

Submission No. 001

(Pawsey Centre)

SL Date: 18/03/2010



**STATEMENT OF EVIDENCE TO
THE PARLIAMENTARY STANDING
COMMITTEE ON PUBLIC WORKS**

**The Pawsey High Performance
Computing Centre for SKA Science**

Kensington, Western Australia

March 2010

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Associated Drawings

Acronym List

1 Introduction

1. The proposal presented in this submission to the Parliamentary Standing Committee on Public Works (PWC) is for the construction of a new High Performance Computing (HPC) Centre at Kensington, Perth, Western Australia. The facility will be known as the Pawsey High Performance Computing Centre for Square Kilometre Array (SKA) Science ('Pawsey Centre').
2. The Pawsey Centre will be a key part of the Federal Government's strategy to address the paucity of high ranked computer systems in Australia. The high performance computing facility proposed to be installed at Kensington will be at the forefront of such facilities in Australia and will rank amongst the top twenty supercomputers in the world at the time of its commissioning in 2013.
3. The investment in the Pawsey Centre will provide a HPC facility that will support the needs of the radio astronomy research community, as well as those of high-end researchers in other areas of computational and data-intensive science, such as nanotechnology, biotechnology and geoinformatics. The investment will also provide additional support for the computational and data processing capabilities required to fully implement the Australian Square Kilometre Array Pathfinder (ASKAP) and Murchison Widefield Array (MWA) radio telescopes.
4. The Pawsey Centre will be funded by the \$1.1 billion Commonwealth Government Super Science Initiative. This funding is focused in three areas of world leading scientific capability: Marine and Climate Science; Space Science and Astronomy; and Future Industries, including the need to provide significant investments in increasing HPC capability.
5. iVEC, an unincorporated joint venture between CSIRO; the Curtin University of Technology; Edith Cowan University; Murdoch University; and the University of Western Australia, will be responsible for the establishment and operation of the Pawsey Centre, whilst CSIRO will own and maintain the Pawsey Centre.
6. iVEC's purpose is to allow science and technology communities including industry to access high performance computing, large-scale storage, high

speed communications and 3D visualisation in order to meet the demands faced by Australian researchers to compete effectively on a global basis.

7. The proposed Pawsey Centre, estimated at \$66 million (excluding GST) at March 2010 prices, comprises:
 - a. the construction of a new building to accommodate the specific environmental and operational requirements for a HPC system;
 - b. the design, procurement and installation of a HPC system that will meet the advanced computing infrastructure needs of the research communities it will serve; and
 - c. the associated site works, infrastructure, landscaping, roadworks, engineering and communications services.

8. Other works related to the proposal, but out of scope for this submission, include a \$14 million expansion to the HPC capacity at existing iVEC sites over the next 9 months. This expanded capacity is essential if Australian researchers are to be prepared to fully exploit the petaflop (1 petaflop = 1000 teraflops) system that will be housed in the Pawsey Centre and commissioned in 2013. This HPC capacity will be made available to the Australian research community through priority and merit allocation schemes operated by the Pawsey Centre, and will enable Australian researchers to develop their expertise in effectively exploiting the power of computers in the 50 to 100 teraflop range.

2 Background

9. A national approach to provide high performance computing or supercomputing capability for the Australian research community commenced in 2000 with the formation of the Australian Partnership for Advanced Computing (APAC), an unincorporated joint venture of the Australian National University (ANU), CSIRO, and six state-based HPC organisations, funded by the then Department of Education, Science and Training (DEST).
10. APAC was structured to achieve two overarching goals: to provide peak computing facilities to Australian researchers via the National Facility at the ANU and to foster national cooperation in the provision of advanced computing infrastructure and services. With the formation of the National Collaborative Research Infrastructure Strategy (NCRIS) Platforms for Collaboration (PfC) capability in 2006, these two activities were separated into two new organisations, the National Computational Infrastructure (NCI) and the Australian Research Collaboration Service (ARCS).
11. In May 2009, the Commonwealth government announced funding for a \$1.1 billion Super Science Initiative. This funding was focused in three areas of world leading scientific capability: Marine and Climate Science, Space Science and Astronomy, and Future Industries. Significant investments in new HPC capability to make Australia internationally competitive were part of this initiative.
12. The Super Science Initiative is providing \$80 million for the creation and development of research infrastructure through the establishment of the Pawsey HPC Centre for SKA Science in Perth ('Pawsey Centre') that has the capacity to host new HPC facilities and other expertise to support the proposed SKA radio astronomy telescope as well as high-end research in other areas of computational and data-intensive science, such as nanotechnology, biotechnology and geoinformatics. The proposed Pawsey Centre will comprise a new building, HPC system and associated works at Kensington, Perth WA, estimated at \$66 million (excluding GST) at March 2010 prices, and other

works related to the proposal, but out of scope for this submission, for a \$14 million expansion to the HPC capacity at existing iVEC sites.

13. The ASKAP and MWA radio telescopes are pathfinder projects which are part of Australia's bid to host the Square Kilometre Array (SKA) radio telescope. The SKA is one of the largest scientific projects undertaken anywhere in the world. A final decision on the site of the full SKA is scheduled in 2012 by the international SKA project. Australia will be well positioned in this selection process with ASKAP and the Pawsey Centre demonstrating both Australia's capability and commitment.
14. The Pawsey Centre will be connected at very high bandwidth to ASKAP and MWA by fibre connections being funded from other sources. The fibre connection from Boolardy to Geraldton is being constructed under contract to CSIRO as part of the ASKAP project. The connection from Geraldton to Perth was identified as a priority route under the National Broadband Network: Regional Backbone Blackspots Program, administered by the Department of Broadband, Communications and the Digital Economy. A contractor has been selected to construct backbone infrastructure connecting a number of regional centres including Geraldton. This infrastructure is expected to be in place within 18 months and will address the bandwidth requirements of high-end radio astronomy.

3 Objectives

15. The primary objective of the proposed works is to construct a national HPC facility that meets the needs of both the radio astronomy research community and high end researchers in other areas of computational and data-intensive science.
16. The proposed Pawsey Centre will:
 - a. provide internationally significant HPC capability, and associated data support, to prioritised radio astronomy data analysis and physical sciences research endeavours;
 - b. develop and operate a resource allocation system that gives priority research on-demand access to allocated resources;

- c. support meritorious research in all fields through the provision of ‘capability’ quality computational services which specifically require petascale HPC processing; and
- d. provide the opportunity to develop world-class HPC expertise among high-end research users.

4 Need

17. Supercomputers are of the highest and most pervasive strategic importance, as a major contributor to the development of science and technology, and to the economic competitiveness of oil, gas and mineral resources, and medical and pharmaceutical industries, to name but a few.
18. There is growing recognition that new and validated ways to conduct research have emerged across most research disciplines. Adding to traditional forms of research that rely on experiment, theory and testing hypotheses using data, it is now evident that researchers also collect increasingly larger sets of data as a primary form of research; and use data modelling tools to assist them in deriving patterns, perceptions and trends that can form the basis for establishing and confirming hypotheses.
19. Information and Communications Technology (ICT) is the cornerstone of such new approaches, providing the means not only for increasingly powerful computer-enabled simulation and modelling, but also the very avenue to manage and integrate the increasing volume and complexity of datasets and collections. Hence, ICT is not only a resource to administer and manage research but also to drive and innovate the ways in which research is conducted.
20. The 2008 *Strategic Roadmap for Australian Research Infrastructure* stated that “further significant computing needs exist as do new forms of computing aggregations so that the demand for HPC services is expected to grow for the foreseeable future”. The establishment of the Pawsey Centre will address that need.

