15. APPENDIX B: CONNELL HATCH WAGON LIDS ANALYSIS ENVIRONMENTAL EVALUATION QUEENSLAND RAIL LIMITED

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Wagon Lids Analysis
Environmental Evaluation
Queensland Rail Limited

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Contents

Executive summary

The supplementary report presents the particulars of an analysis of wagon lids that was undertaken by Connell Hatch with respect to the Environmental Evaluation commissioned by Queensland Rail Limited. Covering coal wagons with lids has been identified as a mitigation strategy to reduce coal dust emissions from the top of both loaded and unloaded wagons. This report must address two potential variations to the proposed mitigation strategy, retrofitting lids to existing wagons and designing lids into future wagons. Accordingly, for each of the aforementioned, the aim of this report is to:

- Determine the advantages and disadvantages associated with implementing wagon lids
- Consider the impact of lid failures to the industry
- Estimate the capital investment and operational cost associated with wagon lids
- Assess the mitigation strategy for practicability and cost-effectiveness

The outcomes achieved with respect to the aims of this report include:

- The major advantages associated with implementing wagons lids include:
  - 99% reduction in coal dust emissions from the top of wagons, the major coal dust emission source
  - Potential to completely seal the wagons doors
  - Reduction in aerodynamic drag
  - Environmentally friendly solution
- The major disadvantages associated with implementing wagons lids include:
  - Large operating cost (retrofitting only)
  - Modifications to all loading and unloading sites
  - Ramifications of lid failure
- The estimated costs associated with implementing both options are highly dependant upon factors which require a detailed investigation, prior to making an informed judgement. Accordingly, it is considered to be prudent to accept the outcomes of the practicability and cost-effectiveness assessment, which currently show relatively good results, in the absences of such an analysis
- The major concerns with the introduction of any form of lids is the untried nature of these in the coal industry, a harsh environment. The lids proposed as a retrofit are of an experimental nature, hence are not able to be tried with any certainty as to whether they are reliable, safe or effective. The lids which would be incorporated in any design are by definition untried, however QR experience with this style of lids in other industries has proven that these are maintenance intensive, hence cannot be recommended without significant development work being undertaken.
- The final finding of this report is that the implementation of lids to wagons is not to be undertaken at the current time, with further development being warranted prior to any implementation proposal.

Glossary of terms

CQCI
Central Queensland Coal Industry – entire coal supply chain

CQCN
Central Queensland Coal Network – entire rail infrastructure network

EE
Environmental Evaluation

QR
Queensland Rail Limited

QRNA
Queensland Rail Network Access – below rail operator

QRN
Queensland Rail National – above rail operator

1. Introduction

Queensland Rail Limited (QR) has appointed Connell Hatch, John Planner of Introspec Consulting and Katestone Environmental to prepare an Environmental Evaluation (EE) of coal dust emissions engendered from rollingstock in the Central Queensland Coal Industry (CQCI) in response to a Notice issued by the Queensland Environmental Protection Agency (EPA). The deliverables of the report have been stipulated by the Terms of Reference for the project which encompass:

a) *Identify all potential sources of coal dust emissions from QR trains in Central Queensland on land described as rail lines connecting coal mines in the Bowen and Callide Basins with ports at Dalrymple Bay, Hay Point and Gladstone*

b) *Quantify the potential risk of environmental harm posed by each dust source*

c) *Identify the factors and circumstances that contribute to dust emissions and/or impacts from each source. Consideration should be given to (but not limited to) issues such as coal type, coal properties and meteorological conditions.*

d) *Based on the findings from the above, identify locations within QR's Central Queensland operations where proximity of railway lines to communities may give rise to higher risk of environmental harm due to fugitive coal dust*

e) *Identify ways to reduce the risk being caused by coal dust emissions and assess each for practicability, effectiveness and cost, in relation to the mitigation of environmental impacts of fugitive coal dust emissions*

The sources of coal dust emissions that have been identified in the CCQI include emissions from:

- The coal surface of loaded wagons
- Coal leakage from the doors of loaded wagons
- Wind erosion of spilled coal in the rail corridor
- Residual coal in unloaded wagons and leakage of residual coal from the doors
- Parasitic load on sills, shear plates and bogies of wagons

This supplementary report presents the particulars of an analysis of wagon lids that was undertaken with respect to the EE commissioned by QR. Wagon lids have been identified as mitigation strategy for reducing coal dust emissions from the top of loaded and unloaded wagons. There are two potential approaches that could be adopted regarding wagon lids: retrofitting lids to existing wagons or designing lids into wagons. The former is a shorter-term strategy whereas the latter is considered to be a longer-term option, therefore it is imperative that both options are considered exclusively.

