

Assessment Report

Environmental Impact Statement
Olympic Dam Expansion



Assessment Report

ENVIRONMENTAL IMPACT STATEMENT **Olympic Dam Expansion**

Minister for Mineral Resources Development and
Minister for Urban Development, Planning and the City of Adelaide

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Chapter 1

Introduction



Chapter 1: Introduction

1.1 General

This Assessment Report (AR) has been prepared jointly by the Minister for Urban Development, Planning and the City of Adelaide and the Minister for Mineral Resources Development¹, pursuant to section 46(B)(9) of the *Development Act 1993* and clause 28 of the indenture schedule to the *Roxby Downs (Indenture Ratification) Act 1982* (Indenture).

It has been prepared in consultation with the Australian Government Department of Sustainability, Environment, Water, Population and Communities to support the Secretary's report under section 105 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act). It provides an evaluation of the environmental, social and economic impacts of key components of BHP Billiton Olympic Dam Corporation Pty Ltd's (BHPB) proposal to expand the existing Olympic Dam mine and associated infrastructure.

The proposed expansion was the subject of an Environmental Impact Statement (EIS) which represents the highest level of assessment available under the *Development Act 1993*. The EIS was prepared by BHPB, submitted as the Draft Environmental Impact Statement (DEIS) and released publicly on 1 May 2009.

The Department of Planning and Local Government (DPLG) managed the whole-of-government environmental impact assessment process for this project in accordance with the *Development Act 1993*.

The objective of this report is to summarise the key issues associated with the potential impacts of key components of the project on the physical, social and economic environments at the local, regional, state and national levels. It is not intended to record all the matters which were identified and subsequently settled. Instead, it concentrates on the substantive issues identified during the EIS process.

Assessed material includes the DEIS dated 2009, the Supplementary Environmental Impact Statement (SEIS) dated 2011, released publicly on 13 May 2011; and submissions received on the project. It also relies on information, comments and advice provided by appropriate South Australian, Northern Territory and Australian government agencies through a collaborative assessment process. This report also recognises that the Olympic Dam mine has been subject to previous environmental assessments which resulted in the environmental regime for the existing operations.

¹ Reference to the two Ministers means the Minister for Mineral Resources Development in his own capacity and in his capacity as delegate for the Minister for Urban Development, Planning and the City of Adelaide.

1.2 Project overview

1.2.1 The proponent

The project proponent is BHP Billiton Olympic Dam Corporation Pty Ltd (BHPB). The BHPB group is the world's largest producer of export thermal coal, the third-largest copper, nickel and iron-ore producer, and the fourth-largest producer of uranium, at more than 100 sites across 25 countries.

Underground mining at Olympic Dam started in 1988 at a rate of 45,000 tonnes per annum (tpa) of copper plus associated products uranium oxide, gold and silver. Further approvals and optimisation projects in 1992 and 1995 increased production to 66,000 tpa and 85,000 tpa of copper respectively. In 1997, production increased to 170,000 tpa of copper plus associated products. Current nameplate capacity - the production capacity of the mine based on existing production methods - is 235,000 tonnes of copper plus associated products. Olympic Dam has conditional approval from the Australian Government to produce 350,000 tpa of copper plus associated products from underground mining.

1.2.2 The project

The proposed Olympic Dam expansion project would result in a new open-pit mine producing an additional 515,000 tpa of copper and associated products, increasing to 750,000 tpa. Given the size of the resource, combined with likely technological advances and improved operating efficiencies, it is probable that production rates would increase and extend beyond the 40-year timeframe contemplated in the DEIS.

However, the approval being sought is for a mine production life of 40 years. While BHPB has variously described the production limits as being based on an 'average annual' production rate, a maximum production rate has been adopted for the purposes of assessment and condition setting. BHPB would need to seek subsequent government approvals if a further expansion was proposed that extended the mine production life or increased production beyond the levels considered in this assessment.

The DEIS was prepared on the assumption the expansion would be developed progressively over an 11-year construction period, enabling a progressive increase in the production rates of refined metal and concentrate. However, the project schedule will ultimately depend on demand, the timing and nature of other and subsequent regulatory approvals, and the final investment decision of the BHPB Board, which could result in an 'extended construction' scenario. Indicative staging and timing for the key components of the proposed expansion has been set out in Table 5.3 in the DEIS. The SEIS introduced some further economic modelling based on amended construction timelines, including a 16 year construction period.

BHPB proposes to operate the open pit mine simultaneously with the existing underground mine. Over a 40-year development period the open pit is expected to grow to 4.1km long, 3.5km wide and 1km deep. The existing smelter would be expanded and new concentrator and hydrometallurgical plants built to process the additional ore. Additional infrastructure to support the mine expansion would include:

- Establishment of a waste rock storage facility (RSF) that would cover approximately 6720 hectares (ha) and reach about 150m high; and
- Expansion of the tailings storage facility (TSF) by the addition of up to nine cells (in addition to the existing four cells) to a height of 65m high each and covering approximately 4400ha.

Major infrastructure items proposed to support the mine expansion and the subject of this AR include:

- A 280 megalitre per day (ML/d) coastal desalination plant (200ML/d identified as being required for Olympic Dam, with an additional 80ML/d available to supply alternate but not yet quantified third-party users, located at Point Lowly on the Upper Spencer Gulf, near Whyalla, with an associated 320km water supply pipeline to Olympic Dam;
- Establishment of local saline wellfields providing up to 40ML/d of water suitable for dust suppression;
- Establishment of a 270km electricity transmission line from Port Augusta, or a new gas-fired power station supplied via a new gas pipeline from Moomba, or a combination of these facilities, to meet an increased maximum electricity demand of 650MW;
- A cogeneration power station at Olympic Dam that would capture waste heat from the processing plant to supplement the primary electricity supply;
- A 105km rail spur to connect Olympic Dam to the national rail network near Pimba to move product and supplies by rail instead of road;
- A new rail/road intermodal freight terminal at Pimba to ensure increased road traffic associated with the construction of the rail spur doesn't hinder the transport of materials;
- A new airport to replace the existing airport at Olympic Dam;
- A landing facility on the Upper Spencer Gulf, south of Port Augusta, to unload equipment from barges, and an access corridor to a pre-assembly yard on the outskirts of Port Augusta;
- A new accommodation village for workers, named Hiltaba Village;
- Expansion of the nearby Roxby Downs township;
- A sulphur-handling facility at Outer Harbour at the Port of Adelaide (not the subject of this AR); and
- Additional facilities at the Port of Darwin, Northern Territory, to handle the import of supplies and export of product (not the subject of this AR).

The scope of the AR does not include broader issues relating to the use of exported uranium in the nuclear fuel cycle. This is a matter of government policy and beyond the control of BHPB, and has not been addressed in this AR.

1.2.3 Rationale for the project

Olympic Dam has the world's fourth-largest copper resource and by far the largest known uranium resource in the world. The underground operation is the 16th-largest producer of copper and third-largest of uranium. The main objective of the proposed expansion is to unlock the full potential of the deposit to meet the growing world demand for copper and uranium. In terms of economic benefits that would accrue over the life of the project, BHPB estimates the expansion of Olympic Dam would:

- Support 4000 full-time jobs, plus a peak short-term demand for 6000 jobs, over and above the current workforce, as well as other significant business opportunities;
- Contribute \$45.7-billion to South Australia's Gross State Product (GSP) and \$936-million to the GSP of the Northern Territory ; and
- Contribute \$18.7-billion to Australia's gross domestic product (GDP).

Chapter 2

Environmental impact assessment



Chapter 2: Environmental Impact Assessment

2.1 General

Environmental Impact Assessment (EIA) is the process of identifying the potential social, environmental and economic impacts of a proposal and identifying appropriate measures that may be taken to minimise the impacts. The main purpose of EIA is to inform decision-makers of the likely effects of a proposal before any decisions are made. EIA also allows the community to be consulted and make submissions on a proposal. It provides a comprehensive means for considering relevant issues and impacts, and whether a proposal warrants approval and, if so, under what conditions.

Due to the magnitude and complexity of the project, the EIA undertaken by BHP Billiton Olympic Dam Corporation Pty Ltd (BHPB), is based on the maximum project requirements over a 40-year timeframe. It takes into account the need for BHPB to maximise the production performance of the mine over this period and provides a framework for the subsequent closure and rehabilitation process. Should BHPB seek to extend the production life of the mine beyond 40 years it would need to seek further approvals from government. Given the size of the mineral resource, the project design being employed for the mine is based in part on not compromising BHPB's ability to further approvals.