21. It is anticipated that a very broad range of disciplines will use the Pawsey Centre, such as:
- a. on-demand processing and database queries of ASKAP and MWA science products to produce cross catalogue identifications and/or new catalogues and high level data products;
 - b. conversion of SKA pathfinder data output into images and other science products;
 - c. deep searches for fast, highly dispersed pulsars;
 - d. computational geoscience;
 - e. geospatial image analysis;
 - f. interactive simulation of molecular systems for computational nanotechnology; and
 - g. interactive data analysis for ocean observing.
22. The use of supercomputing in all of these areas is growing. Countries with mature supercomputing infrastructures typically play a leading role in the development of science and technology. These countries and their industries are more likely to develop their human resources expertise, advance their research and development, accelerate innovation, create important new knowledge and shorten time-to-market for new products. The national HPC capability will be increasingly essential to Australia's business success in a global economy.
23. As a result of the Federal Government's Super Science initiative and other investment in high performance computing, Australia will have three internationally significant research HPC facilities in place within the next three years:
- the Pawsey Centre, with a focus on radio astronomy;
 - the Super Science Marine and Climate HPC Centre hosted by the Australian National University, building on an earlier NCRIS investment in the National Computational Infrastructure (NCI); and
 - the Victorian Life Sciences Computation Initiative (VLSCI) established by the Victorian Government and the University of Melbourne.

Each of these systems has a particular discipline focus, while significantly contributing to raising the overall HPC capacity to support Australian research. Close working relationships are being established between the three facilities to

share experiences around the development and operation of these facilities. The NCI facility hosted by the Australian National University has already been partly commissioned, and is informing the design and specification of the Pawsey Centre. Once all three systems are in place, Australia will have a national network of research HPC resources that will make Australia internationally competitive in computational capacity.

24. If the Pawsey Centre failed to eventuate, the loss of such computing power would deprive Australian governments, industry and the scientific research community of an unprecedented opportunity to leverage this powerful strategic resource to 'turbocharge' innovation.

5 Urgency

25. As the provider of high performance computing facilities to CSIRO and all four public universities in Western Australia, iVEC's ability to provide high end computing power to its research clients is at capacity. This limitation will have a direct impact on the ability to attract and retain high end scientific research both in Western Australia (WA) and nationally.
26. As the presence of radio astronomy research in WA grows through the establishment of the ASKAP and MWA projects, and other priority areas ramp up their computational activities, the demand for high performance computing capability will increase rapidly over the next three years.
27. The timetable for the decision in 2012 regarding location of the SKA, will require that the pathfinder telescopes are up and running to support the Australian bid. One of the functions of the Pawsey Centre is to provide additional computing capability for the ASKAP and MWA pathfinder telescopes.

6 Site

6.1 General Description

28. The Pawsey Centre is to be constructed at Lot 15 Dick Perry Avenue, Kensington, Perth WA. The land is an undeveloped site located adjacent to the

existing CSIRO Australian Resources Research Centre (ARRC) facility at Technology Park, Bentley and approximately 6 kilometres from the Perth CBD. The site is owned by CSIRO in freehold title.

29. The site and surrounding area is moderately sloped. The site is lightly treed with remnants of a previous pine plantation.

6.2 Planning

30. Site development and planning shall be consistent with the requirements of the City of South Perth Town Planning Scheme in relation to site coverage, building height and boundary setbacks.
31. The siting of the Pawsey Centre shall be consistent with CSIRO's site master plan, allowing for future expansion of the Centre and take into account the need for future expansion of CSIRO's existing facilities.

6.3 Geotechnical Conditions

32. Detailed site geotechnical investigations are being undertaken to allow the foundation and earthworks solution for the building and associated works to be finalised. A previous investigation for the adjacent CSIRO ARRC facility indicated that the soil conditions on the two sites will be similar. Information gained from the previous site investigations and existing geological maps suggest that the site subsurface conditions consist of Bassendean sand.

6.4 Heritage Considerations

33. There are no known heritage issues in relation to the proposal.

6.5 Indigenous Considerations

34. There are no known indigenous sites affected by the proposal. Previous Ethnographic studies undertaken for the CSIRO Australian Resources Research Centre did not identify any issues with respect to the Aboriginal Heritage Act.

6.6 Flora and Fauna

35. Pursuant to the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (the EPBC Act), CSIRO will refer the Pawsey Centre

project to the Department of the Environment, Heritage and the Arts (DEWHA) for determination by the Minister as to whether approval is necessary, and, if so, the type of assessment that will be undertaken.

7 Consultation

36. The following authorities and Departments have been contacted and/or consulted by CSIRO and its consultants during the preparation of this submission and/or will be consulted during development of the proposed works:

Department of Environment, Water, Heritage and the Arts
Department of Innovation, Industry, Science and Research
Department of Employment, Education and Workplace Relations
Department of Finance and Deregulation
WA Department of Planning and Infrastructure
WA Department of Environment and Conservation
WA Department of Commerce
WA Department of Agriculture and Food
WA Department of the Premier and Cabinet
Fire & Emergency Authority of Western Australia
The City of South Perth
Federal Member - Member for Swan, Mr Steve Irons
State Member - Member for South Perth, Mr John McGrath
City of South Perth - Moresby Ward Councillor – Ms Sue Doherty
City of South Perth - Moresby Ward Councillor – Mr Kevin Trent
Western Power
Telstra / Optus / AARNet
Curtin University of Technology
Edith Cowan University
Murdoch University
The University of Western Australia
The South Perth Chamber of Commerce
Kensington Community Association.

8 Technical Solution

8.1 General

37. The proposed Technical Solution addresses both The Pawsey Centre Building and associated infrastructure; and the HPC System to be housed within it.

8.2 The HPC System

38. The HPC system to be housed in the Pawsey Centre will comprise three main networked subsystems. These are:
- a. **High Performance Compute subsystem.** This will be housed in the HPC cell of the Pawsey Centre, and will be a multi-processor petascale class machine, with a capability of in excess of a thousand trillion floating point operations per second (the fastest machine in the world currently is rated at around two thousand trillion floating point operations per second);
 - b. **Disk storage subsystem.** This component deals with the burgeoning data storage requirements of researchers, including the huge volumes of data to be stored and processed by radio astronomers and other researchers with substantial computational requirements. The rapid-access disk subsystem will have a capacity in the tens of petabytes range, and will be housed in the disk cell of the Centre;
 - c. **Tape storage subsystem.** Simple economics dictate that not all the data required to be stored can be accommodated permanently on rapid-access spinning disk. Hence, a hierarchical storage system will be required, where data that is accessed less frequently is automatically migrated from disk to tape, freeing up disk space. The tape subsystem will consist of a number of very large, interconnected automatic tape libraries, and will be housed in the tape cell of the Pawsey Centre.
39. The specification of these subsystems will be developed in consultation with the relevant stakeholders in the networking and research communities.

8.3 The Building

40. The proposed Pawsey Centre will comprise a single storey building and basement of approximately 4,000 square metres gross floor area (GFA). The building has three connected, but distinct functional zones comprising working

accommodation for Administration and ancillary support, the Computer Hall and Plant rooms.