In order to assess the practicability and cost-effectiveness, the capital investment and operational costs associated with each option will be determined and then each option will be rated against a set of weighted rating factors.

2. Advantages

There are numerous advantages that would result from the implementation of wagon lids, the most influential of which include:

- 99% reduction in coal dust emissions from the top of loaded and unloaded wagons
- Potential to completely seal the wagons doors
- Reduction in aerodynamic drag
- Environmentally friendly solution

The reduction in aerodynamic drag had been reported to be in the order of 20% based on trials conducted in the US (diesel haul). Due to varying conditions between the US trials and what would be experienced in the CQCI, this figure cannot be applied to the CQCI. Considering that the majority of the network is electrified, the only feasible method of estimating the reduction in aerodynamic drag would be to conduct trials in the CQCI and measure the change in, and cost of, the energy savings.

3. Disadvantages

There are numerous disadvantages that would result from the implementation of wagon lids, the most influential of which include:

- Additional capital expenditure to purchase and install
- Lid failure (discussed in detail in the Section 3.1 Failure)
- Decreased payload due to the weight of the lids
- Modifications required to all loading and unloading stations
- Provisions must be provided for lid maintenance and replacement operations
- Cost of maintenance to lids on wagons

3.1 Failure

3.1.1 Definition

Lid failure is defined as any situation when the wagon lid does not function as it is designed. This definition therefore includes all instances where lids do not open or close as designed, seizes up, collides with other equipment, inhibits the supply chain in any way due to malfunction etc.

3.1.2 Consequences

In a continuous loading situation, the failure of a lid could result in a chute or loading system component colliding with the lid causing damage to both the lid and loading system. Alternatively, the loading system could attempt to load the wagon, damaging the lid, spilling coal and significantly increasing the potential to derail the train. Increased automatic sensing equipment in the control system is required to be implemented in order to avoid either of the aforementioned incidents. Regardless of the potential for damage, if a lid was to fail under any circumstances, the potential resulting scenarios include:

- Stop the train and attempt to fix the lid
  - Delays train
  - Requires trained personnel
  - If the lid cannot be fixed then the wagon will travel around empty until it can be shunted out of the wagon set or replaced
- Leave the wagon unloaded
  - The wagon will travel around empty until it can be shunted out of the wagon set or replaced

A potential problem with leaving damaged lids in service is that if loading and unloading operators are unaware of the failure or particular operations are autonomous, there is the potential for further damage to the lid and surrounding infrastructure, downtime etc if an already failed lid is activated.

Another consideration which would need to be made is how to deal with a failure. Presuming that a failed lid needs replacing, it can either be done immediately, resulting in significant downtime for a particular train and wagon set. Or, the wagon would have to remain in service unloaded until it receives its next three-weekly reliability evaluation. There are many factors which could influence which course of action to take, such as if there were multiple failures in a wagon set, or how close the wagons were to their next reliability evaluation.

4. Costing

4.1 Retrofit

In order to estimate the costs involved with retrofitting lids to the existing fleet, an industry supplier of wagon lids was engaged.