The Final Environment Impact Statement (FEIS), being the combined DEIS and SEIS, provides a strategic outline of the project. It details in general terms the nature, size and location of each project component but does not provide the detailed technical specifications for each. This approach adopted in the FEIS is common for large-scale development proposals with long lead times, where it is not feasible or preferable to provide detailed technical specifications or plans for all components of a project before it commences.

Depending on the nature and location of project components, some have been assessed as having a greater level of potential constraints and impacts. In these cases, a greater level of detail has been required in the FEIS. However, in general, conceptual detail is preferred to allow sufficient flexibility for BHPB to use the most advanced technology and methods available at the time the project component is required.

The EIA process is capable of accommodating project refinements. Further assessment of the project would be required if project refinements resulted in activities which, in the relevant Minister's opinion would "significantly affect the substance of the EIS". Such changes may also require a variation or separate assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.2 Olympic Dam expansion EIS process

2.2.1 Collaborative assessment

The proposed Olympic Dam expansion is subject to regulation by three jurisdictions - the Australian, South Australian (SA) and Northern Territory (NT) governments.

It was agreed that a collaborative assessment process by a single EIS would satisfy the requirements of all three governments. This approach was deemed appropriate as the EIS would be required to consider the whole project, not just parts relevant to each jurisdiction, and provide one process for the community to be informed and provide comment.

An EIS represents the highest level of assessment available in South Australia. The EIS is required to describe to the Government and community what the proponent proposes to do, what the environmental impacts will be, and how the proponent plans to manage these impacts.

Although one EIS was prepared, there are separate decisions required of each jurisdiction. The following is a summary of the steps in the EIA process followed for the Olympic Dam expansion project:

2.2.2 Australian Government determination

On 15 August 2005, BHPB referred the proposed expansion to the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 2 September 2005 the Australian Minister for the Environment and Heritage determined that the proposed expansion required approval under the EPBC Act. Subsequently on 8 November 2005 the Minister determined that an Environmental Impact Statement (EIS) would be required.

2.2.3 SA Government first 'major development' declaration and guidelines

On 15 September 2005 the South Australian Minister for Mineral Resources Development declared that certain key elements of the proposed expansion of Olympic Dam would be a 'major development' under the *Development Act 1993*. In accordance with the Olympic Dam Indenture, a schedule to the *Roxby Downs (Indenture Ratification) Act 1982* (Indenture), the first declaration was limited to development on the Special Mining Lease (SML) and land required for the provision of water, power and petroleum.

Following the making of the first declaration and the subsequent lodgement of a development application by BHPB, the Minister, acting pursuant to the Indenture, assumed the role of the Development Assessment Commission (DAC) in setting an EIS level of assessment and developing the joint Guidelines/Issues Paper with the Australian Government, which was released on 13 February 2006.

2.2.4 Second 'major development' declaration and guidelines

On 21 August 2008, a second 'major development' declaration under the *Development Act 1993* was made by the South Australian Minister for Urban Development and Planning, to capture activities not covered by the first declaration. BHPB subsequently lodged a second, 'updated', development application for activities captured by both declarations, requiring the formulation of a second guidelines document. This process was not modified by the Indenture and followed the standard major development process, including the issuing of a second guidelines document by the Development Assessment Commission (DAC).

Following a review of the proposal as described in the second development application, and of the existing guidelines issued in February 2006, the DAC endorsed an EIS as the appropriate level of assessment. The DAC also determined that the existing guidelines comprehensively covered all issues associated with the project components, subject to minor modifications to better reflect the current project description and assessment process. The second guidelines document was issued to BHPB on 1 December 2008.

All developments covered by the two major development declarations are components of a single project for the expansion of the Olympic Dam operations.

2.2.5 Variations to the declarations

On 14 December 2006 and 10 April 2008 two minor variations to the declarations were made to facilitate activities that would inform the preparation of the EIS. These included exempting the following activities from the declarations and hence the major development process:

- The pilot desalination plant (14 December 2006); and
- 'Preliminary activities' (10 April 2008) including:
 - Activities relating to the investigation of the extent of dewatering of the proposed open pit;
 - Activities relating to the investigation of the potential establishment of a water borefield for supply of water and/or the potential to re-inject water produced by the dewatering of the open pit; and
 - Activities relating to geotechnical investigations.

Accordingly, separate approvals, outside the EIS process were required by BHPB to undertake the above listed activities.

2.2.6 Northern Territory Government involvement

As the project configuration was modified and further defined, BHPB sought to investigate the option for the transport and shipment of copper concentrate and uranium oxide through the Port of Darwin. This triggered the involvement of the Northern Territory Government, which released Guidelines for Preparation of an EIS for the NT Transport Option Project in November 2008.

Although three sets of guidelines apply to the project, it was determined that a single EIS would address the requirements of all guidelines documents, for assessment by the SA, NT and Australian governments.

2.2.7 DEIS public exhibition

BHPB prepared the DEIS in response to the guidelines and submitted it to the Minister for Urban Development and Planning, the Minister for Mineral Resources Development and the then Australian Government Minister for the Environment, Heritage and the Arts on 30 January 2009 for approval to release the document for public exhibition. Following a compliance check by the three governments to ensure the guidelines documents had been adequately addressed, the DEIS was put on public exhibition for 14 weeks, from 1 May until 7 August 2009, during which time the public and Government agencies were invited to make submissions.

During the public consultation period, six statutory public meetings were held, four in South Australia (Roxby Downs, Whyalla, Port Augusta and Adelaide) and two in Northern Territory for the NT Transport Option only (Darwin and Alice Springs). The South Australian meetings were run in an 'open-house' format, with expo-style booths operating for six-hour periods to cater for the potentially large numbers of community members. Hourly presentations were provided on the EIS and submission process. The Adelaide and regional meetings were generally well attended. The two Northern Territory meetings were run in a traditional public meeting format.

As the majority of the proposed expansion activities would be located in South Australia, the Government of South Australia coordinated the DEIS submissions process on behalf of the three governments. Notification of the exhibition period was advertised through the following media outlets:

- The Australian – 19 May 2009;
- Roxby Monitor – 20 May 2009;
- The Transcontinental – 20 May 2009;
- The Advertiser – 20 May 2009;
- The Roxby Sun – 21 May 2009; and
- Whyalla News – 21 May 2009.

The DEIS was placed in local, regional and state libraries and council offices for viewing during business hours. It was also made available for inspection on the internet at a dedicated Government website www.olympicdameis.sa.gov.au. The DEIS, appendices, information sheets, executive summary, videos and animations were also accessible from the BHPB website www.bhpbilliton.com. Hard copies and CD-Rom versions were available for purchase; copies of the Executive Summary, which included a CD-Rom of the DEIS, were available free of charge.

To make the submission process quicker and easier, submissions were invited via email as well as traditional post. In total, 4197 public submissions were received, 3806 of which were pro-forma letters. Submissions covering 459 issues were also lodged by the three governments. All submissions were provided to BHPB for consideration and response in the SEIS.

Copies of all public submissions and the SA and NT Government's submissions were made available during the assessment and decision-making period at www.olympicdameis.com.au.

In summary, the substantive issues raised in submissions on the DEIS were:

- Desalination plant discharge;
- Greenhouse gas emissions and renewable energy;
- Mining impacts, including the management of radioactive tailings and operational impacts such as air quality;
- Impacts to groundwater in the region;
- Impacts from the landing facility on nearby residents;

- Transport logistics and safety;
- Local impacts on communities (governance, provision of services etc);
- Economic issues, including royalty rates;
- Australian Government nuclear policy; and
- The content and operation of the *Roxby Downs Indenture Act*.

2.2.8 Other public information and consultation activities

BHPB conducted a public information and consultation program throughout the DEIS process, including:

- Taking out advertisements in local and state-wide news publications publicising the consultation process and detailing where and when consultation sessions were being held;
- Providing a dedicated telephone line, email address and website to provide project information and receive feedback;
- Holding community focus groups, briefings and workshops in Roxby Downs, Andamooka and Woomera, Upper Spencer Gulf, Eyre Peninsula, the Mid North and the Far North of South Australia to canvass attitudes to the expansion and general mining issues; and
- Putting on information displays at public events, including at Royal Adelaide Show, Eyre Peninsula Field Days at Cleve and Roxby Downs Market Days.

2.2.9 SEIS

In response to submissions received during the public exhibition period, BHPB lodged a draft Supplementary Environmental Impact Statement (SEIS) with the three governments on 2 December 2010. Under the provisions of the EPBC Act, the Commonwealth Environment Minister was required to determine whether the document contained sufficient information to make an informed decision on whether to approve the proposed expansion before accepting the FEIS. This was referred to as the 'adequacy check'.