41. The building will be sited to face Burvill Court, responding to the CSIRO site master plan whilst integrating with the City of South Perth planning framework. The main entrance and office areas will address the street and through a northerly orientation to maximise solar access and provide good levels of natural light. The Computer Hall will be insulated by the adjacent office areas, plant room spaces and the existing trees to the south west to minimise solar heat gain.
42. The building floor levels will be set to take advantage of the existing landform to ensure an efficient use of the available land. The Computing Hall and Office and Entry will be set at a single level for universal access and to ensure efficient movement of equipment. A basement level, housing plant and equipment will take advantage of the existing site levels, minimising earthworks whilst still providing on grade access for maintenance. Where external changes in level are required, landscaped embankments will be utilised in preference to retaining walls to ensure compatibility with the existing landform.
43. The proposed building will provide:
 - a. a stable operating environment for the HPC system equipment;
 - b. an appropriate working environment for staff;
 - c. operational areas on a single level enabling barrier free access as well as efficient and safe loading and unloading of equipment;
 - d. purpose designed services infrastructure necessary to meet the operational requirements of the HPC system, including redundancy, temperature and humidity control, and to minimise operating costs;
 - e. purpose designed building services to meet the demands of the HPC system requirements;
 - f. strong visual identity for the building that is appropriate to its context and function;
 - g. controlled service vehicle access; and
 - h. a secure facility compliant with Commonwealth Security Guidelines.

44. The design will use a contemporary palette of materials that will complement the existing ARRC facility developed through:
- a. the Office component which will have a glass facade to enable natural light and provide a legible and identifiable entrance to the facility. A roof canopy will cantilever towards the street, with the eave overhang and horizontal shading devices providing solar protection to the façade;
 - b. the Computer Hall which will be clad in feature coloured concrete panels providing a robustness and durable exterior. The walls will be articulated through relief and inset panels;
 - c. a series of hood elements which will articulate the roof of the Computer Hall and provide the relief air to support 'free cooling' to the facility; a sustainable design initiative; and
 - d. a central plant expressed separate to the main building form.

8.4 Design and Construction Standards

45. The design of the facilities will be consistent with the general design philosophy for all CSIRO research accommodation, requiring long-term flexibility (multiple use of space), adaptability (easy conversion of layout/simple re-servicing) and simplicity of maintenance (with fully accessible engineering services).
46. All buildings, services and external infrastructure will comply with all relevant town planning, Commonwealth and State building, health and safety regulations, the Building Code of Australia and all relevant Australian Standards.
47. All consultant agreements and construction contracts must be compliant with the Australian Government National Code of Practice for the Construction Industry and the Australian Government Building and Construction OHS Accreditation Scheme.

8.5 Mechanical Services

48. The mechanical services will include:
- a. central thermal plant to provide chilled water including a water cooled chiller, cooling towers, pumps and storage tanks;
 - b. close control air conditioning to serve the data cells including humidity control and free cooling;

- c. air conditioning for comfort conditions to all administration areas;
- d. miscellaneous supply and exhaust air ventilation systems;
- e. Building Management System; and
- f. reticulated chilled water pipe work to the computer systems.

8.6 Electrical Services

49. The electrical and communications services will include:

- a. utility power connection and High Voltage switch room;
- b. multi-function metering for the new building connected to the site Building Management System;
- c. new mains and submains cabling; transformers, uninterrupted power supply (UPS) and diesel generator power including power conditioning to the data cells;
- d. distribution boards and power distribution units within the Computer Hall;
- e. internal lighting systems including emergency and exit lighting;
- f. external and security lighting systems;
- g. electrical power installation including general-purpose and special-purpose power outlets; and
- h. voice and data communication cabling.

8.7 Hydraulic Services

50. The hydraulic services will include:

- a. cold water reticulation including supply to mechanical services such as cooling towers and humidifiers;
- b. domestic hot water;
- c. sanitary plumbing and drainage; and
- d. stormwater drainage.

8.8 Fire Protection

51. Fire protection will consist of early smoke detection and automatic fire sprinkler systems as well as fire hydrants, hose reels, extinguishers.

8.9 Landscaping

52. The siting of the building minimises earthworks, with the proposed landscape design respecting the context of the existing CSIRO ARRC site.

53. The landscaping will be consistent with the high quality of landscape design of the CSIRO ARRC campus as well as satisfying the local environmental needs and requirements. Established trees will be incorporated into the landscape design.

8.10 Vehicular Access

54. Service vehicle access will be provided via a new service road off Burvill Court to the north of the site providing secure access for service vehicles to the unloading bay and services area.

55. Access for fire brigade, ambulance and other emergency vehicles will be provided consistent with local regulatory requirements.

8.11 Car Parking and Bicycle Parking

56. The car parking requirements generated by the proposed building are minimal. The existing CSIRO site car parking and bike storage facilities are adequate to meet anticipated growth. An additional accessible parking bay will be provided adjacent to the new facility to support Disability Discrimination Access (DDA) compliance.

8.12 Pedestrian Access

57. Existing conditions provide for a network of pedestrian footpaths around the site. Vehicle access and movement paths crossing pedestrian paths will be sign posted and graded in accordance with acceptable standards.

8.13 Security

58. The facility will be fitted with Commonwealth approved access control and security systems. Perimeter lighting will be provided to the proposed new building to improve night security.

59. The Computing Hall will be designed in accordance with the established physical security standards of the Commonwealth Protective Security.

9 Environmental Sustainable Design Principles

9.1 Energy Conservation Initiatives

60. The new facilities will incorporate both active and passive energy conservation initiatives in order to minimise the energy and environmental impact of such facilities.
61. Passive energy conservation measures will be incorporated into both building and landscape design, whilst the design of mechanical, electrical and hydraulic services will incorporate active energy conservation initiatives. This will include:
- a. optimum building orientation on the site to provide maximum north/south exposure in order to maximise passive solar energy and day lighting;
 - b. provision of primary or borrowed natural light where appropriate to the functional requirements, thus minimising the use of artificial lighting;
 - c. use of free cooling in the mechanical system to the Computer Hall to reduce energy needs when the outside conditions are suitable and can be used for cooling;
 - d. installation and connection of power factor correction to all transformer supplies from the substation to improve the building power factor and reduce energy usage and cost;
 - e. utilisation of LED lighting and highly efficient T5 fluorescent lighting with electronic ballasts and triphosphor tubes for energy conservation and extended lamp life;
 - f. provision of a dedicated automatic lighting control system with features such as;
 - i. time clock control to turn bulk of lighting off at predetermined times;
 - ii. passive infra-red and ultrasonic detectors to activate/de-activate lighting to intermittently used rooms such as toilets, storerooms and meeting rooms; and
 - iii. photo-electric control of lighting in perimeter rooms with access to natural lighting.
 - g. selection of cost effective and energy efficient mechanical plant;
 - h. rainwater capture and reuse in toilet flushing and landscape irrigation; and

- i. connection to the existing ARRC Building Management System to allow monitoring and adjustment of the facility's energy consumption.
62. Alternative renewable power sources such as thermal solar and geothermal systems are being investigated as initiatives to reduce energy use for the facility.
63. Currently there are no Australian standard rating systems such as Greenstar or NABERS for Computer Centres or like facilities. A facility such as the Pawsey Centre can however be rated and benchmarked on its energy efficiencies alone. Measurement of the facility's Power Utilisation Efficiency (PUE) provides an international comparison. The PUE is defined as the ratio of the total power consumed by a data centre to the power consumed by the IT equipment that populates the facility (the closer to 1 the better). The target PUE for the Pawsey Centre is approximately 1.4 to 1.5 which will be achieved by the adoption of energy efficient systems. PUE's in this order are considered as world's best practice.

