons, capital spares, overhauls); and
- Rolling stock operational cost (fuel, maintenance, labour).

The following assumed train configurations were used in the assessment of GICP 40TAL vs GICP 32.5TAL vs GICP 26.5TAL.

| Infrastructure | Train Configuration | Locomotives | Wagon Tare Mass | Train Payload |
|---|---|---|---|---|
| 40TAL | 3 Locos * 270 Wagons | ES44ACi | 26T | 35,640(*) |
| 32.5TAL | 3 Locos * 300 Wagons | ES44Aci | 20.7T | 32,190(**) |
| 26.5TAL | 4 Locos * 300 Wagons | GT42CU AC | 19.4T | 25,380(***) |

Note: (*) :(160 -26 – 2) * 270 = 35,640, (**) : (130 -20.7 – 2) * 300 = 32,190, (***) : (106 -19.4 – 2) * 300 = 25,380

The Train System Model also included assumptions for capital costs (rolling stock, etc.) and operating costs (fuel, maintenance, labour, etc.).

Overall, the results, as shown in Appendix 7(A), indicated that there were potential advantages of the 40TAL over other TAL alternatives and, for the purposes of further modelling of the GICP systems and for input into the economic modelling, 40TAL has been used to represent the GICP railway system.

## 4.4. ABOVE RAIL COMPARABLE COST ASSESSMENT

The above rail cost assessment, as used in the economic modelling, was based on estimated operating and performance data for GICP(40TAL), GVK(32.5TAL) and QRN(26.5TAL).

The Calibre train simulation determined the most optimal train for each railway system. EIG notes that these simulations included a 9% lidded wagon fuel saving on all loaded and empty runs for GICP only. The addition of the lidded design not only incurred a fuel saving, but also limited the loss of coal during the loaded trip supported the assumed payload loss reduced to only 2T to account for loading inaccuracies.

The following assumed train configurations were used in the assessment of GICP 40TAL vs GVK 32.5TAL vs QRN 26.5TAL.

| Infrastructure | Train Configuration | Locomotives | Wagon Tare Mass | Train Payload |
|---|---|---|---|---|
| GICP 40TAL | 3 Locos * 270 Wagons | ES44ACi | 26T | 35,640(*) |
| GVK 32.5TAL | 3 Locos * 240 Wagons | ES44Aci | 20.7T | 25,320(**) |
| QRN 26.5TAL | 4 Locos * 120 Wagons | GT42CU AC | 19.4T | 9,912(***) |

Note: (*) :(160 -26 – 2) * 270 = 35,640, (**) : (130 -20.7 – 2 - 2) * 240 = 25,320, , (***) : (106 -19.4 – 2 - 2) * 120 = 9,912

The number of operational days for GICP is 320 days as defined in Section 4.2.5. However for the GVK and the QRN Corridors the operational days has been reduced by 10 days per year as the alignments for both of these railway systems are across flood plains and therefore will suffer operational delays due to heavy rainfalls periodically.

Based on the results for the Calibre train simulations, the Train System Model developed by EIG was used to prepare inputs for the economic modelling. Outputs from the Train System Model are included in Appendix 7B.

In all cases:

- The key outputs are expressed as:
  - (a) the payload per train per year, and;
  - (b) the fuel cost per year on a mine by mine basis .
- Payload and fuel cost differences are due to the varying distances from the mines to the port;
- The model includes spur lines;
- Rolling Stock Capital Cost (locomotives, wagons, capital spares, overhauls) are included; and
- Rolling Stock Operational Cost (fuel, maintenance, labour) is included.

### 4.4.1. GICP – Option 1 (40TAL)

The outputs from the simulation of a 3 locomotive by 270 wagons train are summarised in the table below. The length of the train is approximately 5.3kms.

**Assumptions - Simulation Outputs**

Train Configuration - 3 Locomotives * 270 Wagons

Operational Days per Year - 320 (20 - Track/Mine/Port Maint, 15 - network inefficiencies, 10 - rollingstock reli

Loading Time - 4.5 Hours

Unloading Time - 4.5 Hours

| | Hours | Distance | Fuel | Fuel Savings | Energy (GJ) |
|---|---|---|---|---|---|
| Loading/Unloading | | | 2932.5 | | |
| Empty Trip | 7.75 | 573 | 17383 | 0.09 | 345.74 |
| Loaded Trip | 11.3 | 573 | 23846 | 0.09 | 447.17 |

| Mine Name (Abbr) | Mine Name | Mainline (kms) | Spurline (Kms) | Trip Distance | Loaded Trip | Unloaded Trip | Transit Time | Provisioning | Marshalling / Crew | Fuel / Trip |
|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | AMCI | 573 | 65 | 1276 | 12.48 | 8.45 | 20.93 | 2 | 5 | 44147 |
| Waratah CFC | Waratah - China First Coal | 573 | 21 | 1188 | 11.61 | 7.85 | 19.47 | 2 | 5 | 41266 |
| Waratah ANC | Waratah - Alpha North Coal | 530 | 10 | 1080 | 10.48 | 7.01 | 17.50 | 2 | 4.5 | 37381 |
| Waratah AWC | Waratah - Alpha West Coal | 523 | 27 | 1100 | 10.73 | 7.29 | 18.02 | 2 | 4.5 | 38411 |
| HanGVK KC | Hancock/GVK - Kevin's Corner | 548 | 15 | 1126 | 11.02 | 7.48 | 18.50 | 2 | 5 | 39354 |
| HanGVK AC | Hancock/GVK - Alpha Coal | 553 | 21 | 1148 | 11.24 | 7.61 | 18.85 | 2 | 5 | 40048 |
| HanGVK AW | Hancock/GVK - Alpha West | 553 | 28 | 1162 | 11.36 | 7.71 | 19.07 | 2 | 5 | 40492 |
| Vale | Vale | 497 | 10 | 1014 | 9.97 | 6.84 | 16.81 | 2 | 4.5 | 36043 |
| Adani 1 | Adani 1 (T0) | 430 | 10 | 880 | 9.03 | 6.12 | 15.15 | 2 | 4 | 32755 |
| Adani 2 | Adani 2 (Balance) | 430 | 10 | 880 | 9.03 | 6.12 | 15.15 | 2 | 4 | 32755 |
| Bowen 1 | Bowen 1 | 235 | 10 | 490 | 5 | 3.57 | 8.57 | 2 | 2.5 | 19821 |
| Mac Sth | Macmines South | 398 | 25 | 846 | 8.36 | 5.72 | 14.08 | 2 | 4 | 30660 |

The key outputs, as listed in the table below, include (a) the payload per train / year, and (b) fuel cost / year for each of the mines.

| | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match T0 | Adani 2 - rest of Adani | Bowen 1 | Mac mines South |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Payload / train / year (Mtpa)** | 6.82 | 7.10 | 7.63 | 7.51 | 7.30 | 7.22 | 7.18 | 7.79 | 8.35 | 8.35 | 11.41 | 8.66 |
| **Fuel $ / mine / train ($m)** | 10.14 | 9.87 | 9.60 | 9.71 | 9.67 | 9.74 | 9.79 | 9.45 | 9.21 | 9.21 | 7.62 | 8.94 |

### 4.4.2. QRN – 90Mtpa (26.5TAL)

The outputs from the simulation of a 4 locomotive by 120 wagons train are summarised in the table below. The length of the train is approximately 2.3kms.

**Assumptions - Simulation Outputs**

Train Configuration - 4 Locomotives * 120 Wagons

Operational Days per Year - 310 (20 - Track/Mine/Port Maint, 15 - network inefficiencies, 10 - rollingstock reli

Loading Time - 2 Hours

Unloading Time - 2 Hours

| | Hours | Distance | Fuel | Lidded Wagons Fuel Savings | Energy (GJ) |
|---|---|---|---|---|---|
| Loading/Unloading | | | 2932.5 | | |
| Empty Trip | 4.95 | 403 | 7395.4 | 0 | 188.189 |
| Loaded Trip | 6.2 | 403 | 8452.4 | 0 | 222.784 |

| Mine Name (Abbr) | Mine Name | Mainline (kms) | Spurline (Kms) | Trip Distance | Loaded Trip | Unloaded Trip | Transit Time | Provisioning | Marshalling / Crew | Fuel / Trip |
|---|---|---|---|---|---|---|---|---|---|---|
| Adani 1 | Adani 1 (T0) | 403 | 0 | 806 | 6.20 | 4.95 | 11.15 | 2 | 3 | 18780 |
| Adani 2 | Adani 2 (Balance) | 403 | 0 | 806 | 6.20 | 4.95 | 11.15 | 2 | 3 | 18780 |
| Mac Sth | Macmines South | 403 | 69 | 944 | 7.26 | 5.80 | 13.06 | 2 | 3 | 21494 |

The key outputs, as listed in the table below, include (a) the payload per train / year, and (b) fuel cost / year for each of the mines.

| | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match T0 | Adani 2 - rest of Adani | Bowen 1 | Mac mines South |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Payload / train / year (Mtpa)** | | | | | | | | | 3.36 | 3.36 | | 3.07 |
| **Fuel $ / mine / train ($m)** | | | | | | | | | 7.64 | 7.64 | | 7.99 |

### 4.4.3. GVK – 150Mtpa (32.5TAL)

The outputs from the simulation of a 3 locomotive by 300 wagons train are summarised in the table below. The length of the train is approximately 5.3kms.

| Assumptions - Simulation Outputs | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Train Configuration - 3 Locomotives * 240 Wagons | | | Operational Days per Year - 310 (20 - Track/Mine/Port Maint, 15 - network inefficiencies, 10 - rollingstock reli | | | | | | | |
| Loading Time - 3.5 Hours | | | | | | | | | | |
| Unloading Time - 3.5 Hours | | | | | | | | | | |
| | | | | | | Lidded Wagons | | | | |
| | | | Hours | Distance | Fuel | Fuel Savings | Energy (GJ) | | | |
| | Loading/Unloading | | | | 2737 | | | | | |
| | Empty Trip | | 6.15 | 507 | 13766 | 0 | 188.189 | | | |
| | Loaded Trip | | 8.45 | 507 | 16297 | 0 | 222.784 | | | |
| **Mine Name (Abbr)** | **Mine Name** | **Mainline (kms)** | **Spurline (Kms)** | **Trip Distance** | **Loaded Trip** | **Unloaded Trip** | **Transit Time** | **Provisioning** | **Marshalling / Crew** | **Fuel / Trip** |
| Waratah CFC | Waratah - China First Coal | 495 | 41 | 1072 | 8.92 | 6.49 | 15.41 | 2 | 4 | 34462 |
| Waratah ANC | Waratah - Alpha North Coal | 495 | 39 | 1068 | 8.88 | 6.47 | 15.35 | 2 | 4 | 34346 |
| HanGVK KC | Hancock/GVK - Kevin's Corner | 480 | 18 | 996 | 8.28 | 6.03 | 14.31 | 2 | 4 | 32209 |
| HanGVK AC | Hancock/GVK - Alpha Coal | 495 | 10 | 1010 | 8.41 | 6.12 | 14.54 | 2 | 4 | 32667 |
| HanGVK AW | Hancock/GVK - Alpha West | 480 | 28 | 1016 | 8.44 | 6.14 | 14.59 | 2 | 4 | 32771 |
| Vale | Vale | 495 | 74 | 1138 | 9.45 | 6.88 | 16.33 | 2 | 4 | 36372 |

The key outputs, as listed in the table below, include (a) the payload per train / year, and (b) fuel cost / year for each of the mines.

| | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match T0 | Adani 2 - rest of Adani | Bowen 1 | Mac mines South |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Payload / train / year (Mtpa)** | | 6.10 | 6.11 | 6.34 | 6.29 | 6.28 | 5.91 | 6.10 | | | | |
| **Fuel $ / mine / train ($m)** | | 9.96 | 9.95 | 9.68 | 9.74 | 9.75 | 10.19 | 9.96 | | | | |

## 4.5. PASSING LOOPS

The passing loop calculation for each of the lines is an input into the below rail infrastructure model so as to determine when the passing loops are added to the rail system and when the rail system requires the line to be duplicated to carry additional tonnage.

### 4.5.1. GICP Passing Loops

In terms of the GICP network, and based on a 35 hour cycle time, upon expanding to 20 trains (approx. 140 to 150Mtpa) the headway time between trains in both directions is reduced to 1.75 hours. Passing loop length is based on the length on the train (I.e. for GICP 3 loco and 270 wagons), a theoretical stopping distance (1/2 the length of the train when using Electronic Pneumatic Controlled Breaking and an allocation for float (length of train x 10%). Summing up, the length of train is estimated to be approximately 5300m, the stopping distance 2700m and float of 530m. A total length of each passing loop for GICP is approximately 8.5km.

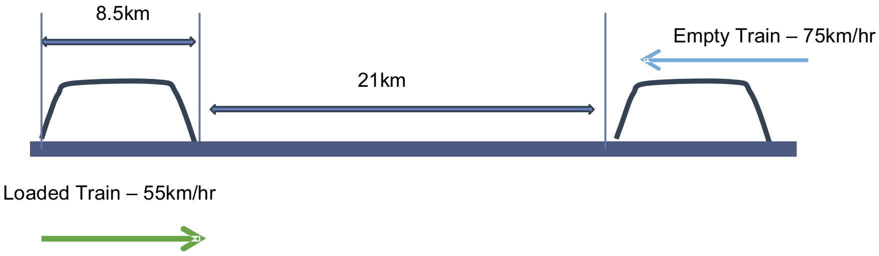
The passing loop calculation is thus:

1. Headway (at 20 trains) = 1.75 hours;
2. Passing loop length = 8.5km;
3. Total length of passing loops (at 20 trains) is 20 * 8.5kms = 170 kms;
4. GICP single line is 577km – 170km = 407 km;
5. Distance between adjacent passing loops is 407/20 = approx. 21 kms;
6. Loaded train typical average speed is 55km/hr;
7. Empty train typical loaded speed is 75km/hr;
8. Time for loaded train to travel 29.5km (21 + 8.5) at 55 km/hr is = 33 mins.
9. Time for empty train to travel 29.5km (21 + 8.5) at 75 km/hr is = 24 mins.

*Note(1): an allowance needs to be made for accelerating the train from the passing loop and braking into the next passing loop. An allowance of 50% of the travel time for the braking and acceleration of the train will be included.*

10. Time for empty train to accelerate, travel 29.5km (21 + 8.5) and brake at 75 km/hr is = 24 mins * 150% = 36mins.

Therefore the spare time after both trains have moved between adjacent passing loops is 105 mins – 33 mins – 36 mins = 36 mins. The spare time percentage of the headway time is 36/105 = 34%.




A new passing loop is added for every additional train on the network until the network reaches a point that the headway is reduced 1.75 hours.

*Note(2): At 140Mtpa to 150Mtpa the GICP will require duplication of the line between adjacent passing loops for each additional train added to the railway system.*

### 4.5.2. QRN Passing Loops

In terms of the QRN network (for both the QRN – 90Mtpa & 60Mtpa), the associated QRN train and based on a 20 hour cycle time, upon expanding to 14 trains (43 Mtpa) the headway time between trains in both directions is reduced to 1.45 hours. Passing loop length is based on the length on the train (I.e. for QRN 4 loco and 120 wagons), a theoretical stopping distance (1/2 the length of the train when using Electronic Pneumatic Controlled Breaking and an allocation for float (length of train x 10%). Summing up, the length of train is estimated to be approximately 2200m, the stopping distance 1100m and float of 220m. A total length of each passing loop for QRN is approximately 3.5km.

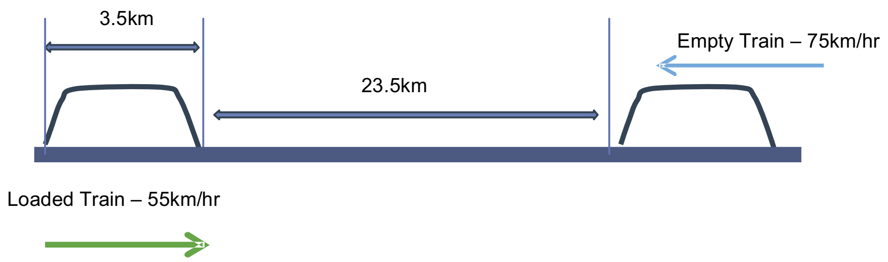
The passing loop calculation is thus:

1. Headway (at 20 trains) = 1.45 hours;
2. Passing loop length = 3.5km
3. Total length of passing loops (at 14 trains) is 14 * 3.5kms = 49 kms;
4. QRN single line is (174km East/West + 205km North/South ) is 380km – 49km = 331 kms
5. Distance between adjacent passing loops is 331/14 = 23.5 kms;
6. Loaded train typical average speed is 55km/hr;
7. Empty train typical loaded speed is 75km/hr;
8. Time for loaded train to travel 27km (23.5 + 3.5) at 55 km/hr is = 29mins;
9. Time for empty train to travel 27km (23.5 + 3.5) at 75 km/hr is = 22mins.

*Note(1): an allowance needs to be made for accelerating the train from the passing loop and braking into the next passing loop. An allowance of 50% of the travel time for the braking and acceleration of the train will be included.*

10. Time for empty train to accelerate, travel 27km (23.5 + 3.5) and brake at 75 km/hr is = 22 mins * 150% = 33mins.

Therefore the spare time after both trains have moved between adjacent passing loops is 87 mins – 29 mins – 33 mins = 25 mins. The spare time percentage of the headway time is 25/87 = approx. 30%.




A new passing loop is added for every additional train on the network until the network reaches a point that the headway is reduced 1.45 hours.

*Note(2): At 45Mtpa the QRN Corridor will require duplication of the line between adjacent passing loops for each additional train added to the railway system.*

*NOTE(3): The 205km North/South portion of the QRN line is using the existing QRN line that links Moranbah with Abbot Point. For the purpose of evaluating cost estimates for the below rail capital cost, it is assumed that passing loops are split evenly between the East/West and North/South portions. At the 45Mtpa trigger point, a major investment is required to enhance the capacity of the North/South portion. This could be by the construction of a brownfield line within the existing corridor or by the construction of a greenfield line along another alignment. The greenfield alignment option was used in the analysis as the cost for zone 1 had already been assessed.*

### 4.5.3. GVK Passing Loops

In terms of the GVK network (for both the GVK – 150Mtpa & 60Mtpa), the associated GVK train and based on a 28 hour cycle time, upon expanding to 16 trains (90 Mtpa) the headway time between trains in both directions is reduced to 1.75

hours. Passing loop length is based on the length on the train (I.e. for GVK 3 loco and 240 wagons), a theoretical stopping distance (1/2 the length of the train when using Electronic Pneumatic Controlled Breaking and an allocation for float (length of train x 10%). Summing up, the length of train is estimated to be approximately 5300m, the stopping distance 2700m and float of 530m. A total length of each passing loop for GVK is approximately 8.5km.

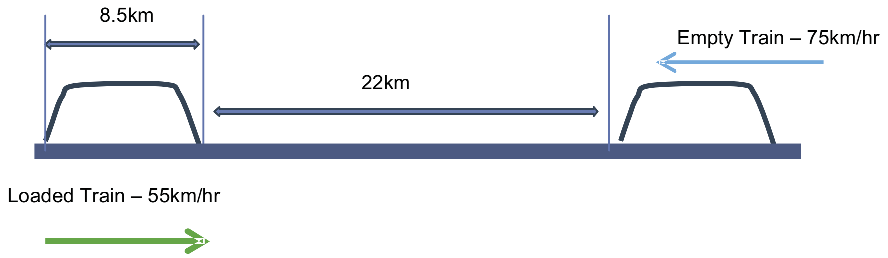
The passing loop calculation is thus:

1. Headway (at 16 trains) = 1.75 hours;
2. Passing loop length = 8.5km;
3. Total length of passing loops (at 16 trains) is 16 * 8.5kms = 136 kms;
4. GICP single line is 485km – 136km = 349 km;
5. Distance between adjacent passing loops is 349/16 = approx. 22 kms;
6. Loaded train typical average speed is 55km/hr;
7. Empty train typical loaded speed is 75km/hr;
8. Time for loaded train to travel 30.5km (22 + 8.5) at 55 km/hr is = 33 mins.
9. Time for empty train to travel 30.5km (22 + 8.5) at 75 km/hr is = 24 mins.

*Note(1): an allowance needs to be made for accelerating the train from the passing loop and braking into the next passing loop. An allowance of 50% of the travel time for the braking and acceleration of the train will be included.*

10. Time for empty train to accelerate, travel 30.5km (22 + 8.5) and brake at 75 km/hr is = 24 mins * 150% = 36mins.

Therefore the spare time after both trains have moved between adjacent passing loops is 105 mins – 33 mins – 36 mins = 36 mins. The spare time percentage of the headway time is 36/105 = approx. 34%.




A new passing loop is added for every additional train on the network until the network reaches a point that the headway is reduced 1.75 hours.

*Note(2): At 90Mtpa the GVK Corridor will require duplication of the line between adjacent passing loops for each additional train added to the railway system.*

# 5. PRELIMINARY OBSERVATIONS

## 5.1. BELOW RAIL COMPARATIVE COST OBSERVATIONS

The following observations were noted from the below rail capital cost assessment:

- The GICP corridor alignment, in *GICP–240Mtpa–Option 1* and *GICP–120Mtpa–Option 2,* has a cost advantage over the alignments assumed for the GVK and QRN corridors as the GICP alignment has:
  - A better cut to fill balance of earthworks across the entire length of the GICP line, resulting in a reduced need to import large quantities of fill material;
  - Less corridor in heavily flood affected areas, resulting in reduced allowances for bridges and culverts;
  - Lower impact on agricultural land, resulting in lower land acquisition costs; and
  - Greater certainty of delivery as the GICP corridor would have a lower exposure to potential delays due to flooding during construction.
- The GICP track, assumed in *GICP–240Mtpa–Option 1* and *GICP–120Mtpa–Option 2,* has a cost disadvantage over the track assumed for the GVK and QRN corridors as the GICP track is:
  - Longer as it services the entire Galilee Basin whereas the assumed GVK and QRN corridors only partially service the mines in the Galilee Basin;
  - Heavier as the 40TAL standard gauge in *GICP–120Mtpa–Option 2* (and partial dual gauge in *GICP–240Mtpa–Option 1)*, is expected to be more costly than the GVK, using 32.5TAL standard gauge and the QRN 26.5TAL narrow gauge line. The quantum of the track cost differences is difficult to assess, as there are no directly comparable 40TAL lines.

## 5.2. BELOW RAIL MAINTENANCE COMPARATIVE COST OBSERVATIONS

The following observations were noted from the below rail maintenance cost assessment:

- The assumed GICP track, at 40TAL, with the anticipated loads, is expected to require higher maintenance effort than other existing rail networks in Australia. It has been assumed that the maintenance costs for the assumed GICP track will be higher on a per kilometre basis than the assumed GVK 32.5TAL and QRN26.5TAL.

## 5.3. ABOVE RAIL MAINTENANCE COMPARATIVE COST OBSERVATIONS

The following observations were noted from the above rail maintenance cost assessment:

- The GICP above rail operations are likely to have an operating cost advantage over the assumed GVK and QRN operations due to:
  - Requiring fewer trains, with each GICP train carrying a greater load (assumed GICP - 35,000 tonnes per train, GVK - 25,000 tonnes and QRN - 10,000 tonnes); and
  - A lower average fuel consumption/tonne carried, including potential efficiencies gained from using wagons with lids.

# 6. FURTHER ASSESSMENT

It is anticipated that further definition would increase the level of project definition and improve the accuracy of the cost estimates for both above and below rail components, including, but not limited to:

- Optimisation of a standard heavy haul 40TAL standard gauge profile;
- Balancing of the vertical alignment and the ruling grade constraints to minimise earthworks material haulage and project costs;
- Selection of horizontal rail alignment to minimise costs and to satisfy mine owners;
- Minimising size of structures and drainage through floodplain areas;
- Improving feasibility of new 40TAL coal wagon technical performance specifications; and
- Modelling detailed train system operations.

East West Line Parks Limited

Galilee Infrastructure Corridor Project

# Above and below rail comparative cost estimates

## Appendices – Part A

July 2012

# Appendix 1 Alignments & Staging Diagrams

The following scope diagrams are based on information supplied by EWLP with the GIC alignment split into a series of zones. Each zone is identified with a zone marker and labelled as "Zone #". The red diamonds indicate the zone interface with other zones and/or interface with a mine spur line.

The scope diagrams have been shown in parts to reflect the comparisons being undertaken in the economic modelling:

- Part A – Base case below rail staging for **GIC Option 1** (operating at 240Mtpa) (**Map 1**)
- Part B - Comparison 1, Base case versus **GVK** operating at **150**Mtpa (**Map 2**) and **QRN** operating at **90**Mtpa (**Map 3**)
- Part C – Comparison 2 Base case versus **GIC Option 2** (operating at 120Mtpa) (**Map 4**) and **GVK only** operating at **60**Mtpa (**Map 5**) and **QRN** only operating at **60**Mtpa (**Map 6**)

***Appendix 1 – Part A***

***Map 1 : GIC - Option 1***

GIC Zone 1 alignment:

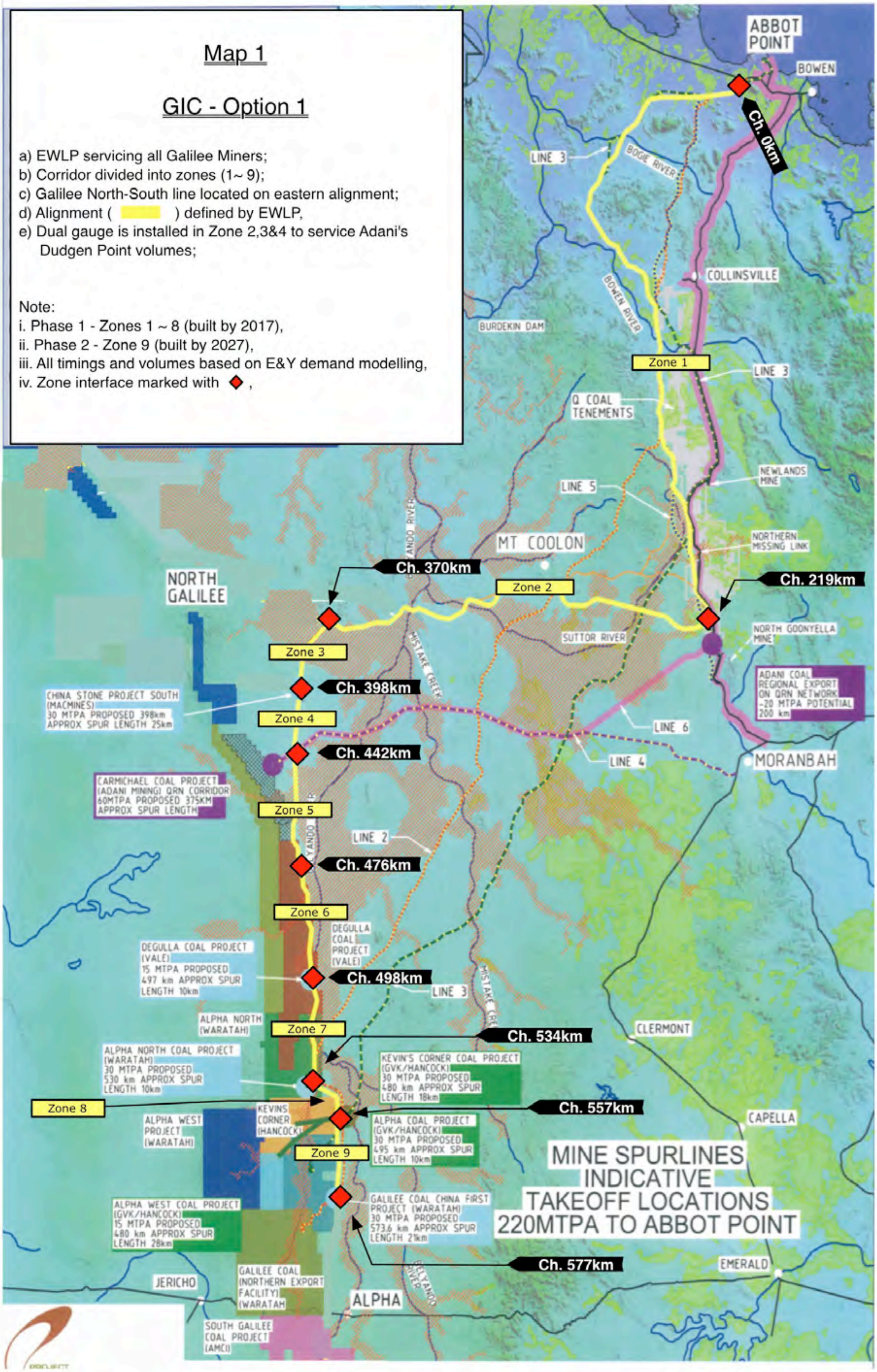
- Commences at chainage 00, located about 25 km from Abbot Point port;
- Heads west/south west 55km from Abbot Point and avoids several of the large hills associated with the Clarke Range, sticking mainly to the flat/hilly areas and heading towards the Bowie River; and
- At this point the lines heads in a southerly direction, adjacent to the Bowie River for 50km before turning due south moving through the low hills of the Leichardt range and then south towards North Goonyella.

GIC Zone 2 alignment

- Continues due west, crossing small sections of flood prone areas;
- Traverses along the edge of the large flood plains associated with Suttor River; and
- Crossing the Suttor river at Ch.315km mark, the line moves slightly south into a west south western direction for another 60km, passing north of the Nairana National Park.

GIC Zone 3 to 9 alignment

- Turning due south and running along the eastern alignment of several coal tenements (notably Adani Carmichael and Vale Degulla Coal Projects) sticking to high ground where possible adjacent to low areas;
- Note: Initially the alignment, for Zones 3 ~ 7, were located along the western perimeters of the Adani Carmichael Coal Project, the Waratah Carmichael East Project, the Vale Degulla Coal Project and through the Waratah Alpha North Coal Project tenements. On the 18th of June the alignment of these zones were adjusted to the Eastern perimeters of these tenements; and
- Continuing south into the Barcaldine Regional Council areas, the line passes adjacent to Hancock/GVK Kevin's Corner staying out of the flood areas and adjacent to Clermont Alpha Road towards Alpha.


Map 1
GIC - Option 1
a) EWLP servicing all Galilee Miners;
b) Corridor divided into zones (1~ 9);
c) Galilee North-South line located on eastern alignment;
d) Alignment ( ) defined by EWLP,
e) Dual gauge is installed in Zone 2,3&4 to service Adani's Dudgen Point volumes;
Note:
i. Phase 1 - Zones 1 ~ 8 (built by 2017),
ii. Phase 2 - Zone 9 (built by 2027),
iii. All timings and volumes based on E&Y demand modelling,
iv. Zone interface marked with ◆ ,
ABBOT POINT
BOWEN
Ch. 0km
LINE 3
BOGIE RIVER
COLLINSVILLE
BOWEN RIVER
BURDEKIN DAM
Zone 1
LINE 3
Q COAL TENEMENTS
NEWLANDS MINE
LINE 5
MT COOLON
NORTHERN MISSING LINK
Ch. 370km
Ch. 219km
NORTH GALILEE
Zone 2
Zone 3
SUTTOR RIVER
NORTH GOONYELLA MINE
ADANI COAL REGIONAL EXPORT ON QRN NETWORK ~20 MTPA POTENTIAL 200 km
Ch. 398km
CHINA STONE PROJECT SOUTH (MACMINES) 30 MTPA PROPOSED 398km APPROX SPUR LENGTH 25km
MISTAKE CREEK
Zone 4
LINE 6
Ch. 442km
LINE 4
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING) QRN CORRIDOR 60MTPA PROPOSED 375KM APPROX SPUR LENGTH
Zone 5
LINE 2
Ch. 476km
Zone 6
DEGULLA COAL PROJECT (VALE)
DEGULLA COAL PROJECT (VALE) 15 MTPA PROPOSED 497 km APPROX SPUR LENGTH 10km
Ch. 498km
LINE 3
ALPHA NORTH (WARATAH)
Zone 7
Ch. 534km
CLERMONT
ALPHA NORTH COAL PROJECT (WARATAH) 30 MTPA PROPOSED 530 km APPROX SPUR LENGTH 10km
KEVIN'S CORNER COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 480 km APPROX SPUR LENGTH 18km
Zone 8
KEVINS CORNER (HANCOCK)
Ch. 557km
ALPHA WEST PROJECT (WARATAH)
ALPHA COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 495 km APPROX SPUR LENGTH 10km
CAPELLA
Zone 9
MINE SPURLINES INDICATIVE TAKEOFF LOCATIONS 220MTPA TO ABBOT POINT
ALPHA WEST COAL PROJECT (GVK/HANCOCK) 15 MTPA PROPOSED 480 km APPROX SPUR LENGTH 28km
GALILEE COAL CHINA FIRST PROJECT (WARATAH) 30 MTPA PROPOSED 573.6 km APPROX SPUR LENGTH 21km
Ch. 577km
EMERALD
JERICHO
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
ALPHA
SOUTH GALILEE COAL PROJECT (AMCI)

## *Appendix 1 – Part B*

***Map 2 : GVK – 150Mtpa***

GVK mainline alignment.

- Commences at chainage 00km, located at Abbot Point port;
- Heads directly west/south west 55km rom Abbot Point and avoids several of the large hills associated with the Clarke Range, sticking mainly to the flat/hilly areas and heading towards the Bowie River;
- At this point the lines heads in a southerly direction, adjacent to the Bowie River for 60km before turning due south and joining the Collinsville Newlands Branch corridor; and
- Leaving the corridor before striking Newlands, the GVK line heads in a south-westerly direction for the remainder of the line. This remaining portion of the line (250km) crosses large sections of flood prone areas in both the Whitsundays and Isaac Regional Council areas.