Following a collaborative review by the three governments of the draft SEIS, further information was sought from BHPB. Following discussions with government and the submission of additional information, the amended SEIS was deemed acceptable for assessment purposes by the Australian Government, on advice from the SA and NT governments, on 21 April 2011.

The SEIS was made available for inspection on the internet at www.olympicdameis.sa.gov.au, and www.bhpbilliton.com from 13 May 2011.

2.2.10 Final Environmental Impact Statement

The Final Environmental Impact Statement (FEIS) as referred to in this AR reflects the DEIS and SEIS documents which in combination make the FEIS under the EPBC Act and provide the information on the proposal to be assessed by the three governments.

2.2.11 Assessment Report

Although three separate Assessment Reports (ARs) have been prepared, all three governments have worked collaboratively to achieve alignment of the documents and conditions, having regard to jurisdictional responsibilities.

This AR outlines the envisaged environmental, social and economic impacts, considers the safeguards or commitments proposed by BHPB to mitigate potential impacts, and proposes appropriate conditions if the proposed expansion of Olympic Dam is approved.

ASSESSMENT REVIEW STRUCTURE	
Chapters 1 - 3	Introduction, background and legislative and policy framework
Chapters 4 - 11	Assessment of impacts for each project component
Chapters 12 - 13	General environmental, social and economic impacts of the proposed expansion project as a whole
Chapters 14	Conclusions and recommendations

The AR has been prepared in close consultation with the three government jurisdictions. Recommended conditions summarised in Chapter 14 of this AR are consistent with those recommended by the Australian Government. However, in some instances one jurisdiction may require a higher level of scrutiny or assessment criteria. Should the various decision-makers accept the recommended conditions, the condition with the highest level of scrutiny would prevail.

2.2.12 Decision

2.2.12.1 South Australia

Both the Minister for Urban Development, Planning and the City of Adelaide and the Minister for Mineral Resources Development have performed their respective functions in relation to the first and second declarations, and this AR is a consolidation of their reports². This consolidated AR provides advice to the decision-maker in determining whether to approve the expansion project and, if it is approved, under what conditions.

BHPB can follow the normal process for major development proposals and seek a decision from the Governor on those key components of the expansion project which are the subject of the two major development" declarations. Alternatively, BHPB may elect to apply under clause 7 of the Indenture, for development approval from the Minister for Mineral Resources Development (Indenture Minister). This modification to the normal major development process is one of the effects of the Indenture. (More information about clause 7 is provided in section 3.2.1).

By letter dated 12 July, BHPB has sought approval for the proposed expansion (EIS) through the clause 7 process under the Indenture. As a result, the Minister responsible for the Indenture will be the decision maker.

² Reference to the two Ministers means the Minister for Mineral Resources Development in his own capacity and in his capacity as delegate for the Minister for Urban Development, Planning and the City of Adelaide.

In making the decision, the Indenture Minister must have regard to the following requirements of the *Development Act 1993* where relevant:

- Provisions of the relevant development plans and regulations;
- The Building Rules;
- The Planning Strategy;
- The objects, general environmental duty and relevant environmental protection policies under the *Environment Protection Act 1993*;
- The prohibitions and restrictions applying within a marine park under the *Marine Parks Act 2007*, and the general duty of care under that Act, if it appears the development may have an impact on any aspect of a marine park;
- The DEIS/SEIS;
- This Assessment Report; and
- May take into account any other matters considered relevant.

Under Section 48(7) of the *Development Act 1993*, the decision maker (Indenture Minister) may grant a development authorisation, subject to conditions, which must be complied with by the proponent. The set of recommended conditions referred to throughout the AR have been consolidated in Chapter 14: 'Recommendations and conclusions'.

2.2.12.2 Australian Government

The AR prepared by the Secretary of the Department of Sustainability, Environment, Water, Population and Communities (SeWPaC), provides advice to the Minister for Sustainability, Environment, Water, Population and Communities on the relevant environmental impacts of the proposal. In deciding whether to approve the proposal the Minister must take the assessment report into account, along with the principles of ecologically sustainable development and other relevant information. The Minister must also consider economic and social matters.

2.2.12.3 Northern Territory Government

The AR prepared by the NT Department of Natural Resources, Environment, the Arts and Sport provides advice and recommendations about whether the NT Transport Option can proceed without unacceptable impacts and, if so, whether any specific conditions should be imposed on a subsequent approval. The AR and recommendations are forwarded by the Minister for Natural Resources, Environment and Heritage to the Minister for Lands and Planning to help inform a consent decision.

Chapter 3

Decision-making framework



Chapter 3: Decision-making framework

3.1 Overarching legislative framework

An overview of the legislative framework for the main project approvals for the proposed Olympic Dam mine expansion is outlined below:

JURISDICTION	LEGISLATION	DECISION	DECISION-MAKER
South Australian Government	<i>Development Act 1993</i> (as modified by the <i>Roxby Downs (Indenture Ratification) Act 1982</i>)	Decision on the major development declarations with the exception of the NT Transport Option	SA Minister for Urban Development, Planning and the City of Adelaide, and Minister for Mineral Resources Development, jointly prepare the Assessment Report (AR) ³ . Decision by the Minister for Mineral Resources Development.
Australian Government	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Decision on the controlled action (whole project)	The Secretary of the Department of Sustainability, Environment, Water, Population and Communities (SeWPaC) prepares the Assessment Report. Decision by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities.
Northern Territory Government	<i>Environment Assessment Act 1982</i>	Recommendations on the NT transport option.	Recommendations are forwarded by the Minister for Natural Resources, Environment and Heritage to the Minister for Lands and Planning to help inform a consent decision.

3.2 South Australian legislative requirements

South Australian approval of the key components of the proposed expansion project is required under the *Development Act 1993*, as modified by the *Roxby Downs (Indenture Ratification) Act 1982*. If the project is approved under the *Development Act 1993*, the proponent, BHPB, would then have to seek a significant number of 'secondary approvals' (licences, permits etc) from the Government as required under other relevant legislation. Notes to the proponent have been recommended in the AR to remind BHPB of the 'secondary approvals' that may be required. These 'notes' would be attached to the decision notice published in the Gazette.

³ Reference to the two Ministers means the Minister for Mineral Resources Development in his own capacity and in his capacity as delegate for the Minister for Urban Development, Planning and the City of Adelaide.

3.2.1 *Roxby Downs (Indenture Ratification) Act 1982*

This Act, and the Indenture in particular, establishes the legal framework for existing and future operations at Olympic Dam and defines the roles and responsibilities of the South Australian Government and BHPB. Should the project be approved under the *Development Act 1993*, it is likely that BHPB would seek amendments to the Indenture to better facilitate the expanded project configuration. Any such amendments do not form part of this assessment and would need to be put to the South Australian Parliament for consideration.

Clauses in the Indenture relevant to the assessment and decision-making process for the Olympic Dam expansion proposal include:

- **Clause 7:** Allows BHPB to apply to the Indenture Minister for State Government approvals/permits required for the implementation of a “Subsequent Project” under the Indenture. An approval/permit granted under clause 7 is deemed to have been granted pursuant to the relevant law and, generally, may not be granted without the agreement of the Minister responsible for the relevant Act.

Where BHPB makes an application under clause 7, it may subsequently bring arbitration proceedings to challenge a decision to refuse approval or impose conditions which BHPB thinks are unreasonable. This contrasts with the normal position under the major development provisions of the *Development Act 1993*, where the Governor’s decision is not open to challenge or review.

- **Clause 28:** Excludes land which is the subject of a Special Mining Lease (SML), or reasonably required for the transport, supply or provision of petroleum (gas), electricity or water, from the operation of the *Development Act 1993*, with the exception of the major development provisions, as modified. The modifications provide for the Indenture Minister to administer the major development process.
- **Clause 19:** Provides for the granting of a “Special Mining Lease” (SML) for mining operations under the Indenture. The SML exists under the Indenture itself, rather than under the *Mining Act 1971*, so much of that Act does not apply to the Olympic Dam operations. Unlike mining operations conducted under a normal mining lease, mining operations under the SML constitute “development” under the *Development Act 1993* and may require approval pursuant to the operation of the major development provisions of that Act.
- **Clause 11:** Requires BHPB to prepare a program for the protection, management and rehabilitation of the environment every three years and annual reporting. For the current underground operation, BHPB has established an Environment Protection & Management Program (EPMP), as the Program to comply with Clause 11. The EPMP comprises the Environmental Manual, and the EPMP.