9.2 Environmental Impact

64. The new facilities will incorporate initiatives to minimise the impact on the environment including:
 - a. selection of materials with low volatile organic compound emissions and those of a proven sustainable manufacture;
 - b. selection of materials with consideration of their embodied energy;
 - c. module selection of building materials to minimise wastage;
 - d. incorporation of water saving devices on hydraulic fittings and fixtures to reduce water consumption; and
 - e. flexibility of the core design so that it does not become obsolete and can adapt to changing needs in the future.
65. An Environmental Management Plan consistent with AS/NZS ISO 14001:2004 will be developed for the post-occupancy management of the facility. The construction contractor will implement an Environmental Management Plan during the construction phase to manage waste, noise, airborne pollutants, dust, erosion and stormwater control.

10 Occupational Health and Safety

66. CSIRO pursues an active Occupational Health and Safety Policy which will be integrated within the design and construction processes and subsequent facility operational procedures.
67. The construction contractor will be accredited under the Federal Safety Commission Accreditation Scheme.

11 Child Care Provisions

68. The child care needs of the proposed Pawsey Centre will be met by the existing child care centre available at the adjacent Technology Park Bentley, established to meet the needs of the Precinct.

12 Impact on Local Community

69. The construction of the Pawsey Centre will ensure Australia's ability to attract high end scientific research; including areas of research that are important to the local and national economy such as engineering, minerals and mining.
70. As one of the leading HPC facilities in the world, the Pawsey Centre will raise the profile of eResearch at a local and national level by promoting research activities that require the power of advanced information and communication technologies for research. As well as attracting research scientists, interest in such a facility will help attract students to study related fields in science and technology in Australia.
71. The Pawsey Centre will complement and enhance the status of the Technology Park, Bentley as a significant Precinct for technology driven and innovative organisations and contributing directly to the long term viability of the Technology Park as the pre-eminent place of employment, research and education in the community; and indirectly to local businesses that support it.
72. Over the building construction period, the construction and associated industries will benefit the community through the generation of over 400 direct, indirect and demand-induced jobs.

13 Cost

73. The estimated out-turn cost of this proposal is \$66 million (exclusive of GST) at March 2010 prices, inclusive of escalation costs, contingencies, all professional fees and authorities' charges. The indicative cost for the Pawsey Centre building is \$26 million and the HPC system \$40 million.

14 Timing

74. Subject to Parliamentary approval, detailed design and documentation will proceed to enable construction of the building to commence in late 2010 and to be completed by late 2011, consistent with the HPC procurement, installation and commissioning program which will be completed in 2013.

15 Conclusion

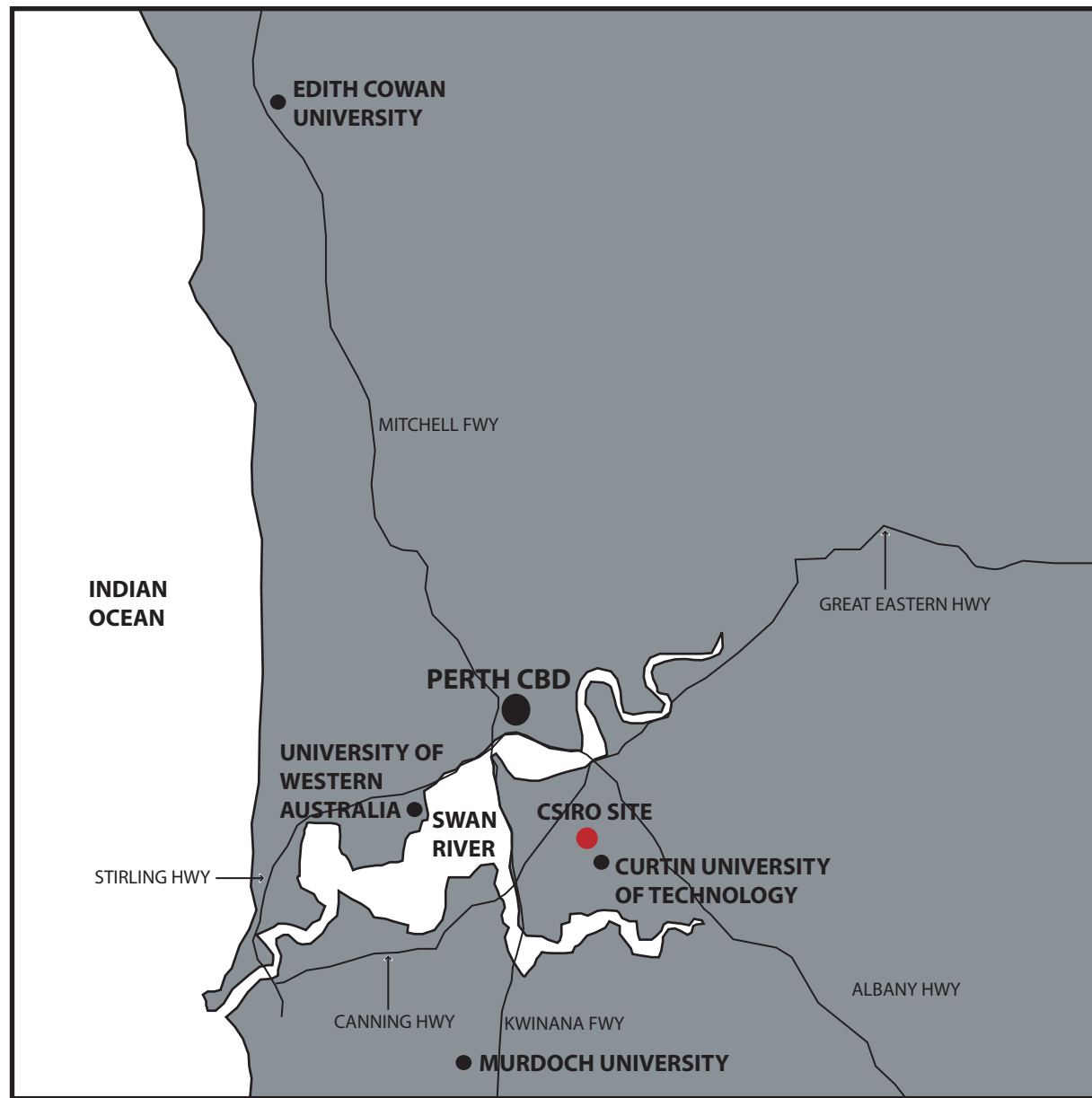
75. This submission is for the construction of the Pawsey High Performance Computing Centre for SKA Science in Kensington, Perth WA.

76. CSIRO is satisfied that the proposed works as described in this submission are the most appropriate, timely and cost effective way to achieve the required objectives.

77. The design properly reflects the CSIRO functional brief and will cater for future changes in research activities and priorities.