The proposal put forward is a leasing arrangement, which will provide the lids for an operating cost on a time basis. The following indicative cost estimate was provided:

- Capital investment : Nil
- Operational cost : $5.00 - $8.00 per wagon trip

The operating cost presented covers the installation, commissioning of the lids as well as modifications to loading and unloading facilities, ongoing service and maintenance and any staff training. However, there are also many costs and benefits that are not included in the price that could have a marked impact on the estimated operational cost, viz:

- Potential energy savings associated with reduced aerodynamic drag. The only feasible method to estimate this cost would be to perform trials in the CQCI with wagon lids installed on trains to measure the energy savings
- Provisions for additional non-electrified sections of track at central points, with appropriate facilities, access and safety features to perform maintenance operations
- Lost payload due to the weight of each wagon lid. The impact of this would depend highly on the weight of each lid in relation to the accuracy of the weighbridge equipment, reportedly 500 kg. If this was the case, for example, it could be argued that a lid of 250 kg would push the average measurement to the next level
- Costs associated with lid failure
  - Train delays
  - Lost payload
  - Removing trains from service and shunting
  - Damage to infrastructure

All of the aforementioned costs are highly variable and dependant on a range of variables, therefore it considered to be prudent not to attempt to quantify these costs without an in-depth analysis of the full costs and benefits associated with wagon lids, taking into account potential scenarios and operational decisions which would alter the outcomes significantly.

4.2 Design

The capital investment required to design lids into wagons is estimated to be $10000 per wagon. This cost reflects the cost difference between a wagon with a lid and one without. Considering the need for a highly reliable and therefore simplistic design with a minimum of moving parts, this cost difference is considered to be relatively minimal. Extrapolating this cost to a fleet of 7,000 wagons, the estimated capital investment required is in the order of $70 million.

There would be no specific operating cost associated with this type of wagon lid as assessed. Further assessment of the option is required to determine the final cost of the lid in totality.

However, all of the costs which are applicable to the retrofitting option which cannot be accurately estimated are not taken into account. Arguably, a highly reliable wagon lid could be designed as part of the wagon, which might reduce the probability of lid failure, which could reduce some of these costs.

5. Assessment

5.1 Prelude

The practicability and cost-effectiveness of introducing wagon lids is determined by giving a weighted score to predetermined rating factors. The rating system has been developed in order to facilitate a weighted score for each mitigation strategy arising from the EE which has a generic comparable base. This was achieved by developing:

- A set of weighted rating factors which are relevant to the practicability and cost-effectiveness of a mitigation strategy, and
- A rating guide (see Appendix B) pertaining to various aspects of the rating factors which will highlight the differences between the different mitigation strategies

5.2 Retrofit

Table 1 shows that retrofitting lids scores well with respect to the rating factors for cost-effectiveness, scoring 3.6 out of 5, with 5 being the highest. This outcome is achieved because of the estimated 99% reduction in coal dust emissions from the top of the wagons, the primary identified coal dust emissions source as well as the fact that full operating cost of the lids cannot be estimated accurately. Table 2 shows that retrofitting lids scores relatively poorly with respect to the weighted rating factors for practicability, scoring 2.15 out of 5.

This score when compared to other alternatives is not in the acceptable range.

Table 1 – Retrofit Lids Cost-Effectiveness Assessment

Factor	Rating Code	Weighting	Rating
Capital Investment	A	20%	4
Operational Cost	B	40%	2*
Effectiveness	C	40%	5
Total		100%	3.6

** Does not account for many factors*

Table 2 – Retrofit Lids Practicability Assessment

Factor	Rating Code	Weighting	Rating
Implementation			
Ease	D	8%	3
Time	E	8%	2
Resources	D	8%	5
Capacity Impact	G	35%	2
Maintainability	D	2%	3
Reliability	F	15%	1
Implementation Risk	G	14%	1
Safety	F	5%	2
Environmental	F	5%	4
Total		100%	2.15

5.3 Design

Table 3 shows that design lids scores acceptably with respect to the rating factors for cost-effectiveness, scoring 3.4 out of 5, with 5 being the highest. This can be associated with the fact that like retrofit lids, this outcome is achieved because of the estimated 99% reduction in coal dust emissions from the top of the wagons, the primary identified coal dust emissions source. Table 4 shows that design lids scores poorly with respect to the weighted rating factors for practicability, scoring 2.32 out of 5.

QR's experience with this style of lid has indicated that the cost of maintenance could be >$10.00 per day per wagon based upon their experience in other industries. This is a significant cost impost when compared to the current maintenance costs.

The combination of these mediocre scores determines that lids are not practical and are not a cost effective mitigation strategy to reduce coal losses from the top of loaded coal wagons during transport in the CQCI.