GVK Zones 7 to 9

- For the purposes of the direct comparison with the GIC, it was assumed that GVK would connect to other the South Galilee local miners in a similar alignment to that used for the GIC alignment. These lines have been identified on this map as Zone 7, 8 & 9.

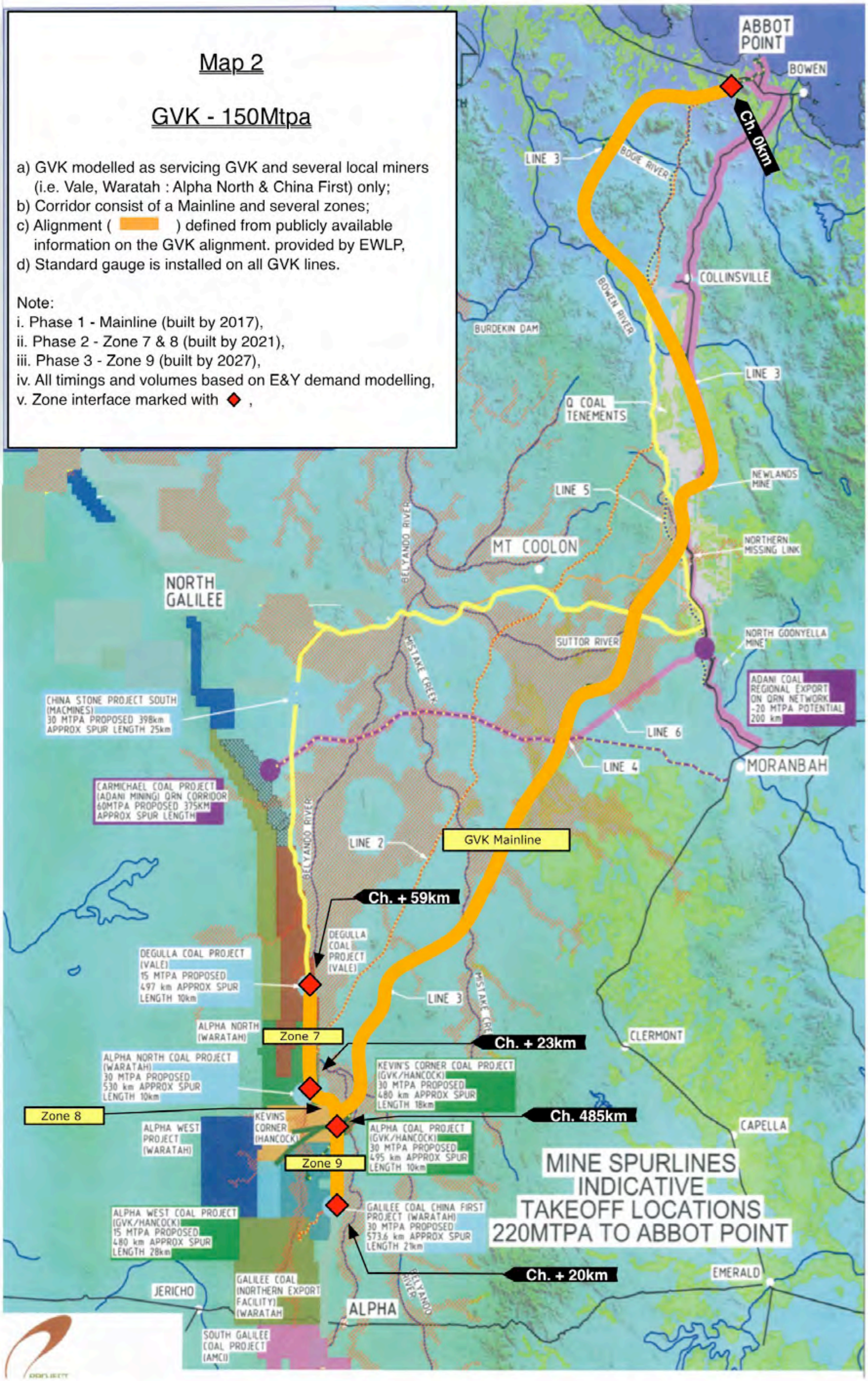
***Map 3 : QRN – 90Mtpa***

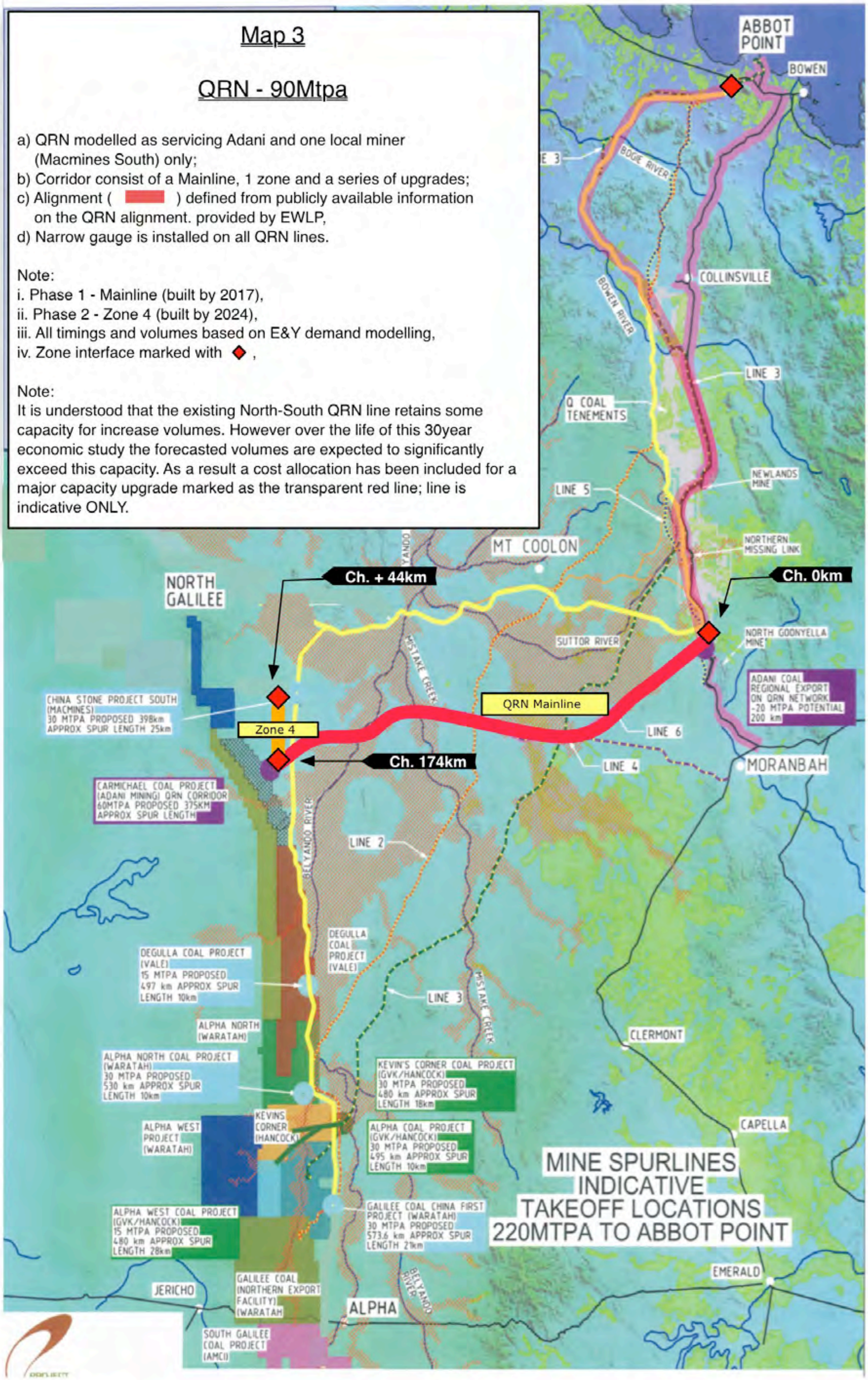
QRN mainline alignment

- Commences at chainage 00km, located at a junction into the existing QRN network at North Goonyella (about 9km south of the GIC Zone 1 / 2 interface) or roughly 40km north of Moranbah;
- Hravels from this junction 55km, crossing floodplain areas, in a south-westerly direction, at which point the line heads west for another 65km;
- At just south of the Nairana National Park the line turns further south for another 64km and arrives at the Adani Carmichael Coal Project. Overall the 174km line crosses almost 100km of flood exposed areas within the Isaac Regional Council catchment; and
- The transparent red line is an indicative line highlighting the capacity constraint and additional work required by QRN to service the full Adani and Macmines South throughput. QRN has stated, (in the Central Queensland Integrated Rail Project – Terms of Reference – EIS, page 8) that upgrades will be required at the Leichardt Range, Collinsville, Briaba, and and Aberdeen in order to accommodate the increased throughput. It is believed that considering the costs associated with this work, there is room for QRN to consider alternate corridors for the North-South Goonyella to Abbott Point corridors.

QRN Zone 4

- It was assumed that QRN would also carry freight from local North Galilee miners. A cost was apportioned to achieve an apples-for-apples comparison with the GIC (serving all miners) options. On this basis we adopted the GIC alignment costs to reach the node point associated with Macmines South.


Map 2
GVK - 150Mtpa
a) GVK modelled as servicing GVK and several local miners (i.e. Vale, Waratah : Alpha North & China First) only;
b) Corridor consist of a Mainline and several zones;
c) Alignment ( ) defined from publicly available information on the GVK alignment. provided by EWLP,
d) Standard gauge is installed on all GVK lines.
Note:
i. Phase 1 - Mainline (built by 2017),
ii. Phase 2 - Zone 7 & 8 (built by 2021),
iii. Phase 3 - Zone 9 (built by 2027),
iv. All timings and volumes based on E&Y demand modelling,
v. Zone interface marked with ,
ABBOT POINT
BOWEN
Ch. 0km
LINE 3
BOGIE RIVER
COLLINSVILLE
BOWEN RIVER
BURDEKIN DAM
LINE 3
Q COAL TENEMENTS
NEWLANDS MINE
LINE 5
MT COOLON
NORTHERN MISSING LINK
NORTH GALILEE
BELYANDO RIVER
SUTTOR RIVER
NORTH GOONYELLA MINE
ADANI COAL REGIONAL EXPORT ON QRN NETWORK -20 MTPA POTENTIAL 200 km
CHINA STONE PROJECT SOUTH (MACMINES) 30 MTPA PROPOSED 398km APPROX SPUR LENGTH 25km
MISTAKE CREEK
LINE 6
LINE 4
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING) QRN CORRIDOR 60MTPA PROPOSED 375KM APPROX SPUR LENGTH
LINE 2
GVK Mainline
Ch. + 59km
DEGULLA COAL PROJECT (VALE)
DEGULLA COAL PROJECT (VALE) 15 MTPA PROPOSED 497 km APPROX SPUR LENGTH 10km
LINE 3
ALPHA NORTH (WARATAH)
Zone 7
Ch. + 23km
CLERMONT
ALPHA NORTH COAL PROJECT (WARATAH) 30 MTPA PROPOSED 530 km APPROX SPUR LENGTH 10km
KEVIN'S CORNER COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 480 km APPROX SPUR LENGTH 18km
Zone 8
KEVINS CORNER (HANCOCK)
Ch. 485km
ALPHA WEST PROJECT (WARATAH)
ALPHA COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 495 km APPROX SPUR LENGTH 10km
CAPELLA
Zone 9
MINE SPURLINES INDICATIVE TAKEOFF LOCATIONS 220MTPA TO ABBOT POINT
ALPHA WEST COAL PROJECT (GVK/HANCOCK) 15 MTPA PROPOSED 480 km APPROX SPUR LENGTH 28km
GALILEE COAL CHINA FIRST PROJECT (WARATAH) 30 MTPA PROPOSED 573.6 km APPROX SPUR LENGTH 21km
Ch. + 20km
EMERALD
JERICHO
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
ALPHA
SOUTH GALILEE COAL PROJECT (AMCI)


Map 3
QRN - 90Mtpa
a) QRN modelled as servicing Adani and one local miner (Macmines South) only;
b) Corridor consist of a Mainline, 1 zone and a series of upgrades;
c) Alignment ( ) defined from publicly available information on the QRN alignment. provided by EWLP,
d) Narrow gauge is installed on all QRN lines.
Note:
i. Phase 1 - Mainline (built by 2017),
ii. Phase 2 - Zone 4 (built by 2024),
iii. All timings and volumes based on E&Y demand modelling,
iv. Zone interface marked with ◆ ,
Note:
It is understood that the existing North-South QRN line retains some capacity for increase volumes. However over the life of this 30year economic study the forecasted volumes are expected to significantly exceed this capacity. As a result a cost allocation has been included for a major capacity upgrade marked as the transparent red line; line is indicative ONLY.
ABBOT POINT
BOWEN
BOGIE RIVER
COLLINSVILLE
BOWEN RIVER
LINE 3
Q COAL TENEMENTS
NEWLANDS MINE
LINE 5
MT COOLON
NORTHERN MISSING LINK
NORTH GALILEE
Ch. + 44km
Ch. 0km
SUTTOR RIVER
NORTH GOONYELLA MINE
ADANI COAL REGIONAL EXPORT ON QRN NETWORK -20 MTPA POTENTIAL 200 km
CHINA STONE PROJECT SOUTH (MACMINES) 30 MTPA PROPOSED 398km APPROX SPUR LENGTH 25km
QRN Mainline
Zone 4
LINE 6
Ch. 174km
LINE 4
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING) QRN CORRIDOR 60MTPA PROPOSED 375KM APPROX SPUR LENGTH
LINE 2
BELYANDO RIVER
MISTAKE CREEK
DEGULLA COAL PROJECT (VALE) 15 MTPA PROPOSED 497 km APPROX SPUR LENGTH 10km
DEGULLA COAL PROJECT (VALE)
LINE 3
ALPHA NORTH (WARATAH)
CLERMONT
ALPHA NORTH COAL PROJECT (WARATAH) 30 MTPA PROPOSED 530 km APPROX SPUR LENGTH 10km
KEVIN'S CORNER COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 480 km APPROX SPUR LENGTH 18km
ALPHA WEST PROJECT (WARATAH)
KEVINS CORNER (HANCOCK)
ALPHA COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 495 km APPROX SPUR LENGTH 10km
CAPELLA
MINE SPURLINES INDICATIVE TAKEOFF LOCATIONS 220MTPA TO ABBOT POINT
ALPHA WEST COAL PROJECT (GVK/HANCOCK) 15 MTPA PROPOSED 480 km APPROX SPUR LENGTH 28km
GALILEE COAL CHINA FIRST PROJECT (WARATAH) 30 MTPA PROPOSED 573.6 km APPROX SPUR LENGTH 21km
EMERALD
JERICHO
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
ALPHA
SOUTH GALILEE COAL PROJECT (AMCI)

***Appendix 1 – Part C***

***Map 4 – GIC - Option 2***

GIC Zone 1 alignment:

- Along the same alignment as GIC – Option 1

GIC Zone 2 alignment

- Along the same alignment as GIC – Option 1

GIC Zone 3 to 9 alignment

- Along the same alignment as GIC – Option 1

**Note:** the phasing of the works commences at a later date than GIC – Option 1 and is delivered over a longer period of time to match with volumes coming available from Galilee south mines.

***Map 5 – GVK – 60Mtpa***

GVK mainline alignment.

- Along the same alignment as GVK – 150Mtpa

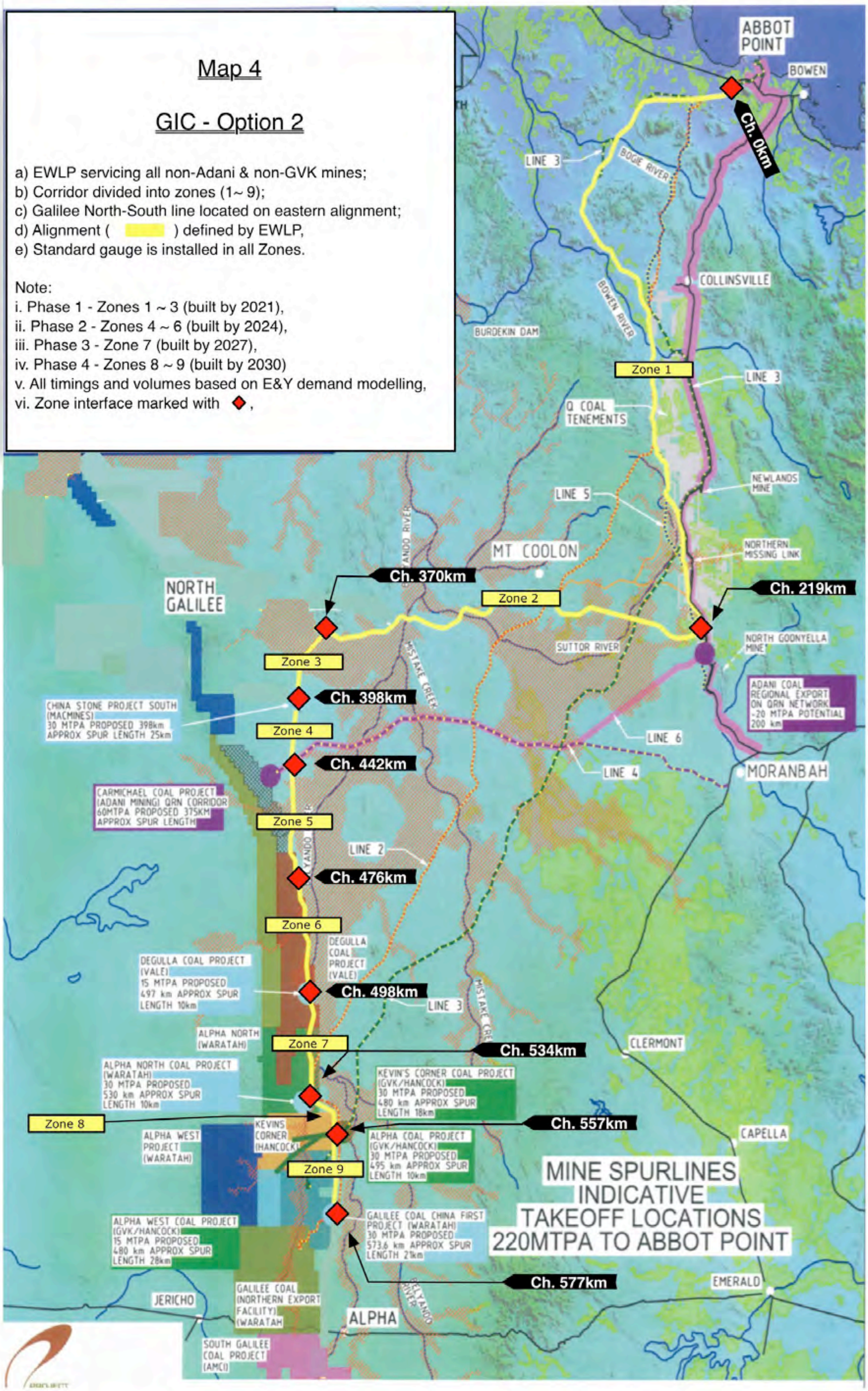
Note: In this comparison, GVK is servicing GVK mines only. As a result not additional zones are required.

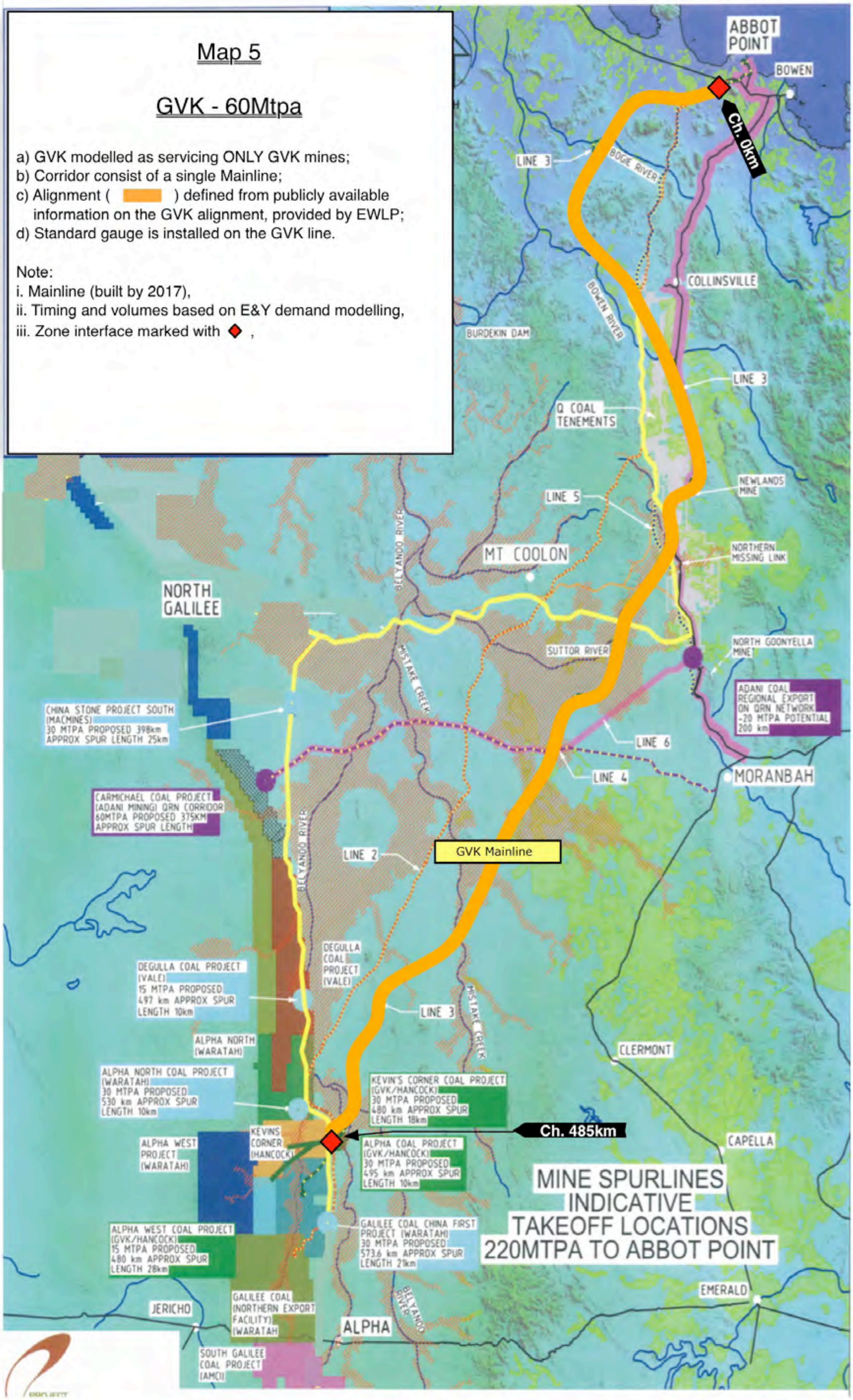
***Map 6 : QRN – 60Mtpa***

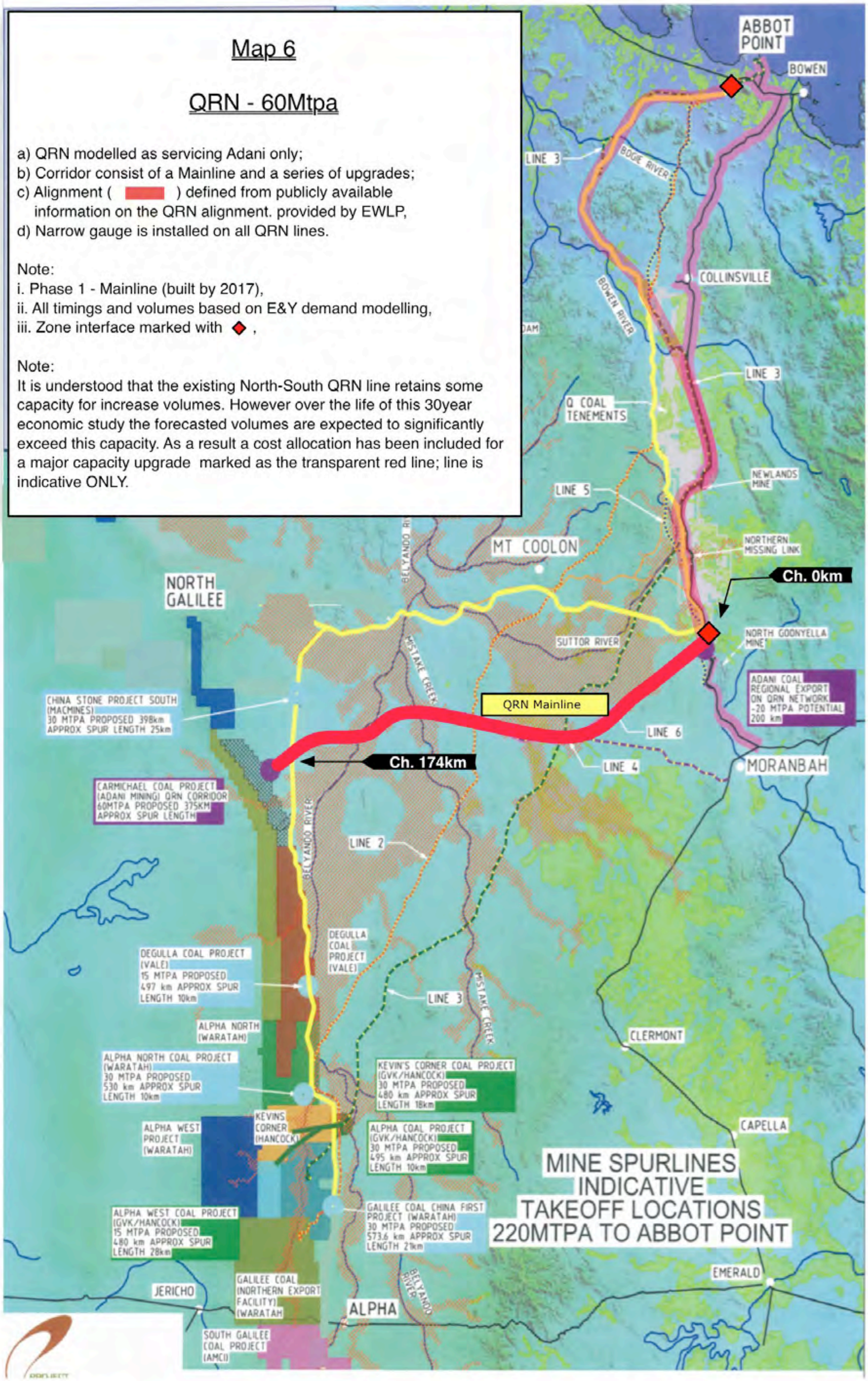
QRN mainline alignment

- Along the same alignment as QRN – 60Mtpa

Note: In this comparison, QRN is servicing the Adani Carmichael Coal Project only. As a result not additional zones are required.


Map 4
GIC - Option 2
a) EWLP servicing all non-Adani & non-GVK mines;
b) Corridor divided into zones (1~ 9);
c) Galilee North-South line located on eastern alignment;
d) Alignment ( ) defined by EWLP,
e) Standard gauge is installed in all Zones.
Note:
i. Phase 1 - Zones 1 ~ 3 (built by 2021),
ii. Phase 2 - Zones 4 ~ 6 (built by 2024),
iii. Phase 3 - Zone 7 (built by 2027),
iv. Phase 4 - Zones 8 ~ 9 (built by 2030)
v. All timings and volumes based on E&Y demand modelling,
vi. Zone interface marked with ,
ABBOT POINT
BOWEN
Ch. 0km
LINE 3
BOGIE RIVER
COLLINSVILLE
BOWEN RIVER
BURDEKIN DAM
Zone 1
LINE 3
Q COAL TENEMENTS
NEWLANDS MINE
LINE 5
MT COOLON
NORTHERN MISSING LINK
Ch. 370km
Ch. 219km
NORTH GALILEE
Zone 2
SUTTOR RIVER
NORTH GOONYELLA MINE
Zone 3
ADANI COAL REGIONAL EXPORT ON QRN NETWORK ~20 MTPA POTENTIAL 200 km
Ch. 398km
CHINA STONE PROJECT SOUTH (MACMINES) 30 MTPA PROPOSED 398km APPROX SPUR LENGTH 25km
Zone 4
LINE 6
Ch. 442km
LINE 4
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING) QRN CORRIDOR 60MTPA PROPOSED 375KM APPROX SPUR LENGTH
Zone 5
LINE 2
Ch. 476km
Zone 6
DEGULLA COAL PROJECT (VALE)
DEGULLA COAL PROJECT (VALE) 15 MTPA PROPOSED 497 km APPROX SPUR LENGTH 10km
Ch. 498km
LINE 3
ALPHA NORTH (WARATAH)
Zone 7
Ch. 534km
CLERMONT
ALPHA NORTH COAL PROJECT (WARATAH) 30 MTPA PROPOSED 530 km APPROX SPUR LENGTH 10km
KEVIN'S CORNER COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 480 km APPROX SPUR LENGTH 18km
Zone 8
KEVINS CORNER (HANCOCK)
Ch. 557km
ALPHA WEST PROJECT (WARATAH)
ALPHA COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 495 km APPROX SPUR LENGTH 10km
CAPELLA
Zone 9
MINE SPURLINES INDICATIVE TAKEOFF LOCATIONS 220MTPA TO ABBOT POINT
ALPHA WEST COAL PROJECT (GVK/HANCOCK) 15 MTPA PROPOSED 480 km APPROX SPUR LENGTH 28km
GALILEE COAL CHINA FIRST PROJECT (WARATAH) 30 MTPA PROPOSED 573.6 km APPROX SPUR LENGTH 21km
Ch. 577km
EMERALD
JERICHO
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
ALPHA
SOUTH GALILEE COAL PROJECT (AMCI)


Map 5
GVK - 60Mtpa
a) GVK modelled as servicing ONLY GVK mines;
b) Corridor consist of a single Mainline;
c) Alignment ( ) defined from publicly available information on the GVK alignment, provided by EWLP;
d) Standard gauge is installed on the GVK line.
Note:
i. Mainline (built by 2017),
ii. Timing and volumes based on E&Y demand modelling,
iii. Zone interface marked with ◆ ,
ABBOT POINT
BOWEN
Ch. 0km
LINE 3
BOGIE RIVER
COLLINSVILLE
BOWEN RIVER
BURDEKIN DAM
LINE 3
Q COAL TENEMENTS
NEWLANDS MINE
LINE 5
MT COOLON
NORTHERN MISSING LINK
BELYANDO RIVER
NORTH GALILEE
SUTTOR RIVER
NORTH GOONYELLA MINE
ADANI COAL REGIONAL EXPORT ON QRN NETWORK ~20 MTPA POTENTIAL 200 km
MISTAKE CREEK
CHINA STONE PROJECT SOUTH (MACMINES) 30 MTPA PROPOSED 398km APPROX SPUR LENGTH 25km
LINE 6
LINE 4
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING) QRN CORRIDOR 60MTPA PROPOSED 375KM APPROX SPUR LENGTH
LINE 2
GVK Mainline
BELYANDO RIVER
DEGULLA COAL PROJECT (VALE)
DEGULLA COAL PROJECT (VALE) 15 MTPA PROPOSED 497 km APPROX SPUR LENGTH 10km
LINE 3
MISTAKE CREEK
ALPHA NORTH (WARATAH)
CLERMONT
ALPHA NORTH COAL PROJECT (WARATAH) 30 MTPA PROPOSED 530 km APPROX SPUR LENGTH 10km
KEVIN'S CORNER COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 480 km APPROX SPUR LENGTH 18km
Ch. 485km
KEVINS CORNER (HANCOCK)
ALPHA WEST PROJECT (WARATAH)
ALPHA COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 495 km APPROX SPUR LENGTH 10km
CAPELLA
MINE SPURLINES INDICATIVE TAKEOFF LOCATIONS 220MTPA TO ABBOT POINT
ALPHA WEST COAL PROJECT (GVK/HANCOCK) 15 MTPA PROPOSED 480 km APPROX SPUR LENGTH 28km
GALILEE COAL CHINA FIRST PROJECT (WARATAH) 30 MTPA PROPOSED 573.6 km APPROX SPUR LENGTH 21km
EMERALD
JERICHO
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
BELYANDO RIVER
ALPHA
SOUTH GALILEE COAL PROJECT (AMCI)


Map 6
QRN - 60Mtpa
a) QRN modelled as servicing Adani only;
b) Corridor consist of a Mainline and a series of upgrades;
c) Alignment ( ) defined from publicly available information on the QRN alignment. provided by EWLP,
d) Narrow gauge is installed on all QRN lines.
Note:
i. Phase 1 - Mainline (built by 2017),
ii. All timings and volumes based on E&Y demand modelling,
iii. Zone interface marked with ◆ ,
Note:
It is understood that the existing North-South QRN line retains some capacity for increase volumes. However over the life of this 30year economic study the forecasted volumes are expected to significantly exceed this capacity. As a result a cost allocation has been included for a major capacity upgrade marked as the transparent red line; line is indicative ONLY.
ABBOT POINT
BOWEN
LINE 3
BOGIE RIVER
BOWEN RIVER
COLLINSVILLE
LINE 3
Q COAL TENEMENTS
NEWLANDS MINE
LINE 5
MT COOLON
NORTHERN MISSING LINK
Ch. 0km
NORTH GALILEE
SUTTOR RIVER
NORTH GOONYELLA MINE
ADANI COAL REGIONAL EXPORT ON QRN NETWORK -20 MTPA POTENTIAL 200 km
CHINA STONE PROJECT SOUTH (MACMINES) 30 MTPA PROPOSED 398km APPROX SPUR LENGTH 25km
QRN Mainline
LINE 6
Ch. 174km
LINE 4
MORANBAH
CARMICHAEL COAL PROJECT (ADANI MINING) QRN CORRIDOR 60MTPA PROPOSED 375KM APPROX SPUR LENGTH
MISTAKE CREEK
BELYANDO RIVER
LINE 2
DEGULLA COAL PROJECT (VALE) 15 MTPA PROPOSED 497 km APPROX SPUR LENGTH 10km
DEGULLA COAL PROJECT (VALE)
LINE 3
ALPHA NORTH (WARATAH)
ALPHA NORTH COAL PROJECT (WARATAH) 30 MTPA PROPOSED 530 km APPROX SPUR LENGTH 10km
KEVIN'S CORNER COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 480 km APPROX SPUR LENGTH 18km
CLERMONT
KEVINS CORNER (HANCOCK)
ALPHA WEST PROJECT (WARATAH)
ALPHA COAL PROJECT (GVK/HANCOCK) 30 MTPA PROPOSED 495 km APPROX SPUR LENGTH 10km
CAPELLA
MINE SPURLINES INDICATIVE TAKEOFF LOCATIONS 220MTPA TO ABBOT POINT
ALPHA WEST COAL PROJECT (GVK/HANCOCK) 15 MTPA PROPOSED 480 km APPROX SPUR LENGTH 28km
GALILEE COAL CHINA FIRST PROJECT (WARATAH) 30 MTPA PROPOSED 573.6 km APPROX SPUR LENGTH 21km
EMERALD
JERICHO
GALILEE COAL (NORTHERN EXPORT FACILITY) (WARATAH)
ALPHA
SOUTH GALILEE COAL PROJECT (AMCI)

# Appendix 2 Terrain type distances

## Terrain Type Distances

The following tables outline the manner in which each zone is defined by terrain category.