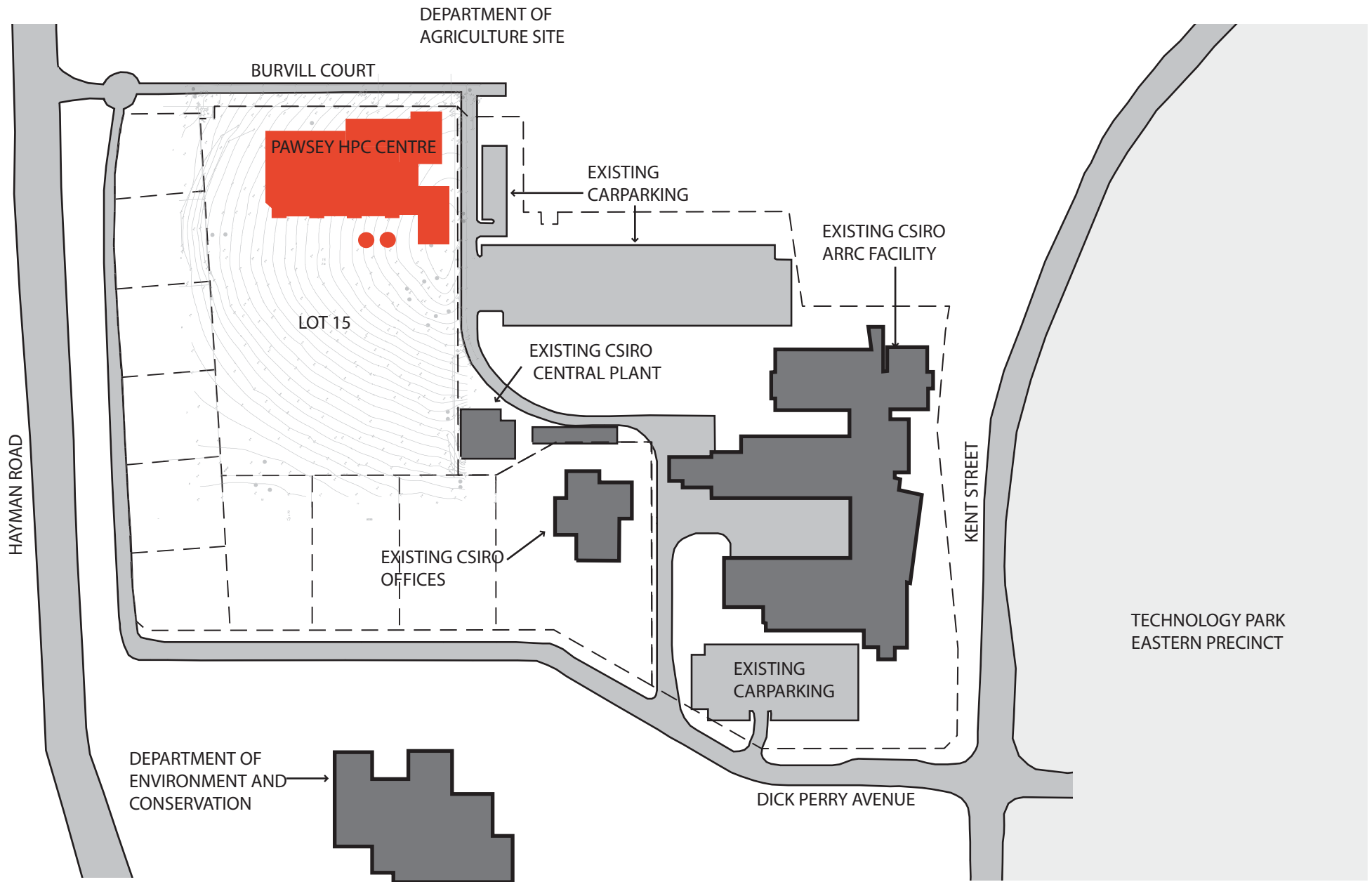
Associated Drawings

- 1 Location Plan
- 2 Technology Park Western Precinct Plan
- 3 Site Plan
- 4 Floor Plan – Ground
- 5 Floor Plan – Basement
- 6 Roof Plan
- 7 North Elevation / South Elevation
- 8 East Elevation / West Elevation
- 9 Sections
- 10 Perspective



PAWSEY HIGH PERFORMANCE COMPUTING CENTRE for SKA SCIENCE
PERTH, WA
 LOCATION PLAN





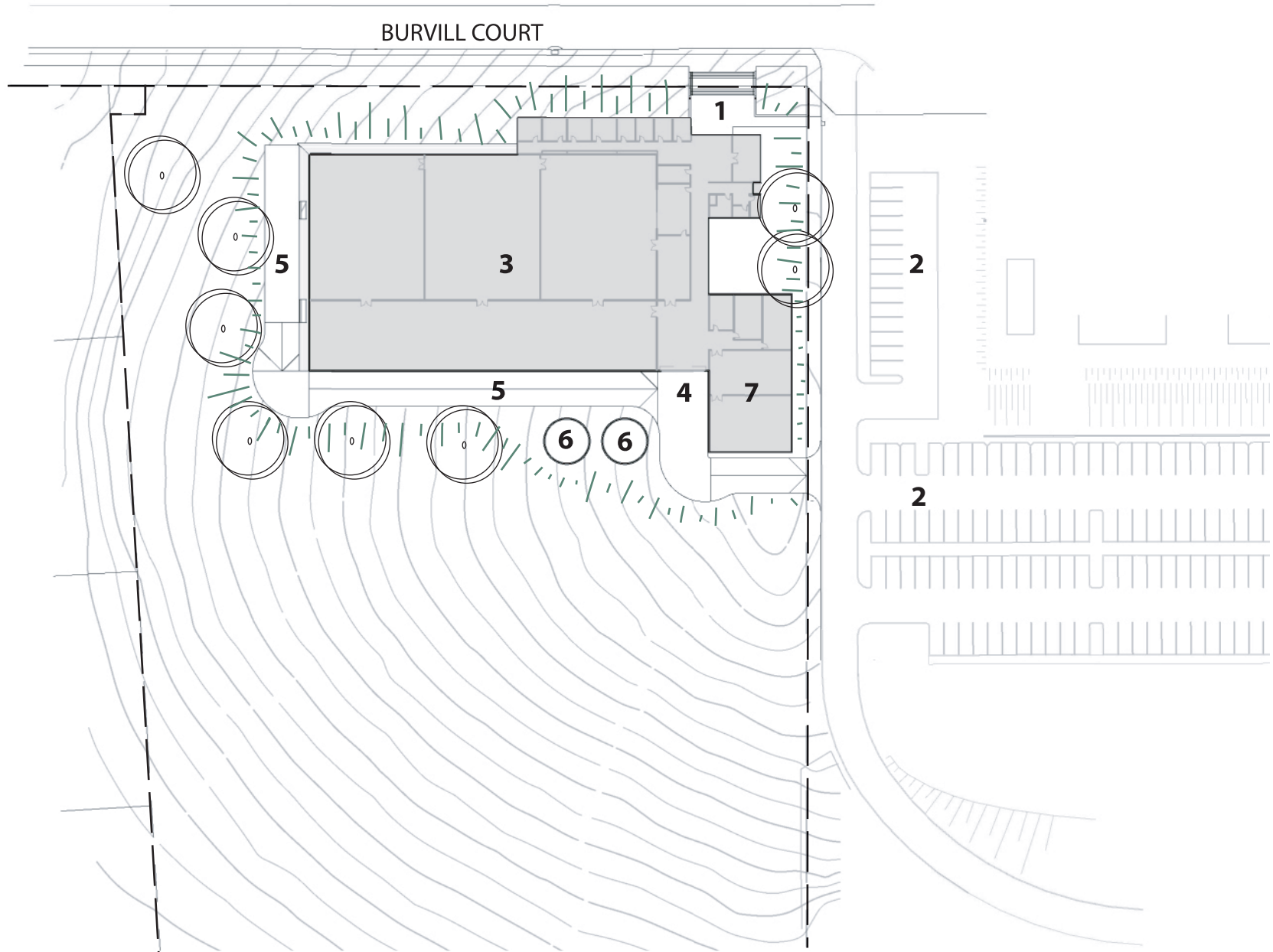
PAWSEY HIGH PERFORMANCE COMPUTING CENTRE for SKA SCIENCE
PERTH, WA
 TECHNOLOGY PARK WESTERN PRECINCT PLAN