Table 3 – Design Lids Cost-Effectiveness Assessment

Factor	Rating Code	Weighting	Rating
Capital Investment	A	20%	3
Operational Cost	B	40%	2
Effectiveness	C	40%	5
Total		100%	3.4

** Does not account for many factors*

Table 4 – Design Lids Practicability Assessment

Factor	Rating Code	Weighting	Rating
Implementation			
Ease	D	8%	5
Time	E	17%	1
Resources	D	8%	5
Capacity Impact	D	40%	2
Maintainability	D	2%	5
Reliability	F	15%	1
Implementation Risk	G	14%	1
Safety	F	5%	2
Environmental	F	5%	5
Total		100%	2.32

5.4 Comparison

Appendix B contains a complete assessment including both practicability and cost-effectiveness for all of the identified mitigation strategies. Figure 1 highlights the distinct difference between the two lid options as mitigation strategies. There are a few factors which contribute to the differences, mainly:

- Cost (both capital investment and operating cost)
- Operational impact

Designing lids is a cheaper operating cost option because if lids are retrofitted and sourced from another company, they will inherently cost more. There is also therefore less control over the design of the lids, the reliability of the lids, the facilities required to operate and maintain the lids etc.

Potentially the most important difference to consider upfront is the difference in timeframes between the options. Retrofitting lids is estimated to be achieved in 1-5 years, whereas given the design life and cost of building wagons, designing lids into wagons would only be reflected in the industry in the 20-30 year period. Accordingly, retrofitting lids is really a shorter-term solution that could be considered in the interim, with designing in wagon lids to be considered as a long-term migration strategy.

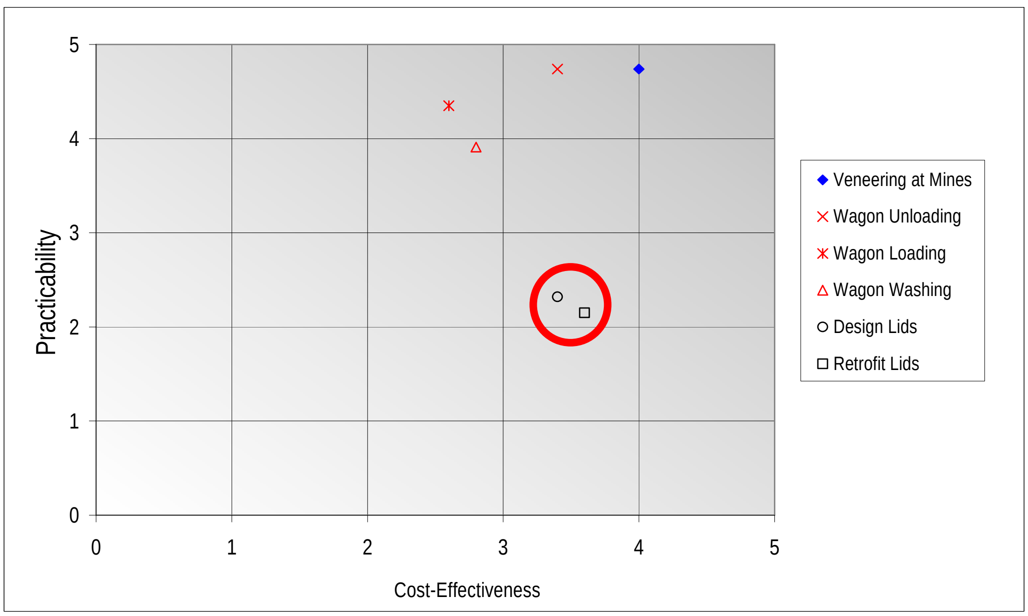


Figure 1 – Mitigation Strategies Assessment Summary

6. Conclusion

An analysis of introducing wagon lids to cover coal wagons in the CQCI has concluded that the major advantages associated with implementing this mitigation strategy would include:

- 99% reduction in coal dust emissions from the top of wagons, the major coal dust emission source
- Potential to completely seal the wagons doors
- Reduction in aerodynamic drag
- Environmentally friendly solution

The major disadvantages associated with implementing wagons lids include:

- Large operating cost (retrofitting only)
- Modifications to all loading and unloading sites
- Ramifications of lid failure

It was acknowledged that there are many potential operational impacts and costs associated with implementing wagon lids that cannot be estimated without a thorough detailed investigation which would need to consider the operational decisions, reliability of lids, facilities at very intricate level of detail. It is therefore considered prudent not to consider wagon lids as a potential mitigation strategy without undertaking the aforementioned course of action.