The EPMP is prepared by BHPB and reviewed by South Australian government agencies every three years. The Indenture Minister can:

- Approve the EPMP as submitted by BHPB, or
- Refuse to approve the EPMP, or
- Approve the EPMP with conditions

Appendix U of the DEIS provided an outline of BHPB's proposed EPMP for all activities relevant to the proposed expansion. The SEIS indicated that management programs and monitoring plans are being developed to manage the environmental aspects and potential impacts for the various components of the project. BHPB has provided a list of management plans and monitoring programs that would be developed, should the project be approved. Where relevant, the AR has replicated relevant sections of Appendix U in chapters 4 to 13.

In addition, BHPB has made a number of commitments as outlined in Table 2.1 of the SEIS. Where relevant, these commitments have also been reproduced in AR Chapters 4 to 13, under the heading "BHPB EM Program and commitments".

3.2.2 SA Development Act 1993

Key components of the proposed expansion of Olympic Dam have been declared 'major development' under the *SA Development Act 1993*. The major development process provides for a whole-of-government assessment where a proposal is considered to be of major economic, social or environmental importance. However, regardless of a proposal's type, size or value, it can only be granted major development status by the Minister, who must 'declare' it as such. To do this the Minister must decide that the development is of 'major environmental, social or economic importance' and that declaring it so is 'appropriate' or 'necessary' for the 'proper' assessment of the proposal.

The Indenture modifies the process prescribed under the *Development Act 1993* as it applies to certain aspects of the Olympic Dam operations, including the expansion project. The modifications give the Minister for Mineral Resources Development (Indenture Minister) the powers to, among other things, make major development declarations and issue guidelines in relation to aspects of the expansion project. But as the Indenture Minister's authority in this regard only extends to activities on the Special Mining Lease (SML) and for the provision of petroleum (gas), water and electricity, a parallel process conducted by the Minister for Urban Development and Planning (now Minister for Urban Development, Planning and the City of Adelaide), was also required for other project activities. Accordingly, two major development declarations and two guidelines documents were required for the expansion project.

3.2.2.1 Building rules

This AR does not include a specific assessment of the proposal against the provisions of the Building Rules under the *Development Act 1993*. If the Indenture Minister grants a development authorisation, pursuant to Section 48 of the Act, the proposal would require certification against the Building Rules.

3.2.3 Other SA legislation

In addition to requiring approval under the *Development Act 1993*, certain activities proposed by BHPB would require further approvals under South Australian legislation. Table 6.4 in the DEIS provides an indicative list of the types of approvals that might be required. Further permits and licences ('secondary approvals') required post-approval of the EIS have been referenced throughout this AR but should not be considered a comprehensive list.

Should the proposed expansion receive major development approval and, then, BHPB Board approval, BHPB would enter the detailed design phase of the project which would define the types of activities and processes to be undertaken for each component. Given the proposed 11-year construction timeframe, some project components will not be required until well into the construction phase.

Other key pieces of legislation include:

3.2.3.1 *Environment Protection Act 1993 (EP Act)*

The EP Act provides for the protection and management of the environment, including site contamination, air and water quality, noise and waste management. A key objective of the Act is to ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment in line with the principles of ecologically sustainable development.

As the proposed expansion involves activities of environmental significance as prescribed by Schedule 1 of the EP Act, it would require ongoing licensing of these activities from the South Australian Environment Protection Authority (EPA). Activities likely to require a license include:

- Chemical storage and warehousing facilities;
- Chemical works;
- Petroleum production, storage or processing works or facilities;
- Abrasive blasting;
- Concrete batching works;
- Ferrous and non-ferrous metal melting;
- Metallurgical works;
- Mineral works;
- Waste or recycling depots;
- Activities Production Listed Wastes;
- Crushing, grinding or milling;
- Fuel burning;
- Extractive industries; and
- Sewage treatment works.

With activities of major environmental significance the Indenture Minister must have regard to the objectives of the EP Act, the general environmental duty and relevant Environment Protection Policies. The following policies were considered in the assessment:

- Environment Protection (Waste Management) Policy, 1994;
- Environment Protection (Air Quality) Policy, 1994;
- Environment Protection (Water Quality) Policy, 2003;
- Environment Protection (Noise) Policy, 2007; and
- Environment Protection (Waste to Resources) Policy, 2010

There is also a range of supporting documents and guidelines endorsed or adopted by the EPA that are relevant to the proposal, including:

- EPA Guideline: Bunding and Spill Management (2007);
- EPA Guideline: Dredging and Earthworks Drainage (2008); and
- National Environmental Protection Measures (NEPM), such as for the Assessment of Site Contamination, Ambient Air Quality, Used Packaging Materials, Air Toxics, Diesel Vehicle Emissions, and Movement of Controlled Waste Between States and Territories.

3.2.3.2 *Marine Parks Act 2007*

In making a decision, the Indenture Minister must have regard to prohibitions and restrictions applying within relevant marine parks as declared under the *Marine Parks Act 2007*. The Act established the legislative framework for the establishment of marine parks in South Australia. A marine park is a zoned area of the ocean where marine habitats, and their plants and animals, can be managed, conserved and protected. Marine parks are similar in status to national parks while allowing for a wider range of uses.

Land adjoining the proposed desalination plant at Point Lowly, is included within the Upper Spencer Gulf Marine Park. Management planning for the State's Marine Park network is in progress and on completion in 2012 will result in individual parks being zoned for multiple uses in a way that effectively balances conservation, commerce and community interests.

3.3 Australian Government legislative requirements

The primary Commonwealth legislation under which the Olympic Dam expansion proposal has been assessed is the *Environment Protection and Biodiversity Conservation Act 1999*. Table 6.2 in the DEIS summarises the relevant Commonwealth legislative and approval requirements. Government policy is that uranium mining, milling and rehabilitation is based on world best-practice standards, on extensive continuing research on environmental impacts, and on the health and safety of employees and affected communities, particularly indigenous communities.

3.3.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act establishes an environmental assessment and approval system based on matters of National Environmental Significance (NES), which is separate from State systems. The Act applies where a person is taking an action that is likely to have a significant impact on a matter of national environmental significance. It also applies to actions on, or affecting, Commonwealth land and actions taken by Commonwealth agencies.

Based on the project referral lodged by BHPB on 15 August 2005, the Commonwealth determined that the proposed expansion required assessment and approval under the EPBC Act. The five controlling provisions were:

- Listed threatened species and communities;
- Listed migratory species;
- Wetlands of international importance (Ramsar wetlands);
- Protection of the environment from nuclear actions; and
- Protection of the environment on Commonwealth land.

3.4 Northern Territory legislative requirements

The Northern Territory Government has only been required to assess the NT Transport Option component of the mine expansion proposal, being the movement of copper concentrate and uranium oxide by rail from Olympic Dam to the Port of Darwin for export. The primary legislation under which the Transport Option has been assessed is the *Environment Assessment Act 1982*. Table 6.6 in the DEIS summarises the relevant legislative and approval requirements.

With the exception of the movement of material by rail from Olympic Dam to the SA/NT border, this AR does not provide an assessment of the Transport Option as the proposed development site is outside the State's jurisdiction. Assessment of the development and recommendations are provided in the ARs of the both the Australian and NT governments.

3.5 Assessment framework – key environmental values

The three governments worked collaboratively to identify the key environmental values for the project, including key outcomes and risks. This culminated in the preparation of a whole-of-government Assessment Framework that identified 21 key environmental values to be protected, and formed the basis of this AR.

The key environmental values used to assess the proposed expansion include:

- **Air quality:** Protecting air quality during construction and operation.
- **Noise and vibration:** Protecting local amenity and minimising noise and vibration during construction and operation
- **Topography and soils:** Minimising disturbance and damage of natural land systems.
- **Groundwater** - Protecting the quantity and quality of groundwater, including GAB, GAB mound springs, Yarra Wurta, Coorlay Lagoon, Andamooka Limestone, Corraberra sandstone aquifers Stuart Shelf, Lake Torrens.
- **Surface water:** Protecting existing drainage patterns and water quality.
- **Water efficiency and conservation:** Minimising water use and maximising re-use.
- **Terrestrial ecology** - Protecting biodiversity values of expansion sites and avoiding impacts on native vegetation and fauna.
- **Marine environment:** Protecting the marine environment of the Upper Spencer Gulf from adverse impacts.
- **Waste:** Minimising general waste and maximising re-use, and ensuring residual waste is managed appropriately.
- **Aboriginal cultural heritage:** Protecting sites of Aboriginal heritage significance and avoiding impacts.
- **Non-Aboriginal heritage:** Protecting historic places and sites from disturbance.
- **Social environment** – Preventing/minimising negative impacts on communities; managing and maintaining communication with communities.
- **Visual amenity:** Protecting visual amenity, including landscape and amenity values of the Outback and coastline.
- **Economy and business:** Minimising negative impacts on local and regional areas.
- **Regional development:** Distributing economic benefits throughout the region in the form of jobs, improved infrastructure and new business opportunities.
- **Traffic and access:** Managing the effects of increased traffic and transportation during construction and operation to minimise impact on the community and maintain public safety.
- **Storage, transport and handling of hazardous materials:** Protecting the marine and terrestrial environments, and human and ecological health, from exposure to hazardous substances.