Note: All amounts shown in km

***Table 1: GIC – Option 1 (Standard Gauge**)***

Note**: To service Adani Carmichael Coal Project and offer narrow gauge lines to allow for throughput to Dudgeon point, GIC – Option 1 includes a dual gauge segment, that being a segment installed with standard and narrow gauge track (areas of zones 2 & 3) with the remaining alignment being stalled as standard gauge.

| GIC | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Zone 1 | 20 | 148 | 15 | 36 | 219 |
| Zone 2 | 128 | | | 23 | 151 |
| Zone 3 | | | 16 | 12 | 28 |
| Zone 4 | | 44 | | | 44 |
| Zone 5 | | | 24 | 10 | 34 |
| Zone 6 | 4 | | | 18 | 22 |
| Zone 7 | 20 | | | 16 | 36 |
| Zone 8 | 21 | | | 2 | 23 |
| Zone 9 | 20 | | | | 20 |
| Totals | 213 | 192 | 55 | 117 | **577** |

***Table 2: GVK – 150Mpta (Standard Gauge)***

Note: To service local mines to the north and south of GVK's Kevin's Corner Coal Project GVK has additional zones included.

| GVK | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 149 | 136 | 20 | 180 | 485 |
| Zone 7 | 20 | | | 16 | 36 |
| Zone 8 | 21 | | | 2 | 23 |
| Zone 9 | 20 | | | | 20 |
| Totals | 210 | 136 | 20 | 198 | **564** |

***Table 3: QRN – 90Mpta (Narrow Gauge)***

Note: To service Macmines South to the north of Adani Carmichael Coal Project an additional zone is included.

| QRN | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 75 | | | 99 | 174 |
| Zone 4 | | 44 | | | 44 |
| Totals | 75 | 44 | | 99 | **218** |

***Table 4: GIC – Option 2 (Standard Gauge)***

Note: All amounts shown in km

| GIC – Option 2 | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Zone 1 | 20 | 148 | 15 | 36 | 219 |
| Zone 2 | 128 | | | 23 | 151 |
| Zone 3 | | | 16 | 12 | 28 |
| Zone 4 | | 44 | | | 44 |
| Zone 5 | | | 24 | 10 | 34 |
| Zone 6 | 4 | | | 18 | 22 |
| Zone 7 | 20 | | | 16 | 36 |
| Zone 8 | 21 | | | 2 | 23 |
| Zone 9 | 20 | | | | 20 |
| Totals | 213 | 192 | 55 | 117 | **577** |

***Table 5: GVK – 60Mpta (Standard Gauge)***

Note: Only GVK's Kevin's Corner Coal Project and surrounding GVK mines are being serviced, therefore no additional zones included.

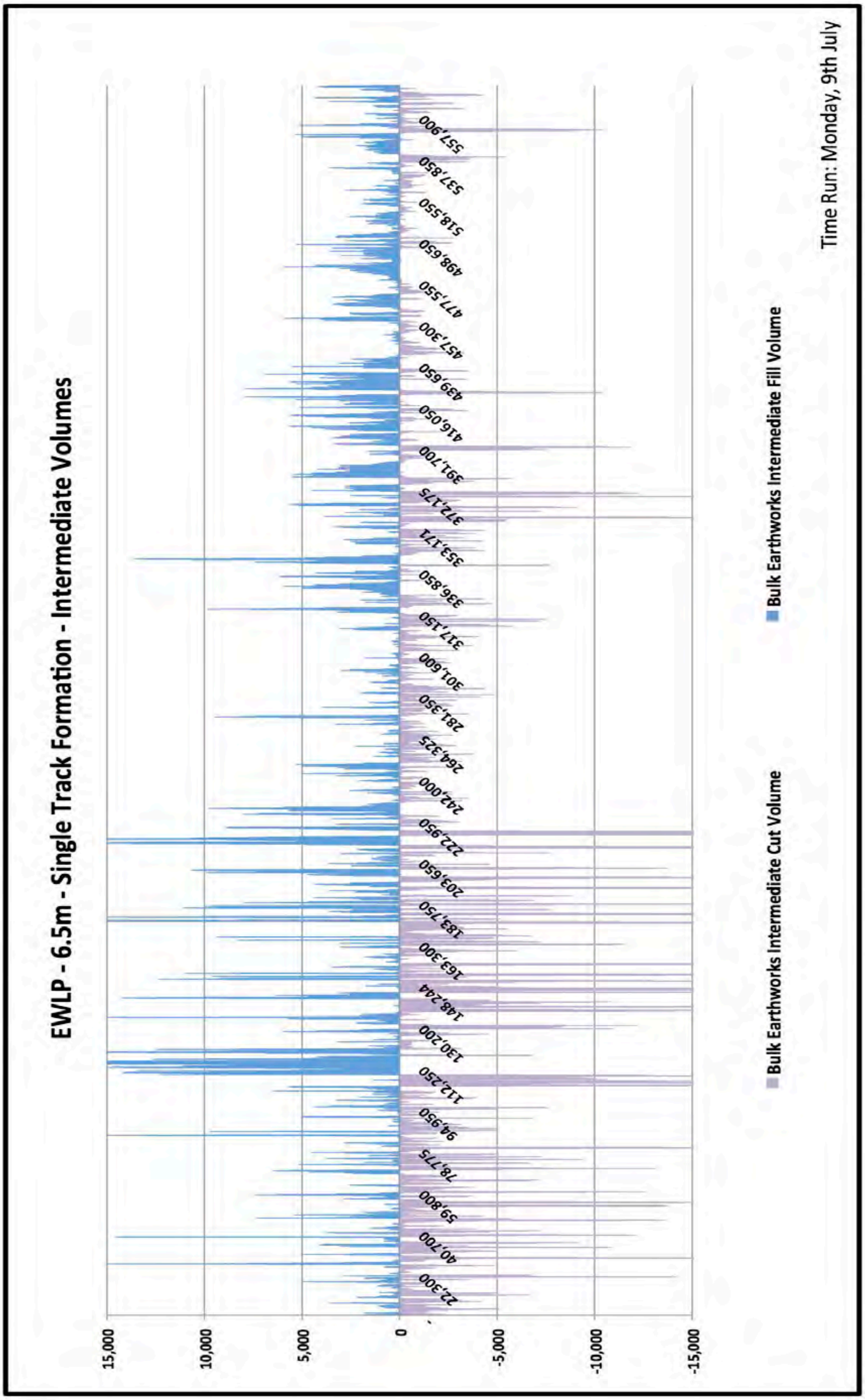
| GVK | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 149 | 136 | 20 | 180 | 485 |

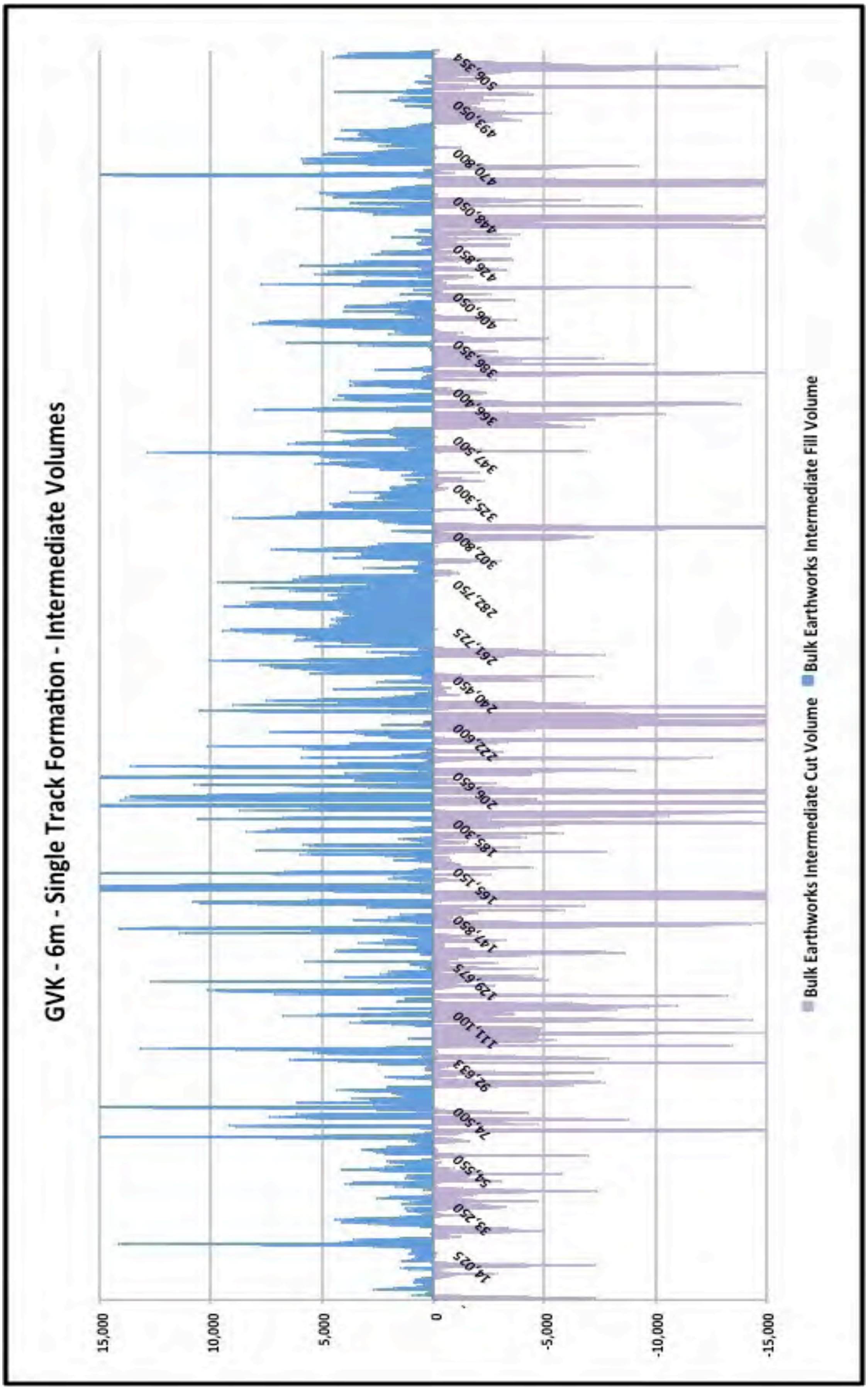
***Table 6: QRN – 60Mpta (Narrow Gauge)***

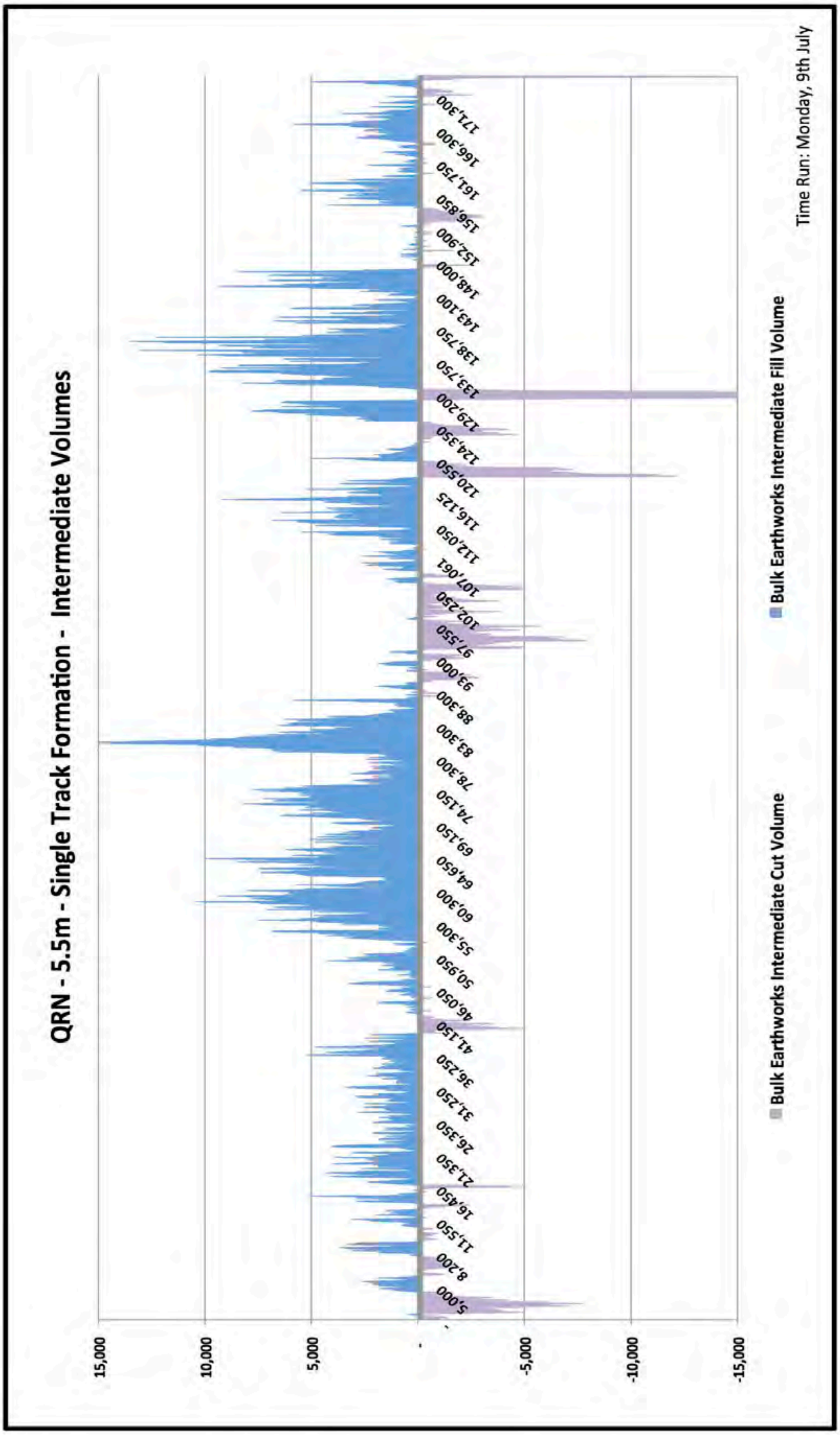
Note: Only Adani's Carmichael Coal Project is being serviced, therefore no additional zones included.

| QRN | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 75 | | | 99 | 174 |

# Appendix 3 Indicative Earthworks Volumes


EWLP - 6.5m - Single Track Formation - Intermediate Volumes
15,000
10,000
5,000
0
-5,000
-10,000
-15,000
22,300
40,700
59,800
78,775
94,950
112,250
130,200
148,244
163,300
183,750
203,650
222,950
242,000
264,325
281,350
301,600
317,150
336,850
353,171
372,175
391,700
416,050
439,650
457,300
477,550
498,650
518,550
537,850
557,900
Bulk Earthworks Intermediate Cut Volume
Bulk Earthworks Intermediate Fill Volume
Time Run: Monday, 9th July


GVK - 6m - Single Track Formation - Intermediate Volumes
15,000
10,000
5,000
0
-5,000
-10,000
-15,000
14,025
33,250
54,550
74,500
92,633
111,100
129,675
147,850
165,150
185,300
206,650
222,600
240,450
261,725
282,750
302,800
325,300
347,500
366,400
386,350
406,050
426,850
448,050
470,800
493,050
506,354
Bulk Earthworks Intermediate Cut Volume
Bulk Earthworks Intermediate Fill Volume


QRN - 5.5m - Single Track Formation - Intermediate Volumes
15,000
10,000
5,000
-
-5,000
-10,000
-15,000
5,000
8,200
11,550
16,450
21,350
26,350
31,250
36,250
41,150
46,050
50,950
55,300
60,300
64,650
69,150
74,150
78,300
83,300
88,300
93,000
97,550
102,250
107,061
112,050
116,125
120,550
124,350
129,200
133,750
138,750
143,100
148,000
152,900
156,850
161,750
166,300
171,300
Bulk Earthworks Intermediate Cut Volume
Bulk Earthworks Intermediate Fill Volume
Time Run: Monday, 9th July

East West Line Parks Limited

Galilee Infrastructure Corridor Project

# Above and below rail comparative cost estimates

# Appendices – Part B

July 2012

# Appendix 4 Direct cost rates - Earthworks by Terrain Types

## Earthworks Cost by Terrain Type

The following tables outline the earthworks cost/ terrain category.

Note: All amounts shown in km

***Table 1: GIC – Option 1 (Standard Gauge**)***

Note**: To service Adani Carmichael Coal Project and offer narrow gauge lines to allow for throughput to Dudgeon point, GIC – Option 1 includes a dual gauge segment, that being a segment installed with standard and narrow gauge track (areas of zones 2 & 3) with the remaining alignment being stalled as standard gauge.

| GIC | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Zone 1 | 0.5 | 1.4 | 0.9 | 1.3 | 1.25 |
| Zone 2 | 0.5 | | | 1.4 | 0.67 |
| Zone 3 | | | 0.9 | 1.4 | 1.08 |
| Zone 4 | | 0.9 | | | 0.95 |
| Zone 5 | | | 1.0 | 1.2 | 1.03 |
| Zone 6 | 0.5 | | | 1.2 | 1.07 |
| Zone 7 | 0.7 | | | 1.2 | 0.90 |
| Zone 8 | 0.5 | | | 0.8 | 0.55 |
| Zone 9 | 0.6 | | | | 0.61 |
| Totals | | | | | **0.98** |

***Table 2: GVK – 150Mpta (Standard Gauge)***

Note: To service local mines to the north and south of GVK's Kevin's Corner Coal Project GVK has additional zones included.

| GVK | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 0.6 | 1.5 | 0.9 | 1.9 | 1.34 |
| Zone 7 | 0.7 | | | 1.2 | 0.90 |
| Zone 8 | 0.5 | | | 0.8 | 0.55 |
| Zone 9 | 0.6 | | | | 0.61 |
| Totals | | | | | **1.25** |

***Table 3: QRN – 90Mpta (Narrow Gauge)***

Note: To service Macmines South to the north of Adani Carmichael Coal Project an additional zone is included.

| QRN | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 0.7 | | | 1.9 | 1.4 |
| Zone 4 | | 0.9 | | | 0.9 |
| Totals | | | | | **1.29** |

***Table 4: GIC – Option 2 (Standard Gauge)***

Note: All amounts shown in km

| GIC – Option 2 | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Zone 1 | 0.5 | 1.4 | 0.9 | 1.3 | 1.25 |
| Zone 2 | 0.5 | | | 1.4 | 0.67 |
| Zone 3 | | | 0.9 | 1.4 | 1.08 |
| Zone 4 | | 0.9 | | | 0.95 |
| Zone 5 | | | 1.0 | 1.2 | 1.03 |
| Zone 6 | 0.5 | | | 1.2 | 1.07 |
| Zone 7 | 0.7 | | | 1.2 | 0.90 |
| Zone 8 | 0.5 | | | 0.8 | 0.55 |
| Zone 9 | 0.6 | | | | 0.61 |
| Totals | | | | | **0.98** |

***Table 5: GVK – 60Mpta (Standard Gauge)***

Note: Only GVK's Kevin's Corner Coal Project and surrounding GVK mines are being serviced, therefore no additional zones included.

| GVK | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 0.6 | 1.5 | 0.9 | 1.9 | 1.34 |

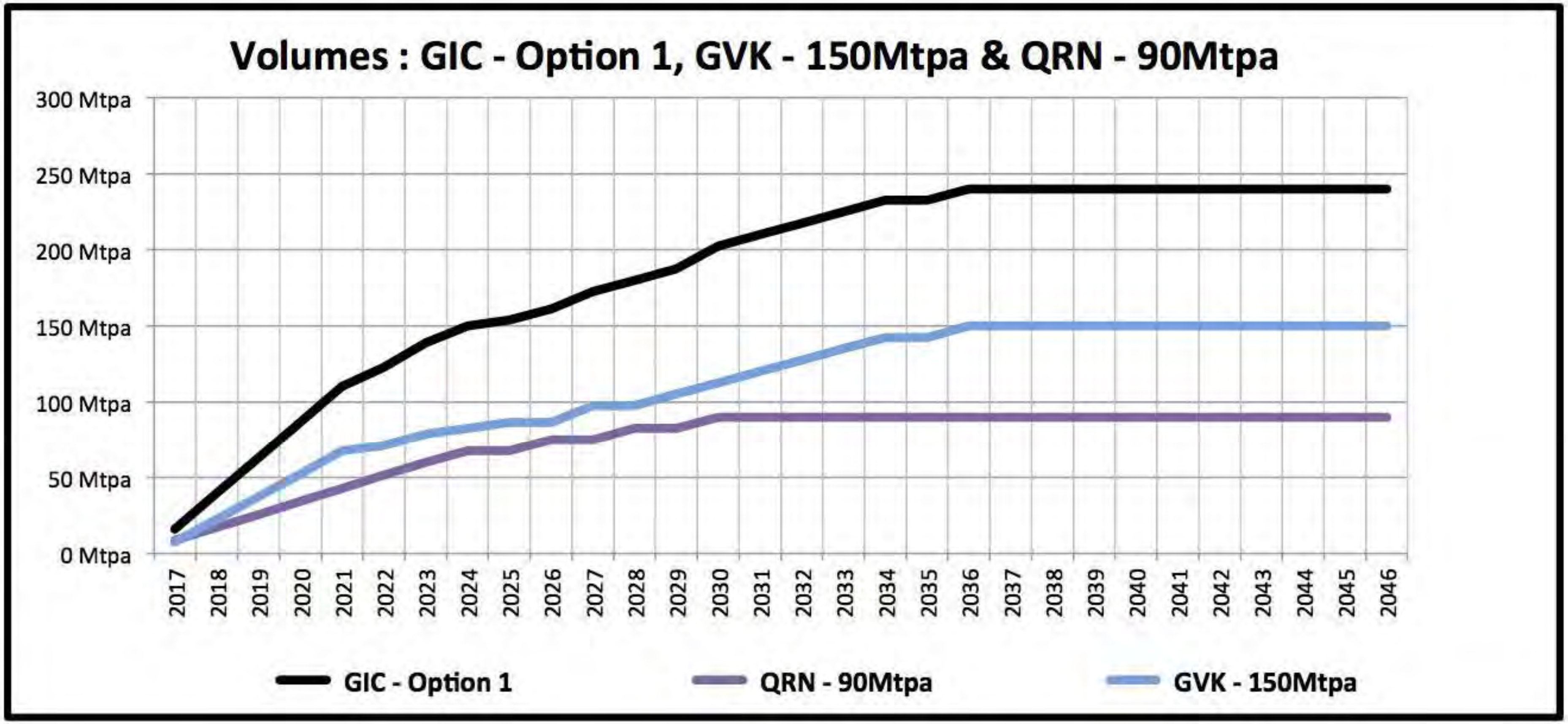
***Table 6: QRN – 60Mpta (Narrow Gauge)***

Note: Only Adani's Carmichael Coal Project is being serviced, therefore no additional zones included.

| QRN | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| Mainline | 0.7 | | | 1.9 | 1.38 |

# Appendix 5 Below rail capacity growth

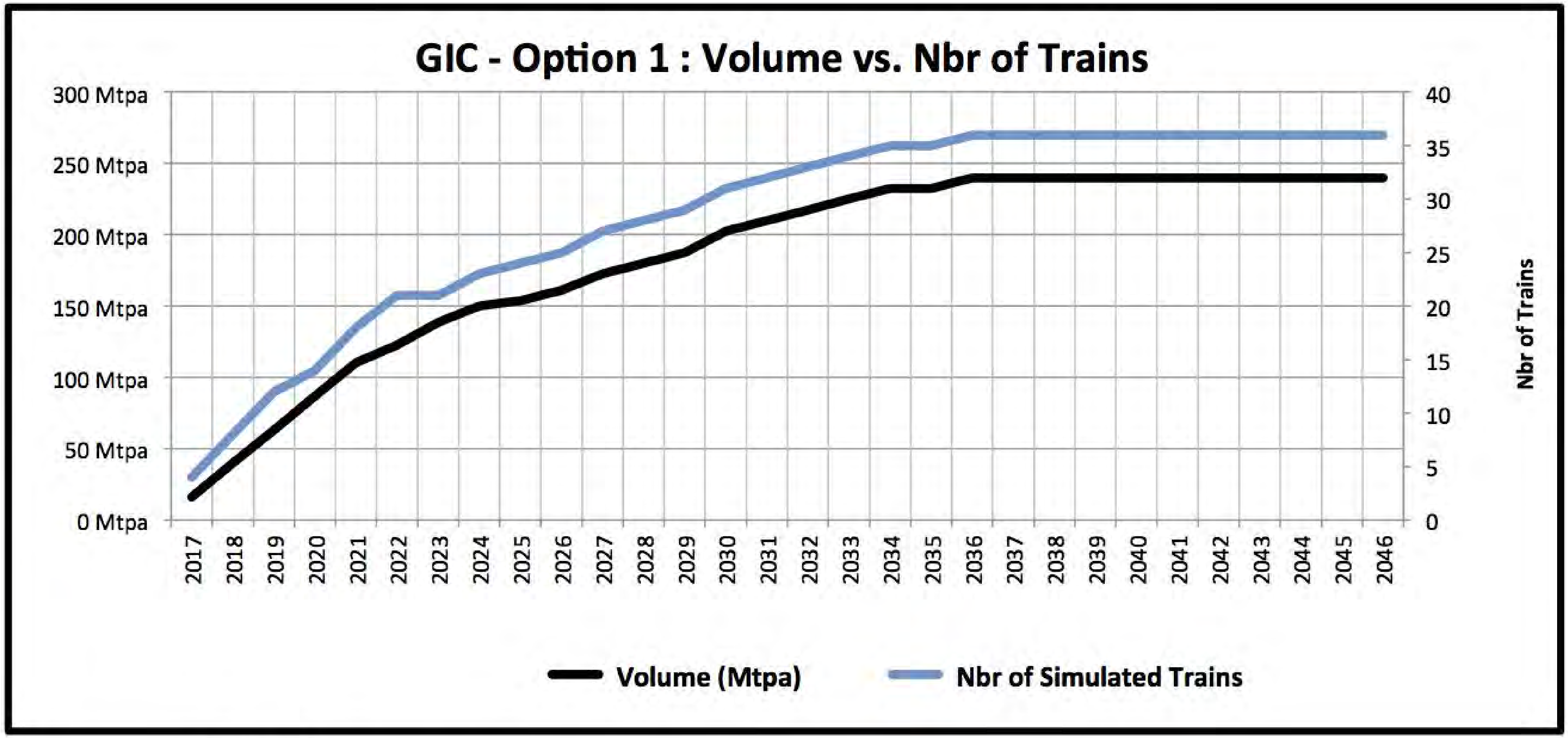
# Graph A




**Observations:**

1. By 2030, QRN line is anticipated to carry 90Mtpa.
2. By 2036, GVK line is anticipated to carry 150Mtpa.
3. By 2036, GIC - Option 1 is anticipated to carry 240Mtpa.

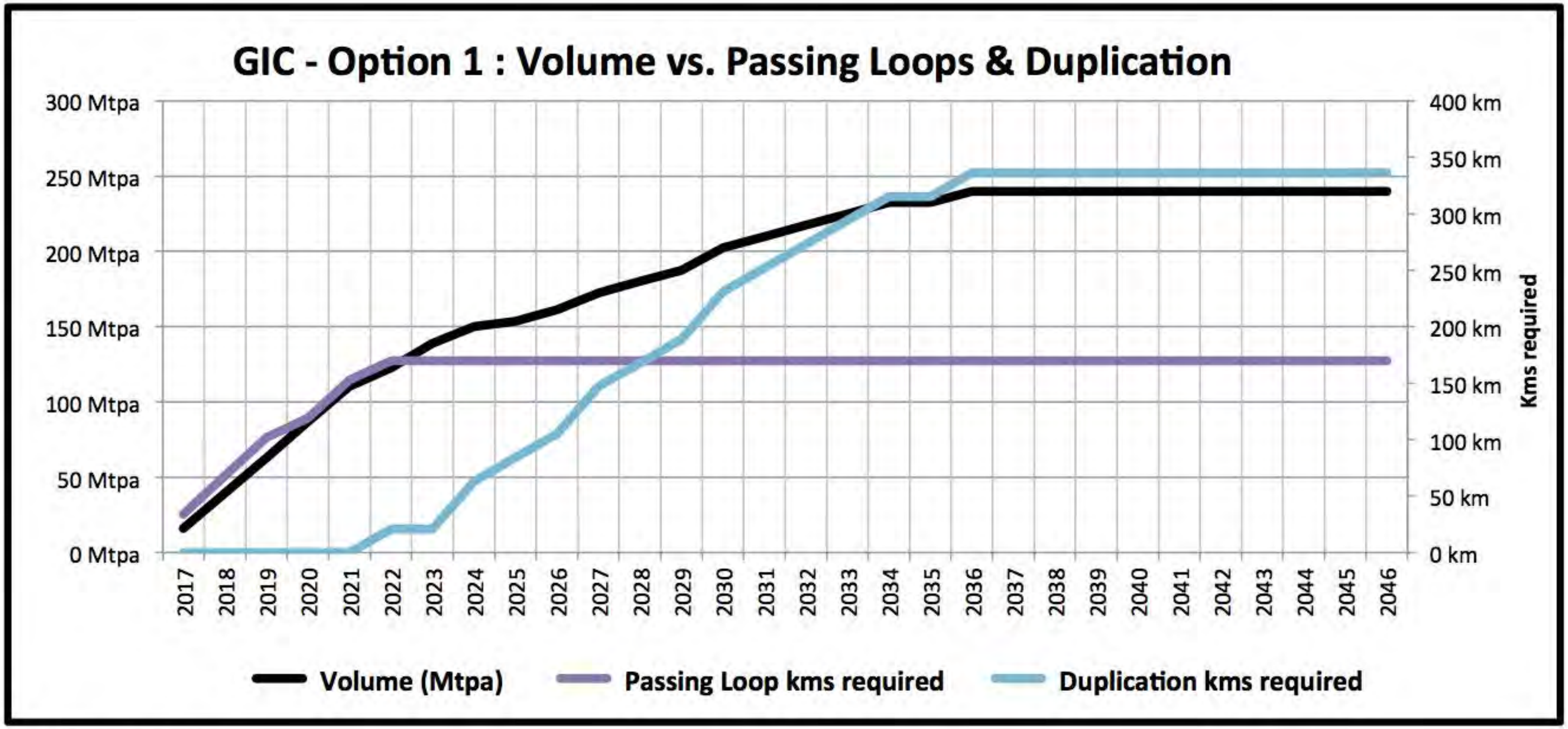
# Graph B




**Observations:**

1. As volume increases the number of trains increases.
2. At 240Mtpa, 36 trains for will be required for GIC - Option 1.

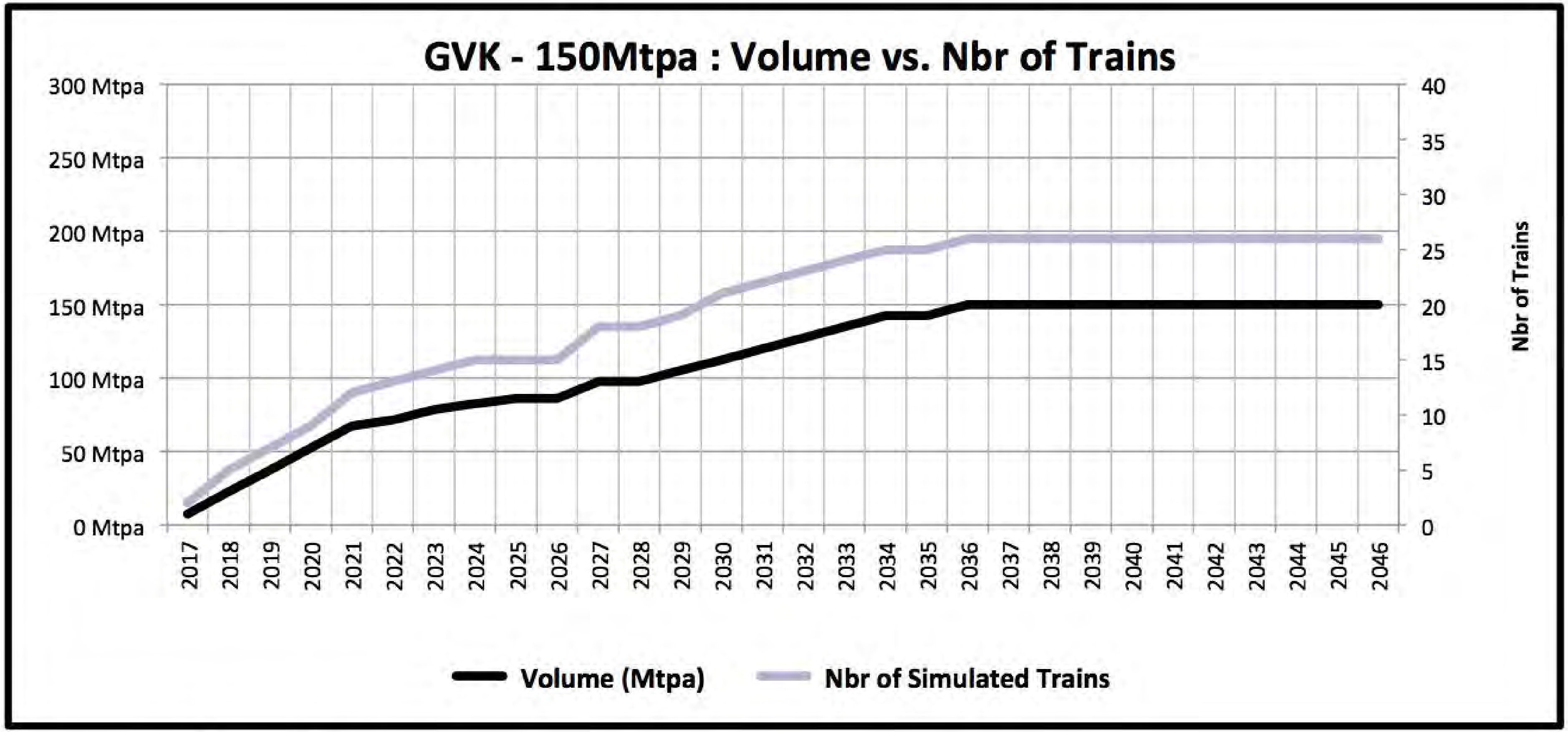
# Graph C




**Observations:**

1. Up to 125Mtpa, passing loops are added as more trains are used to carry capacity.
2. By 2022, the number of trains required to carry the tonnage exceeds the number of passing loops that can be added. After that time, duplication of track between passing loops is required to increase capacity.
3. By 2036 at 240Mtpa, 87% of the track will need to be duplicated (incl. passing loops).