This initial assessment of wagon lids has indicated that both options are not cost effective, given that both would almost eliminate coal dust emissions from the primary dust source, however without a full comprehension of the costs associated with wagon lids, this result cannot be taken at face value. Both retrofitting and designing lids showed mediocre good scores with respect to practicability, but these scores are highly dependant upon the operational impact and reliability of the lids, wither of which can be accurately estimated without a thorough investigation.

Appendix A

Wagon Lids Fact Sheet

Wagon Lids

Lightweight, automatic fibreglass wagon lids can be installed on train wagons to prevent coal loss during transportation.

"The key factor that contributes to the emission rate of coal dust from wagons is the speed of the air passing over the coal surface." (QR EE Interim Report, Jan 2008)

Capital Investment
Nil

Operational Cost
$5.00 - $8.00*

Major Benefit
Stops coal dust and spillage from the top of rail wagons

Operating devices at either side of loading stations will also be required to open and close the lids prior to and following loading.

Installing lids will provide a highly effective and visible solution to managing coal loss, which will address community, environmental and industry concern.

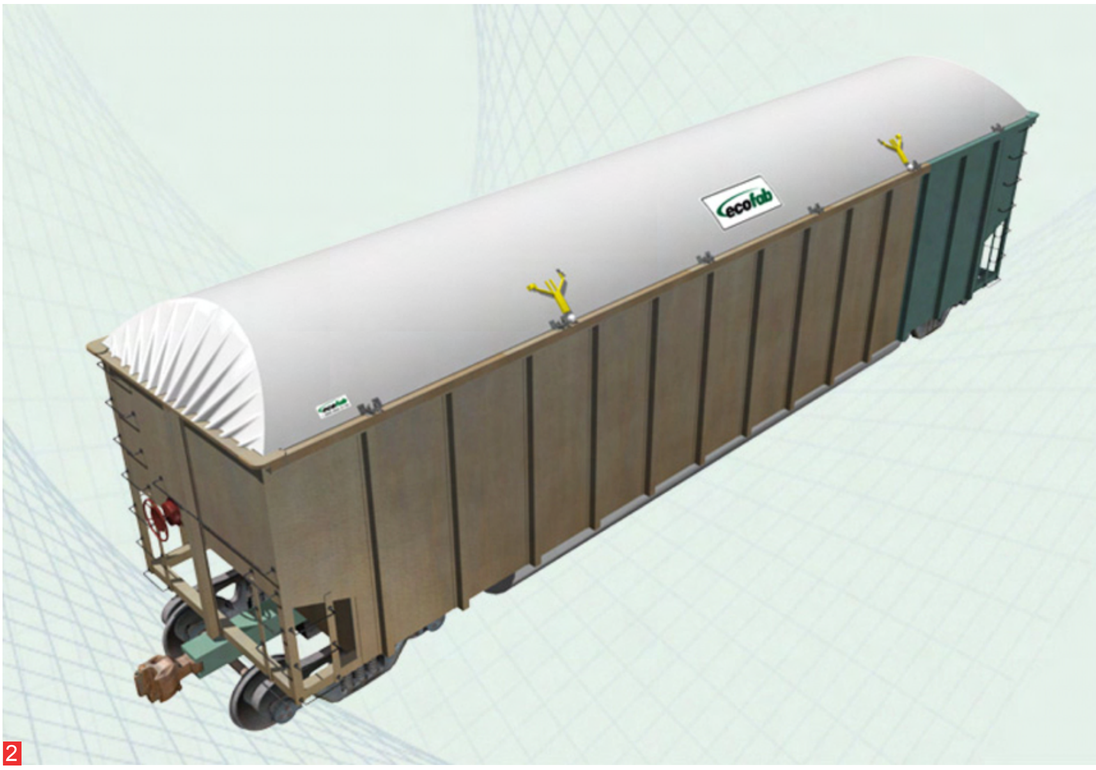
1

Advantages

- Eliminate dust from the top of loaded and empty wagons
- Fuel savings due to reduced aerodynamic drag
- Reduce environmental and community concern