- **Health and safety:** Protecting the environment and human health and safety from the impacts of hazardous materials and activities.
- **Radiation** - Protecting employees and the public from exposure to radiation.
- **Greenhouse gas and sustainability:** Minimising energy use and greenhouse gas emissions throughout design, construction and operation; utilising sustainable energy sources
- **Rehabilitation and closure:** Creating appropriate post-mining landforms.

3.6 South Australian Government policy

The Olympic Dam expansion proposal was also assessed against the State Strategic Plan 2007, and the Far North Region Plan July 2010 (a volume of the SA Planning Strategy), as required under section 48(5) of the *Development Act 1993*. Table 6.5 in the DEIS also provides a brief assessment against the relevant provisions of these plans.

3.6.1 State Strategic Plan 2007

The State Strategic Plan is the overarching policy document influencing the direction of South Australia. Updated in January 2007, the plan seeks to deliver a range of economic, environmental and social outcomes to benefit South Australians. It contains 84 targets aimed at achieving the following key objectives:

- Growing prosperity;
- Improving wellbeing;
- Attaining sustainability;
- Fostering creativity and innovation;
- Building communities; and
- Expanding opportunity.

The targets relevant to the proposed mine expansion are:

SSP TARGET	OBJECTIVE	EXPANSION CONTRIBUTION
T1.1	Economic growth - Exceed the national economic growth rate by 2014	BHPB expects the proposed Olympic Dam mine expansion project to have a significant impact on the South Australian economy. Following completion of the construction phase and when the expanded mine is at full production, South Australia's GSP is estimated to be \$6.9 billion (8.7 per cent) per annum higher in annual average terms compared to the Business As Usual Case (BAU-case) projection.
T1.10	Jobs - Better the Australian average employment growth rate by 2014	In full-time equivalent (FTE) terms, employment in South Australia is projected by BHPB to increase by 13,100 (5.2 per cent) over the 30 year modelling period compared to the BAU-case, with an increase of 7000 (19 per cent) in the Northern Statistical Division (SD) and a 6600 increase (1.2 per cent) in the Adelaide SD.
T1.18	Minerals production - Increase the value of minerals production to \$3-billion by 2014	This information is classified as Commercial in Confidence and not for disclosure.

SSP TARGET	OBJECTIVE	EXPANSION CONTRIBUTION
T1.19	Minerals processing - Increase the value of minerals processing to \$1-billion by 2014.	This information is classified as Commercial in Confidence and not for disclosure.
T1.26	Aboriginal unemployment - Reduce the gap between Aboriginal and non-Aboriginal unemployment rates each year.	The Olympic Dam Agreement between BHP Billiton and Aboriginal groups Barngarla, Kokatha and Kuyani includes specific employment targets for indigenous employment which is focused on the northern region of the State.
T3.12	Renewable energy - Support the development of renewable energy so that it comprises 20 per cent of the state's electricity production and consumption by 2014.	BHPB has committed to the use of renewable energy for the desalination plant and water supply pipeline. Other sustainability measures have also been proposed, including solar panels to supplement power to the airport and initiatives for dwellings in Roxby Downs such as solar hot water.
T5.9	Regional population levels - Maintain regional South Australia's share of the state's population (18 per cent).	If the project is approved, the population of Roxby Downs is expected to double to approximately 10,000. Population increases of a more modest scale would also be expected in Port Augusta, Whyalla, Woomera, Pimba and Andamooka.

The AR concludes that the proposed expansion furthers the relevant objectives of the State Strategic Plan for South Australia.

3.6.2 Far North Region Plan 2010

The *Planning Strategy for Regional SA (January 2003)* referred to in the DEIS has since been superseded and replaced by the Far North Regional Plan (FNRP) which was adopted as a volume of the **South Australian Planning Strategy** on 1 July 2010. The plan offers an integrated and coordinated vision for future land use and development in the Far North in response to growth of the mining and tourism industries.

The region includes areas covered by the Port Augusta City Council and the Municipal Council of Roxby Downs, among others. To ensure the greatest future benefit for communities, the plan broadly identifies where housing, population and industry growth is best located across the region. It provides formal direction to councils and the private sector on land use and development.

The proposed expansion activities generally accord with the principles of the FNRP, especially Principle 9 which seeks to safeguard mineral resources and support further exploration, extraction and processing. The Land Not Within a Council Area (LNWCA) Development Plan - which is most of the region - was updated in 2010 to ensure appropriate policies were put in place to support the expansion of mining. Policies include protection of resources from encroachment, and facilitating the provision of associated infrastructure and facilities such as processing and accommodation. Other priorities include protection and development of strategic infrastructure assets, including transport networks and energy, water and telecommunications infrastructure.

Another key principle of the FNRP is to retain and strengthen the economic potential of pastoral lands by making towns the focus of housing development, preventing land fragmentation and managing interfaces between pastoral and other uses. The proposed expansion would not compromise this principle as the linear infrastructure for gas and water would be buried, and the electricity transmission line would run parallel to the existing line. BHPB has committed to consult with affected pastoralists during the construction phase of the infrastructure to ensure any impacts are minimised and managed appropriately.

Principle 13 of the FNRP seeks to focus commercial development in key towns to ensure it is well sited and designed. The aim is to achieve the economies of scale required to attract retailers and other services, and enable people to undertake a number of activities in one location. Roxby Downs fills an important role as a regional centre, and plans to expand the town centre to provide a single retail/civic/commercial/educational core support and advance Principle 13. Key strategies for the expansion of Roxby Downs have been provided in a draft Master Plan which forms Appendix F4 of the DEIS.

The AR concludes that the proposed expansion supports and furthers the relevant principles of the Far North Region Plan 2010.

3.7 Development Plan policy

Under section 48(5) of the *Development Act 1993*, the Indenture Minister, in considering the Olympic Dam expansion proposal, must have regard to local development plans but is not bound by them. Assessment against the relevant provisions of the five development plans affected by the proposal has been included in this AR. Project components of the expansion proposal are located across three local government areas as well as in areas outside council boundaries which comes under Land Not Within a Council Area (LNWCA) development plans. An assessment of each project component against the intent and objectives of the relevant development plans forms Appendix G2 of the DEIS.

The development plans involved are:

- Land not within a Council Area (Eyre, Far North, Riverland and Whyalla) Development Plan (consolidated – 31 March 2011);
- Land Not Within a Council Area (Flinders) Development Plan (consolidated 25 September 2003);
- Port Augusta (City) Development Plan (consolidated 15 July 2010);
- Roxby Downs (Municipality) Development Plan (consolidated 3 March 2011); and
- Whyalla Council Development Plan (consolidated – 16 June 2011).

The DEIS included an assessment of the sulphur-handling facility at Port Adelaide under the Port Adelaide Enfield City Development Plan. As BHPB is not seeking approval for this through the major development process, an assessment against the Port Adelaide Enfield Development Plan has not been undertaken in this AR. Should BHPB choose to proceed with the sulphur-handling facility it would be required under the *Development Act 1993* to apply to the relevant authority (or alternatively apply to the Indenture Minister under Clause 7 of the Indenture).

3.7.1 Land not within a Council Area (Eyre, Far North, Riverland and Whyalla)

3.7.1.1 Remote Areas Zone

The Remote Areas Zone under the Land Not Within a Council Area (Eyre, Far North, Riverland and Whyalla) Development Plan applies to a number of project components including the Special Mining Lease (SML), Hiltaba Village, airport, gas supply pipeline, rail line, Pimba intermodal facility, water supply pipeline and electricity transmission line.

The intent of the Remote Areas Zone is to accommodate a range of uses that are consistent with remote areas, including pastoral, conservation, mining and remote townships. The zone supports the growth of these industries and uses while protecting areas of environmental and cultural significance.