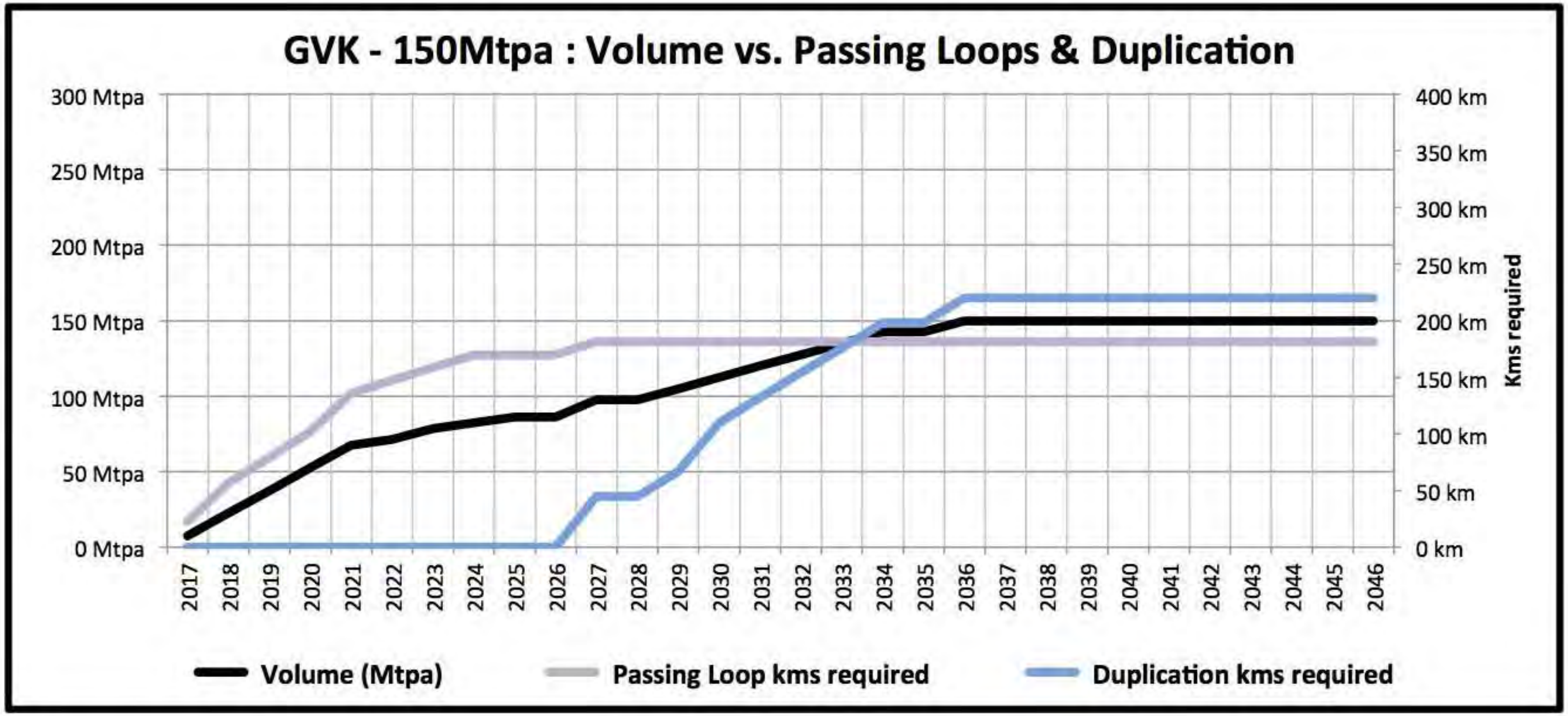
# Graph D




**Observations:**

1. As volume increases the number of trains increases.
2. At 150Mtpa, 26 trains for will be required for GVK - 150Mtpa.

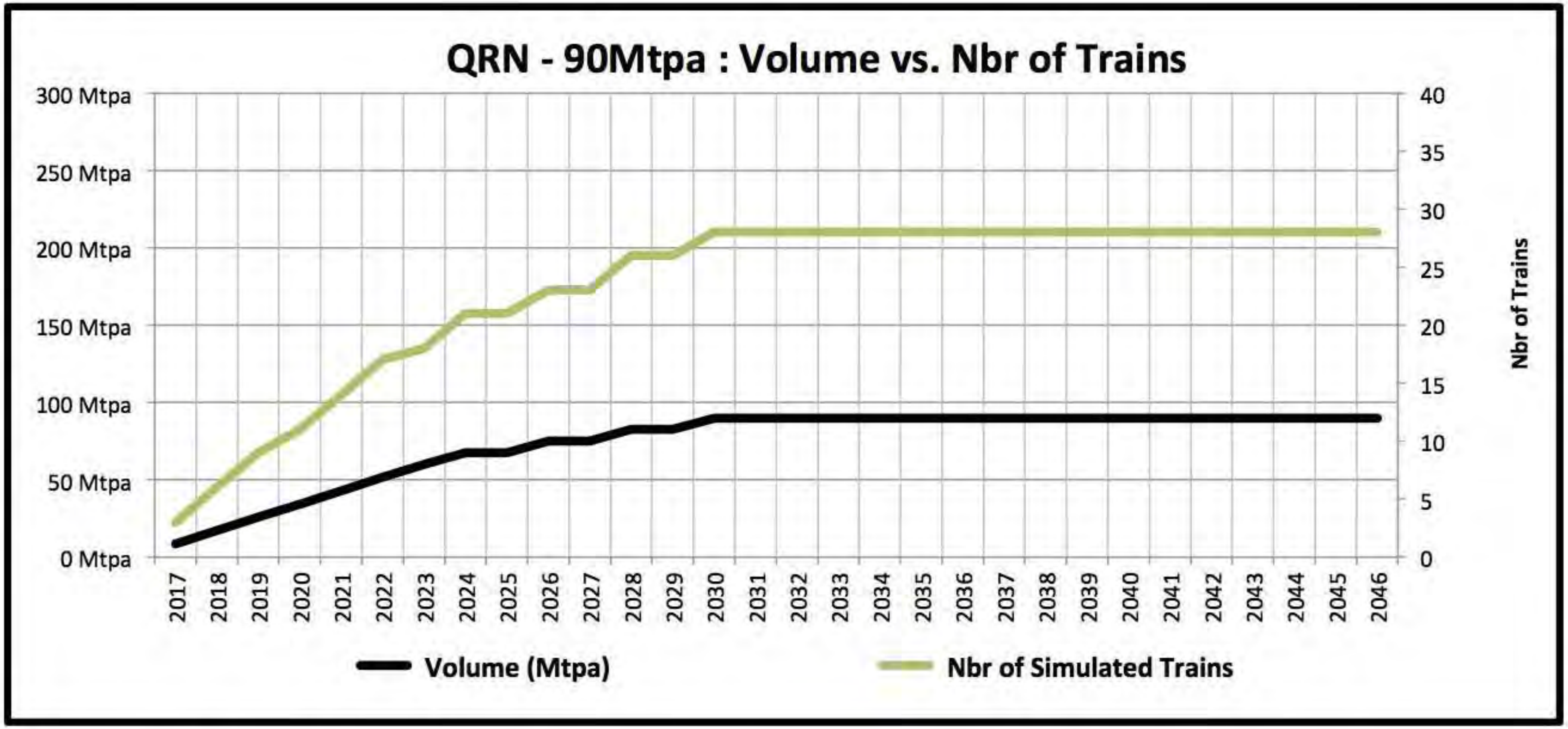
# Graph E




**Observations:**

1. Up to 90Mtpa, passing loops are added as more trains are used to carry capacity.
2. By 2026, the number of trains required to carry the tonnage exceeds the number of passing loops that can be added. After that time, duplication of track between passing loops is required to increase capacity.
3. By 2036 at 150Mtpa, 63% of the track will need to be duplicated (incl. passing loops).

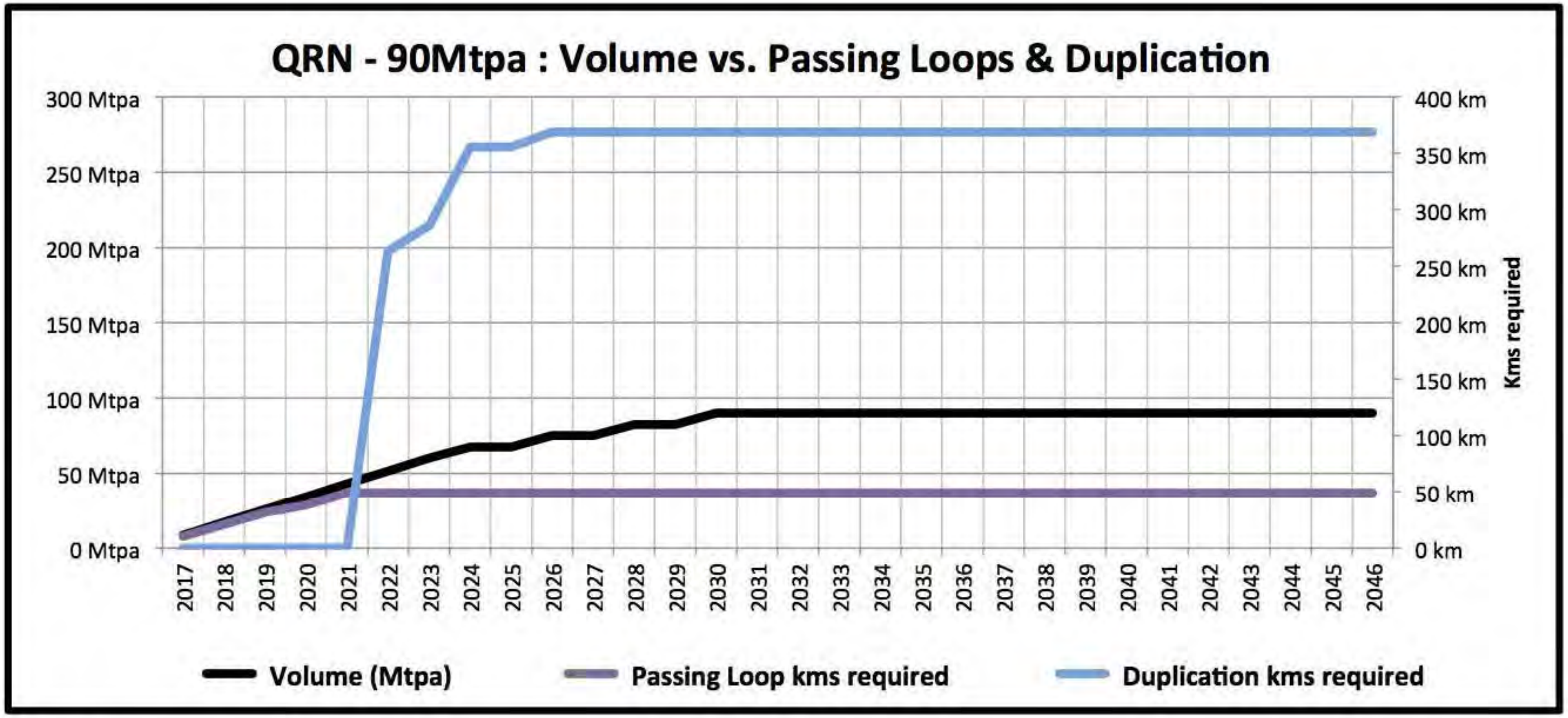
# Graph F




**Observations:**

1. As volume increases the number of trains increases.
2. At 90Mtpa, 28 trains for will be required for QRN - 90Mtpa.

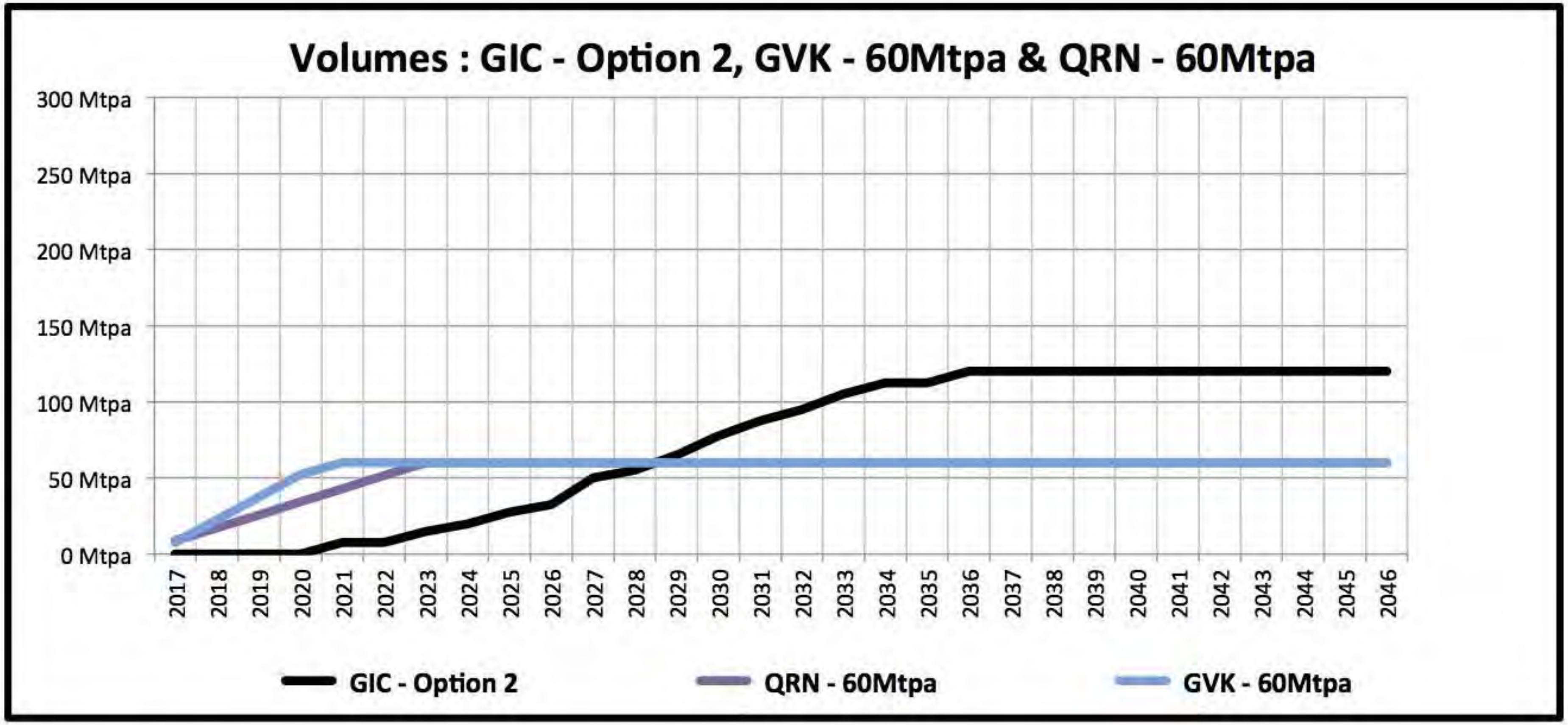
# Graph G




**Observations:**

1. Up to 45Mtpa, passing loops are added as more trains are used to carry capacity.
2. By 2022, the number of trains required to carry the tonnage exceeds the number of passing loops that can be added. After that time, duplication of track between passing loops is required to increase capacity.
3. By 2030 at 90Mtpa, 100% of the track will need to be duplicated (incl. passing loops).
4. The large jump in duplication (2021) is modeled on the necessity for major increase in capicity of the North/South QRN line between Goonyella and Abbot Point, simulated by the need for a greenfield single track along this alignment.

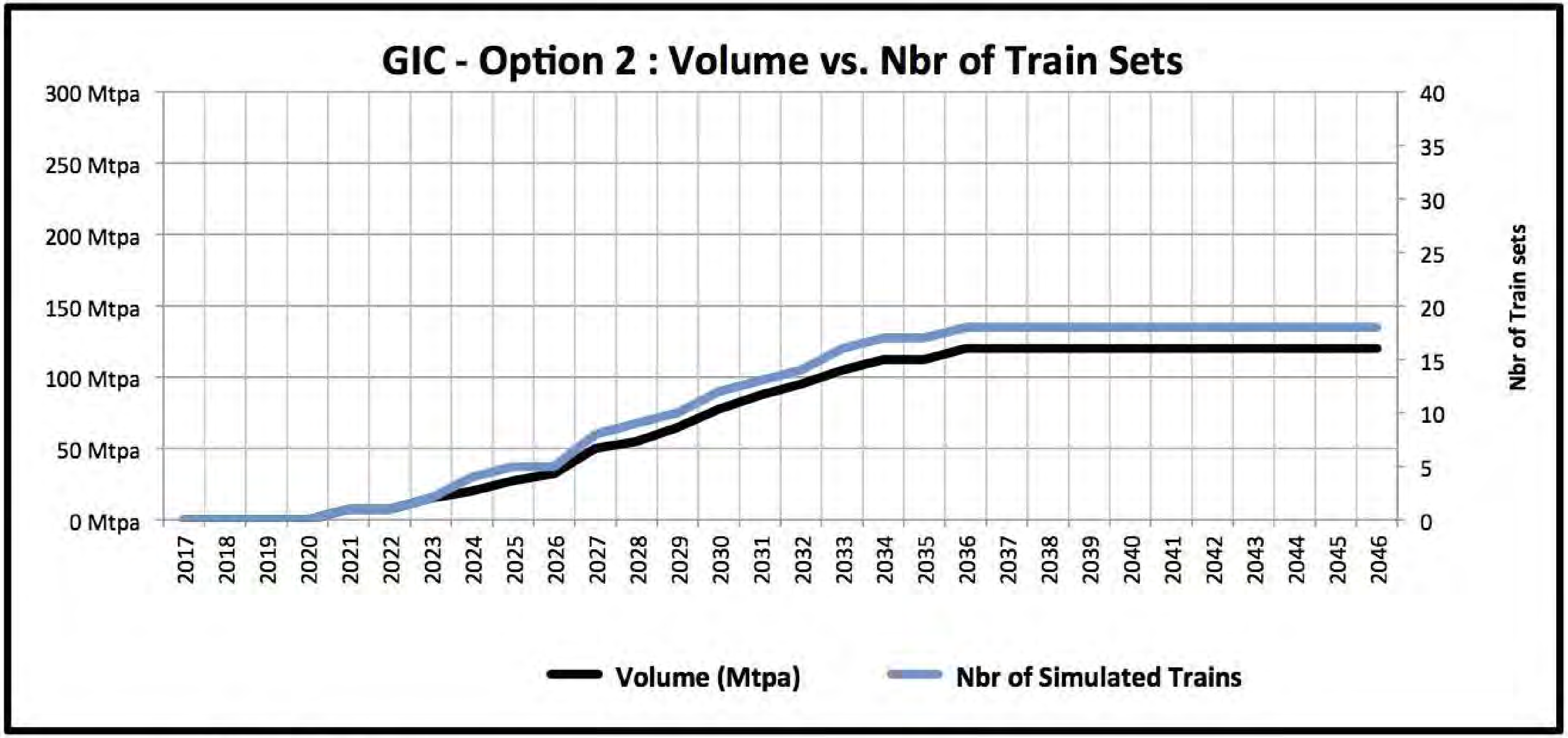
## Graph H




**Observations:**

1. By 2021, GVK line is anticipated to carry 60Mtpa.
2. By 2036, GVK line is anticipated to carry 60Mtpa.
3. By 2036, GIC - Option 2 is anticipated to carry 120Mtpa.

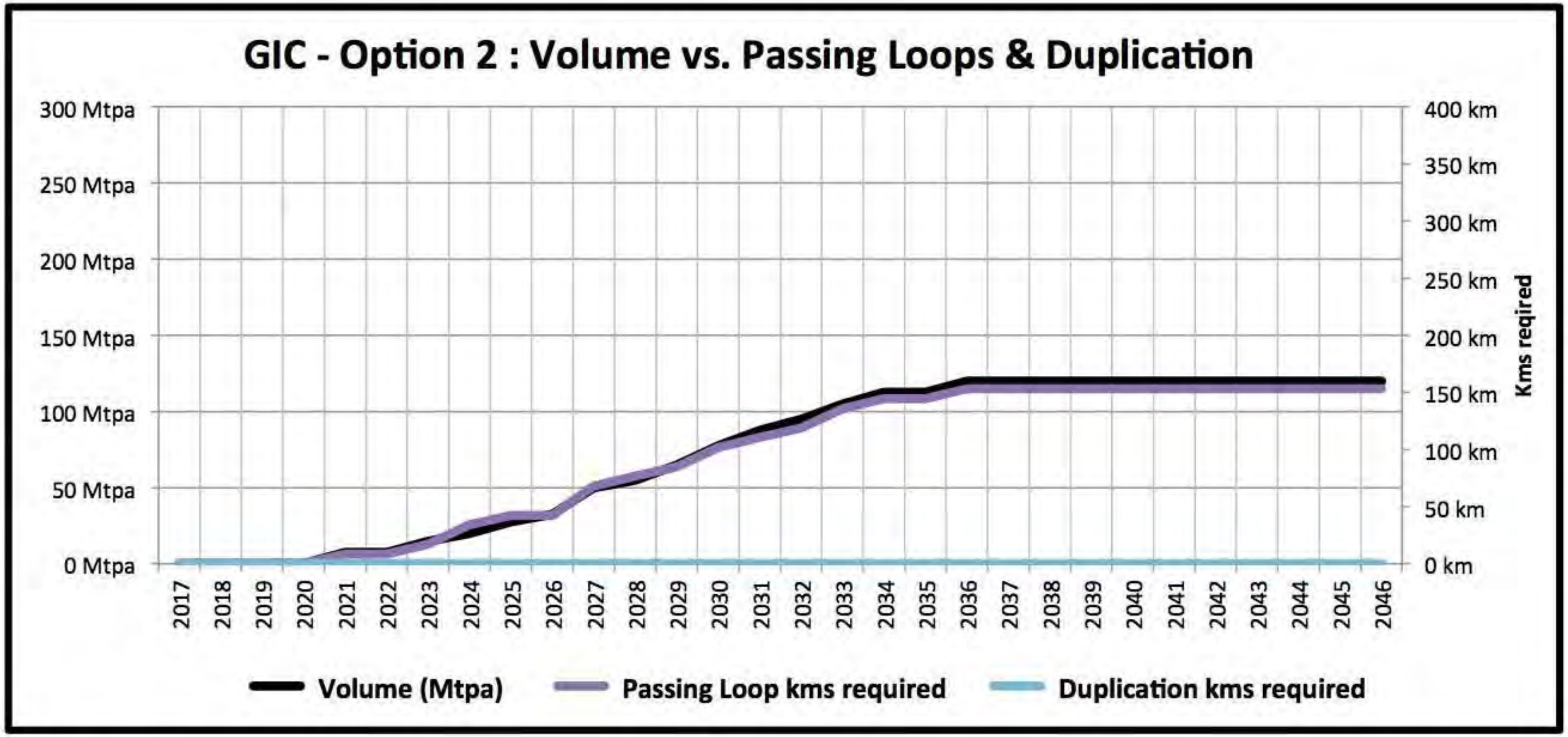
# Graph I




**Observations:**

1. As volume increases the number of trains increases.
2. At 120Mtpa, 18 trains for will be required for GIC - Option 2.

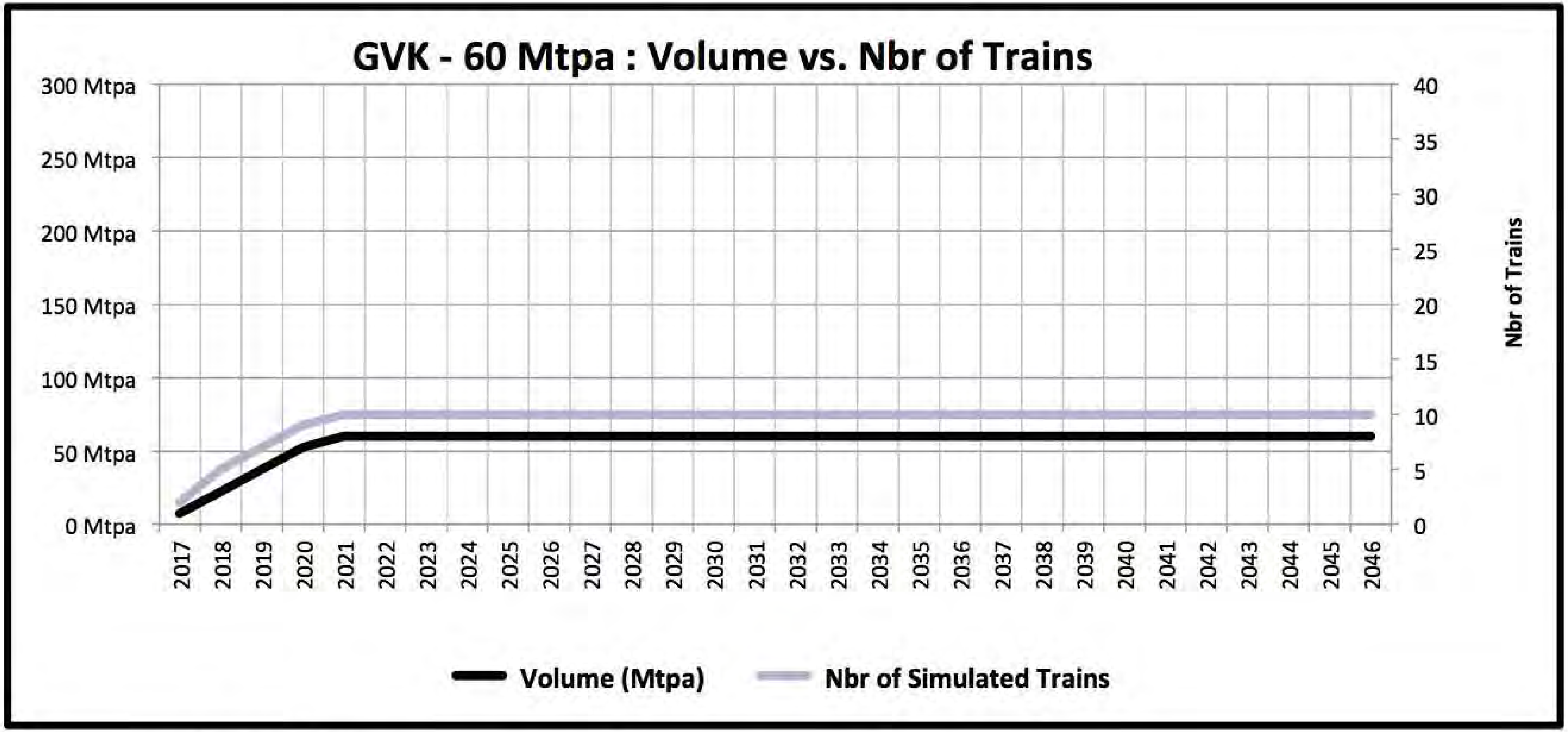
# Graph J




**Observations:**

1. Passing loops are added as more trains are used to carry capacity and are able to accommodate the forcasted capacity for GIC - Option 2.
2. No additional duplication is required.
3. By 2036 at 120Mtpa, 26% of the track will need to be duplicated (with passing loops).

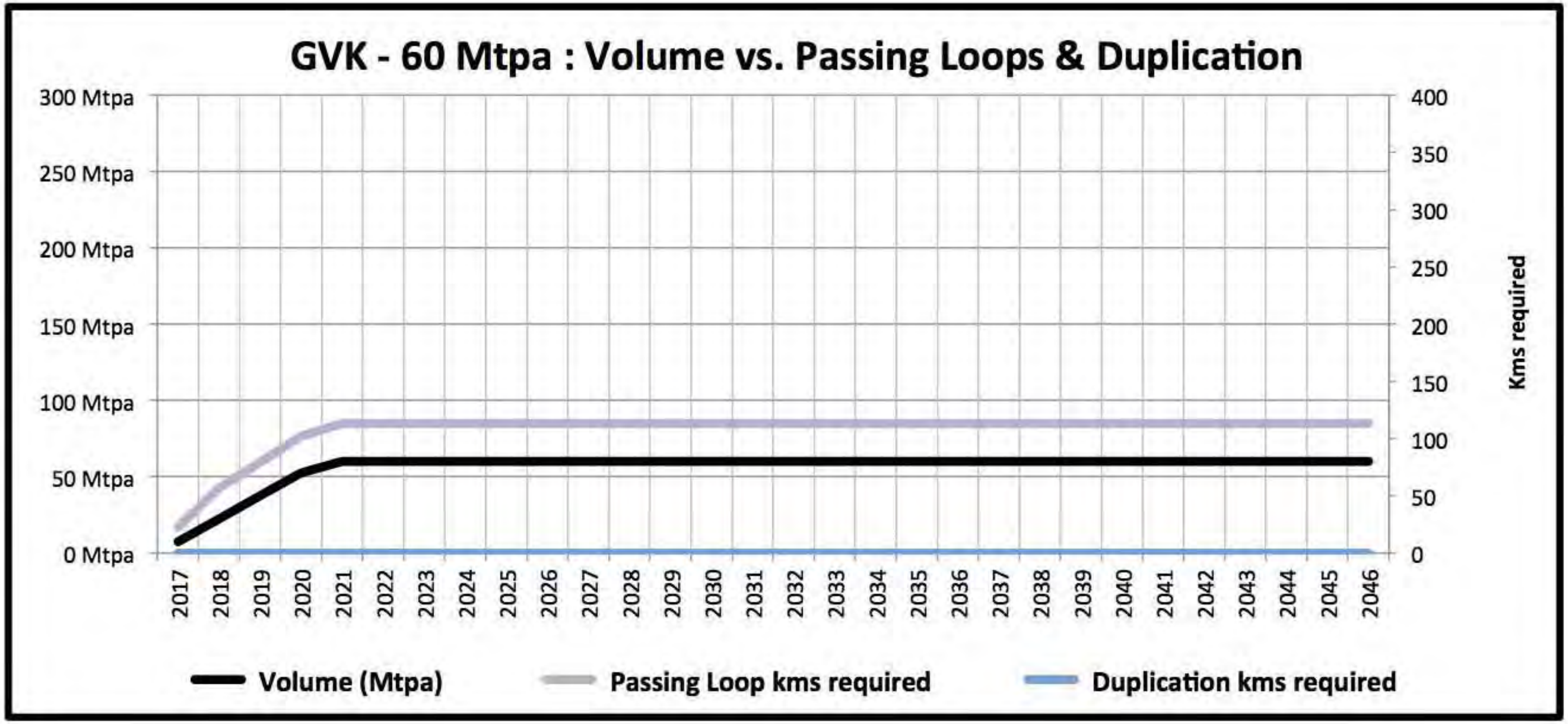
# Graph K




**Observations:**

1. As volume increases the number of trains increases.
2. At 60Mtpa, 10 trains for will be required for GVK - 60Mtpa.

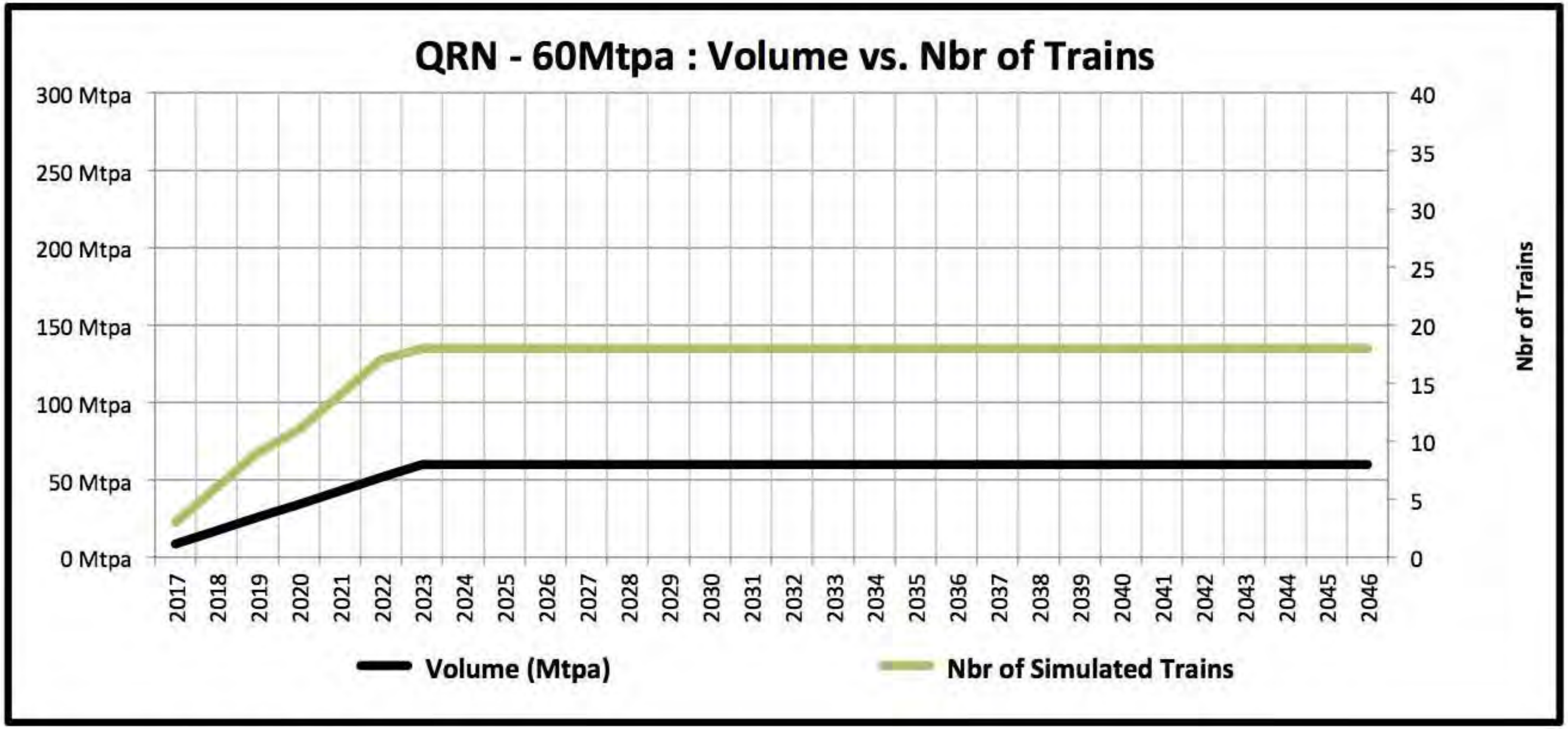
# Graph L




**Observations:**

1. Passing loops are added as more trains are used to carry capacity and are able to accommodate the forcasted capacity for GVK - 60Mtpa.
2. No additional duplication is required.
3. By 2021 at 60Mtpa, 17% of the track will need to be duplicated (with passing loops).