Disadvantages

- Modifications required to all loading systems
- Capacity impacts due to lid failure



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1. Artist impression © Ecofab 2008
2. Artist impression © Ecofab 2008

* per wagon trip - does not account for lid failure or fuel savings

Appendix B

Mitigation Strategies Assessment

Client: Queensland Rail Limited
Job Number: H327578-N00-EE00
Project: Environmental Evaluation
Description: Coal Dust Emissions Mitigation Strategies Rating Guide

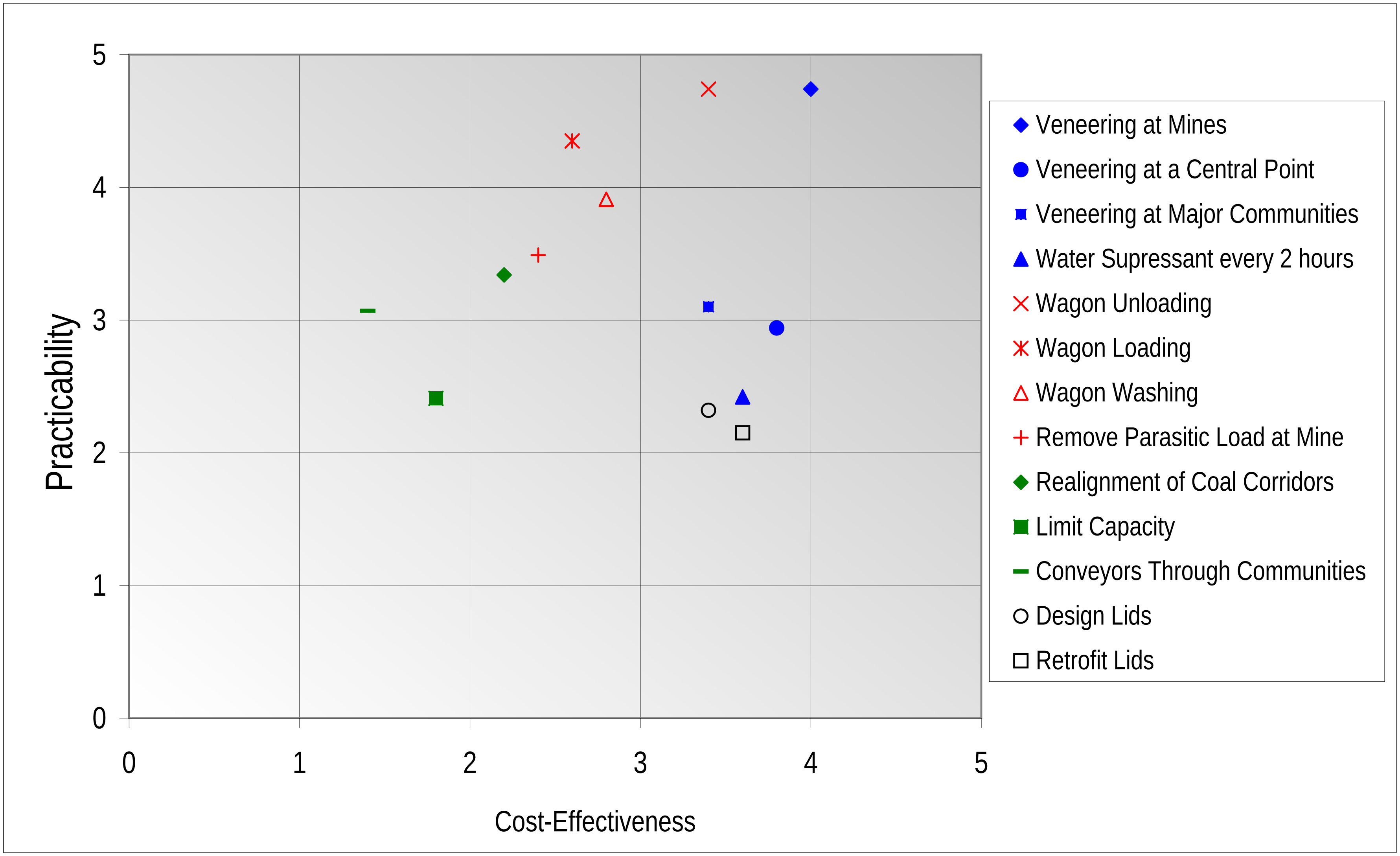
Date: 31.03.2008
Revision: 0

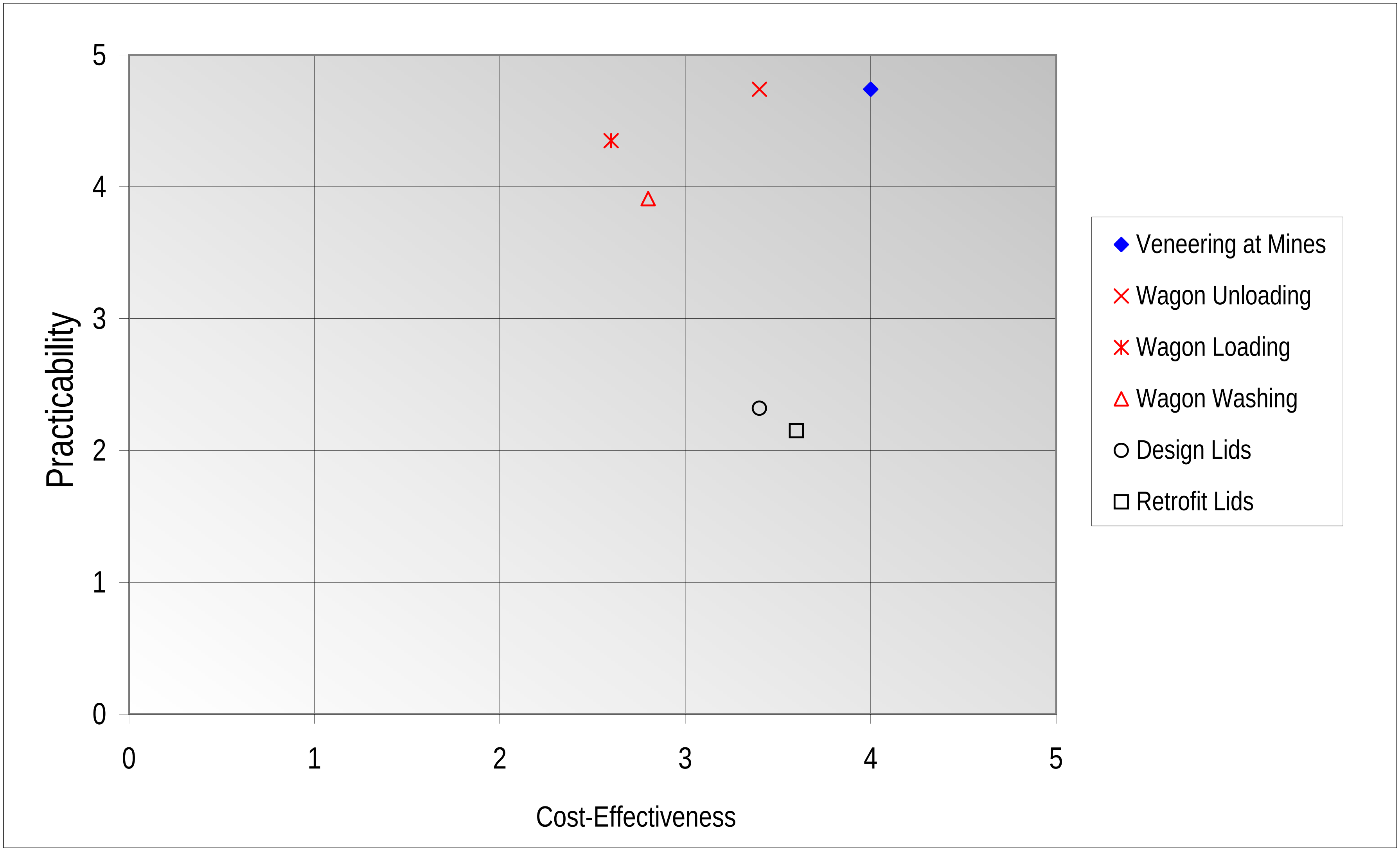
Mitigation Strategies Rating Guide

		Rating Code						
		A	B	C	D	E	F	G
Rating	5	<$1M	<$1	>80%	Very Easy	<1 month	No Impact	Very Low
	4	$1M – $10M	$1 – $5	>60 – 80%	Easy	1-12 months	Low Impact	Low
	3	>$10M - $25M	>$5 – $10	>40 – 60%	Achievable	>1-2 years	Some Impact	Medium
	2	>$25M - $50M	>$10 –$15	20 – 40%	Difficult	>2-5 years	High Impact	High
	1	>$50M	>$15	<20%	Extremely Difficult	>5 years	Untried	Very High

Rating Units