BURVILL COURT

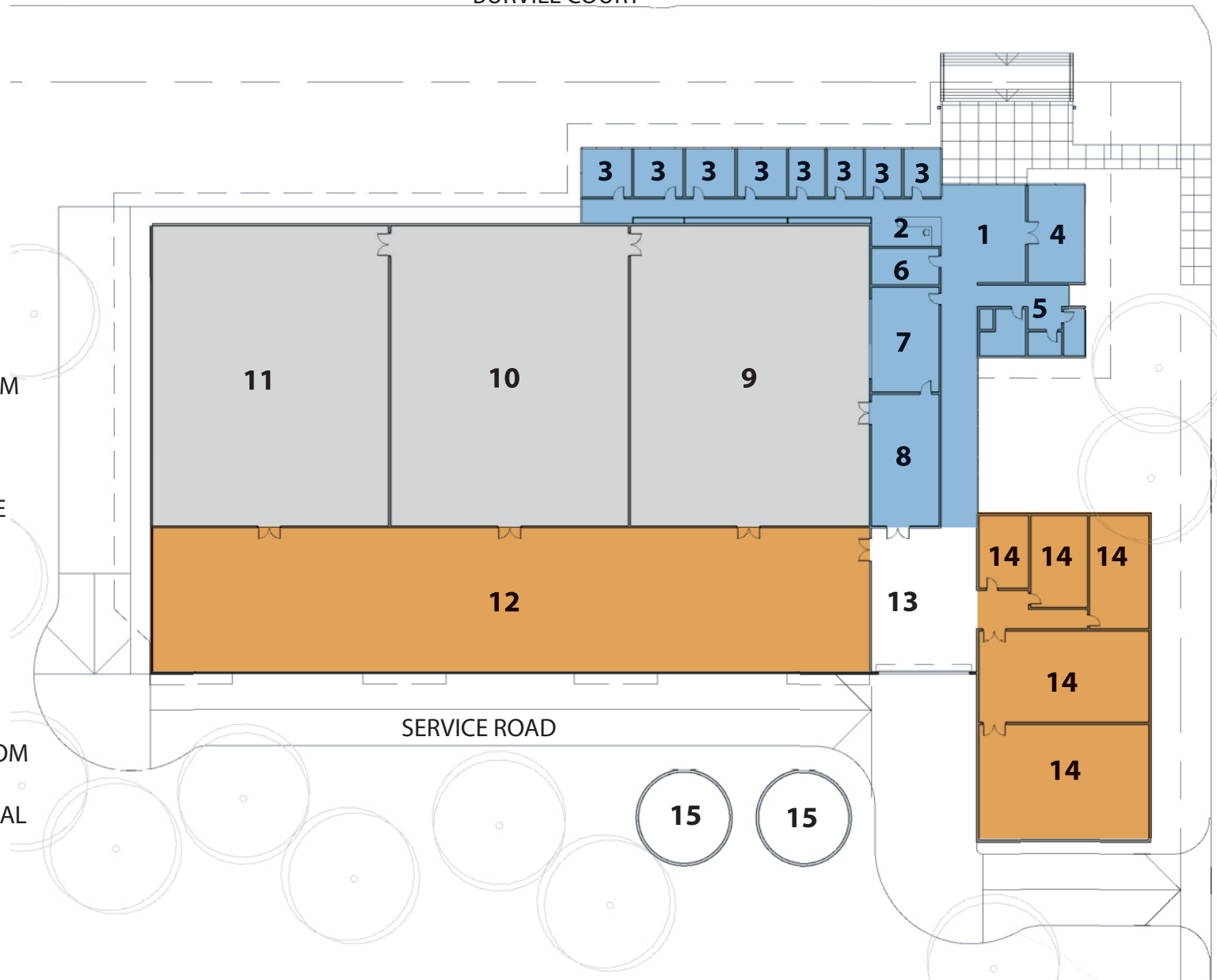
LEGEND

- 1 ENTRY
- 2 EXISTING CARPARKING
- 3 PAWSEY HPC CENTRE
- 4 LOADING AREA
- 5 SERVICE ACCESS
- 6 FIRE SERVICE TANKS
- 7 CENTRAL PLANT