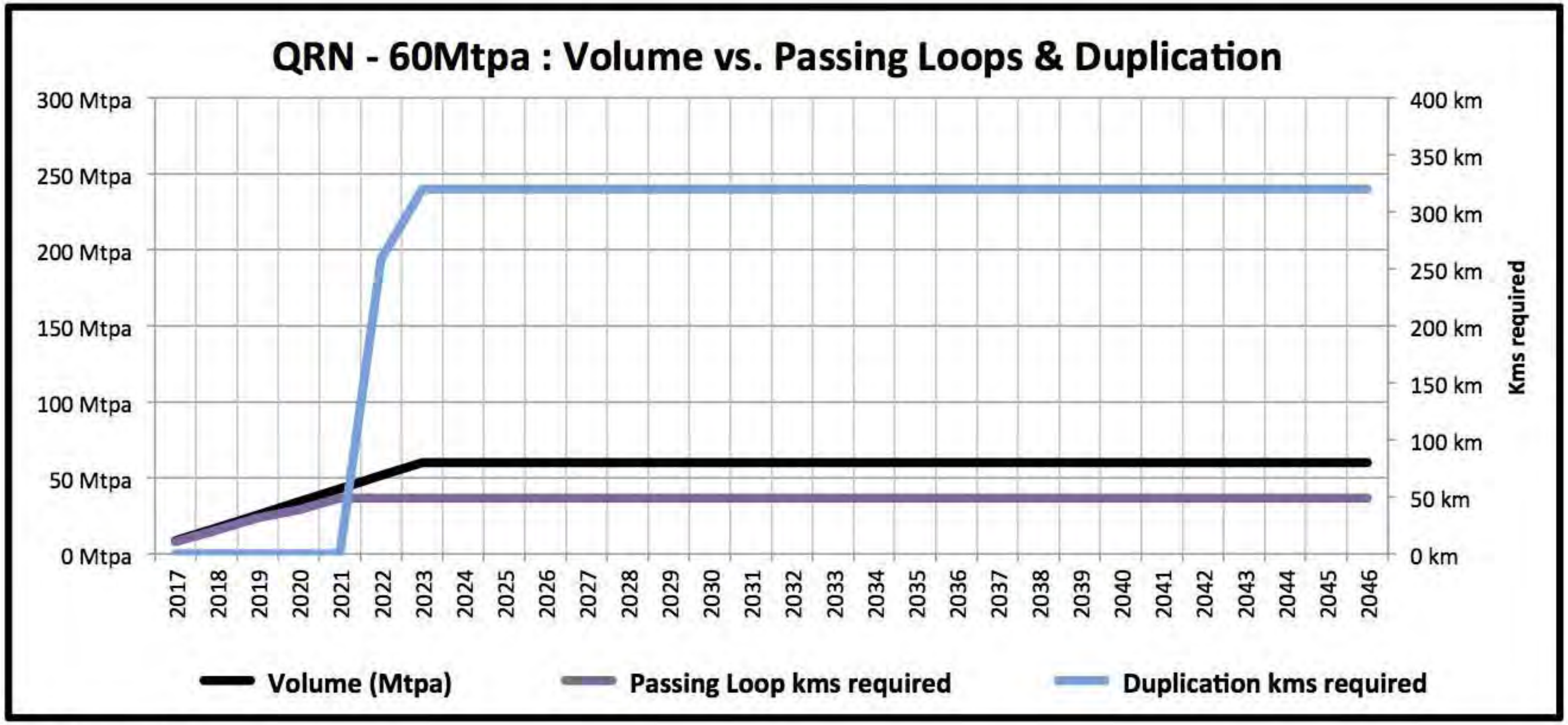
# Graph M




**Observations:**

1. As volume increases the number of trains increases.
2. At 60Mtpa, 18 trains for will be required for QRN - 60Mtpa.

# Graph N




**Observations:**

1. Up to 43Mtpa, passing loops are added as more trains are used to carry capacity.
2. By 2022, the number of trains required to carry the tonnage exceeds the number of passing loops that can be added. After that time, duplication of track between passing loops is required to increase capacity.
3. By 2030 at 60Mtpa, 88% of the track will need to be duplicated (incl. passing loops).
4. The large jump in duplication (2021) is modeled on the necessity for major increase in capicity of the North/South QRN line between Goonyella and Abbot Point, simulated by the need for a greenfield single track along this alignment.

EVERYTHING INFRASTRUCTURE

East West Line Parks Limited

Galilee Infrastructure Corridor Project

# Above and below rail comparative cost estimates

# Appendices – Part C

July 2012

# Appendix 6 Below Rail Rates Tables

# Galilee Basin Rail Corridor Construction Rates

## PERMANENT WAY

| | Supply 40 TAL track materials | | | Rate | Labour | Plant | Material | Sub Con | Total | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| T1 | | m | 10,000 | | | | | | | Assume sleepers are mfrd in Grafton and |
| | Supply 68Kg Rail | m | 10,000 | 330 | 3,300,000 | | | | 3,300,000 | trucked/railed to Bowen $120 plus $65 |
| | Supply Sleepers | Each | 15,000 | 185 | | 2,775,000 | | | 2,775,000 | |
| | Supply Ballast | m3 | 13,100 | 40 | | 524,000 | | | 524,000 | |
| | TOTAL ITEM T1 | wk | 10,000 | $659.90 | 3,300,000 | 3,299,000 | 0 | 0 | 6,599,000 | |
| T2 | Turnouts 1:12 | Each | 100 | | | | | | | |
| | | Each | 100 | 187,000 | | 18,700,000 | | | 18,700,000 | |
| | TOTAL ITEM T2 | wk | 100 | $187,000.00 | 0 | 18,700,000 | 0 | 0 | 18,700,000 | |
| T3 | Turnout 1:20 | Each | 100 | | | | | | | |
| | | Each | 100 | 319,000 | | 31,900,000 | | | 31,900,000 | |
| | TOTAL ITEM T3 | wk | 100 | $319,000.00 | 0 | 31,900,000 | 0 | 0 | 31,900,000 | |

| | Supply 40 TAL DUAL GAUGE track materials | | | Rate | Labour | Plant | Material | Sub Con | Total | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| T4 | | m | 10,000 | | | | | | | |
| | Supply 68Kg Rail | m | 10,000 | 495 | 4,950,000 | | | | 4,950,000 | Rail cost 40 TAL plus 50% |
| | Supply Sleepers | Each | 15,000 | 190 | | 2,850,000 | | | 2,850,000 | Assumes sleeper mfrd in Grafton and |
| | Supply Ballast | m3 | 13,100 | 40 | | 524,000 | | | 524,000 | trucked/railed to Bowen. $125 plus $65 |
| | TOTAL ITEM T1 | wk | 10,000 | $832.40 | 4,950,000 | 3,374,000 | 0 | 0 | 8,324,000 | |
| T5 | Turnouts 1:12 | Each | 100 | | | | | | | |
| | | Each | 100 | 543,000 | | 54,300,000 | | | 54,300,000 | Cost from IRAS study. Assumes supply and transport to yard |
| | TOTAL ITEM T2 | wk | 100 | $543,000.00 | 0 | 54,300,000 | 0 | 0 | 54,300,000 | |
| T6 | Turnout 1:20 | Each | 100 | | | | | | | |
| | | Each | 100 | 733,000 | | 73,300,000 | | | 73,300,000 | Cost from IRAS study. Assumes supply and transport to yard |
| | TOTAL ITEM T3 | wk | 100 | $733,000.00 | 0 | 73,300,000 | 0 | 0 | 73,300,000 | |

| | Supply 32 TAL track materials | | | Rate | Labour | Plant | Material | Sub Con | Total | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| T7 | | m | 10,000 | | | | | | | |
| | Supply 68Kg Rail | m | 10,000 | 330 | 3,300,000 | | | | 3,300,000 | Same as 40 TAL |
| | Supply Sleepers | Each | 15,000 | 175 | | 2,625,000 | | | 2,625,000 | Assumes sleepers mfrd in Grafton and |
| | Supply Ballast | m3 | 13,100 | 40 | | 524,000 | | | 524,000 | trucked/railed to Bowen. $110 plus $65 |
| | TOTAL ITEM T1 | wk | 10,000 | $644.90 | 3,300,000 | 3,149,000 | 0 | 0 | 6,449,000 | |
| T8 | Turnouts 1:12 | Each | 100 | | | | | | | |
| | | Each | 100 | 154,880 | | 15,488,000 | | | 15,488,000 | |
| | TOTAL ITEM T2 | wk | 100 | $154,880.00 | 0 | 15,488,000 | 0 | 0 | 15,488,000 | |
| T9 | Turnout 1:18.5 | Each | 100 | | | | | | | |
| | | Each | 100 | 206,800 | | 20,680,000 | | | 20,680,000 | |
| | TOTAL ITEM T3 | wk | 100 | $206,800.00 | 0 | 20,680,000 | 0 | 0 | 20,680,000 | |

| | Supply 26.5 TAL track materials | | | Rate | Labour | Plant | Material | Sub Con | Total | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| T7 | | m | 10,000 | | | | | | | This is the ARTC rate for 60kg rail. At Bowen |
| | Supply 60Kg Rail | m | 10,000 | 266 | 2,660,000 | | | | 2,660,000 | costs might be higher. We have quote for |
| | Supply Sleepers | Each | 40 | 175 | | 7,000 | | | 7,000 | $960/tonne FOB China port in 25m lengths. |
| | Supply Ballast | m3 | 0 | 0 | | 0 | | | 0 | Assumes sleepers are mfrd at Grafton and trucked/railed to Bowen . Same cost as 32 |
| | TOTAL ITEM T1 | wk | 10,000 | $266.70 | 2,660,000 | 7,000 | 0 | 0 | 2,667,000 | TAL sleepers |
| T8 | Turnouts 1:12 | Each | 100 | | | | | | | Leave ballast qty as is for SG but may |
| | As per Price RS | Each | 100 | 141,000 | | 14,100,000 | | | 14,100,000 | increase with better info. |
| | TOTAL ITEM T2 | wk | 100 | $141,000.00 | 0 | 14,100,000 | 0 | 0 | 14,100,000 | |
| T9 | Turnout 1:18.5 | Each | 100 | | | | | | | |
| | As per Price RS | Each | 100 | 188,000 | | 18,800,000 | | | 18,800,000 | |
| | TOTAL ITEM T3 | wk | 100 | $188,000.00 | 0 | 18,800,000 | 0 | 0 | 18,800,000 | |

| | Installation of Track Items | | | Rate | Labour | Plant | Material | Sub Con | Total | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| T10 | **Costs based on Industry Knowledge;** | | | | | | | | | |
| | 1. Average cost of FMG track (439 kms) in WA is $672,000 ($472,000 materials + $200,000 installation) per km (2006) | | | | | | | | | |
| | 2. Average cost of BHP track (286 kms) in WA is $673000 ($473,000 materials + $200,000 installation) per km. per km (2006) | | | | | | | | | |
| | 3. Average cost of track materials & installation in CQCA region over 6 projects is $957,000 per km. | | | | | | | | | |
| | 4. Average cost of track materials & installation in SBR over 4 sections (estimate) is $972,000 per km | | | | | | | | | |
| | 5. New dual gauge track installation is $260,000 per km. | | | | | | | | | |
| | Therefore for EWLP it is proposed to use the following: | | | | | | | | | |
| | Installation of 30TAL to be | m | 10,000 | 190,000 | | | | | | |
| | Installation of 40TAL to be | m | 10,000 | 220,000 | | | | | | |
| | Installation of DUAL GAUGE of 40TAL to be | m | 10,000 | 260,000 | | | | | | |
| T11 | Installation of turnouts 1:12 | Each | 100 | | | | | | | |
| | As per Price RS | Each | 100 | 137,000 | | 13,700,000 | | | 13,700,000 | |
| | TOTAL ITEM T2 | wk | 100 | $137,000.00 | 0 | 13,700,000 | 0 | 0 | 13,700,000 | |
| T12 | Installation of turnout 1:18.5 | Each | 100 | | | | | | | |
| | As per Price RS | Each | 100 | 151,000 | | 15,100,000 | | | 15,100,000 | |
| | TOTAL ITEM T3 | wk | 100 | $151,000.00 | 0 | 15,100,000 | 0 | 0 | 15,100,000 | |

# Galilee Basin Rail Corridor Construction Rates

## ENVIRONMENTAL

| | Silt Fencing | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| B2 | | m | 1,000 | | | | | | | |
| | Supply Silt Fence | m | 2,000 | 4 | | | | 8,000 | | 8,000 |
| | Supply Star Pickets | No | 667 | 9 | | | | 6,000 | | 6,000 |
| | Install at 200m/day | | | | | | | | | |
| | Exc/Loader | hr | 80 | 135 | | | 10,800 | | | 10,800 |
| | Lab x 2 | hr | 53 | 55 | | 2,933 | | | | 2,933 |
| | Maintenance included elsewhere | m | 0 | 5 | | | 0 | | | 0 |
| | Hay Bales at Creek edge allow 1/1000 | m | 60 | 50 | | | | | 3,000 | 3,000 |
| | TOTAL ITEM B2 | M | 1,000 | $30.73 | 0 | 2,933 | 10,800 | 14,000 | 3,000 | 30,733 |

| | Environmental Maintenace | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| B2 | | wk | 156 | | | | | | | |
| | Allow following Crew following rains nd Maintain | | | | | | | | | |
| | Lab x 2 50% time | hr | 7,800 | 60 | | 468,000 | | | | 468,000 |
| | Vehicle | hr | 78 | 150 | | | 11,700 | | | 11,700 |
| | Backhoe 20% | hr | 1,560 | 90 | | | 140,400 | | | 140,400 |
| | Truck 20% | hr | 1,560 | 100 | | | 156,000 | | | 156,000 |
| | Replacement Silt Fence 20% replacemen | m | 80,000 | 3 | | | | 240,000 | | 240,000 |
| | Pickets | each | 0 | 8 | | | | 0 | | 0 |
| | TOTAL ITEM B2 | wk | 156 | $6,513.46 | 0 | 468,000 | 308,100 | 240,000 | 0 | 1,016,100 |

| | Sedimentation Basins | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| B8 | | Each | 100 | | | | | | | |
| | Total Capacity/Basin = 600m3 | m3 | 60,000 | | | | | | | |
| | Area = 20m x 20m | m2 | 40,000 | | | | | | | |
| | Clear | m2 | 40,000 | 2 | | | 80,000 | | | 80,000 |
| | Strip and Replace Topsoil 200mm | m3 | 12,000 | 8 | | | 96,000 | | | 96,000 |
| | Construct Basin | | | | | | | | | |
| | Dozer @ 40m3/hr | hr | 1,500 | 140 | | | 210,000 | | | 210,000 |
| | Excavator | hr | 1,500 | 140 | | | 210,000 | | | 210,000 |
| | Water Cart | hr | 1,500 | 95 | | | 142,500 | | | 142,500 |
| | Roller | hr | 1,500 | 100 | | | 150,000 | | | 150,000 |
| | Trim Batters | m2 | 40,000 | 2 | | | 60,000 | | | 60,000 |
| | Floatage | no | 100 | 700 | | | 70,000 | | | 70,000 |
| | Overflow | m2 | 2,400 | 100 | | | 240,000 | | | 240,000 |
| | Low Level Flow | no | 0 | 3,500 | | | 0 | | | 0 |
| | Turf/Veg | m2 | 40,000 | 5 | | | | | 200,000 | 200,000 |
| | Maintain for 6mths -Included elsewhere | Mth | 0 | 900 | | | 0 | | | 0 |
| | TOTAL ITEM B.8 | Each | 100 | $14,585 | | 0 | 1,258,500 | 0 | 200,000 | 1,458,500 |

# Galilee Basin Rail Corridor Construction Rates

## FENCING

| | Rural Wire Fencing | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.1 | | m | 1,000 | | | | | | | |
| | 5 Strand fence with Conc Posts | m | 1,000 | 16 | | | | | 16,000 | 16,000 |
| | TOTAL ITEM 4.1 | m | 1,000 | 16 | | 0 | 0 | 0 | 16,000 | 16,000 |

| | Rural Gates - 5m | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.2 | | Each | 100 | | | | | | | |
| | Supply and install Rural Gates | Each | 100 | 650 | | | | | 65,000 | 65,000 |
| | TOTAL ITEM 4.2 | Each | 100 | 650 | | 0 | 0 | 0 | 65,000 | 65,000 |

| | Cattle Grid | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.4 | | Each | 100 | | | | | | | |
| | Supply Cattle Grid | Each | 100 | 3,000 | | | | | 300,000 | 300,000 |
| | Install | | | | | | | | | |
| | Float | N | 50 | 600 | | | 30,000 | | | 30,000 |
| | Exc | Hr | 500 | 145 | | | 72,500 | | | 72,500 |
| | Lab x 2 | Hr | 1,000 | 60 | | 60,000 | | | | 60,000 |
| | Truck from Yard | Hr | 500 | 100 | | | 50,000 | | | 50,000 |
| | TOTAL ITEM 4.4 | Each | 100 | 5,125 | | 60,000 | 152,500 | 0 | 300,000 | 512,500 |

# Galilee Basin Rail Corridor Construction Rates

## EARTHWORKS

| | Clearing and Grubbing-Minimal | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| E1 | | m2 | 10000 | | | | | | |
| | Overall Area | m2 | 10,000 | | | | | | |
| | Clear of trees @= 10000m2/day | m2 | 10,000 | | | | | | |
| | Excavator | hr | 0 | 145 | | 0 | | | 0 |
| | Dozer | hr | 10 | 180 | | 1,800 | | | 1,800 |
| | Lab | hr | 20 | 60 | 1,200 | | | | 1,200 |
| | S/Plant | d | 2 | 600 | | 1,333 | | | 1,333 |
| | Mulcher | hr | 3 | 300 | | 1,000 | | | 1,000 |
| | Excavator | hr | 3 | 145 | | 483 | | | 483 |
| | Truck to Stockpile | hr | 3 | 100 | | 333 | | | 333 |
| | TOTAL ITEM 5.1 | m2 | 10000 | 0.62 | 1,200 | 4,950 | 0 | 0 | 6,150 |

| | Clearing and Grubbing-Medium | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| 5.1 | | m2 | 10000 | | | | | | |
| | Overall Area | m2 | 10,000 | | | | | | |
| | Clear of trees @= 6000m2/day | m2 | 6,000 | | | | | | |
| | Excavator | hr | 17 | 145 | | 2,417 | | | 2,417 |
| | Dozer | hr | 17 | 220 | | 3,667 | | | 3,667 |
| | Lab | hr | 50 | 60 | 3,000 | | | | 3,000 |
| | S/Plant | d | 4 | 600 | | 2,222 | | | 2,222 |
| | Mulcher | hr | 8 | 300 | | 2,500 | | | 2,500 |
| | Excavator | hr | 8 | 145 | | 1,208 | | | 1,208 |
| | Truck to Stockpile | hr | 8 | 100 | | 833 | | | 833 |
| | TOTAL ITEM 5.1 | m2 | 10000 | 1.58 | 3,000 | 12,847 | 0 | 0 | 15,847 |

| | Clearing and Grubbing-Heavy | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| 5.1 | | m2 | 10000 | | | | | | |
| | Overall Area | m2 | 10,000 | | | | | | |
| | Clear of trees @= 4000m2/day | m2 | 4,000 | | | | | | |
| | Excavator | hr | 25 | 145 | | 3,625 | | | 3,625 |
| | Dozer | hr | 25 | 220 | | 5,500 | | | 5,500 |
| | Lab | hr | 75 | 60 | 4,500 | | | | 4,500 |
| | S/Plant | d | 6 | 600 | | 3,333 | | | 3,333 |
| | Mulcher | hr | 17 | 300 | | 5,000 | | | 5,000 |
| | Excavator | hr | 17 | 145 | | 2,417 | | | 2,417 |
| | Truck to Stockpile | hr | 17 | 100 | | 1,667 | | | 1,667 |
| | TOTAL ITEM 5.1 | m2 | 10000 | 2.60 | 4,500 | 21,542 | 0 | 0 | 26,042 |

| | Removal and Stockpiling of topsoil | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| E2 | | m3 | 10,000 | | | | | | |
| | Allow 200mm Topsoil ave. | m3 | 10,000 | | | | | | |
| | Allow 100% Exc+Trucks | | | | | | | | |
| | Excavate by Truck and Cart to Stockpile | m3 | 10,000 | | | | | | |
| | Dozer push up | hr | 250 | 150 | | 37,500 | | | 37,500 |
| | Excavator @ 40m3/hr | hr | 250 | 145 | | 36,250 | | | 36,250 |
| | Moxies x 10min Hauls | hr | 500 | 145 | | 72,500 | | | 72,500 |
| | Lab | hr | 125 | 60 | 7,500 | | | | 7,500 |
| | TOTAL ITEM 5.2 | m3 | 10,000 | 15 | 7,500 | 146,250 | 0 | 0 | 153,750 |
| | | m2 | | 2.31 | | | | | |

| | Unsuitable Material -Cut | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| E3 | | m3 | 10,000 | | | | | | |
| | Assume 500mm Removal in Cuts | | | | | | | | |
| | **Allow exc and dispose,import and fill** | m3 | 10000 | | | | | | |
| | Allow to Dispose within 5klm - no tip fees | | | | | | | | |
| | D9 Dozer Rip and push up to stockpile | hr | 125 | 300 | | 37,500 | | | 37,500 |
| | Excavator PC300 @ 80m3/hr | hr | 125 | 145 | | 18,125 | | | 18,125 |
| | Truck x 4 | hr | 500 | 130 | | 65,000 | | | 65,000 |
| | Allow to Control fill on site | | | | | | | | |
| | D6 Dozer push up to stockpile | hr | 125 | 145 | | 18,125 | | | 18,125 |
| | Supply and place | | | | | | | | |
| | Supply Fill - From within site. Raise Haul and Dump | m3 | 10000 | 10 | | | 100,000 | | 100,000 |
| | Production | m3/hr | | | | | | | |
| | **Place and compact @ 50m3/hr** | | | | | | | | |
| | Spotter | hr | 200 | 60 | 12,000 | | | | 12,000 |
| | Roller | hr | 200 | 110 | | 22,000 | | | 22,000 |
| | W/Cart | hr | 200 | 95 | | 19,000 | | | 19,000 |
| | Dozer | hr | 200 | 145 | | 29,000 | | | 29,000 |
| | Testing @ 1/300m3 | No | | 110 | | | | 0 | 0 |
| | TOTAL ITEM R44P4 | M3 | 10,000 | 32 | 12,000 | 208,750 | 100,000 | 0 | 320,750 |
| | | m2 | | 16.04 | | | | | |

# Galilee Basin Rail Corridor Construction Rates

## ACCESS ROAD

| | Access Road | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| G1 | | M | 10000 | | | | | | |
| | Assume 5m wide x 200mm Thick Road Base | | | | | | | | |
| | **Cut/Fil and trim Base** | | | | | | | | |
| | *Allow 300m/day* | | | | | | | | |
| | Dozer +GPS | hr | 300 | 220 | | 66,000 | | | 66,000 |
| | Roller | hr | 300 | 100 | | 30,000 | | | 30,000 |
| | W/Cart x 2 No | hr | 300 | 95 | | 28,500 | | | 28,500 |
| | Lab | hr | 300 | 60 | 18,000 | | | | 18,000 |
| | **Supply Road base** | m3 | 11000 | | | | | | |
| | Supply from Quarry | T | 26400 | 24 | | | | 633,600 | 633,600 |
| | **Place,Compact and Trim** | m3 | 10000 | | | | | | |
| | Place and compact | | | | | | | | |
| | Grader + GPS @ 40m3/hr | hr | 250 | 165 | | 41,250 | | | 41,250 |
| | W/Cart | hr | 250 | 95 | | 23,750 | | | 23,750 |
| | Roller | hr | 250 | 100 | | 25,000 | | | 25,000 |
| | Lab | hr | 250 | 60 | 15,000 | | | | 15,000 |
| | Trim @ 150m2/hr | m2 | 50000 | | | | | | |
| | Grader +GPS | hr | 333 | 165 | | 55,000 | | | 55,000 |
| | W/Cart | hr | 333 | 95 | | 31,667 | | | 31,667 |
| | Roller | hr | 333 | 100 | | 33,333 | | | 33,333 |
| | Lab | hr | 333 | 60 | 20,000 | | | | 20,000 |
| | Culvert Crossing- allow one every 200m | each | 50 | 2000 | | | | 100,000 | 100,000 |
| | Testing 1/500m2 | No | 0 | 135 | | | | 0 | 0 |
| | **Total -Access Road** | **m** | **10000** | **$112.11** | **53,000** | **334,500** | **0** | **733,600** | **1,121,100** |

| | MAINTAIN ACCESS ROAD | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| G1 | | wk | 156 | | | | | | |
| | Assume 5m wide x 200mm Thick Road Base | week | 156 | | | | | | |
| | For project 200Klm a full time crew would be required | | | | | | | | |
| | *Allow 1000m/day* | | | | | | | | |
| | Grader + x 2 | hr | 12480 | 135 | | 1,684,800 | | | 1,684,800 |
| | Roller 20% | hr | 2496 | 100 | | 249,600 | | | 249,600 |
| | W/Cart x 1No | hr | 6240 | 95 | | 592,800 | | | 592,800 |
| | **Supply Road base to touch up** | | | | | | | | |
| | Supply from Quarry | T | 16380 | 24 | | | | 393,120 | 393,120 |
| | **Total -Access Road** | **KLm** | **200** | **#######** | **0** | **2,527,200** | **0** | **393,120** | **2,920,320** |

# Galilee Basin Rail Corridor Construction Rates

## STRUCTURAL & CAPPING LAYER

| | Structural Layer | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| G1 | | m3 | 10000 | | | | | | |
| | Allowance of Structural Materials | | | | | | | | |
| | Structural won from site | m3 | 10000 | | | | | | |
| | **Raise** | | | | | | | | |
| | *Onsite Material* | | | | | | | | |
| | Blast | m3 | 10,000 | | | | | | |
| | Quotes not yet obtained -allow 2.5m to 4m bench rate (HEX)-PLUG | T | 22000 | 7 | | | | 154,000 | 154,000 |
| | Powder factor 0.55g/cc: MIC <50kg>25Kg | | | | | | | | |
| | Rip and Push @ 200m3/hr | | | | | | | | |
| | D10 | hr | 50 | 400 | | | 20,000 | | 20,000 |
| | **Process** | m3 | 10000 | | | | | | |
| | Allow to crush and Screen -Plug | T | 24000 | 4 | | | | 96,000 | 96,000 |
| | Dispose of Waste | m3 | 1000 | 25 | | | 25,000 | | 25,000 |
| | **Load and Haul** | m3 | 10000 | | | | | | |
| | **Assume 5Klm Hauls** | m3 | 12505.5 | | | | | | |
| | Excavator PC300 @ 70m3/hr | hr | 179 | 145 | | 25,904 | | | 25,904 |
| | Trucks x 5No | hr | 715 | 130 | | 92,898 | | | 92,898 |
| | **Place,Compact and Trim** | m3 | 10000 | | | | | | |
| | Place and compact | | | | | | | | |
| | Grader + GPS @ 70m3/hr | hr | 143 | 165 | | 23,571 | | | 23,571 |
| | W/Cart x 2 No | hr | 286 | 95 | | 27,143 | | | 27,143 |
| | Roller | hr | 143 | 100 | | 14,286 | | | 14,286 |
| | Lab | hr | 143 | 60 | 8,571 | | | | 8,571 |
| | Trim @ 150m2/hr | m2 | 33333 | | | | | | |
| | Grader +GPS | hr | 222 | 165 | | 36,667 | | | 36,667 |
| | W/Cart x 2 No | hr | 444 | 95 | | 42,222 | | | 42,222 |
| | Roller | hr | 222 | 100 | | 22,222 | | | 22,222 |
| | Lab | hr | 222 | 60 | 13,333 | | | | 13,333 |
| | Testing 1/500m2 | No | 0 | 135 | | | | 0 | 0 |
| | **Total -F1 -Structural** | **m3** | **10000** | **$60.18** | **21,905** | **284,913** | **45,000** | **250,000** | **601,818** |

| | Capping Layer | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| G2 | | m3 | 10000 | | | | | | |
| | Assume from Quarry 20KLm Hauls | | | | | | | | |
| | Allowance of Structural Materials | | | | | | | | |
| | Import Structural | t | 22500 | 28 | | | 630,000 | | 630,000 |
| | **Load and Haul included in supply** | m3 | 10000 | | | | | | |
| | **Place,Compact and Trim** | m3 | 10000 | | | | | | |
| | Place and compact | | | | | | | | |
| | Grader + GPS @ 60m3/hr | hr | 167 | 165 | | 27,500 | | | 27,500 |
| | W/Cart x 2 No | hr | 333 | 95 | | 31,667 | | | 31,667 |
| | Roller | hr | 167 | 100 | | 16,667 | | | 16,667 |
| | Lab | hr | 167 | 55 | 9,167 | | | | 9,167 |
| | Trim @ 150m2/hr | m2 | 33333 | | | | | | |
| | Grader +GPS | hr | 222 | 165 | | 36,667 | | | 36,667 |
| | W/Cart x 2 No | hr | 444 | 95 | | 42,222 | | | 42,222 |
| | Roller | hr | 222 | 100 | | 22,222 | | | 22,222 |
| | Lab | hr | 222 | 55 | 12,222 | | | | 12,222 |
| | Testing 1/500m2 | No | 0 | 135 | | | | 0 | 0 |
| | **Total F2 - Capping** | **m3** | **10000** | **$82.83** | **21,389** | **176,944** | **630,000** | **0** | **828,333** |