A	industry cost
B	per wagon trip
C	reduction of overall emissions
D	overall assessment
E	implementation timeframe
F	overall assessment
G	overall assessment


Practicability
Cost-Effectiveness
0
1
2
3
4
5
Veneering at Mines
Veneering at a Central Point
Veneering at Major Communities
Water Supressant every 2 hours
Wagon Unloading
Wagon Loading
Wagon Washing
Remove Parasitic Load at Mine
Realignment of Coal Corridors
Limit Capacity
Conveyors Through Communities
Design Lids
Retrofit Lids


5
4
3
2
1
0
Practicability
0
1
2
3
4
5
Cost-Effectiveness
Veneering at Mines
Wagon Unloading
Wagon Loading
Wagon Washing
Design Lids
Retrofit Lids

Cost-Effectiveness Assessment

	Rating Code	Weighting	Veneering at Mines	Wagon Loading	Wagon Washing	Wagon Unloading	Retrofit Lids	Design Lids	Conveyors Through Communities	Realignment of Coal Corridors	Limit Capacity	Remove Parasitic Load at Mine	Water Supressant every 2 hours	Apply Deflectors to Wagons	Veneering at a Central Point	Veneering at Major Communities
Capital Investment	A	20%	4	1	2	3	4	3	1	1	5	2	4	3	5	5