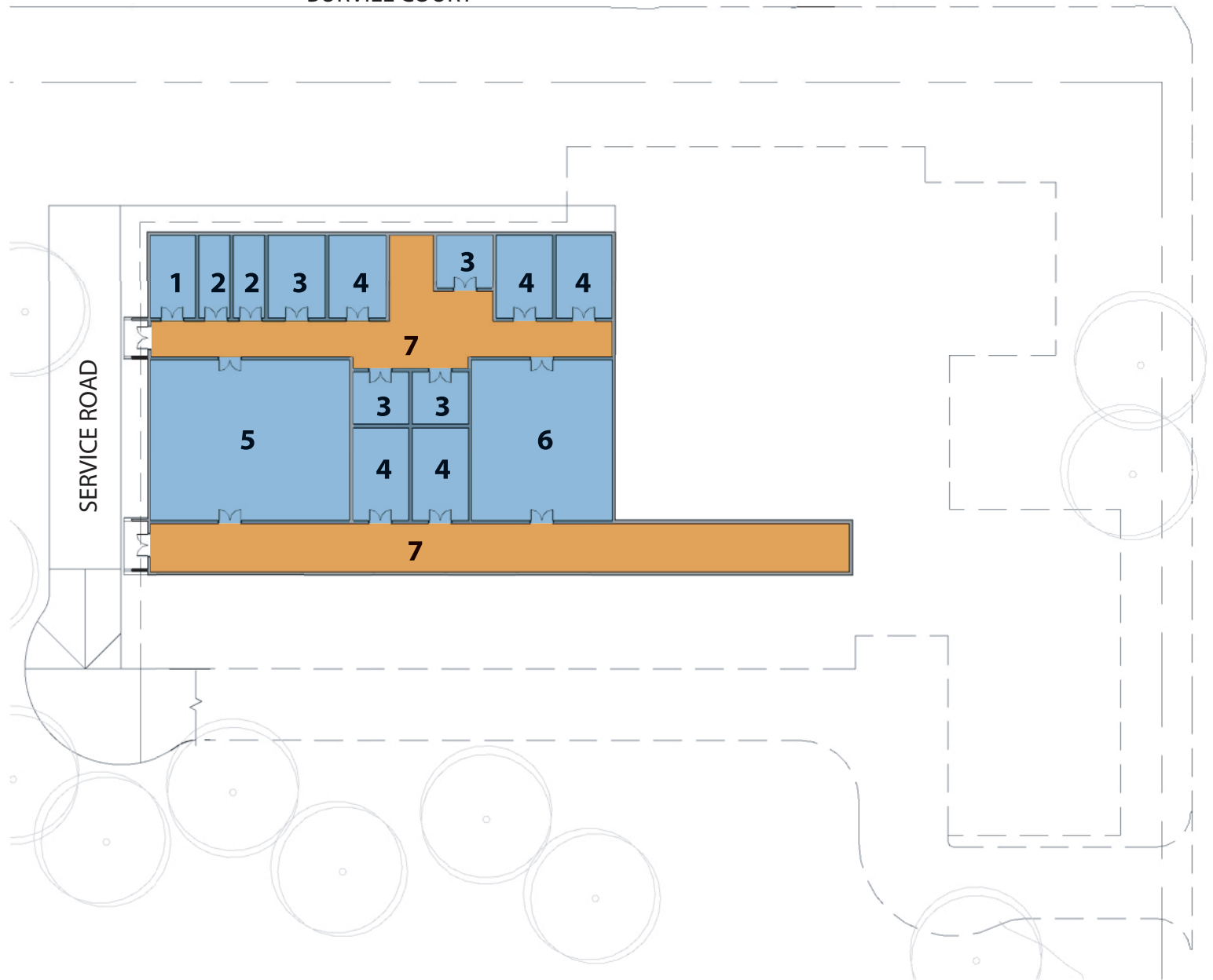
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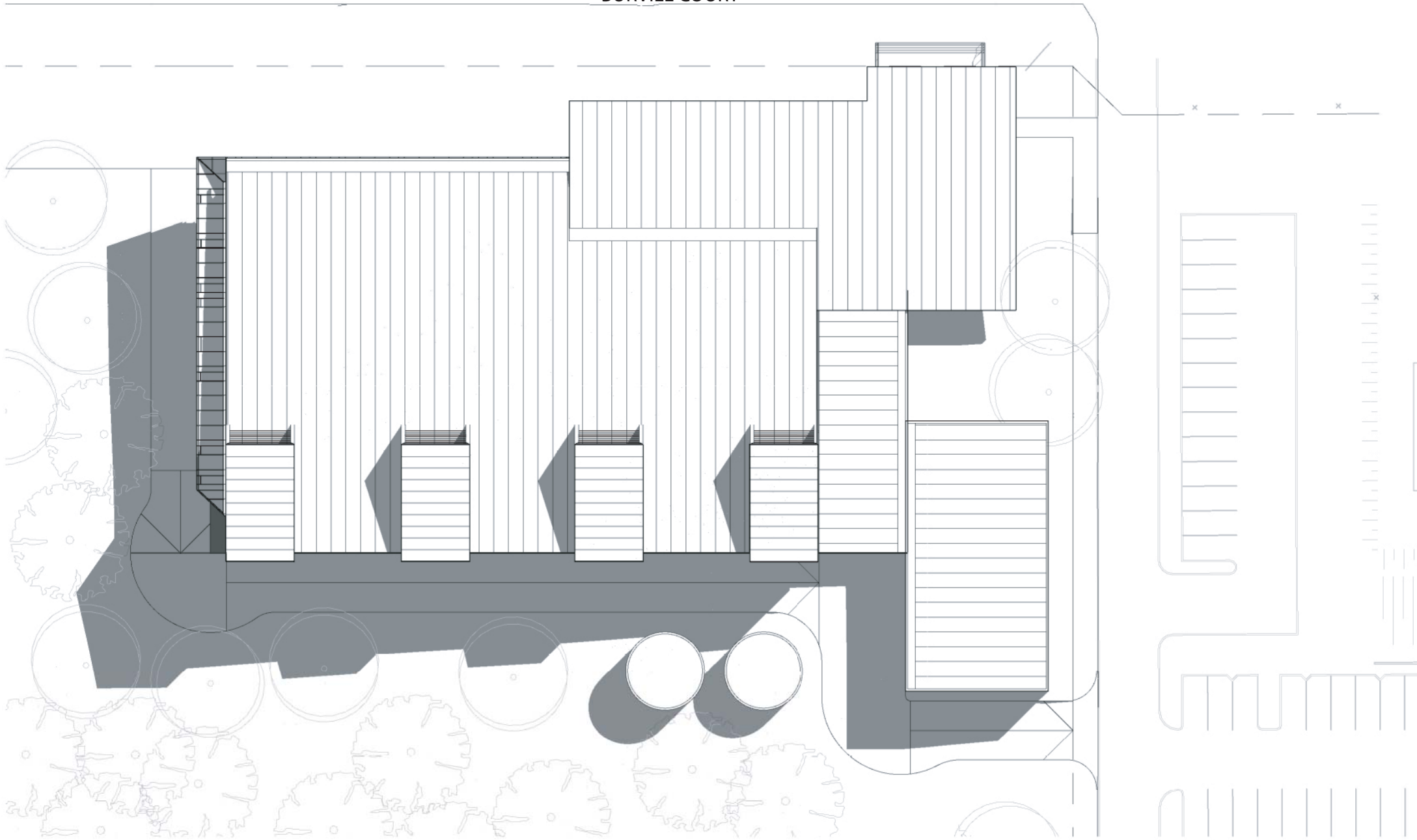
- 1 FOYER
- 2 RECEPTION
- 3 OFFICES
- 4 MEETING ROOM
- 5 AMENITIES
- 6 INCOMING CARRIER ROOM
- 7 OPERATIONS ROOM
- 8 BUILD/UNPACK/STORAGE
- 9 HPC CELL
- 10 DISK CELL
- 11 TAPE CELL
- 12 MECHANICAL PLANT ROOM
- 13 LOADING/WASTE DISPOSAL
- 14 CENTRAL PLANT ROOMS
- 15 FIRE SERVICE TANKS