# Galilee Basin Rail Corridor Construction Rates

## BRIDGEWORKS

| | Bridge Type 1 -12m Long | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| S1 | **Allow 1 Span x 12m** | **m** | **12** | | | | | | |
| | **Spans** | **No** | **1** | | | | | | |
| | **Width incl Parapet** | **m** | **4.9** | | | | | | |
| | **Bridge Area** | **m2** | **58.8** | | | | | | |
| | **Bridge Type: Super Tee -Type 1** | | | | | | | | |
| | Access Road | m2 | 60 | 150 | | | | 9,000 | 9,000 |
| | Platform | m2 | 100 | 400 | | | | 40,000 | 40,000 |
| | Est Pile Rig | Item | 1 | 30000 | | | | 30,000 | 30,000 |
| | Rig Moves | No | 1 | 5000 | | | | 5,000 | 5,000 |
| | Pile Cast Insitu 700 Dia -allow 15m | m | 60 | 800 | | | | 48,000 | 48,000 |
| | Abutments and Curtain Wall | m3 | 23 | 1400 | 9,837 | 6,558 | 16,395 | | 32,791 |
| | Pile Caps | m3 | 0 | 1200 | 0 | 0 | 0 | | 0 |
| | Piers | m3 | 0 | 1400 | 0 | 0 | 0 | | 0 |
| | Headstocks | m3 | | 1600 | 0 | 0 | 0 | | 0 |
| | Bearing pads | No | 4 | 4500 | 5,400 | 3,600 | 9,000 | | 18,000 |
| | Super Tees 12m x 1200 2.4T/m | T | 57.6 | 900 | 15,552 | 10,368 | 25,920 | | 51,840 |
| | Est Crane | Item | 1 | 20000 | | | | 20,000 | 20,000 |
| | Install Beams | Each | 2 | 7000 | 4,200 | 2,800 | 7,000 | | 14,000 |
| | Perm Formwork | m2 | 19 | 180 | 1,037 | 691 | 1,728 | | 3,456 |
| | Diaphrams | m3 | 1.2 | 2000 | 720 | 480 | 1,200 | | 2,400 |
| | Approach slab | m² | 0 | 200 | 0 | 0 | 0 | | 0 |
| | Topping slab approx 200mm thick to top of PSC girders | m² | 59 | 300 | 5,292 | 3,528 | 8,820 | | 17,640 |
| | Expansion Joint | m | 10 | 600 | 1,764 | 1,176 | 2,940 | | 5,880 |
| | Parapet | m | 24 | 300 | 2,160 | 1,440 | 3,600 | | 7,200 |
| | 700mm Walkway | m2 | 8 | 800 | 2,016 | 1,344 | 3,360 | | 6,720 |
| | Handrail | m | 24 | 150 | 1,080 | 720 | 1,800 | | 3,600 |
| | Membrane | m² | 59 | 40 | 706 | 470 | 1,176 | | 2,352 |
| | **TOTAL ITEM S1** | **Each** | **1** | **317879** | **49,764** | **33,176** | **82,939** | **68,000** | **317,879** |

| | Bridge Type 1 -15m Long | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| S2 | **Allow 1 Span x 15m** | **m** | **15** | | | | | | |
| | **Spans** | **No** | **1** | | | | | | |
| | **Width incl Parapet** | **m** | **4.9** | | | | | | |
| | **Bridge Area** | **m2** | **73.5** | | | | | | |
| | **Bridge Type: Super Tee -Type 1** | | | | | | | | |
| | Access Road | m2 | 75 | 150 | | | | 11,250 | 11,250 |
| | Platform | m2 | 100 | 400 | | | | 40,000 | 40,000 |
| | Est Pile Rig | Item | 1 | 30000 | | | | 30,000 | 30,000 |
| | Rig Moves | No | 1 | 5000 | | | | 5,000 | 5,000 |
| | Pile Cast Insitu 700 Dia -allow 15m | m | 60 | 800 | | | | 48,000 | 48,000 |
| | Abutments and Curtain Wall | m3 | 23 | 1400 | 9,837 | 6,558 | 16,395 | | 32,791 |
| | Pile Caps | m3 | 0 | 1200 | 0 | 0 | 0 | | 0 |
| | Piers | m3 | 0 | 1400 | 0 | 0 | 0 | | 0 |
| | Headstocks | m3 | | 1600 | 0 | 0 | 0 | | 0 |
| | Bearing pads | No | 4 | 4500 | 5,400 | 3,600 | 9,000 | | 18,000 |
| | Est Crane | Item | 1 | 20000 | | | | 20,000 | 20,000 |
| | Super Tees 15m x 1200 2.4T/m | T | 72 | 900 | 19,440 | 12,960 | 32,400 | | 64,800 |
| | Install Beams | Each | 2 | 7000 | 4,200 | 2,800 | 7,000 | | 14,000 |
| | Perm Formwork | m2 | 24 | 180 | 1,296 | 864 | 2,160 | | 4,320 |
| | Diaphrams | m3 | 1.2 | 2000 | 720 | 480 | 1,200 | | 2,400 |
| | Approach slab | m² | 0 | 200 | 0 | 0 | 0 | | 0 |
| | Topping slab approx 200mm thick to top of PSC girders | m² | 74 | 300 | 6,615 | 4,410 | 11,025 | | 22,050 |
| | Expansion Joint | m | 10 | 600 | 1,764 | 1,176 | 2,940 | | 5,880 |
| | Parapet | m | 30 | 300 | 2,700 | 1,800 | 4,500 | | 9,000 |
| | 700mm Walkway | m2 | 11 | 800 | 2,520 | 1,680 | 4,200 | | 8,400 |
| | Handrail | m | 30 | 150 | 1,350 | 900 | 2,250 | | 4,500 |
| | Membrane | m² | 74 | 40 | 882 | 588 | 1,470 | | 2,940 |
| | **TOTAL ITEM S2** | **Each** | **1** | **343331** | **56,724** | **37,816** | **94,540** | **68,000** | **343,331** |

# Galilee Basin Rail Corridor Construction Rates

## CULVERTS

| | Culvert - C1 | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| C1 | **1x3000x3000x5m** | Item | 1 | | | | | | |
| | 1/3.0m x 3.0m RC BC | m | 5 | | | | | | |
| | Excavation | m3 | 54 | 60 | 1,620 | 1,620 | | | 3,240 |
| | Foundation 800mm Road Base | m2 | 25 | 80 | 400 | 600 | 1,000 | | 2,000 |
| | Base Slab 300mm | m2 | 18 | 330 | 1,188 | 1,782 | 2,970 | | 5,940 |
| | Supply Units | m | 5.3 | 3,000 | | | 15,750 | | 15,750 |
| | Supply Links | m | 0 | 350 | | | 0 | | 0 |
| | Install Units | m | 5 | 700 | 1,838 | 1,838 | | | 3,675 |
| | Backfill | m3 | 60 | 60 | 720 | 1,080 | 1,800 | | 3,600 |
| | Headwalls -Cast Insitu | No | 2 | | | | | | |
| | Exc,FRP | m3 | 18 | 1,600 | | | | 28,800 | 28,800 |
| | Handrail | m | 8 | 200 | | | | 1,600 | 1,600 |
| | **TOTAL ITEM C1** | **Item** | **1** | **64,605** | **5,766** | **6,920** | **21,520** | **30,400** | **64,605** |

| | Culvert - C2 | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| C2 | **2x3000x3000x5m** | Item | 1 | | | | | | |
| | 2/3.0m x 3.0m RC BC | m | 5 | | | | | | |
| | Excavation | m3 | 81 | 60 | 2,430 | 2,430 | | | 4,860 |
| | Foundation 800mm Road Base | m2 | 40 | 80 | 640 | 960 | 1,600 | | 3,200 |
| | Base Slab 300mm | m2 | 37 | 330 | 2,442 | 3,663 | 6,105 | | 12,210 |
| | Supply Units | m | 10.5 | 3,000 | | | 31,500 | | 31,500 |
| | Supply Links | m | 0 | 350 | | | 0 | | 0 |
| | Install Units | m | 21 | 700 | 7,350 | 7,350 | | | 14,700 |
| | Backfill | m3 | 60 | 60 | 720 | 1,080 | 1,800 | | 3,600 |
| | Headwalls -Cast Insitu | No | 2 | | | | | | |
| | Exc,FRP | m3 | 24 | 2,000 | | | | 48,000 | 48,000 |
| | Handrail | m | 16 | 200 | | | | 3,200 | 3,200 |
| | **TOTAL ITEM C2** | **Item** | **1** | **121,270** | **13,582** | **15,483** | **41,005** | **51,200** | **121,270** |

| | Culvert - C3 | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| C3 | **3x3000x3000x5m** | Item | 1 | | | | | | |
| | 3/3.0m x 3.0m RC BC | m | 5 | | | | | | |
| | Excavation | m3 | 117 | 60 | 3,510 | 3,510 | | | 7,020 |
| | Foundation 800mm Road Base | m2 | 65 | 80 | 1,040 | 1,560 | 2,600 | | 5,200 |
| | Base Slab 300mm | m2 | 58 | 330 | 3,795 | 5,693 | 9,488 | | 18,975 |
| | Supply Units | m | 15.8 | 3,000 | | | 47,250 | | 47,250 |
| | Supply Links | m | 0 | 350 | | | 0 | | 0 |
| | Install Units | m | 47 | 700 | 16,538 | 16,538 | | | 33,075 |
| | Backfill | m3 | 60 | 60 | 720 | 1,080 | 1,800 | | 3,600 |
| | Headwalls -Cast Insitu | No | 2 | | | | | | |
| | Exc,FRP | m3 | 38 | 2,000 | | | | 76,000 | 76,000 |
| | Handrail | m | 22 | 200 | | | | 4,400 | 4,400 |
| | **TOTAL ITEM C3** | **Item** | **1** | **195,520** | **25,603** | **28,380** | **61,138** | **80,400** | **195,520** |

| | Culvert - C4 | | | Rate | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|
| C4 | **3x3000x3000x9m** | Item | 1 | | | | | | |
| | 3/3.0m x 3.0m RC BC | m | 9 | | | | | | |
| | Excavation | m3 | 211 | 60 | 6,318 | 6,318 | | | 12,636 |
| | Foundation 800mm Road Base | m2 | 117 | 80 | 1,872 | 2,808 | 4,680 | | 9,360 |
| | Base Slab 300mm | m2 | 104 | 330 | 6,831 | 10,247 | 17,078 | | 34,155 |
| | Supply Units | m | 28.4 | 3,000 | | | 85,050 | | 85,050 |
| | Supply Links | m | 0 | 350 | | | 0 | | 0 |
| | Install Units | m | 85 | 700 | 29,768 | 29,768 | | | 59,535 |
| | Backfill | m3 | 108 | 60 | 1,296 | 1,944 | 3,240 | | 6,480 |
| | Headwalls -Cast Insitu | No | 2 | | | | | | |
| | Exc,FRP | m3 | 38 | 2,000 | | | | 76,000 | 76,000 |
| | Handrail | m | 22 | 200 | | | | 4,400 | 4,400 |
| | **TOTAL ITEM C4** | **Item** | **1** | **287,616** | **46,085** | **51,084** | **110,048** | **80,400** | **287,616** |

# Galilee Basin Rail Corridor Construction Rates

## INCIDENTAL RATES

| | Road Re Alignment | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| I1 | | m | 500 | | | | | | | |
| | Clear | m2 | 10000 | 2 | | | | | 20,000 | 20,000 |
| | Strip Topsoil | m3 | 1500 | 20 | | | | | 30,000 | 30,000 |
| | Foundation Treatment | m2 | 10000 | 5 | | | | | 50,000 | 50,000 |
| | Cut/Fill from Rail Formation allow 1m above Natural Surface | m3 | 10000 | 16 | | | | | 160,000 | 160,000 |
| | Roadworks 9m wide including shoulders | m2 | 4500 | 160 | | | | | 720,000 | 720,000 |
| | Transverse Drainage -allow 1 crossing/100m | m | 5 | 20000 | | | | | 100,000 | 100,000 |
| | Signage | No | 10 | 400 | | | | | 4,000 | 4,000 |
| | Topsoil and Hydroseed Batters | m2 | 3000 | 10 | | | | | 30,000 | 30,000 |
| | No alowance for Lighting | | | | | | | | | |
| | No allowance for kerbing or Longitudinal Drainage | | | | | | | | | |
| | TOTAL ITEM I1 | m | 500 | 2228 | | 0 | 0 | 0 | 0 | 1,114,000 |

| | Protection of Pipelines | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| I2 | | m | 500 | | | | | | | |
| | Excavation | m3 | 32.5 | 50 | | | | | 1,625 | 1,625 |
| | PotHoling and Monitoring | Item | 1 | 5000 | | | | | 5,000 | 5,000 |
| | 200mm Protection slab allow 20m long | m2 | 20 | 300 | | | | | 6,000 | 6,000 |
| | Establish Pile Rig | Item | 1 | 30000 | | | | | 30,000 | 30,000 |
| | 750mm Piles x 8m deep | m | 32 | 1500 | | | | | 48,000 | 48,000 |
| | Top of Piles | No | 4 | 600 | | | | | 2,400 | 2,400 |
| | Loose Sand | m3 | 9.6 | 50 | | | | | 480 | 480 |
| | Blinding | m2 | 30.25 | 55 | | | | | 1,664 | 1,664 |
| | 1.0m Concrete Slab | m2 | 26.01 | 1500 | | | | | 39,015 | 39,015 |
| | Backfill | m3 | 48 | 20 | | | | | 960 | 960 |
| | Pipeline Super visor | hr | 40 | 150 | | | | | 6,000 | 6,000 |
| | Approvals | Item | 1 | 100000 | | | | | 100,000 | 100,000 |
| | No alowance for Lighting | | | | | | | | | |
| | No allowance for kerbing or Longitudinal Drainage | | | | | | | | | |
| | TOTAL ITEM I2 | Each | 1 | 241144 | | 0 | 0 | 0 | 0 | 241,144 |

| | Noise Attenuation | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| I3 | | each | 100 | | | | | | | |
| | Glasng of standard House | Item | 100 | 18000 | | | | | 1,800,000 | 1,800,000 |
| | A/Condition | Item | 100 | 4000 | | | | | 400,000 | 400,000 |
| | TOTAL ITEM I3 | each | 100 | 22000 | | 0 | 0 | 0 | 0 | 2,200,000 |

| | Rehabiliation -Low | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| I4 | | m | 1000 | | | | | | | |
| | Trim Batters to grade | m2 | 6000 | 1 | | | | | 6,000 | 6,000 |
| | Topsoil Batters -site won material- allow 3m batters x 2 sides | m2 | 6000 | 4 | | | | | 24,000 | 24,000 |
| | Hydroseed | m2 | 6000 | 1 | | | | | 6,000 | 6,000 |
| | Maintain | m2 | 6000 | 1 | | | | | 6,000 | 6,000 |
| | TOTAL ITEM I4 | Klm | 1 | 42000 | | 0 | 0 | 0 | 0 | 42,000 |

| | Rehabiliation - Medium | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| I5 | | m | 1000 | | | | | | | |
| | Trim Batters to grade | m2 | 6000 | 1 | | | | | 6,000 | 6,000 |
| | Topsoil Batters -site won material- allow 3m batters x 2 sides | m2 | 6000 | 4 | | | | | 24,000 | 24,000 |
| | Hydroseed | m2 | 6000 | 1 | | | | | 6,000 | 6,000 |
| | Minor Planting - Viro | each | 30000 | 3 | | | | | 90,000 | 90,000 |
| | Maintain | m2 | 6000 | 1 | | | | | 6,000 | 6,000 |
| | TOTAL ITEM I5 | Klm | 1 | 132000 | | 0 | 0 | 0 | 0 | 132,000 |

# Galilee Basin Rail Corridor Construction Rates

## CONSTRUCTION CAMP

| | Main Office Set Up and Demobilisation | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| IC1 | | Item | 1 | | | | | | | |
| | **Establishment** | | | | | | | | | |
| | Allow area 100m x 70m for Accomodation | | | | | | | | | |
| | Allow are 60m x 50m Storage | | | | | | | | | |
| | Clear | m2 | 10000 | 2 | | | | | 20,000 | 20,000 |
| | Strip Topsoil | m3 | 1500 | 20 | | | | | 30,000 | 30,000 |
| | Two Coat Seal Pavement | m2 | 5000 | 60 | | | | | 300,000 | 300,000 |
| | Gravel Pavement | m2 | 3000 | 40 | | | | | 120,000 | 120,000 |
| | Fencing | m | 500 | 52 | | | | | 26,000 | 26,000 |
| | Gates | No | 3 | 750 | | | | | 2,250 | 2,250 |
| | Shaker Grids | No | 2 | 5000 | | | | | 10,000 | 10,000 |
| | Sed Basin | No | 1 | 15000 | | | | | 15,000 | 15,000 |
| | Transport Sheds to Site | Item | 1 | 80000 | | | | | 80,000 | 80,000 |
| | Erect Sheds | Item | 1 | 60000 | | | | | 60,000 | 60,000 |
| | Office Fitout | Item | 1 | 30000 | | | | | 30,000 | 30,000 |
| | Power Connections and setup in offices | Item | 1 | 30000 | | | | | 30,000 | 30,000 |
| | Standby Geny | Item | 1 | 200000 | | | | | 200,000 | 200,000 |
| | Power to Site -Plug | Item | 1 | 250000 | | | | | 250,000 | 250,000 |
| | Telecommunications to Site -Plug | Item | 1 | 150000 | | | | | 150,000 | 150,000 |
| | Water Tanks | No | 3 | 6000 | | | | | 18,000 | 18,000 |
| | Sewer and water setup | Item | 1 | 15000 | | | | | 15,000 | 15,000 |
| | Telecommunications | Item | 1 | 10000 | | | | | 10,000 | 10,000 |
| | Radio and Satelite Communications setup for Office and Vehicles | Item | 1 | 35000 | | | | | 35,000 | 35,000 |
| | Office IT and Seciurity | Item | 1 | 25000 | | | | | 25,000 | 25,000 |
| | Walkways | m2 | 300 | 60 | | | | | 18,000 | 18,000 |
| | Pergolas | m2 | 1200 | 150 | | | | | 180,000 | 180,000 |
| | Set up Work shop | Item | 1 | 20000 | | | | | 20,000 | 20,000 |
| | Set up and Licience for Fuel Farm | Item | 1 | 20000 | | | | | 20,000 | 20,000 |
| | | | | | | | | | | |
| | **Plant Establishment** | | | | | | | | | |
| | Dozers | No | 10 | 9000 | | | | | 90,000 | 90,000 |
| | Excavators | No | 20 | 1500 | | | | | 30,000 | 30,000 |
| | Backhoes and Loaders | No | 30 | 1000 | | | | | 30,000 | 30,000 |
| | Scrapers | No | 8 | 12000 | | | | | 96,000 | 96,000 |
| | Rollers and Compactors | No | 6 | 3500 | | | | | 21,000 | 21,000 |
| | Off Highway Trucks | No | 10 | 2000 | | | | | 20,000 | 20,000 |
| | Graders | No | 10 | 1500 | | | | | 15,000 | 15,000 |
| | Batch Plants and Pugmills | No | 3 | 10000 | | | | | 30,000 | 30,000 |
| | Misc | No | 20 | 1200 | | | | | 24,000 | 24,000 |
| | On site Moves | No | 1000 | 700 | | | | | 700,000 | 700,000 |
| | | | | | | | | | | |
| | **Disestablishment** | | | | | | | | | |
| | Load out Buildings | Item | 1 | 50000 | | | | | 50,000 | 50,000 |
| | Disconnection of Services | Item | 1 | 25000 | | | | | 25,000 | 25,000 |
| | Remove Workshop and fuel farm | Item | 1 | 15000 | | | | | 15,000 | 15,000 |
| | Remove fencing | m | 500 | 12 | | | | | 6,000 | 6,000 |
| | Remove Hardstand | m3 | 2400 | 10 | | | | | 24,000 | 24,000 |
| | Retopsoil and Hydroseed and Water | m2 | 8000 | 10 | | | | | 80,000 | 80,000 |
| | | | | | | | | | | |
| | **TOTAL ITEM IC1** | **m** | **1** | **2920250** | | **0** | **0** | **0** | **0** | **2,920,250** |

| | Satelite Office Set Up and Demobilisation | | | Rate | | Labour | Plant | Material | Sub Con | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| IC2 | | Each | 1 | | | | | | | |
| | **Establishment** | | | | | | | | | |
| | Allow area 60m x 50m for Accomodation and Storage | | | | | | | | | |
| | Clear | m2 | 3000 | 2 | | | | | 6,000 | 6,000 |
| | Strip Topsoil | m3 | 450 | 20 | | | | | 9,000 | 9,000 |
| | Gravel Pavement | m2 | 3000 | 45 | | | | | 135,000 | 135,000 |
| | Fencing | m | 300 | 52 | | | | | 15,600 | 15,600 |
| | Gates | No | 2 | 750 | | | | | 1,500 | 1,500 |
| | Shaker Grids | No | 1 | 5000 | | | | | 5,000 | 5,000 |
| | Sed Basin | No | 1 | 10000 | | | | | 10,000 | 10,000 |
| | Erect Sheds | Item | 1 | 20000 | | | | | 20,000 | 20,000 |
| | Office Fitout | Item | 1 | 8000 | | | | | 8,000 | 8,000 |
| | Power Connections -Geny | Item | 1 | 60000 | | | | | 60,000 | 60,000 |
| | Sewer and water- Portable | Item | 1 | 15000 | | | | | 15,000 | 15,000 |
| | Telecommunications | Item | 1 | 10000 | | | | | 10,000 | 10,000 |
| | Radio and Satelite Communications setup for Office | Item | 1 | 10000 | | | | | 10,000 | 10,000 |
| | Office IT and Seciurity | Item | 1 | 8000 | | | | | 8,000 | 8,000 |
| | Walkways | m2 | 100 | 60 | | | | | 6,000 | 6,000 |
| | | | | | | | | | | |
| | **Disestablishment** | | | | | | | | | |
| | Load out Buildings | Item | 1 | 20000 | | | | | 20,000 | 20,000 |
| | Disconnection of Services | Item | 1 | 15000 | | | | | 15,000 | 15,000 |
| | Remove fencing and Gates | m | 300 | 20 | | | | | 6,000 | 6,000 |
| | Remove Hardstand | m3 | 3000 | 10 | | | | | 30,000 | 30,000 |
| | Retopsoil and Hydroseed and Water | m2 | 3000 | 10 | | | | | 30,000 | 30,000 |
| | | | | | | | | | | |
| | **TOTAL ITEM IC2** | **Each** | **1** | **420100** | | **0** | **0** | **0** | **0** | **420,100** |

# Appendix 7 (A) GIC Rail Systems Analysis

## GIC - 40TAL

The outputs from the simulation of a 3 locomotive by 270 wagons train are summarised in the table below. The length of the train is approximately 5.3kms.

**Assumptions - Simulation Outputs**

Train Configuration - 3 Locomotives * 270 Wagons

Operational Days per Year - 320 (20 - Track/Mine/Port Maint, 15 - network inefficiencies, 10 - rollingstock reli

Loading Time - 4.5 Hours

Unloading Time - 4.5 Hours

| | Hours | Distance | Fuel | Fuel Savings | Energy (GJ) |
|---|---|---|---|---|---|
| Loading/Unloading | | | 2932.5 | | |
| Empty Trip | 7.75 | 573 | 17383 | 0.09 | 345.74 |
| Loaded Trip | 11.3 | 573 | 23846 | 0.09 | 447.17 |

| Mine Name (Abbr) | Mine Name | Mainline (kms) | Spurline (Kms) | Trip Distance | Loaded Trip | Unloaded Trip | Transit Time | Provisioning | Marshalling / Crew | Fuel / Trip |
|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | AMCI | 573 | 65 | 1276 | 12.48 | 8.45 | 20.93 | 2 | 5 | 44147 |
| Waratah CFC | Waratah - China First Coal | 573 | 21 | 1188 | 11.61 | 7.85 | 19.47 | 2 | 5 | 41266 |
| Waratah ANC | Waratah - Alpha North Coal | 530 | 10 | 1080 | 10.48 | 7.01 | 17.50 | 2 | 4.5 | 37381 |
| Waratah AWC | Waratah - Alpha West Coal | 523 | 27 | 1100 | 10.73 | 7.29 | 18.02 | 2 | 4.5 | 38411 |
| HanGVK KC | Hancock/GVK - Kevin's Corner | 548 | 15 | 1126 | 11.02 | 7.48 | 18.50 | 2 | 5 | 39354 |
| HanGVK AC | Hancock/GVK - Alpha Coal | 553 | 21 | 1148 | 11.24 | 7.61 | 18.85 | 2 | 5 | 40048 |
| HanGVK AW | Hancock/GVK - Alpha West | 553 | 28 | 1162 | 11.36 | 7.71 | 19.07 | 2 | 5 | 40492 |
| Vale | Vale | 497 | 10 | 1014 | 9.97 | 6.84 | 16.81 | 2 | 4.5 | 36043 |
| Adani 1 | Adani 1 (T0) | 430 | 10 | 880 | 9.03 | 6.12 | 15.15 | 2 | 4 | 32755 |
| Adani 2 | Adani 2 (Balance) | 430 | 10 | 880 | 9.03 | 6.12 | 15.15 | 2 | 4 | 32755 |
| Bowen 1 | Bowen 1 | 235 | 10 | 490 | 5 | 3.57 | 8.57 | 2 | 2.5 | 19821 |
| Mac Sth | Macmines South | 398 | 25 | 846 | 8.36 | 5.72 | 14.08 | 2 | 4 | 30660 |

The key outputs, as listed in the table below, include (a) the payload per train / year, and (b) fuel cost / year for each of the mines.

| | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match T0 | Adani 2 - rest of Adani | Bowen 1 | Mac mines South |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Payload / train / year (Mtpa)** | 6.82 | 7.10 | 7.63 | 7.51 | 7.30 | 7.22 | 7.18 | 7.79 | 8.35 | 8.35 | 11.41 | 8.66 |
| **Fuel $ / mine / train ($m)** | 10.14 | 9.87 | 9.60 | 9.71 | 9.67 | 9.74 | 9.79 | 9.45 | 9.21 | 9.21 | 7.62 | 8.94 |

## GIC - 32.5TAL

The outputs from the simulation of a 3 locomotive by 300 wagons train are summarised in the table below. The length of the train is approximately 5.0 kms.

**Assumptions - Simulation Outputs**

Train Configuration - 3 Locomotives * 300 Wagons | Operational Days per Year - 320 (20 - Track/Mine/Port Maint, 15 - network inefficiencies, 10 - rollingstock reli
Loading Time - 5 Hours
Unloading Time - 5 Hours

| | Hours | Distance | Fuel | Fuel Savings | Energy (GJ) |
|---|---|---|---|---|---|
| Loading/Unloading | | | 2932.5 | | |
| Empty Trip | 7.5 | 573 | 16905 | 0.09 | 345.74 |
| Loaded Trip | 10.75 | 573 | 22454 | 0.09 | 447.17 |

| Mine Name (Abbr) | Mine Name | Mainline (kms) | Spurline (Kms) | Trip Distance | Loaded Trip | Unloaded Trip | Transit Time | Provisioning | Marshalling / Crew | Fuel / Trip |
|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | AMCI | 573 | 65 | 1276 | 11.87 | 8.17 | 20.04 | 2 | 5 | 42253 |
| Waratah CFC | Waratah - China First Coal | 573 | 21 | 1188 | 11.04 | 7.59 | 18.64 | 2 | 5 | 39503 |
| Waratah ANC | Waratah - Alpha North Coal | 530 | 10 | 1080 | 9.97 | 6.78 | 16.75 | 2 | 4.5 | 35780 |
| Waratah AWC | Waratah - Alpha West Coal | 523 | 27 | 1100 | 10.20 | 7.05 | 17.25 | 2 | 4.5 | 36785 |
| HanGVK KC | Hancock/GVK - Kevin's Corner | 548 | 15 | 1126 | 10.48 | 7.23 | 17.71 | 2 | 5 | 37684 |
| HanGVK AC | Hancock/GVK - Alpha Coal | 553 | 21 | 1148 | 10.69 | 7.36 | 18.05 | 2 | 5 | 38346 |
| HanGVK AW | Hancock/GVK - Alpha West | 553 | 28 | 1162 | 10.80 | 7.46 | 18.26 | 2 | 5 | 38769 |
| Vale | Vale | 497 | 10 | 1014 | 9.49 | 6.62 | 16.11 | 2 | 4.5 | 34541 |
| Adani 1 | Adani 1 (T0) | 430 | 10 | 880 | 8.61 | 5.93 | 14.53 | 2 | 4 | 31450 |
| Adani 2 | Adani 2 (Balance) | 430 | 10 | 880 | 8.61 | 5.93 | 14.53 | 2 | 4 | 31450 |
| Bowen 1 | Bowen 1 | 235 | 10 | 490 | 5 | 3.57 | 8.57 | 2 | 2.5 | 19759 |
| Mac Sth | Macmines South | 398 | 25 | 846 | 7.96 | 5.54 | 13.50 | 2 | 4 | 29424 |

The key outputs, as listed in the table below, include (a) the payload per train / year, and (b) fuel cost / year for each of the mines.

| | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match T0 | Adani 2 - rest of Adani | Bowen 1 | Mac mines South |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Payload / train / year (Mtpa)** | 6.14 | 6.38 | 6.84 | 6.74 | 6.55 | 6.49 | 6.45 | 6.97 | 7.45 | 7.45 | 9.86 | 9.86 |
| **Fuel $ / mine / train ($m)** | 9.67 | 9.40 | 9.12 | 9.24 | 9.20 | 9.23 | 9.32 | 8.98 | 8.74 | 8.74 | 7.26 | 7.26 |

## GIC - 26.5TAL

The outputs from the simulation of a 4 locomotive by 300 wagons train are summarised in the table below. The length of the train is approximately 5.0 kms.