The desired character of the Remote Areas Zone recognises the importance of the Olympic Dam mine expansion and envisages the expanded mining and processing activities within the SML, the gas pipeline and development of new mining settlements such as Hiltaba Village. The zone also envisages a number of ancillary uses such as recreational facilities, taverns, administrative buildings and shops. The intermodal facility and linear infrastructure for water and electricity supply, although not specifically identified in the principles of development control, are required to facilitate the development of the mine expansion and meet the general intent of the zone. Overall, the proposed developments are considered to be in keeping with the desired character of the Remote Areas Zone.

The Minister for Urban Development and Planning has started a Development Plan Amendment (DPA) process that includes policy and zoning changes to the Land Not Within a Council Area (Eyre, Far North, Riverland and Whyalla) Development Plan, in parallel with amendments to the Roxby Downs Development Plan. The DPA proposes zoning and policy changes to allow for a new village for temporary workers and a new airport, which includes creating new mining settlement and airfield policy areas within the Remote Areas Zone, should the expansion be approved. This would allow for any future development at Hiltaba Village and the airport (beyond that envisaged by the EIS) to be regulated under the *Development Act 1993* by the Development Assessment Commission.

3.7.2 Port Augusta (City) Development Plan

The proposed transmission line, water supply pipeline, access corridor, landing facility and pre-assembly yard are located in the area governed by the Port Augusta (City) Development Plan (consolidated 15 July 2010). This has required assessment against six zones under the development plan.

3.7.2.1 Coastal Conservation Zone

The proposed landing facility and access corridor are located in the Coastal Conservation Zone under the Port Augusta (City) Development Plan. The primary intent of the zone is to protect the scenic, cultural, recreational and conservation values of the coastline. Any development should be compatible with the conservation and enhancement of the coastal environment and scenic beauty of the zone. Although the proposed uses are not consistent with the zone, commitments have been made by BHPB to minimise the impacts, including design measures to minimise visual impact and provide protection from coastal hazards, as well as minimising the clearing of marine and land vegetation. BHPB has committed to the preparation and implementation of construction and operational management plans to limit the impacts on the coastal environment.

To minimise potential visual impact, BHPB has indicated that only one building, the site office, and a pier/jetty structure would be required for the land component of the landing facility. Although neither is in accordance with the intent of the Coastal Conservation Zone, the merit in the proposed landing facility is that it will significantly reduce the movement of oversized vehicle loads on the national road network enabling large components and equipment to be moved over water. BHPB considered the site appropriate because it was already disturbed and visually compromised by the Northern Power Station on the other side of the channel. It was also chosen to limit the impacts on the environment because it would require minimal sea-grass and mangrove clearance and avoid the need for dredging. To ensure the impact is temporary, conditions have been recommended for the landing facility to be closed and rehabilitated when the construction phase of the proposed Olympic Dam expansion is completed.

In the context of the site already being disturbed and located nearby an operating power station, as well as the potential benefits of reducing heavy vehicle loads on the national road network, the AR concludes that sufficient merit has been demonstrated to support non-compliance with the zone, provided the use is temporary (for the life of the construction period) and appropriate mitigation and management measures are imposed.

3.7.2.2 Defence Zone

The proposed access corridor for some of its length runs along the edge of the Defence Zone under the Port Augusta (City) Development Plan. The primary intent of the zone is to accommodate military defence installations, activities and buildings, and preserve the rural character of the area. Although an access corridor has not been envisaged in the zone, it is not expected to interfere with defence activities and structures within the Cultana Training Area, and discussions between BHPB and the Department of Defence indicate the proposed use would be acceptable.

The AR concludes that the proposed corridor would not detract from the activities of the Department of Defence and is generally in keeping with the intent of the zone.

3.7.2.3 Industry Zone

The proposed access corridor, pre-assembly yard and electricity transmission line occur in part within the Industry Zone under the Port Augusta (City) Development Plan. The primary intent of the zone is to accommodate a wide range of industrial, warehouse and transport-related land uses.

The AR considers the proposed uses to be generally consistent in the zone, provided appropriate design measures, including setbacks, lighting, building height and landscaping are adopted for the pre-assembly yard which is adjacent to the Rural Living Zone. Landscaping may also be required in sections of the access corridor expected to have a visual impact.

3.7.2.4 Primary Industry Zone

Sections of the proposed water supply pipeline, access corridor and electricity transmission line are located in the Primary Industry Zone under the Port Augusta (City) Development Plan. The primary intent of the zone is the protection of productive, efficient and environmentally sustainable primary production. Although the proposed uses do not involve agricultural or pastoral uses, they are not expected to compromise the zone's objectives as current land uses would not be significantly affected in the medium to long term.

While some impact would be expected during construction, the design of the proposed developments, including burying the water pipeline and aligning the electricity line with the existing line, is expected to minimise operational impacts and not hinder pastoral activities. Further, the unsealed, at-grade nature of the access corridor is considered to be generally in keeping with the rural character of the zone.

Accordingly, the AR concludes that primary production in the zone would not be unduly compromised by the proposed developments.

3.7.2.5 Rural Living Zone and Recreation Zone

A small section of the electricity line is proposed to traverse both the Rural Living and Recreation zones under the Port Augusta (City) Development Plan. The primary objective of the Rural Living Zone is to accommodate dwellings on large allotments and ancillary activities that do not adversely impact on the semi-rural amenity of the locality. The primary objective of the Recreation Zone is for the provision of community, sporting and recreational uses.

Although transmission lines are not complying developments in either zone, it is reasonable to assume that essential infrastructure would not compromise the objectives sought for the zones. It is proposed that the electricity line would be located adjacent to the existing transmission line and would only traverse the Rural Living Zone for approximately 4km and the Residential Zone for approximately 1.5km.

The AR concludes that the proposed transmission line would have minimal impact on the achievement of the objectives for the respective zones due to the minimal disturbance required and the location of the infrastructure adjacent to the existing transmission line. It is also considered the proposed use would provide an essential service to the region.

3.7.3 Roxby Downs (Municipality) Development Plan

3.7.3.1 Township expansion

Should the proposed Olympic Dam expansion project be approved under the *Development Act 1993*, the expansion of Roxby Downs would be subject to the provisions of the Roxby Downs (Municipality) Development Plan. Local township uses were excluded from the major development declarations because such uses are best managed under the normal *Development Act 1993* process by the local authority. They include:

- Land divisions and development reasonably required for a particular land division;
- Residential houses and other development primarily to provide accommodation within the Roxby Downs municipality;
- Offices, warehouses, workshops and other buildings in light or heavy industrial areas in the Roxby Downs municipality;
- New service stations in the Roxby Downs municipality; and
- Connections to, or other work on, any element of a power, water or gas distribution or wastewater collection system in the Roxby Downs municipality.

The intent of the EIS process and this AR was to assess the overall impacts of the township expansion and ensure appropriate local policy and zoning provisions have been recommended for inclusion in amendments to the Roxby Downs Development Plan, which would guide the future development of the township. Accordingly, a detailed assessment of the proposed township expansion against the current development plan has not been undertaken.

To recognise the predicted levels of township growth should the expansion project be approved, the Minister for Urban Development and Planning commenced a Development Plan Amendment (DPA) process which proposed amendments to land-use policy and zoning. The Ministerial DPA process has been run concurrently with the EIS process, with the draft DPA put on public display at the same time as the DEIS. A final decision by the Minister for Urban Development, Planning and the City of Adelaide on the DPA would not be made until after a decision to proceed with the Olympic Dam expansion project. Further information on the DPA process is provided on the Department of Planning and Local Government's website at www.sa.gov.au/planning/olympicdamexpansion.

3.7.3.2 Linear infrastructure

The proposed linear infrastructure of the rail line, water supply pipeline and electricity transmission line traverses for about 13km the Buffer and Rural Landscape zones under the Roxby Downs Development Plan (consolidated 3 March 2011). BHPB has proposed where practicable to co-locate linear infrastructure within existing service corridors to limit disturbance, and committed to bury the water pipeline to further reduce the impact of the infrastructure.

The provision of essential infrastructure for the proposed expansion has been considered in the DPA process and, should the mine expansion be approved, it is likely the Buffer Zone would be altered to accommodate future growth. Due to the essential nature of the infrastructure in the context of the proposed township expansion, the AR considers sufficient merit has been demonstrated to warrant non-complying development in the zones.

3.7.4 Whyalla Council Development Plan

The proposed desalination plant and associated intake and outfall pipelines, and sections of the water supply pipeline and electricity transmission line, are located in the area governed by the Whyalla Council Development Plan (consolidated 15 July 2010). Since the DEIS was prepared the Whyalla Development Plan has been amended in relation to the zoning of Point Lowly, the location of the desalination plant and associated infrastructure. The amendments included:

- Changing the zoning from Industry (Port) Zone to Special Industry (Hydrocarbons) Zone, which affects the location of the proposed desalination plant; and
- Removing the Primary Production Zone and replacing it with 'no zones', which affects a small length of the water supply pipeline and electricity transmission line.