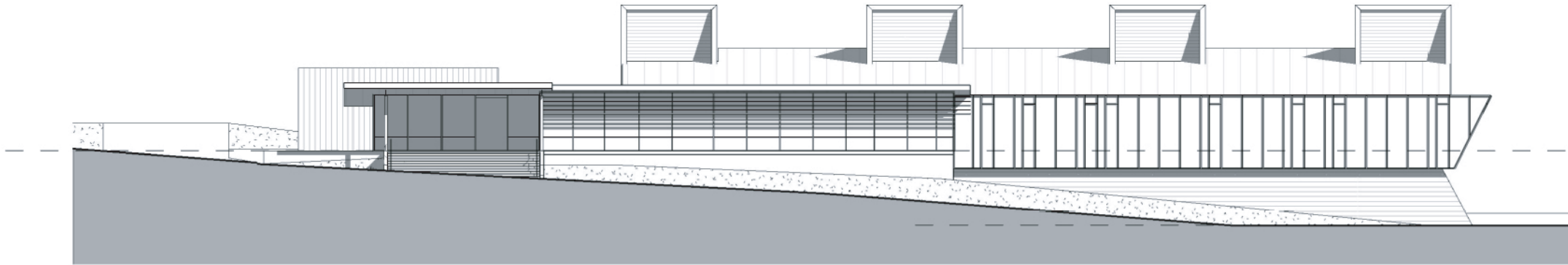


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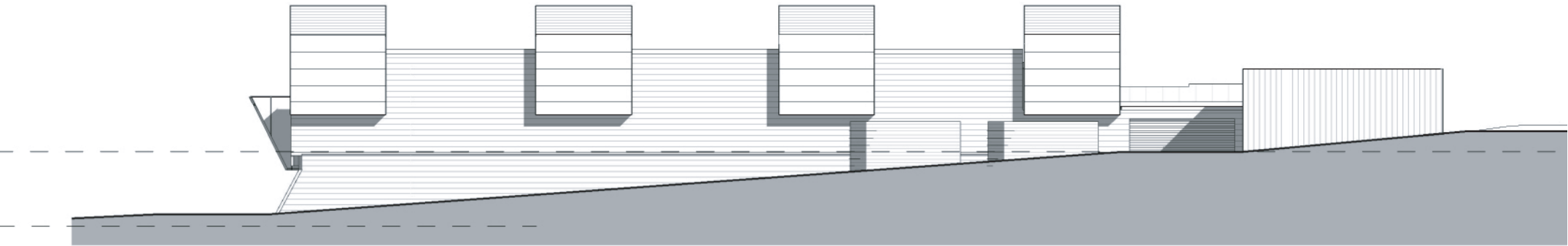
- 1 FIRE SERVICE PUMP
- 2 HV SWITCH ROOM
- 3 TRANSFORMER ROOM
- 4 ELECTRICAL SWITCH ROOM
- 5 DISK/TAPE CELL UPS
- 6 HPC CELL UPS
- 7 SERVICE CORRIDOR



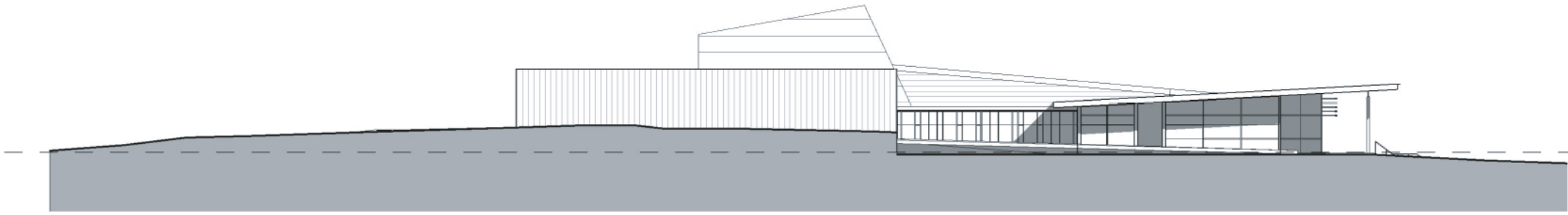




NORTH ELEVATION



SOUTH ELEVATION



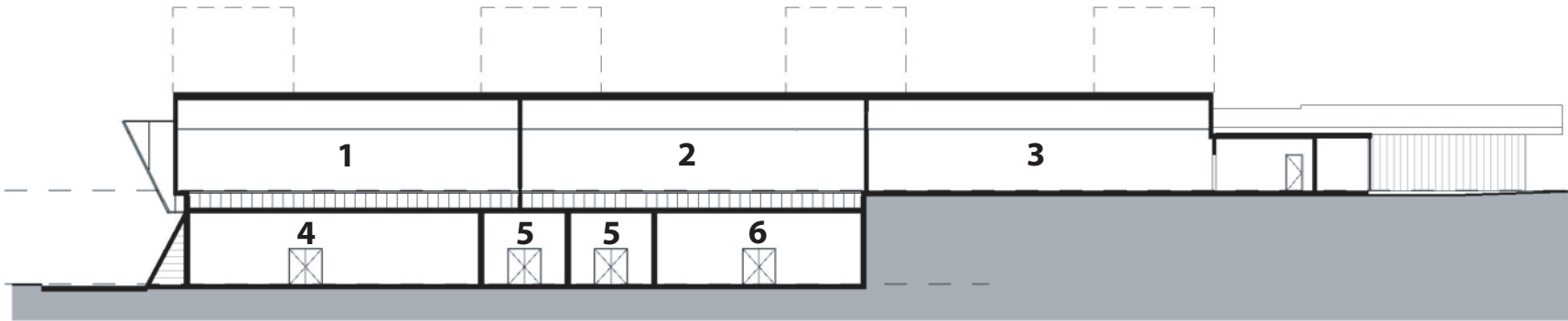
EAST ELEVATION



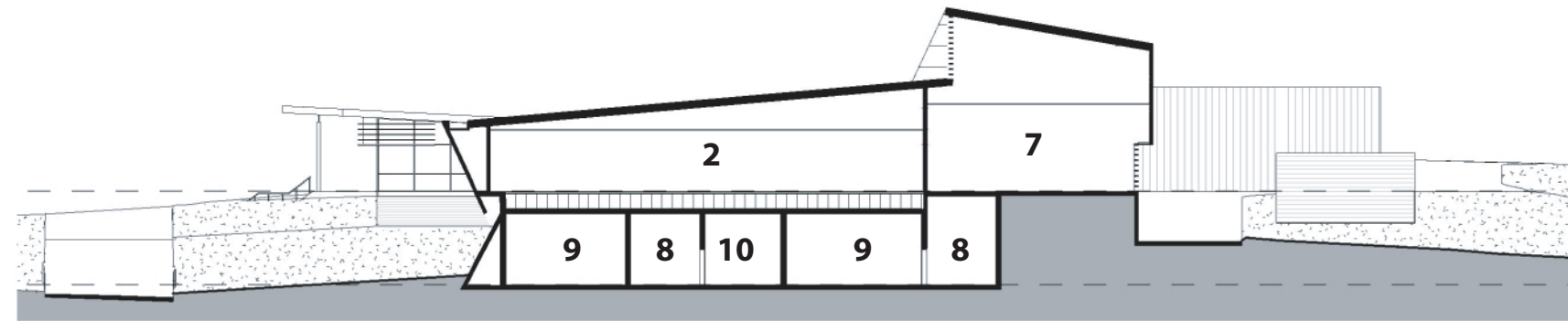
WEST ELEVATION

LEGEND

- 1 TAPE CELL
- 2 DISK CELL
- 3 HPC CELL
- 4 DISK TAPE CELL UPS
- 5 ELECTRICAL SWITCH ROOM
- 6 HPC CELL UPS
- 7 MECHANICAL PLANT ROOM
- 8 SERVICE CORRIDOR
- 9 ELECTRICAL SWITCH ROOM
- 10 TRANSFORMER ROOM



LONGITUDINAL SECTION



CROSS SECTION



PAWSEY HIGH PERFORMANCE COMPUTING CENTRE for SKA SCIENCE
PERTH WA
 SECTIONS

A scale bar with markings at 0, 1, 2, 5, and 10. To the right of the scale bar is a yellow rectangular box containing the text "DRAWING 9".



Acronym list

ASKAP	Australian Square Kilometre Array Pathfinder
BCA	Building Code of Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEWHA	Department of the Environment, Water, Heritage and the Arts
DIISR	Department of Innovation, Industry, Science and Research
EPA	Environmental Protection Authority
EPBC Act	Environmental Protection, Biodiversity and Conservation Act
ICT	Information and Communications Technologies
MWA	Murchison Widefield Array
NCRIS	National Collaborative Research Infrastructure Strategy
PWC	Public Works Committee
SKA	Square Kilometre Array