**Assumptions - Simulation Outputs**

Train Configuration - 4 Locomotives (GT42) * 300 Wagons
Operational Days per Year - 320 (20 - Track/Mine/Port Maint, 15 - network inefficiencies, 10 - rollingstock reli
Loading Time - 5 Hours
Unloading Time - 5 Hours

| | Hours | Distance | Fuel | Fuel Savings | Energy (GJ) |
|---|---|---|---|---|---|
| Loading/Unloading | | | 3910 | | |
| Empty Trip | 7.80 | 573 | 15934 | 0.09 | 345.74 |
| Loaded Trip | 10.6 | 573 | 19993 | 0.09 | 447.17 |

| Mine Name (Abbr) | Mine Name | Mainline (kms) | Spurline (Kms) | Trip Distance | Loaded Trip | Unloaded Trip | Transit Time | Provisioning | Marshalling / Crew | Fuel / Trip |
|---|---|---|---|---|---|---|---|---|---|---|
| AMCI | AMCI | 573 | 65 | 1276 | 11.70 | 8.50 | 20.21 | 2 | 5 | 39806 |
| Waratah CFC | Waratah - China First Coal | 573 | 21 | 1188 | 10.89 | 7.91 | 18.79 | 2 | 5 | 37296 |
| Waratah ANC | Waratah - Alpha North Coal | 530 | 10 | 1080 | 9.83 | 7.06 | 16.89 | 2 | 4.5 | 33900 |
| Waratah AWC | Waratah - Alpha West Coal | 523 | 27 | 1100 | 10.06 | 7.33 | 17.40 | 2 | 4.5 | 34814 |
| HanGVK KC | Hancock/GVK - Kevin's Corner | 548 | 15 | 1126 | 10.33 | 7.52 | 17.86 | 2 | 5 | 35634 |
| HanGVK AC | Hancock/GVK - Alpha Coal | 553 | 21 | 1148 | 10.53 | 7.66 | 18.20 | 2 | 5 | 36238 |
| HanGVK AW | Hancock/GVK - Alpha West | 553 | 28 | 1162 | 10.65 | 7.77 | 18.42 | 2 | 5 | 36625 |
| Vale | Vale | 497 | 10 | 1014 | 9.35 | 6.88 | 16.24 | 2 | 4.5 | 32762 |
| Adani 1 | Adani 1 (T0) | 430 | 10 | 880 | 8.49 | 6.16 | 14.65 | 2 | 4 | 29931 |
| Adani 2 | Adani 2 (Balance) | 430 | 10 | 880 | 8.49 | 6.16 | 14.65 | 2 | 4 | 29931 |
| Bowen 1 | Bowen 1 | 235 | 10 | 490 | 5 | 3.57 | 8.57 | 2 | 2.5 | 19128 |
| Mac Sth | Macmines South | 398 | 25 | 846 | 7.85 | 5.75 | 13.61 | 2 | 4 | 28087 |

The key outputs, as listed in the table below, include (a) the payload per train / year, and (b) fuel cost / year for each of the mines.

| | AMCI | Waratah - China First Coal | Waratah - Alpha North Coal | Waratah - Alpha West Coal | Hancock / GVK - Kevin's Corner | Hancock / GVK - Alpha Coal | Hancock / GVK - Alpha West | Vale | Adani 1 - scaled to match T0 | Adani 2 - rest of Adani | Bowen 1 | Mac mines South |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Payload / train / year (Mtpa)** | 4.82 | 5.01 | 5.37 | 5.29 | 5.14 | 5.09 | 5.06 | 5.48 | 5.85 | 5.85 | 7.77 | 6.05 |
| **Fuel $ / mine / train ($m)** | 9.07 | 8.83 | 8.61 | 8.71 | 8.66 | 8.72 | 8.76 | 8.49 | 8.28 | 8.28 | 7.03 | 8.03 |

# Appendix 7 (B) Above Rail Train Models

## TRAIN SYSTEM MODEL

| | Value | Unit | | | Value | Unit |
|---|---|---|---|---|---|---|
| | | | | **FUEL COST** | | |
| **MINE** | Mac Nth | | | Fuel per Trip | 33943 | L |
| | | | | Fuel per Year | 7800042 | ML |
| | | | | Fuel Cost | 1.2 | $/L |
| **HAULAGE REQUIREMENT** | | | | Overall Fuel Cost | 9.3601 | $m / Year |
| Payload per Year | 8.19 | MT | | | | |
| | | | | **CAPEX COST** | | |
| **TRAIN CONFIGURATION** | | | | Locomotive Price | 3.5 | $m / Loco |
| Track Axle Load | 40 | T | | Locomotive Overhaul % | 0.75 | % |
| Locomotive Mass | 196 | T | | Wagon Price | 0.13 | $m / Wagon |
| Wagon Tare Mass | 26 | T | | Wagon Overhaul % | 0.5 | % |
| Locomotives per Train | 3 | Locos | | Locomotive Fleet | 4 | Locos |
| Wagons per Train | 270 | Wagons | | Wagon Fleet | 261 | Wagons |
| Payload per Wagon | 132 | T | | Capital Spares (Locos/Wagons) | 1.0 | $m |
| Payload per Train | 35640 | T | | Rollingstock Initial Capex | 47.9 | $m |
| | | | | Locomotive Overhaul Capex | 21.0 | $m |
| **CYCLE TIME** | | | | Wagon Overhaul Capex | 17.0 | $m |
| Loading per Wagon | 1 | min | | | | |
| Unloading per Wagon | 1 | min | | **MAINTENANCE COST (Incl Facility Charge)** | | |
| Loading Time | 4.50 | Hrs | | Model Life | 30 | Years |
| Unloading Time | 4.50 | Hrs | | Annual Distance | 242 | Kms (k) |
| Provisioning | 2.00 | Hrs | | Energy per Trip | 655 | GJ |
| Marshalling | 4.00 | Hrs | | Annual Power | 15152 | MWhrs / Loco |
| Loaded Trip | 9.41 | Hrs | | Locomotive per Year | 0.4 | $m / Loco |
| Unloaded Trip | 6.34 | Hrs | | Wagon per Year | 0.012 | $m / Wagon |
| Days per Trips | 1.28 | Trips | | Rollingstock Maintenance | 4.3 | $m / Year |
| Operational Days | 320 | Days | | Locomotives Facility Charge | 0.018 | $m / Loco / Yr |
| Trips per Year | 250 | Trips | | Wagons Facility Charge | 0.0004 | $m / Wagon / Yr |
| Trip Distance | 970 | Kms | | Maintenance Cost USD | 0.533 | $m / Yr |
| | | | | Maintenance Cost AUD | 4.373 | $m / Yr |
| **PAYLOAD** | | | | **TRAIN CREW/CONTROL COST** | | |
| Payload per Year | 8.90 | MTpa/Train | | Drivers | 0.15 | Salary / Yr |
| | | | | Crews (2 man crews) | 3 | Crews / Train |
| **ROLLING STOCK REQUIREMENTS** | | | | Total Drivers | 6 | People |
| Trains for Payload | 0.920 | Trains | | Overall Crews (10% Overhead) | 0.99 | $m / Year |
| Locomotives | 2.76 | Locos | | Train Control | 0.12 | Salary / Yr |
| Wagons | 248.42 | Wagons | | Max Trains per Controller | 4 | Trains |
| % Spare Locos | 0.10 | % | | Train Control Team | 0.75 | People |
| % Spare Wagons | 0.05 | % | | Overall Train Control | 0.09 | $m / Year |
| Spare Locomotives | 0.28 | Qty | | Overall Labour Cost | 1.08 | $m / Year |
| Spare Wagons | 12.42 | Qty | | | | |
| | | | | **LIFE CYCLE COST** | | |
| **INPUT DATA** | | | | Life Cycle Cost per Year | 0.007 | $ / Tkm |
| Simulation Output | (green) | | | Life Cycle Cost | 416 | $m |
| Market Price | (yellow) | | | | | |
| Operational Experience | (blue) | | | | | |
| Customer | (grey) | | | | | |

## TRAIN SYSTEM MODEL

| | Value | Unit | | | Value | Unit |
|---|---|---|---|---|---|---|
| | | | | **FUEL COST** | | |
| **MINE** | **HanGVK KC** | | | Fuel per Trip | 39354 | L |
| | | | | Fuel per Year | 8060622 | ML |
| | | | | Fuel Cost | 1.2 | $/L |
| **HAULAGE REQUIREMENT** | | | | Overall Fuel Cost | 9.6727 | $m / Year |
| Payload per Year | **7.30** | MT | | | | |
| | | | | **CAPEX COST** | | |
| **TRAIN CONFIGURATION** | | | | Locomotive Price | 3.5 | $m / Loco |
| Track Axle Load | 40 | T | | Locomotive Overhaul % | 0.75 | % |
| Locomotive Mass | 196 | T | | Wagon Price | 0.13 | $m / Wagon |
| Wagon Tare Mass | 26 | T | | Wagon Overhaul % | 0.5 | % |
| Locomotives per Train | 3 | Locos | | Locomotive Fleet | 4 | Locos |
| Wagons per Train | 270 | Wagons | | Wagon Fleet | 261 | Wagons |
| Payload per Wagon | 132 | T | | Capital Spares (Locos/Wagons) | 1.0 | $m |
| Payload per Train | 35640 | T | | Rollingstock Initial Capex | 47.9 | $m |
| | | | | Locomotive Overhaul Capex | 21.0 | $m |
| **CYCLE TIME** | | | | Wagon Overhaul Capex | 17.0 | $m |
| Loading per Wagon | 1 | min | | | | |
| Unloading per Wagon | 1 | min | | **MAINTENANCE COST (Incl Facility Charge)** | | |
| Loading Time | 4.50 | Hrs | | Model Life | 30 | Years |
| Unloading Time | 4.50 | Hrs | | Annual Distance | 251 | Kms (k) |
| Provisioning | 2.00 | Hrs | | Energy per Trip | 770 | GJ |
| Marshalling | 5.00 | Hrs | | Annual Power | 15865 | MWhrs / Loco |
| Loaded Trip | 11.02 | Hrs | | Locomotive per Year | 0.4 | $m / Loco |
| Unloaded Trip | 7.48 | Hrs | | Wagon per Year | 0.012 | $m / Wagon |
| Days per Trips | 1.44 | Trips | | Rollingstock Maintenance | 4.3 | $m / Year |
| Operational Days | 320 | Days | | Locomotives Facility Charge | 0.018 | $m / Loco / Yr |
| Trips per Year | 223 | Trips | | Wagons Facility Charge | 0.0004 | $m / Wagon / Yr |
| Trip Distance | 1126 | Kms | | Maintenance Cost USD | 0.533 | $m / Yr |
| | | | | Maintenance Cost AUD | 4.373 | $m / Yr |
| **PAYLOAD** | | | | **TRAIN CREW/CONTROL COST** | | |
| Payload per Year | 7.93 | MTpa/Train | | Drivers | 0.15 | Salary / Yr |
| | | | | Crews (2 man crews) | 3 | Crews / Train |
| **ROLLING STOCK REQUIREMENTS** | | | | Total Drivers | 6 | People |
| Trains for Payload | 0.920 | Trains | | Overall Crews (10% Overhead) | 0.99 | $m / Year |
| Locomotives | 2.76 | Locos | | Train Control | 0.12 | Salary / Yr |
| Wagons | 248.40 | Wagons | | Max Trains per Controller | 4 | Trains |
| % Spare Locos | 0.10 | % | | Train Control Team | 0.75 | People |
| % Spare Wagons | 0.05 | % | | Overall Train Control | 0.09 | $m / Year |
| Spare Locomotives | 0.28 | Qty | | Overall Labour Cost | 1.08 | $m / Year |
| Spare Wagons | 12.42 | Qty | | | | |
| | | | | **LIFE CYCLE COST** | | |
| **INPUT DATA** | | | | Life Cycle Cost per Year | 0.008 | $ / Tkm |
| Simulation Output | | | | Life Cycle Cost | 425 | $m |
| Market Price | | | | | | |
| Operational Experience | | | | | | |
| Customer | | | | | | |

# TRAIN SYSTEM MODEL

| | Value | Unit | | | Value | Unit |
|---|---|---|---|---|---|---|
| | | | | **FUEL COST** | | |
| **MINE** | HanGVK KC | | | Fuel per Trip | 37684 | L |
| | | | | Fuel per Year | 7667815 | ML |
| | | | | Fuel Cost | 1.2 | $/L |
| **HAULAGE REQUIREMENT** | | | | Overall Fuel Cost | 9.2014 | $m / Year |
| Payload per Year | 6.55 | MT | | | | |
| | | | | **CAPEX COST** | | |
| **TRAIN CONFIGURATION** | | | | Locomotive Price | 3.5 | $m / Loco |
| Track Axle Load | 32.5 | T | | Locomotive Overhaul % | 0.75 | % |
| Locomotive Mass | 196 | T | | Wagon Price | 0.13 | $m / Wagon |
| Wagon Tare Mass | 20.7 | T | | Wagon Overhaul % | 0.5 | % |
| Locomotives per Train | 3 | Locos | | Locomotive Fleet | 4 | Locos |
| Wagons per Train | 300 | Wagons | | Wagon Fleet | 290 | Wagons |
| Payload per Wagon | 107.3 | T | | Capital Spares (Locos/Wagons) | 1.0 | $m |
| Payload per Train | 32190 | T | | Rollingstock Initial Capex | 51.7 | $m |
| | | | | Locomotive Overhaul Capex | 21.0 | $m |
| **CYCLE TIME** | | | | Wagon Overhaul Capex | 18.8 | $m |
| Loading per Wagon | 1 | min | | | | |
| Unloading per Wagon | 1 | min | | **MAINTENANCE COST (Incl Facility Charge)** | | |
| Loading Time | 5.00 | Hrs | | Model Life | 30 | Years |
| Unloading Time | 5.00 | Hrs | | Annual Distance | 249 | Kms (k) |
| Provisioning | 2.00 | Hrs | | Energy per Trip | 769 | GJ |
| Marshalling | 5.00 | Hrs | | Annual Power | 15760 | MWhrs / Loco |
| Loaded Trip | 10.48 | Hrs | | Locomotive per Year | 0.4 | $m / Loco |
| Unloaded Trip | 7.23 | Hrs | | Wagon per Year | 0.012 | $m / Wagon |
| Days per Trips | 1.45 | Trips | | Rollingstock Maintenance | 4.7 | $m / Year |
| Operational Days | 320 | Days | | Locomotives Facility Charge | 0.018 | $m / Loco / Yr |
| Trips per Year | 221 | Trips | | Wagons Facility Charge | 0.0004 | $m / Wagon / Yr |
| Trip Distance | 1126 | Kms | | Maintenance Cost USD | 0.533 | $m / Yr |
| | | | | Maintenance Cost AUD | 4.731 | $m / Yr |
| **PAYLOAD** | | | | **TRAIN CREW/CONTROL COST** | | |
| Payload per Year | 7.12 | MTpa/Train | | Drivers | 0.15 | Salary / Yr |
| | | | | Crews (2 man crews) | 3 | Crews / Train |
| **ROLLING STOCK REQUIREMENTS** | | | | Total Drivers | 6 | People |
| Trains for Payload | 0.920 | Trains | | Overall Crews (10% Overhead) | 0.99 | $m / Year |
| Locomotives | 2.76 | Locos | | Train Control | 0.12 | Salary / Yr |
| Wagons | 275.89 | Wagons | | Max Trains per Controller | 4 | Trains |
| % Spare Locos | 0.10 | % | | Train Control Team | 0.75 | People |
| % Spare Wagons | 0.05 | % | | Overall Train Control | 0.09 | $m / Year |
| Spare Locomotives | 0.28 | Qty | | Overall Labour Cost | 1.08 | $m / Year |
| Spare Wagons | 13.79 | Qty | | | | |
| | | | | **LIFE CYCLE COST** | | |
| **INPUT DATA** | | | | Life Cycle Cost per Year | 0.009 | $ / Tkm |
| Simulation Output | | | | Life Cycle Cost | 417 | $m |
| Market Price | | | | | | |
| Operational Experience | | | | | | |
| Customer | | | | | | |

# TRAIN SYSTEM MODEL

| | Value | Unit | | Value | Unit |
|---|---|---|---|---|---|
| | | | **FUEL COST** | | |
| **MINE** | HanGVK KC | | Fuel per Trip | 35634 | L |
| | | | Fuel per Year | 7216627 | ML |
| | | | Fuel Cost | 1.2 | $/L |
| **HAULAGE REQUIREMENT** | | | Overall Fuel Cost | 8.6600 | $m / Year |
| Payload per Year | 5.14 | MT | | | |
| | | | **CAPEX COST** | | |
| **TRAIN CONFIGURATION** | | | Locomotive Price | 3.5 | $m / Loco |
| Track Axle Load | 26.5 | T | Locomotive Overhaul % | 0.75 | % |
| Locomotive Mass | 132 | T | Wagon Price | 0.13 | $m / Wagon |
| Wagon Tare Mass | 19.4 | T | Wagon Overhaul % | 0.5 | % |
| Locomotives per Train | 4 | Locos | Locomotive Fleet | 5 | Locos |
| Wagons per Train | 300 | Wagons | Wagon Fleet | 290 | Wagons |
| Payload per Wagon | 84.6 | T | Capital Spares (Locos/Wagons) | 1.1 | $m |
| Payload per Train | 25380 | T | Rollingstock Initial Capex | 55.1 | $m |
| | | | Locomotive Overhaul Capex | 26.3 | $m |
| **CYCLE TIME** | | | Wagon Overhaul Capex | 18.8 | $m |
| Loading per Wagon | 1 | min | | | |
| Unloading per Wagon | 1 | min | **MAINTENANCE COST (Incl Facility Charge)** | | |
| Loading Time | 5.00 | Hrs | Model Life | 30 | Years |
| Unloading Time | 5.00 | Hrs | Annual Distance | 248 | Kms (k) |
| Provisioning | 2.00 | Hrs | Energy per Trip | 769 | GJ |
| Marshalling | 5.00 | Hrs | Annual Power | 11773 | MWhrs / Loco |
| Loaded Trip | 10.33 | Hrs | Locomotive per Year | 0.4 | $m / Loco |
| Unloaded Trip | 7.52 | Hrs | Wagon per Year | 0.012 | $m / Wagon |
| Days per Trips | 1.45 | Trips | Rollingstock Maintenance | 5.1 | $m / Year |
| Operational Days | 320 | Days | Locomotives Facility Charge | 0.018 | $m / Loco / Yr |
| Trips per Year | 220 | Trips | Wagons Facility Charge | 0.0004 | $m / Wagon / Yr |
| Trip Distance | 1126 | Kms | Maintenance Cost USD | 0.667 | $m / Yr |
| | | | Maintenance Cost AUD | 5.014 | $m / Yr |
| **PAYLOAD** | | | **TRAIN CREW/CONTROL COST** | | |
| Payload per Year | 5.59 | MTpa/Train | Drivers | 0.15 | Salary / Yr |
| | | | Crews (2 man crews) | 3 | Crews / Train |
| **ROLLING STOCK REQUIREMENTS** | | | Total Drivers | 6 | People |
| Trains for Payload | 0.919 | Trains | Overall Crews (10% Overhead) | 0.99 | $m / Year |
| Locomotives | 3.68 | Locos | Train Control | 0.12 | Salary / Yr |
| Wagons | 275.76 | Wagons | Max Trains per Controller | 4 | Trains |
| % Spare Locos | 0.10 | % | Train Control Team | 0.75 | People |
| % Spare Wagons | 0.05 | % | Overall Train Control | 0.09 | $m / Year |
| Spare Locomotives | 0.37 | Qty | Overall Labour Cost | 1.08 | $m / Year |
| Spare Wagons | 13.79 | Qty | | | |
| | | | **LIFE CYCLE COST** | | |
| **INPUT DATA** | | | Life Cycle Cost per Year | 0.011 | $ / Tkm |
| Simulation Output | | | Life Cycle Cost | 414 | $m |
| Market Price | | | | | |
| Operational Experience | | | | | |
| Customer | | | | | |

# TRAIN SYSTEM MODEL

| | Value | Unit | | | Value | Unit |
|---|---|---|---|---|---|---|
| | | | | **FUEL COST** | | |
| **MINE** | **HanGVK KC** | | | Fuel per Trip | 39354 | L |
| | | | | Fuel per Year | 8060622 | ML |
| | | | | Fuel Cost | 1.2 | $/L |
| **HAULAGE REQUIREMENT** | | | | Overall Fuel Cost | 9.6727 | $m / Year |
| Payload per Year | **7.30** | MT | | | | |
| | | | | **CAPEX COST** | | |
| **TRAIN CONFIGURATION** | | | | Locomotive Price | 3.5 | $m / Loco |
| Track Axle Load | 40 | T | | Locomotive Overhaul % | 0.75 | % |
| Locomotive Mass | 196 | T | | Wagon Price | 0.13 | $m / Wagon |
| Wagon Tare Mass | 26 | T | | Wagon Overhaul % | 0.5 | % |
| Locomotives per Train | 3 | Locos | | Locomotive Fleet | 4 | Locos |
| Wagons per Train | 270 | Wagons | | Wagon Fleet | 261 | Wagons |
| Payload per Wagon | 132 | T | | Capital Spares (Locos/Wagons) | 1.0 | $m |
| Payload per Train | 35640 | T | | Rollingstock Initial Capex | 47.9 | $m |
| | | | | Locomotive Overhaul Capex | 21.0 | $m |
| **CYCLE TIME** | | | | Wagon Overhaul Capex | 17.0 | $m |
| Loading per Wagon | 1 | min | | | | |
| Unloading per Wagon | 1 | min | | **MAINTENANCE COST (Incl Facility Charge)** | | |
| Loading Time | 4.50 | Hrs | | Model Life | 30 | Years |
| Unloading Time | 4.50 | Hrs | | Annual Distance | 251 | Kms (k) |
| Provisioning | 2.00 | Hrs | | Energy per Trip | 770 | GJ |
| Marshalling | 5.00 | Hrs | | Annual Power | 15865 | MWhrs / Loco |
| Loaded Trip | 11.02 | Hrs | | Locomotive per Year | 0.4 | $m / Loco |
| Unloaded Trip | 7.48 | Hrs | | Wagon per Year | 0.012 | $m / Wagon |
| Days per Trips | 1.44 | Trips | | Rollingstock Maintenance | 4.3 | $m / Year |
| Operational Days | 320 | Days | | Locomotives Facility Charge | 0.018 | $m / Loco / Yr |
| Trips per Year | 223 | Trips | | Wagons Facility Charge | 0.0004 | $m / Wagon / Yr |
| Trip Distance | 1126 | Kms | | Maintenance Cost USD | 0.533 | $m / Yr |
| | | | | Maintenance Cost AUD | 4.373 | $m / Yr |
| **PAYLOAD** | | | | **TRAIN CREW/CONTROL COST** | | |
| Payload per Year | 7.93 | MTpa/Train | | Drivers | 0.15 | Salary / Yr |
| | | | | Crews (2 man crews) | 3 | Crews / Train |
| **ROLLING STOCK REQUIREMENTS** | | | | Total Drivers | 6 | People |
| Trains for Payload | 0.920 | Trains | | Overall Crews (10% Overhead) | 0.99 | $m / Year |
| Locomotives | 2.76 | Locos | | Train Control | 0.12 | Salary / Yr |
| Wagons | 248.40 | Wagons | | Max Trains per Controller | 4 | Trains |
| % Spare Locos | 0.10 | % | | Train Control Team | 0.75 | People |
| % Spare Wagons | 0.05 | % | | Overall Train Control | 0.09 | $m / Year |
| Spare Locomotives | 0.28 | Qty | | Overall Labour Cost | 1.08 | $m / Year |
| Spare Wagons | 12.42 | Qty | | | | |
| | | | | **LIFE CYCLE COST** | | |
| **INPUT DATA** | | | | Life Cycle Cost per Year | 0.008 | $ / Tkm |
| Simulation Output | | | | Life Cycle Cost | 425 | $m |
| Market Price | | | | | | |
| Operational Experience | | | | | | |
| Customer | | | | | | |

## TRAIN SYSTEM MODEL

| | Value | Unit | | Value | Unit |
|---|---|---|---|---|---|
| | | | **FUEL COST** | | |
| **MINE** | **Adani 1** | | Fuel per Trip | 18780 | L |
| | | | Fuel per Year | 6366203 | ML |
| | | | Fuel Cost | 1.2 | $/L |
| **HAULAGE REQUIREMENT** | | | Overall Fuel Cost | 7.6394 | $m / Year |
| Payload per Year | **3.36** | MT | | | |
| | | | **CAPEX COST** | | |
| **TRAIN CONFIGURATION** | | | Locomotive Price | 3.5 | $m / Loco |
| Track Axle Load | 26.5 | T | Locomotive Overhaul % | 0.75 | % |
| Locomotive Mass | 196 | T | Wagon Price | 0.12 | $m / Wagon |
| Wagon Tare Mass | 19.4 | T | Wagon Overhaul % | 0.5 | % |
| Locomotives per Train | 4 | Locos | Locomotive Fleet | 5 | Locos |
| Wagons per Train | 120 | Wagons | Wagon Fleet | 116 | Wagons |
| Payload per Wagon | 82.6 | T | Capital Spares (Locos/Wagons) | 0.6 | $m |
| Payload per Train | 9912 | T | Rollingstock Initial Capex | 31.4 | $m |
| | | | Locomotive Overhaul Capex | 26.3 | $m |
| **CYCLE TIME** | | | Wagon Overhaul Capex | 6.9 | $m |
| Loading per Wagon | 1 | min | | | |
| Unloading per Wagon | 1 | min | **MAINTENANCE COST (Incl Facility Charge)** | | |
| Loading Time | 2.00 | Hrs | Model Life | 30 | Years |
| Unloading Time | 2.00 | Hrs | Annual Distance | 298 | Kms (k) |
| Provisioning | 2.00 | Hrs | Energy per Trip | 411 | GJ |
| Marshalling | 3.00 | Hrs | Annual Power | 10538 | MWhrs / Loco |
| Loaded Trip | 6.20 | Hrs | Locomotive per Year | 0.4 | $m / Loco |
| Unloaded Trip | 4.95 | Hrs | Wagon per Year | 0.012 | $m / Wagon |
| Days per Trips | 0.84 | Trips | Rollingstock Maintenance | 3.0 | $m / Year |
| Operational Days | 310 | Days | Locomotives Facility Charge | 0.018 | $m / Loco / Yr |
| Trips per Year | 369 | Trips | Wagons Facility Charge | 0.0004 | $m / Wagon / Yr |
| Trip Distance | 806 | Kms | Maintenance Cost USD | 0.667 | $m / Yr |
| | | | Maintenance Cost AUD | 2.858 | $m / Yr |
| **PAYLOAD** | | | **TRAIN CREW/CONTROL COST** | | |
| Payload per Year | 3.66 | MTpa/Train | Drivers | 0.15 | Salary / Yr |
| | | | Crews (2 man crews) | 3 | Crews / Train |
| **ROLLING STOCK REQUIREMENTS** | | | Total Drivers | 6 | People |
| Trains for Payload | 0.918 | Trains | Overall Crews (10% Overhead) | 0.99 | $m / Year |
| Locomotives | 3.67 | Locos | Train Control | 0.12 | Salary / Yr |
| Wagons | 110.17 | Wagons | Max Trains per Controller | 4 | Trains |
| % Spare Locos | 0.10 | % | Train Control Team | 0.75 | People |
| % Spare Wagons | 0.05 | % | Overall Train Control | 0.09 | $m / Year |
| Spare Locomotives | 0.37 | Qty | Overall Labour Cost | 1.08 | $m / Year |
| Spare Wagons | 5.51 | Qty | | | |
| | | | **LIFE CYCLE COST** | | |
| **INPUT DATA** | | | Life Cycle Cost per Year | 0.012 | $ / Tkm |
| Simulation Output | | | Life Cycle Cost | 347 | $m |
| Market Price | | | | | |
| Operational Experience | | | | | |
| Customer | | | | | |

## TRAIN SYSTEM MODEL

| | Value | Unit | | Value | Unit |
|---|---|---|---|---|---|
| | | | **FUEL COST** | | |
| **MINE** | **HanGVK KC** | | Fuel per Trip | 32209 | L |
| | | | Fuel per Year | 8065095 | ML |
| | | | Fuel Cost | 1.2 | $/L |
| **HAULAGE REQUIREMENT** | | | Overall Fuel Cost | 9.6781 | $m / Year |
| Payload per Year | **6.34** | MT | | | |
| | | | **CAPEX COST** | | |
| **TRAIN CONFIGURATION** | | | Locomotive Price | 3.5 | $m / Loco |
| Track Axle Load | 32.5 | T | Locomotive Overhaul % | 0.75 | % |
| Locomotive Mass | 196 | T | Wagon Price | 0.12 | $m / Wagon |
| Wagon Tare Mass | 20.5 | T | Wagon Overhaul % | 0.5 | % |
| Locomotives per Train | 3 | Locos | Locomotive Fleet | 4 | Locos |
| Wagons per Train | 240 | Wagons | Wagon Fleet | 232 | Wagons |
| Payload per Wagon | 105.5 | T | Capital Spares (Locos/Wagons) | 0.8 | $m |
| Payload per Train | 25320 | T | Rollingstock Initial Capex | 41.8 | $m |
| | | | Locomotive Overhaul Capex | 21.0 | $m |
| **CYCLE TIME** | | | Wagon Overhaul Capex | 13.9 | $m |
| Loading per Wagon | 0.875 | min | | | |
| Unloading per Wagon | 0.875 | min | **MAINTENANCE COST (Incl Facility Charge)** | | |
| Loading Time | 3.50 | Hrs | Model Life | 30 | Years |
| Unloading Time | 3.50 | Hrs | Annual Distance | 271 | Kms (k) |
| Provisioning | 2.00 | Hrs | Energy per Trip | 403 | GJ |
| Marshalling | 4.00 | Hrs | Annual Power | 10162 | MWhrs / Loco |
| Loaded Trip | 8.28 | Hrs | Locomotive per Year | 0.4 | $m / Loco |
| Unloaded Trip | 6.03 | Hrs | Wagon per Year | 0.012 | $m / Wagon |
| Days per Trips | 1.14 | Trips | Rollingstock Maintenance | 4.0 | $m / Year |
| Operational Days | 310 | Days | Locomotives Facility Charge | 0.018 | $m / Loco / Yr |
| Trips per Year | 272 | Trips | Wagons Facility Charge | 0.0004 | $m / Wagon / Yr |
| Trip Distance | 996 | Kms | Maintenance Cost USD | 0.533 | $m / Yr |
| | | | Maintenance Cost AUD | 4.011 | $m / Yr |
| **PAYLOAD** | | | **TRAIN CREW/CONTROL COST** | | |
| Payload per Year | 6.90 | MTpa/Train | Drivers | 0.15 | Salary / Yr |
| | | | Crews (2 man crews) | 3 | Crews / Train |
| **ROLLING STOCK REQUIREMENTS** | | | Total Drivers | 6 | People |
| Trains for Payload | 0.919 | Trains | Overall Crews (10% Overhead) | 0.99 | $m / Year |
| Locomotives | 2.76 | Locos | Train Control | 0.12 | Salary / Yr |
| Wagons | 220.62 | Wagons | Max Trains per Controller | 4 | Trains |
| % Spare Locos | 0.10 | % | Train Control Team | 0.75 | People |
| % Spare Wagons | 0.05 | % | Overall Train Control | 0.09 | $m / Year |
| Spare Locomotives | 0.28 | Qty | Overall Labour Cost | 1.08 | $m / Year |
| Spare Wagons | 11.03 | Qty | | | |
| | | | **LIFE CYCLE COST** | | |
| **INPUT DATA** | | | Life Cycle Cost per Year | 0.008 | $ / Tkm |
| Simulation Output | | | Life Cycle Cost | 416 | $m |
| Market Price | | | | | |
| Operational Experience | | | | | |
| Customer | | | | | |

Everything Infrastructure

East West Line Parks Limited

Galilee Infrastructure Corridor Project

# Above and below rail comparative cost estimates

# Appendices – Part D

July 2012

# Appendix 8 Above Rail Capital Component

## Above Rail Capital Component

Prices for the rolling stock are based on 2012 market prices. Quotations have not been obtained specifically for the purpose of this assessment. The price list is developed from knowledge for contract prices for the listed rolling stock for other clients in 2012,

| Rolling Stock | Price Range | Source | Inflation Rate |
|---|---|---|---|
| ES44ACi Locomotive | $3.3 to 3.5m USD | Rio Tinto | 0.4% - Import Price Index |
| GT42CU AC Locomotive | $4.8 to 5.0m USD | QRN and PN | 0.4% - Import Price Index |
| 40TAL Wagon | $125 to 130k USD | Extrapolated from 26.5TAL | 0.4% - Import Price Index |
| 32.5TAL Wagon | $115 to 120k USD | FreightCar America | 0.4% - Import Price Index |
| 26.5TAL Wagon | $105 to 110k USD | QRN and PN, Quotes from China | 0.4% - Import Price Index |
| Locomotive Capital Spares | $70k USD for ES44ACi Loco | Assumed 2% of capital price | 0.4% - Import Price Index |
| | $100k USD for GT42CU AC Loco | Assumed 2% of capital price | 0.4% - Import Price Index |
| Wagon Capital Spares | $2.6k USD for 40TAL Wagon | Assumed 2% of capital price | 0.4% - Import Price Index |
| | $2.4k USD for 32.5TAL Wagon | Assumed 2% of capital price | 0.4% - Import Price Index |
| | $2.2k USD for 26.5TAL Wagon | Assumed 2% of capital price | 0.4% - Import Price Index |
| Locomotive Overhaul | $1.785m USD and $0.8925m AUD for ES44ACi Locomotive | Assumed 75% of capital price (50% USD, 25% AUD) based on knowledge of past major overhaul projects | 0.4% - Import Price Index for USD, 3.15% - Producer Price Index and Labour Index for AUD |
| | $2.55m USD and $1.275m AUD for GT42CU AC Locomotive | Assumed 75% of capital price (50% USD, 25% AUD) based on knowledge of past major overhaul projects | 0.4% - Import Price Index for USD, 3.15% - Producer Price Index and Labour Index for AUD |
| Wagon Overhaul | $33.15k USD and $33.15k AUD for 40TAL Wagon | Assumed 50% of capital price (25% USD, 25% AUD) based on knowledge of past major overhaul projects | 0.4% - Import Price Index for USD, 3.15% - Producer Price Index and Labour Index for AUD |
| | $30.6k USD and $30.6k AUD for 32.5TAL Wagon | Assumed 50% of capital price (25% USD, 25% AUD) based on knowledge of past major overhaul projects | 0.4% - Import Price Index for USD, 3.15% - Producer Price Index and Labour Index for AUD |
| | $28.1k USD and $28.1k AUD for 26.5TAL Wagon | Assumed 50% of capital price (25% USD, 25% AUD) based on knowledge of past major overhaul projects | 0.4% - Import Price Index for USD, 3.15% - Producer Price Index and Labour Index for AUD |

## Above Rail Operational Component

The prices listed below for the rolling stock operations are based on 2012 market prices. The price list is developed from knowledge for contract prices for the listed rolling stock operations for other clients in 2012.

| Operational Task | Price Range | Source | Inflation Rate |
|---|---|---|---|
| Fuel | $1.10 to $1.20 per litre | Rolling Stock operator in Queensland | 2.7% - Consumer Price Index |
| Locomotive Maintenance | $117 to $133k USD and $233 to $266 AUD per loco per year | Industry standard for maintenance price for ES44ACi Locomotives | 0.4% - Import Price Index for USD, 3.15% - Producer Price Index and Labour Index for AUD |
| Wagon Maintenance | $10 to $12k AUD per wagon per year | Industry standard for maintenance price for Bradken Wagons | 3.15% - Producer Price Index and Labour Index for AUD |
| Locomotive Maintenance Facility Charge | $15 to $18k AUD per locomotive per year | Industry standard for a facility charge | 3.15% - Producer Price Index and Labour Index for AUD |
| Wagon Maintenance Facility Charge | $0.35 to $0.4k AUD per wagon per year | Industry standard for a facility charge | 3.15% - Producer Price Index and Labour Index for AUD |
| Train Driver | $140 to $150k per driver per year | Rolling stock operator | 3.68% - Labour Index |

# Appendix 9 Capex Estimate Data Sheets

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

## GIC - Option 1

| | | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|---|
| **ZONE 1 - BELOW RAIL - Capex** | | | **20 km** | **148 km** | **15 km** | **36 km** | **219 km** |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2013,
Construction pricing inflation rate: 4% — suggest inflation rate of 4%pa for construction pricing increases

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) / Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 64,780,350 | 351,172,997 | 35% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 286,392,647 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 274,448,183 | | | |
| Capping Layer | 130,942,000 | | | |
| Structures | 32,316,604 | | | |
| Permanent Way | 192,698,100 | | | |
| Incidental & Environmental Works | 13,291,642 | | | |
| Fencing | 7,195,850 | 650,892,379 | 65% | |
| **Total Construction Costs** | **$ 1,002,065,375** | | | |

**Contractors Mark Up** +10% $ 100,206,538

**Total Contractor's Price** $ 1,102,271,913

**Client Costs (PM, Planning & Approvals)** +10% $ 110,227,191
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 32,900,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 1,245,399,104**

**Contingencies** $ 373,619,731 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 1,619,018,835** (Base case) **$ 7,392,780 /km**
Cost Base Date : 1st Jul 2012

**ZONE 1 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

## GIC - Option 1

NOTE: This is a DUAL GAUGE section

| | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| ZONE 2 - BELOW RAIL - Capex | 128 km | 0 km | 0 km | 23 km | 151 km |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices & environmental surveys | 31,540,000 | 203,721,670 | 34% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 172,181,670 | | | NB: Includes allowance to fix price and time for construction contra |
| Earthworks | 101,440,583 | | | |
| Capping Layer | 90,918,000 | | | |
| Structures | 20,427,619 | | | |
| Permanent Way | 164,952,400 | | | |
| Incidental & Environmental Works | 8,681,400 | | | |
| Fencing | 4,901,975 | 391,321,978 | 66% | |
| Total Construction Costs | 595,043,648 | | | |

| | | | |
|---|---|---|---|
| Contractors Mark Up | +10% | $ | 59,504,365 |
| Total Contractor's Price | | $ | 654,548,013 |
| Client Costs (PM, Planning & Approvals) | +10% | $ | 65,454,801 |