As a result of these amendments the proposed developments were required to be assessed against four zones under the Whyalla Development Plan.

3.7.4.1 Special Industry (Hydrocarbons) Zone

The proposed desalination plant is located in the newly created Special Industry (Hydrocarbons) Zone under the Whyalla Council Development Plan. The primary intent of the new zone is to accommodate chemical production and compatible industries. Industrial development should be designed and located to minimise impacts upon the terrestrial and marine environments and the recreational resource of Point Lowly. The principles of development control provide for the protection of industrial uses in the zone while seeking to protect the amenity and heritage values of Point Lowly through landscaping, site selection and building design.

The AR concludes that although a desalination plant is not envisaged in the zone it is considered an industrial use that would be in keeping with the general intent of the zone and would not constrain the operation of existing or future chemical industries. Further, the desalination plant accords with the Point Lowly Settlement Zone Concept Plan (refer Concept Plan Map Wh/1), which identifies the area more broadly for industrial uses.

Provided appropriate measures are imposed to manage the environmental and visual impact of the proposed desalination plant, the AR concludes that sufficient merit has been demonstrated to support an industrial use at the site, adjacent to the nearby Santos Hydrocarbon Facility and working port.

3.7.4.2 Settlement Zone

The outfall pipeline for the desalination plant would extend through the Settlement Zone under the Whyalla Council Development Plan. The primary intent of the zone is to foster a 'village' environment containing a small collection of low-density dwellings, holiday accommodation, recreational and community facilities. The desired character for the zone is one that highlights the natural beauty and tourism potential of Point Lowly.

If the desalination plant was approved the entire length of the outfall pipeline would be buried underground, preferably within the road reserve, so no permanent change of use is proposed for the site. Some impacts would be expected during construction but provided they were managed appropriately the future use of the area as a coastal settlement would not be constrained by the underground pipeline. The AR concludes that the proposal has demonstrated sufficient merit, provided appropriate management measures are imposed during construction. The measures proposed are outlined in the DEIS Chapter 19 and Chapter 5: 'Desalination plant' of this AR.

3.7.4.3 Coastal Marina Zone

The intake pipeline and pump station for the proposed desalination plant would be located in the Coastal Marina Zone under the Whyalla Council Development Plan. The primary intent of the zone is to accommodate marina and maritime structures such as pontoons, jetties and piers, and support services like refuelling areas. Public access should be maintained, with public spaces being landscaped and paved to provide an attractive coastal setting.

Because the intake pipe would be located underground, no permanent change of land use would occur at the site. As with the outfall pipeline, some impacts would be expected during construction phase but provided they were appropriately managed the AR considers the primary intent of the zone would not be compromised.

3.7.4.4 Coastal Open Space Zone

The outfall pipeline for the desalination plant would also extend through the Coastal Open Space Zone under the Whyalla Council Development Plan. The primary intent of the zone is to protect coastal land by limiting the development to conservation, recreation and public facilities. Development envisaged for the zone should be for public purposes, and includes uses such as boardwalks, jetties, recreation areas and small-scale club rooms, which consider the natural landscape in form and scale. Development at Point Lowly should be sympathetic to the heritage values of the lighthouse and lighthouse cottages.

If the desalination plant was approved the entire length of the outfall pipeline would be buried underground so no permanent change of use has been proposed for the zone as the footprint would be rehabilitated when construction was complete.

Where the outfall pipeline is proposed to traverse the rocky shoreline at Point Lowly, underground and then underwater, it would be engineered in such a way to prevent instability or erosion of the foreshore, during both construction and operation. Its location ensures the lighthouse and associated cottages would not be disturbed.

The AR considers that the siting of the outfall pipeline for the proposed desalination plant is unavoidable in a coastal location. Provided appropriate management measures are implemented during construction and operation the underground pipeline should not compromise desired character of the zone in the medium to long term.

3.7.5 Land not within a Council Area (Flinders)

3.7.5.1 Pastoral Zone

The Pastoral Zone under the Land Not Within a Council Area (Flinders) Development Plan (consolidated 25 September 2003) contains about 20km of the gas pipeline corridor options and about 45km of the southern infrastructure corridor for the water supply pipeline and electricity transmission line.

The primary intent of the Pastoral Zone is to accommodate activities related to the grazing of livestock. Development should preserve the natural environment and character of the zone. The introduction of linear infrastructure in the Pastoral Zone is not expected to have any significant medium to long-term impacts on the grazing of livestock as the gas and water supply pipelines would be buried and the electricity line located adjacent to the existing line, permanently affecting only about 10ha. This level of impact in such a vast environment is not expected to have significant impacts on grazing or the amenity of the locale. Criteria for the detailed design of the infrastructure would include avoidance of natural features to minimise visual and environmental impacts. Some localised disturbance would be expected during construction.

Accordingly, with the provision of appropriate management measures during construction of the linear infrastructure, the AR considers that the medium to long term character of the zone would not be compromised.

Chapter 4

Mining operations and processing



Chapter 4: Mining operations and processing

4.1 General

4.1.1 Site and locality

The Olympic Dam site is 575km north-north west of Adelaide in South Australia. The existing operations are conducted on a Special Mining Lease (SML). The expansion is proposed to be located adjacent to the existing underground mine, mineral processing plant and tailings storage facility and would require an expansion of the SML.

Roxby Downs is 14km south of the existing Olympic Dam operations by sealed road. If the expansion is approved Roxby Downs would be located 9km to 10km south of the processing plant and open pit respectively.

The town of Andamooka is 30km east of the Olympic Dam mine and can be accessed by a sealed road. Other regional towns are located at Woomera and Pimba, 85km and 95km respectively south of Olympic Dam.

4.1.2 Existing environment

A description of the existing environment of the Environmental Impact Statement (EIS) study area is provided in Chapter 13: 'Effects on the Environment' of this Assessment Report (AR) because the descriptions are common across the various project components and, accordingly, not repeated in this section.

Where relevant, a brief description of the existing environment has been provided in sections of this chapter to provide a comparison with the proposed use and potential impacts on a particular issue.

4.2 Project description – key elements

4.2.1 Mineral resources

The Olympic Dam ore body is a poly-metallic deposit which contains copper, uranium, gold and silver. In addition the ore body contains rare earths and iron (hematite). BHP Billiton Olympic Dam Corporation Pty Ltd (BHPB) has indicated that technology to extract additional minerals economically at Olympic Dam is not available at the current time, and/or incompatible with its proposed operations. The opportunity for recovery of additional minerals would be reviewed periodically by BHPB.

The ore reserves as provided by BHPB in the Draft Environmental Impact Statement (DEIS) are shown in the following table:

4.2.1.1 Mineral resource estimate

RESOURCE CATEGORY	MILLIONS OF DRY METRIC TONNES	COPPER %	URANIUM OXIDE %	GOLD G/T	SILVER G/T
Measured resource	1,329	1.11	0.33	0.32	2.17
Indicated resource	4,515	0.89	0.28	0.34	1.59
Inferred resource	2,497	0.73	0.25	0.25	1.00
Total resource	8,339	0.88	0.28	0.31	1.50

The following table provides information of mining rates and production for the existing operations, the proposed expansion and combined operations:

4.2.1.2 Indicative ore, mine rock and metal production

PRODUCTION MEASURE	CURRENT OPERATION	PROPOSED EXPANSION	COMBINED OPERATIONS
Ore mined (Mtpa)	12	60	72
Mine rock (Mtpa)	0	350-390	350-390
Total material movement (Mtpa)	12	410	422
Copper concentrate (tpa)	600,000	1,800,000	2,400,000
Refined copper (tpa)	235,000	515,000	750,000
Uranium oxide (tpa)	4,500	14,500	19,000
Gold bullion (oz/a)	100,000	700,000	800,000
Silver bullion (oz/a)	800,000	2,100,000	2,900,000

4.2.1.3 Start-up infrastructure/facility requirements

Prior to commencement of mining operations, a range of facilities and infrastructure would be required, including:

- An industrial area for mine maintenance including servicing haul trucks, equipment warehousing and hydrocarbon storage (DEIS Figure 5.13);
- An area of operations for the contractor involved in pre-stripping the overburden (including truck and shovel assembly facilities and offices);
- Relocation of the existing on-site desalination plant;
- A refuelling and explosive facility;
- Relocation of roads and services; and
- A power supply for electric rope shovels and electric drills.