Operational Cost	B	40%	4	5	4	5	2	2	2	4	1	4	5	5	4	4
Effectiveness	C	40%	4	1	2	2	5	5	1	1	1	1	2	0	3	2
Total:		100%	4	2.6	2.8	3.4	3.6	3.4	1.4	2.2	1.8	2.4	3.6	2.6	3.8	3.4

Practicability Assessment

	Rating Code	Weighting	Veneering at Mines	Wagon Loading	Wagon Washing	Wagon Unloading	Retrofit Lids	Design Lids	Conveyors Through Communities	Realignment of Coal Corridors	Limit Capacity	Remove Parasitic Load at Mine	Water Supressant every 2 hours	Apply Deflectors to Wagons	Veneering at a Central Point	Veneering at Major Communities
Implementation																
Ease	D	8%	5	2	2	4	3	5	1	1	2	3	2	2	3	4
Time	E	8%	4	2	2	4	2	1	1	1	2	3	3	1	4	4
Resources	D	8%	4	5	3	5	5	5	4	2	5	2	1	5	3	4
Capacity Impact	G	35%	5	5	5	5	2	2	3	4	1	4	1	5	1	1
Maintainability	D	2%	5	4	4	5	3	5	4	5	5	4	4	4	4	4
Reliability	F	15%	5	4	4	5	1	1	3	5	4	3	3	5	5	5
Implementation Risk	G	14%	5	5	3	5	1	1	4	3	1	3	4	1	4	4
Safety	F	5%	5	5	5	4	2	2	5	4	5	5	5	5	5	5
Environment	F	5%	3	5	5	4	4	5	4	3	5	5	5	5	3	3
Total:		100%	4.74	4.35	3.91	4.74	2.15	2.32	3.07	3.34	2.41	3.49	2.42	3.86	2.94	3.1