[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client

Defect liability period $ - Not included : assumed covered by maintenance contractors

Land Acquisition (provided by EWLP) $ 15,100,000
[Including clear & grub outside of stage 1 rail reserve]

Project Costs (excluding contingencies) $ 735,102,814

Contingencies $ 220,530,844 ( 30% Base Case)
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

Total Zone 2 Construction Costs $ 955,633,659 (Base case) $ 6,328,700 /km
Cost Base Date : 1st Jul 2012

**ZONE 2 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above
Maintenance Cost escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 7.5 Mtpa
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

Total Construction Cost [Brownfield] of Typical Passing Loop $5,250,000 /km
Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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**EWLP**
**Galilee Infrastructure Corridor Project (GICP)**
**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

## GIC - Option 1

**NOTE : This is a DUAL GUAGE Zone**

| ZONE 3 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| | 0 km | 0 km | 16 km | 12 km | 28 km |

**Start of Construction** 1/01/14 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

**Construction pricing inflation rate** 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| **Spend curve (Year)** | 1 | 2 | 3 | 4 | 5 | Total |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| **Construction (Third Party Costs)** | **Costs $** | | | |
|---|---|---|---|---|
| Establishment of construction offices & environmental surveys | 215,000 | 36,985,857 | 31% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 36,770,857 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 30,236,836 | | | |
| Capping Layer | 16,801,000 | | | |
| Structures | 3,854,644 | | | |
| Permanent Way | 30,587,200 | | | |
| Incidental & Environmental Works | 1,176,000 | | | |
| Fencing | 914,450 | 83,570,129 | 69% | |
| **Total Construction Costs** | 120,555,986 | | | |

**Contractors Mark Up** +10% $ 12,055,599

**Total Contractor's Price** $ 132,611,584

**Client Costs (PM, Planning & Approvals)** +10% $ 13,261,158
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,400,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** $ 147,272,743

**Contingencies** $ 44,181,823 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 2 Construction Costs** $ 191,454,566 (Base case) **$ 6,837,663 /km**
Cost Base Date : 1st Jul 2012

**ZONE 3 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

**GIC - Option 1**

| ZONE 4 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| | 0 km | 44 km | 0 km | 0 km | 44 km |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 30,115,000 | 80,840,057 | 41% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 50,725,057 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 41,607,423 | | | |
| Capping Layer | 26,584,800 | | | |
| Structures | 5,117,148 | | | |
| Permanent Way | 38,715,600 | | | |
| Incidental & Environmental Works | 1,848,000 | | | |
| Fencing | 1,411,250 | 115,284,221 | 59% | |
| Total Construction Costs | $ 196,124,278 | | | |

| | | |
|---|---|---|
| Contractors Mark Up | +10% | $ 19,612,428 |
| Total Contractor's Price | | $ 215,736,706 |

Client Costs (PM, Planning & Approvals) +10% $ 21,573,671
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

Defect liability period $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 2,200,000.00
[Including clear & grub outside of stage 1 rail reserve]

Project Costs (excluding contingencies) $ 239,510,377

Contingencies $ 71,853,113 ( 30% Base Case)
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

Total Zone 1 Construction Costs $ 311,363,489 (Base case) $ 7,076,443 /km
Cost Base Date : 1st Jul 2012

**ZONE 4 -BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 7.5 Mtpa
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

Total Construction Cost [Brownfield] of Typical Passing Loop $5,250,000 /km
Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

## GIC - Option 1

| ZONE 5 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| | 0 km | 0 km | 24 km | 10 km | 34 km |

Start of Construction: 1/01/14
Construction pricing inflation rate: 4%

NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | |
|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 215,000 | 41,438,160 | 31% |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 41,223,160 | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 35,109,682 | | |
| Capping Layer | 20,454,000 | | |
| Structures | 5,673,341 | | |
| Permanent Way | 29,916,600 | | |
| Incidental & Environmental Works | 1,430,228 | | |
| Fencing | 1,105,150 | 93,689,001 | 69% |
| Total Construction Costs | $ 135,127,161 | | |

**Contractors Mark Up** +10% $ 13,512,716

Total Contractor's Price $ 148,639,877

**Client Costs (PM, Planning & Approvals)** +10% $ 14,863,988
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost (1%), Community/Fees (1%), Contract Support Services (0.5%), Insurance (1.5%) = 10%]

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,700,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** $ 165,203,865

**Contingencies** $ 49,561,159 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** $ 214,765,024 (Base case) $ 6,316,618 /km
Cost Base Date : 1st Jul 2012

**ZONE 5 - BELOW RAIL - Opex**

| Throughput (Mtpa) | | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 7.5 Mtpa
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

Total Construction Cost [Brownfield] of Typical Passing Loop $5,250,000 /km
Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

## GIC - Option 1

| | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| ZONE 6 - BELOW RAIL - Capex | 4 km | 0 km | 0 km | 18 km | 22 km |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | |
|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 30,895,000 | 58,053,128 | 48% |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 27,158,128 | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 23,508,733 | | |
| Capping Layer | 13,065,000 | | |
| Structures | 4,153,410 | | |
| Permanent Way | 19,357,800 | | |
| Incidental & Environmental Works | 924,000 | | |
| Fencing | 714,075 | 61,723,019 | 52% |
| Total Construction Costs | $ 119,776,147 | | |

Contractors Mark Up +10% $ 11,977,615

Total Contractor's Price $ 131,753,762

Client Costs (PM, Planning & Approvals) +10% $ 13,175,376
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost (1%),

Defect liability period $ - Not included : assumed covered by maintenance contractors

Land Acquisition (provided by EWLP) $ 1,100,000
[Including clear & grub outside of stage 1 rail reserve]

Project Costs (excluding contingencies) $ 146,029,138

Contingencies $ 43,808,741 (30% Base Case)
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

Total Zone 1 Construction Costs $ 189,837,880 (Base case) $ 8,628,995 /km
Cost Base Date : 1st Jul 2012

ZONE 6 - BELOW RAIL - Opex

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

Maintenance Cost Escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

PASSING LOOPS - GENERAL

As a rule of thumb each of train can carry 7.5 Mtpa
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

Total Construction Cost [Brownfield] of Typical Passing Loop $5,250,000 /km
Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

## GIC - Option 1

| ZONE 7 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| | 36 km | 0 km | 0 km | 0 km | 36 km |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases
Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) / Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 215,000 | 41,612,727 | 31% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 41,397,727 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 32,345,763 | | | |
| Capping Layer | 21,352,000 | | | |
| Structures | 6,033,977 | | | |
| Permanent Way | 31,676,400 | | | |
| Incidental & Environmental Works | 1,514,228 | | | |
| Fencing | 1,163,375 | 94,085,743 | 69% | |
| **Total Construction Costs** | $ 135,698,470 | | | |

**Contractors Mark Up** +10% $ 13,569,847

**Total Contractor's Price** $ 149,268,317

**Client Costs (PM, Planning & Approvals)** +10% $ 14,926,832
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,800,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** $ 165,995,149

**Contingencies** $ 49,798,545 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** $ 215,793,693 (Base case) **$ 6,078,696 /km**
Cost Base Date : 1st Jul 2012

### ZONE 7 - BELOW RAIL - Opex

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

### PASSING LOOPS - GENERAL

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

## GIC - Option 1

| ZONE 8 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| | 21 km | 0 km | 0 km | 2 km | 23 km |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 215,000 | 24,509,623 | 31% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 24,294,623 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 12,559,398 | | | |
| Capping Layer | 14,046,000 | | | |
| Structures | 5,829,256 | | | |
| Permanent Way | 20,237,700 | | | |
| Incidental & Environmental Works | 1,781,448 | | | |
| Fencing | 761,250 | 55,215,052 | 69% | |
| **Total Construction Costs** | **$ 79,724,674** | | | |

**Contractors Mark Up** +10% $ 7,972,467

**Total Contractor's Price** $ 87,697,142

**Client Costs (PM, Planning & Approvals)** +10% $ 8,769,714
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,200,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 97,666,856**

**Contingencies** $ 29,300,057 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 126,966,913** (Base case) **$ 5,520,301 /km**
Cost Base Date : 1st Jul 2012

**ZONE 8 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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**EWLP**
**Galilee Infrastructure Corridor Project (GICP)**
**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

## GIC - Option 1

| | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| **ZONE 9 - BELOW RAIL - Capex** | **20 km** | **0 km** | **0 km** | **0 km** | **20 km** |

**Start of Construction** **1/01/26** NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases

**Construction pricing inflation rate** 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| **Spend curve (Year)** | **1** | **2** | **3** | **4** | **5** | **Total** |
| **Spend profile / curve - applied to all zone spend** | 100% | 0% | 0% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| **Construction (Third Party Costs)** | **Costs $** | | |
|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 13,652,017 | **34,008,952** | 42% |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 20,356,935 | | NB: Includes allowance to fix price and time for construction contrac |
| Earthworks | 12,245,341 | | |
| Capping Layer | 12,084,000 | | |
| Structures | 2,842,043 | | |
| Permanent Way | 17,598,000 | | |
| Incidental & Environmental Works | 842,228 | | |
| Fencing | 654,150 | **46,265,762** | 58% |
| **Total Construction Costs** | **$ 80,274,714** | | |

**Contractors Mark Up** **+10%** $ 8,027,471

**Total Contractor's Price** $ 88,302,185

**Client Costs (PM, Planning & Approvals)** **+10%** $ 8,830,218
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,000,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 98,132,403**

**Contingencies** $ 29,439,721 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 127,572,124** (Base case) **$ 6,378,606 /km**
Cost Base Date : 1st Jul 2012

**ZONE 9 - BELOW RAIL - Opex**

| | **Throughput (Mtpa)** | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

**GVK - 150Mtpa**

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| **GVK Main Line - BELOW RAIL - Capex** | | 149 km | 136 km | 20 km | 180 km | 485 km |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| | | | | | | |
|---|---|---|---|---|---|---|
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | |
|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 127,975,550 | 796,875,781 | 35% |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 668,900,231 | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 647,594,477 | | |
| Capping Layer | 288,366,000 | | |
| Structures | 77,943,959 | | |
| Permanent Way | 404,926,500 | | |
| Incidental & Environmental Works | 19,483,576 | | |
| Fencing | 15,816,425 | 1,454,130,937 | 65% |
| **Total Construction Costs** | **$ 2,251,006,719** | | |

**Contractors Mark Up** +10% $ 225,100,672

**Total Contractor's Price** $ 2,476,107,390

**Client Costs (PM, Planning & Approvals)** +10% $ 247,610,739
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 76,100,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 2,799,818,129**

**Contingencies** $ 839,945,439 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 3,639,763,568** (Base case) **$ 7,504,667 /km**
Cost Base Date : 1st Jul 2012

**GVK Main Line - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $50,000 | $50,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **6.0 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,000,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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**EWLP**
**Galilee Infrastructure Corridor Project (GICP)**
**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

## GVK - 150Mtpa

| | Flat | Hilly | Rolling | Flood | Total km |
|---|---|---|---|---|---|
| **GVK - ZONE 7 - BELOW RAIL - Capex** | 20 km | 0 km | 0 km | 16 km | 36 km |

Start of Construction: 1/01/19 — NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) | | | | | | |
| Spend profile / curve - applied to all zone spend | 50% | 50% | 0% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 3,555,350 | 47,836,067 | 32% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 44,280,717 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 40,518,012 | | | |
| Capping Layer | 21,352,000 | | | |
| Structures | 6,033,977 | | | |
| Permanent Way | 30,056,400 | | | |
| Incidental & Environmental Works | 1,514,228 | | | |
| Fencing | 1,163,375 | 100,637,993 | 68% | |
| **Total Construction Costs** | **$ 148,474,060** | | | |

**Contractors Mark Up** +10% $ 14,847,406

**Total Contractor's Price** $ 163,321,466

**Client Costs (PM, Planning & Approvals)** +10% $ 16,332,147
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,800,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 181,453,612**

**Contingencies** $ 54,436,084 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 235,889,696** (Base case) **$ 6,552,492 /km**
Cost Base Date : 1st Jul 2012

**GVK - ZONE 7 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $50,000 | $50,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **6.0 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,000,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

**GVK - 150Mtpa**

| GVK - ZONE 8 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| | 21 km | 0 km | 0 km | 2 km | 23 km |

Start of Construction: 1/01/19 — NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases
Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) / Spend profile / curve - applied to all zone spend | 50% | 50% | 0% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 15,555,000 | 39,512,165 | 42% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 23,957,165 | | | NB: Includes allowance to fix price and time for construction contra |
| Earthworks | 12,827,448 | | | |
| Capping Layer | 14,046,000 | | | |
| Structures | 5,829,256 | | | |
| Permanent Way | 19,202,700 | | | |
| Incidental & Environmental Works | 1,781,448 | | | |
| Fencing | 761,250 | 54,448,102 | 58% | |
| **Total Construction Costs** | **$ 93,960,267** | | | |

**Contractors Mark Up** +10% $ 9,396,027

**Total Contractor's Price** $ 103,356,294

**Client Costs (PM, Planning & Approvals)** +10% $ 10,335,629
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,200,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 114,891,923**

**Contingencies** $ 34,467,577 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 149,359,500** (Base case) **$ 6,493,891 /km**
Cost Base Date : 1st Jul 2012

**GVK - ZONE 8 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $50,000 | $50,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **6.0 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,000,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

**GVK - 150Mtpa**

| GVK - ZONE 9 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| | 20 km | 0 km | 0 km | 0 km | 20 km |

Start of Construction: 1/01/26 — NB: For start of construction date later than 1st Jan 2014, suggest inflation rate of 4%pa for construction pricing increases
Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 100% | 0% | 0% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | |
|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 13,652,017 | 33,440,912 | 43% |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 19,788,895 | | NB: Includes allowance to fix price and time for construction contrac |
| Earthworks | 11,854,341 | | |
| Capping Layer | 12,084,000 | | |
| Structures | 2,842,043 | | |
| Permanent Way | 16,698,000 | | |
| Incidental & Environmental Works | 842,228 | | |
| Fencing | 654,150 | 44,974,762 | |
| Total Construction Costs | $ 78,415,674 | | |

Contractors Mark Up +10% $ 7,841,567

Total Contractor's Price $ 86,257,241

Client Costs (PM, Planning & Approvals) +10% $ 8,625,724
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

Defect liability period $ - Not included : assumed covered by maintenance contractors

Land Acquisition (provided by EWLP) $ 1,000,000
[Including clear & grub outside of stage 1 rail reserve]

Project Costs (excluding contingencies) $ 95,882,965

Contingencies $ 28,764,890 (30% Base Case)
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

Total Zone 1 Construction Costs $ 124,647,855 (Base case) $ 6,232,393 /km
Cost Base Date : 1st Jul 2012

**GVK - ZONE 9 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $50,000 | $50,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 6.0 Mtpa
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

Total Construction Cost [Brownfield] of Typical Passing Loop $5,000,000 /km
Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

**QRN - 90Mtpa**

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| QRN/Adani - BELOW RAIL - Capex | | 75 km | 0 km | 0 km | 99 km | 174 km |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases
Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) / Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 64,995,350 | 305,423,314 | 37% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 240,427,964 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 242,222,398 | | | |
| Capping Layer | 103,329,000 | | | |
| Structures | 28,671,193 | | | |
| Permanent Way | 134,136,600 | | | |
| Incidental & Environmental Works | 8,678,220 | | | |
| Fencing | 5,632,075 | 522,669,486 | 63% | |
| **Total Construction Costs** | $ 828,092,800 | | | |

**Contractors Mark Up** +10% $ 82,809,280

**Total Contractor's Price** $ 910,902,080

**Client Costs (PM, Planning & Approvals)** +10% $ 91,090,208
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost (1%),

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 26,100,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** $ 1,028,092,287

**Contingencies** $ 308,427,686 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** $ 1,336,519,974 (Base case) **$ 7,681,149 /km**
Cost Base Date : 1st Jul 2012

**QRN/Adani - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $45,000 | $45,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **3.2 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$4,875,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

**QRN - 90Mtpa**

| QRN ZONE 4 - BELOW RAIL - Capex | | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|---|
| | | 0 km | 44 km | 0 km | 0 km | 44 km |

Start of Construction: 1/01/23 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases
Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) / Spend profile / curve - applied to all zone spend | 100% | 0% | 0% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 3,815,350 | 53,733,573 | 32% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 49,918,223 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 44,569,709 | | | |
| Capping Layer | 26,584,800 | | | |
| Structures | 5,117,148 | | | |
| Permanent Way | 33,919,600 | | | |
| Incidental & Environmental Works | 1,848,000 | | | |
| Fencing | 1,411,250 | 113,450,507 | 68% | |
| **Total Construction Costs** | $ 167,184,080 | | | |

**Contractors Mark Up** +10% $ 16,718,408

**Total Contractor's Price** $ 183,902,488

**Client Costs (PM, Planning & Approvals)** +10% $ 18,390,249
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost (1%),

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 2,200,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** $ 204,492,736

**Contingencies** $ 61,347,821 (**30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** $ 265,840,557 (Base case) — $ 6,041,831 /km
Cost Base Date : 1st Jul 2012

**QRN ZONE 4 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $45,000 | $45,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : 2.5% — Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 3.2 Mtpa
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** $4,875,000 /km
Passing Loop escalation Factor : 4.0% — Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
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## GIC - Option 2

| | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| ZONE 1 - BELOW RAIL - Capex | 20 km | 148 km | 15 km | 36 km | 219 km |

Start of Construction: 1/01/18 — NB: For start of construction date later than 1st Jan 2013,
Construction pricing inflation rate: 4% — suggest inflation rate of 4%pa for construction pricing increases

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) / Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | |
|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 64,780,350 | 351,172,997 | 35% |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 286,392,647 | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 274,448,183 | | |
| Capping Layer | 130,942,000 | | |
| Structures | 32,316,604 | | |
| Permanent Way | 192,698,100 | | |
| Incidental & Environmental Works | 13,291,642 | | |
| Fencing | 7,195,850 | 650,892,379 | 65% |
| Total Construction Costs | $ 1,002,065,375 | | |

Contractors Mark Up +10% $ 100,206,538

Total Contractor's Price $ 1,102,271,913

Client Costs (PM, Planning & Approvals) +10% $ 110,227,191
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

Defect liability period $ - Not included : assumed covered by maintenance contractors

Land Acquisition (provided by EWLP) $ 32,900,000
[Including clear & grub outside of stage 1 rail reserve]

Project Costs (excluding contingencies) $ 1,245,399,104

Contingencies $ 373,619,731 ( 30% Base Case)
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

Total Zone 1 Construction Costs $ 1,619,018,835 (Base case) $ 7,392,780 /km
Cost Base Date : 1st Jul 2012

**ZONE 1 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 7.5 Mtpa
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

Total Construction Cost [Brownfield] of Typical Passing Loop $5,250,000 /km
Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

## GIC - Option 2

| ZONE 2 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| | 128 km | 0 km | 0 km | 23 km | 151 km |

Start of Construction: 1/01/18 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices & environmental surveys | 31,540,000 | 187,908,091 | 35% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 156,368,091 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 94,954,502 | | | |
| Capping Layer | 90,918,000 | | | |
| Structures | 21,059,379 | | | |
| Permanent Way | 132,864,900 | | | |
| Incidental & Environmental Works | 10,682,144 | | | |
| Fencing | 4,903,100 | 355,382,025 | 65% | |
| Total Construction Costs | 543,290,117 | | | |

Contractors Mark Up +10% $ 54,329,012

Total Contractor's Price $ 597,619,128

Client Costs (PM, Planning & Approvals) +10% $ 59,761,913
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client

Defect liability period $ - Not included : assumed covered by maintenance contractors

Land Acquisition (provided by EWLP) $ 15,100,000
[Including clear & grub outside of stage 1 rail reserve]

Project Costs (excluding contingencies) $ 672,481,041

Contingencies $ 201,744,312 ( 30% Base Case)
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

Total Zone 2 Construction Costs $ 874,225,354 (Base case) $ 5,789,572 /km
Cost Base Date : 1st Jul 2012

**ZONE 2 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry 7.5 Mtpa
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

Total Construction Cost [Brownfield] of Typical Passing Loop $5,250,000 /km
Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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**EWLP**
**Galilee Infrastructure Corridor Project (GICP)**
**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

## GIC - Option 2

| ZONE 3 - BELOW RAIL - Capex | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| | 0 km | 0 km | 16 km | 12 km | 28 km |

**Start of Construction** 1/01/18 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

**Construction pricing inflation rate** 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| **Spend curve (Year)** | | | | | | |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| **Construction (Third Party Costs)** | **Costs $** | | | |
|---|---|---|---|---|
| Establishment of construction offices & environmental surveys | - | 31,830,175 | 31% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 31,830,175 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 24,958,014 | | | |
| Capping Layer | 16,801,000 | | | |
| Structures | 3,854,644 | | | |
| Permanent Way | 24,637,200 | | | |
| Incidental & Environmental Works | 1,176,000 | | | |
| Fencing | 914,450 | 72,341,308 | 69% | |
| **Total Construction Costs** | **104,171,483** | | | |

**Contractors Mark Up** +10% $ 10,417,148

**Total Contractor's Price** $ 114,588,632

**Client Costs (PM, Planning & Approvals)** +10% $ 11,458,863
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,400,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 127,447,495**

**Contingencies** $ 38,234,248 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 2 Construction Costs** **$ 165,681,743** (Base case) **$ 5,917,205 /km**
Cost Base Date : 1st Jul 2012

**ZONE 2 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

**EWLP**
**Galilee Infrastructure Corridor Project (GICP)**
**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

| | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| **Option 2 - ZONE 4 - BELOW RAIL - Capex** | 0 km | 44 km | 0 km | 0 km | 44 km |

Start of Construction: 1/01/22
Construction pricing inflation rate: 4%
NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 50% | 50% | 0% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| Construction (Third Party Costs) | Costs $ | | |
|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 215,000 | 50,940,057 | 31% |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 50,725,057 | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 41,607,423 | | |
| Capping Layer | 26,584,800 | | |
| Structures | 5,117,148 | | |
| Permanent Way | 38,715,600 | | |
| Incidental & Environmental Works | 1,848,000 | | |
| Fencing | 1,411,250 | 115,284,221 | 69% |
| **Total Construction Costs** | **$ 166,224,278** | | |

**Contractors Mark Up** +10% $ 16,622,428

**Total Contractor's Price** $ 182,846,706

**Client Costs (PM, Planning & Approvals)** +10% $ 18,284,671
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost (1%), Community/Fees (1%), Contract Support Services (0.5%), Insurance (1.5%) = 10%]

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 2,200,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 203,331,377**

**Contingencies** $ 60,999,413 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 264,330,789** (Base case) **$ 6,007,518 /km**

**Option 2 - Zone 4 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.

Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
**Galilee Infrastructure Corridor Project (GICP)**
**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

## GIC - Option 2

| | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| **ZONE 5 - BELOW RAIL - Capex** | **0 km** | **0 km** | **24 km** | **10 km** | **34 km** |

Start of Construction: **1/01/22** — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases
Construction pricing inflation rate: **4%**

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| **Spend curve (Year)** / **Spend profile / curve - applied to all zone spend** | 50% | 50% | 0% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 18,895,350 | 59,694,213 | 39% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 40,798,863 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 34,145,369 | | | |
| Capping Layer | 20,454,000 | | | |
| Structures | 5,673,341 | | | |
| Permanent Way | 29,916,600 | | | |
| Incidental & Environmental Works | 1,430,228 | | | |
| Fencing | 1,105,150 | 92,724,688 | 61% | |
| **Total Construction Costs** | **$ 152,418,900** | | | |

**Contractors Mark Up** **+10%** $ 15,241,890

**Total Contractor's Price** $ 167,660,790

**Client Costs (PM, Planning & Approvals)** **+10%** $ 16,766,079
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost (1%), Community/Fees (1%), Contract Support Services (0.5%), Insurance (1.5%) = 10%]

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,700,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 186,126,869**

**Contingencies** $ 55,838,061 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 241,964,930** (Base case) **$ 7,116,616 /km**
Cost Base Date : 1st Jul 2012

**ZONE 5 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

**EWLP**
**Galilee Infrastructure Corridor Project (GICP)**
**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

## GIC - Option 2

| | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| **ZONE 6 - BELOW RAIL - Capex** | 4 km | 0 km | 0 km | 18 km | 22 km |

**Start of Construction** 1/01/22 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

**Construction pricing inflation rate** 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| **Spend curve (Year)** | | | | | | |
| **Spend profile / curve - applied to all zone spend** | 50% | 50% | 0% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| **Construction (Third Party Costs)** | **Costs $** | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 215,000 | 22,154,319 | 31% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 21,939,319 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 13,087,926 | | | |
| Capping Layer | 13,309,000 | | | |
| Structures | 3,834,737 | | | |
| Permanent Way | 17,996,000 | | | |
| Incidental & Environmental Works | 924,000 | | | |
| Fencing | 710,425 | 49,862,088 | 69% | |
| **Total Construction Costs** | **$ 72,016,407** | | | |

**Contractors Mark Up** **+10%** $ 7,201,641

**Total Contractor's Price** $ 79,218,048

**Client Costs (PM, Planning & Approvals)** **+10%** $ 7,921,805
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,100,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 88,239,853**

**Contingencies** $ 26,471,956 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 114,711,809** (Base case) **$ 5,214,173 /km**
Cost Base Date : 1st Jul 2012

**ZONE 6 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

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**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

| | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| **Option 2 - ZONE 7 - BELOW RAIL - Capex** | **20 km** | **0 km** | **0 km** | **16 km** | **36 km** |

Start of Construction: **1/01/26**
Construction pricing inflation rate: **4%**
NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend profile / curve - applied to all zone spend | 100% | 0% | | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 13,782,017 | 55,179,744 | 37% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 41,397,727 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 32,345,763 | | | |
| Capping Layer | 21,352,000 | | | |
| Structures | 6,033,977 | | | |
| Permanent Way | 31,676,400 | | | |
| Incidental & Environmental Works | 1,514,228 | | | |
| Fencing | 1,163,375 | 94,085,743 | 63% | |
| **Total Construction Costs** | **$ 149,265,487** | | | |

**Contractors Mark Up** +10% $ 14,926,549

**Total Contractor's Price** $ 164,192,035

**Client Costs (PM, Planning & Approvals)** +10% $ 16,419,204
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost (1%), Community/Fees (1%), Contract Support Services (0.5%), Insurance (1.5%) = 10%]

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,800,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 182,411,239**

**Contingencies** $ 54,723,372 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 237,134,611** (Base case) **$ 6,587,073 /km**

**Option 2 - ZONE 7 - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

**Project Costs (excluding contingencies)** **$ 97,666,856**



**Contingencies** $ 29,300,057 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**EWLP**
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**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

## GIC - Option 2

| | Flat | Hilly | Rolling | Flood | Total Km |
|---|---|---|---|---|---|
| **ZONE 9 - BELOW RAIL - Capex** | **20 km** | **0 km** | **0 km** | **0 km** | **20 km** |

Start of Construction: 1/01/29 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases
Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| **Spend curve (Year)** | | | | | | |
| **Spend profile / curve - applied to all zone spend** | 100% | 0% | 0% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| **Construction (Third Party Costs)** | **Costs $** | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 13,652,017 | **34,008,952** | 42% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 20,356,935 | | | NB: Includes allowance to fix price and time for construction contrac |
| Earthworks | 12,245,341 | | | |
| Capping Layer | 12,084,000 | | | |
| Structures | 2,842,043 | | | |
| Permanent Way | 17,598,000 | | | |
| Incidental & Environmental Works | 842,228 | | | |
| Fencing | 654,150 | **46,265,762** | 58% | |
| **Total Construction Costs** | **$ 80,274,714** | | | |

**Contractors Mark Up** +10% $ 8,027,471

**Total Contractor's Price** $ 88,302,185

**Client Costs (PM, Planning & Approvals)** +10% $ 8,830,218
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 1,000,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 98,132,403**

**Contingencies** $ 29,439,721 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 127,572,124** (Base case) **$ 6,378,606 /km**
Cost Base Date : 1st Jul 2012

**ZONE 9 - BELOW RAIL - Opex**

| | **Throughput (Mtpa)** | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $60,000 | $60,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost Escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **7.5 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,250,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EVERYTHING INFRASTRUCTURE

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**Galilee Infrastructure Corridor Project (GICP)**
**Below Rail Costing - CAPEX**
**Output template - for use in EY financial model**

## GVK - 60Mtpa

| | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|
| **GVK Mainline - BELOW RAIL - Capex** | **149 km** | **136 km** | **20 km** | **180 km** | **485 km** |

Start of Construction: **1/01/14** — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| | | | | | | Total |
|---|---|---|---|---|---|---|
| **Spend curve (Year)** | 1 | 2 | 3 | 4 | 5 | **Total** |
| **Spend profile / curve - applied to all zone spend** | 30% | 40% | 30% | 0% | 0% | 100% |

**Spend required in this zone**
**Categories**

| **Construction (Third Party Costs)** | **Costs $** | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 127,975,550 | 796,875,781 | 35% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 668,900,231 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 647,594,477 | | | |
| Capping Layer | 288,366,000 | | | |
| Structures | 77,943,959 | | | |
| Permanent Way | 404,926,500 | | | |
| Incidental & Environmental Works | 19,483,576 | | | |
| Fencing | 15,816,425 | 1,454,130,937 | 65% | |
| **Total Construction Costs** | **$ 2,251,006,719** | | | |

**Contractors Mark Up** +10% $ 225,100,672

**Total Contractor's Price** $ 2,476,107,390

**Client Costs (PM, Planning & Approvals)** +10% $ 247,610,739
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 76,100,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** **$ 2,799,818,129**

**Contingencies** $ 839,945,439 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** **$ 3,639,763,568** (Base case) **$ 7,504,667 /km**
Cost Base Date : 1st Jul 2012

**GVK Mainline - BELOW RAIL - Opex**

| | **Throughput (Mtpa)** | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $50,000 | $50,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : **2.5%** Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **6.0 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** **$5,000,000** /km
Passing Loop escalation Factor : **4.0%** Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012

EWLP
Galilee Infrastructure Corridor Project (GICP)
Below Rail Costing - CAPEX
Output template - for use in EY financial model

**QRN - 60Mtpa**

| | | Flat | Hilly | Rolling | Flood | Total |
|---|---|---|---|---|---|---|
| **QRN Mainline - BELOW RAIL - Capex** | | 75 km | 0 km | 0 km | 99 km | 174 km |

Start of Construction: 1/01/14 — NB: For start of construction date later than 1st Jan 2013, suggest inflation rate of 4%pa for construction pricing increases

Construction pricing inflation rate: 4%

| | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Spend curve (Year) | 1 | 2 | 3 | 4 | 5 | Total |
| Spend profile / curve - applied to all zone spend | 30% | 40% | 30% | 0% | 0% | 100% |

Spend required in this zone
Categories

| Construction (Third Party Costs) | Costs $ | | | |
|---|---|---|---|---|
| Establishment of construction offices, camps & environmental surveys | 64,995,350 | 305,423,314 | 37% | |
| Contractor's Indirect Costs (non-recurring & recurring costs) | 240,427,964 | | | NB: Includes allowance to fix price and time for construction contract |
| Earthworks | 242,222,398 | | | |
| Capping Layer | 103,329,000 | | | |
| Structures | 28,671,193 | | | |
| Permanent Way | 134,136,600 | | | |
| Incidental & Environmental Works | 8,678,220 | | | |
| Fencing | 5,632,075 | 522,669,486 | 63% | |
| **Total Construction Costs** | $ 828,092,800 | | | |

**Contractors Mark Up** +10% $ 82,809,280

**Total Contractor's Price** $ 910,902,080

**Client Costs (PM, Planning & Approvals)** +10% $ 91,090,208
[PM (3%), Contractor procurement (1%), Concept Design & Environmental Approval (2%), Client running cost

**Defect liability period** $ - Not included : assumed covered by maintenance contractors

**Land Acquisition** (provided by EWLP) $ 26,100,000
[Including clear & grub outside of stage 1 rail reserve]

**Project Costs (excluding contingencies)** $ 1,028,092,287

**Contingencies** $ 308,427,686 **( 30% Base Case)**
[NB: Range from -10% ~ + 30%, therefore use +30% for base case]
[Preliminary evaluation at strategic level based on market rates and supplied quantities / alignments]

**Total Zone 1 Construction Costs** $ 1,336,519,974 (Base case) $ 7,681,149 /km
Cost Base Date : 1st Jul 2012

**QRN Mainline - BELOW RAIL - Opex**

| | Throughput (Mtpa) | | | | |
|---|---|---|---|---|---|
| Assumed Lower Limit | 0 | 11 | 31 | 51 | 101 |
| Assumed Upper Limit | 10 | 30 | 50 | 100 | 400 |
| Annual track maintenance cost per km | $12,000 | $22,000 | $30,000 | $45,000 | $45,000 |

NB: Assume for the purposes of modelling, maintenance costs are stepped as shown in the table above.
Maintenance Cost escalation Factor : 2.5% Assumed annual inflation rate based on CPI (mainly labour)
Maintenance Cost Base Date : 1st Jul 2012

**PASSING LOOPS - GENERAL**

As a rule of thumb each of train can carry **3.2 Mtpa**
No passing loops have been included in the Total Construction Costs.
For each additional train a new passing loop will be required.
It is assumed passing loops are build every 3 years

**Total Construction Cost [Brownfield] of Typical Passing Loop** $4,875,000 /km
Passing Loop escalation Factor : 4.0% Assumed annual inflation rate based on construction costs
Cost Base Date : 1st Jul 2012