BHPB has indicated that an extensive range of machinery would be required to excavate the pit, including:

- 14 large electric rope shovels to load 160 “ultra class” trucks each with a capacity greater than 300 tonnes;
- Various-sized diesel hydraulic shovels;
- Hydraulic excavators, front-end loaders, and bulldozers; and
- 150 ancillary heavy vehicles (graders, rollers, water trucks, drill rigs, scrapers, and fuel and lube vehicles).

The indicative location of the on-site facilities, including the initial infrastructure, is shown in the Supplementary Environmental Impact Statement (SEIS) Figure 1.11. Notably, all but the lay-down facility would ultimately be covered by the Rock Storage Facility (RSF) in the longer term.

4.2.2 Open-pit mine

The open pit is proposed to be developed by the establishment of a starter pit and subsequently expanded by a series of 150m to 400m wide 'push-backs' to expose additional ore. About 410 million tonnes per annum (Mtpa) of material would be removed from the open pit over the 40 years of operation, resulting in a void 4.1km long, 3.5km wide and 1km deep, covering an area of 1010ha. The DEIS indicated that before the ore body was reached, extensive earthworks over a period of up to five years would be required to remove the 300–350m of un-mineralised sediments (overburden).

Hard rock mining, using standard drilling, blasting, loading and haulage activities would commence from an estimated depth of 10–40m below the surface. Following blasting the fragmented overburden and ore would be loaded by electric shovels into haul trucks. Ore would be tipped into the run-of-mine (ROM) ore stockpile or directly into the crusher. Mine rock (overburden) would be taken to the RSF for long-term storage or to the new Tailings Storage Facility (TSF) to be used in perimeter walls. BHPB has investigated the option of installing an in-pit crusher and conveyancing system but determined that a conventional mining system would be more efficient at this time. It stated it would reassess this option throughout the mine life.

The open pit would be developed in a series of batters (faces) and benches. The height of the production benches would vary between 14m and 20m and the batter angle would vary from 60-90 degrees, depending on the geological structure. The overall pit wall angle would vary from 35-53 degrees depending on the requirements for local stability and the geological structure (DEIS Figure 5.15). The DEIS stated that the proposed slopes were consistent with industry practice.

Haul roads would be constructed from materials excavated from the pit and would be watered regularly by water carts using chemical dust suppressants to minimise dust and provide a compacted all-weather surface.

The construction and operation of the open pit would necessitate additional demands for water, electricity and workforce which are indicatively outlined below:

EXPANSION REQUIREMENT	PROPOSED EXPANSION
Water demand (ML/d)	32
Electricity consumption (MWh/a)	283,000
Diesel usage (ML/a)	350
Peak construction/shut down workforce	3,000
Ongoing operational workforce	2,500
Total land disturbance: open pit and RSF (ha)	7,730

4.2.2.1 Dewatering of the open pit

Dewatering of aquifers in the area of the open pit would be required for the life of the expanded mine to control groundwater inflow, and to reduce pore pressures to improve the stability of the open pit walls. BHPB has estimated that groundwater would be extracted at a rate of 5 ML/d but in the initial 6 years could be up to 15 ML/d. BHPB has outlined the following design principles have been followed for the proposed dewatering program:

- Establishment of about 20 to 35 dewatering wells located in the Corraberra Sandstone and Arcoona Quartzite geological formations;
- Water entering the pit would be controlled via in-pit horizontal drains, in-pit wells and pumping from sumps in the pit floor;
- Low permeability cover sequence and basement rocks would be depressurised using in-pit horizontal drain holes (and possibly by drain holes drilled from an underground access tunnel);
- Additional wells may be required for areas of higher inflow;
- Stormwater run-off would be prevented from entering the open pit by surface grading and construction of an earth bund around the perimeter; and.
- Rainfall that enters the pit or accumulates from significant rainfall events would be managed by the use of primary and mobile transfer pumping stations and would either be discharged into natural depressions or used in the pit for dust suppression.

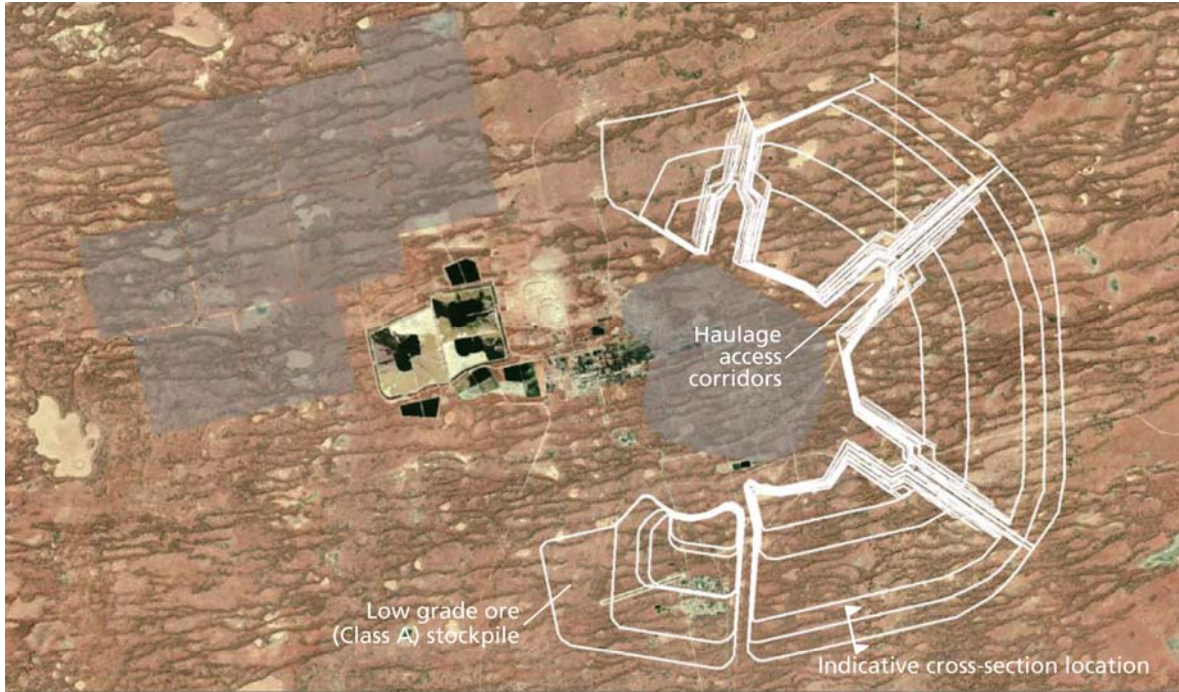
The groundwater from dewatering activities is expected to have a salinity varying from 40,000 to 200,000 mg/L total dissolved solids (TDS) and would be used primarily for dust suppression. Some could be desalinated on-site at the existing facility for use in the metallurgical plant.

4.2.3 Rock Storage Facility (RSF)

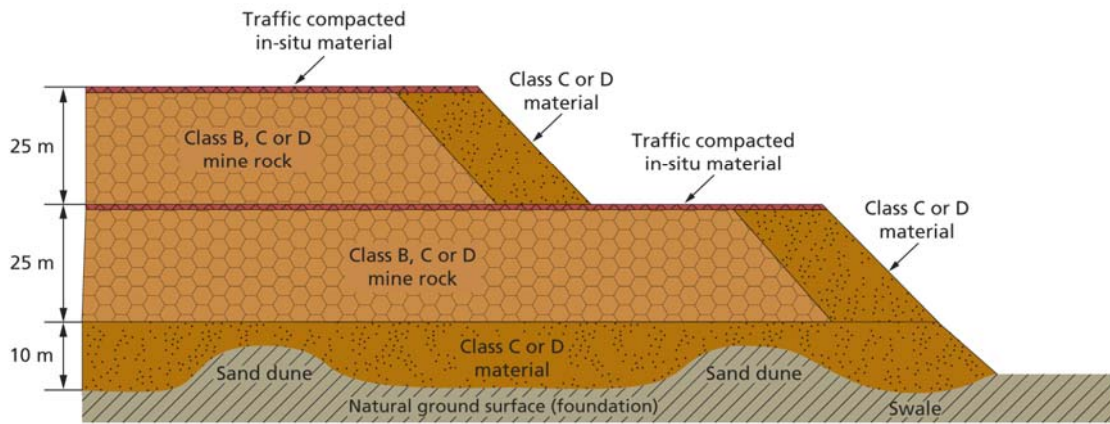
It is proposed that the Rock Storage Facility (RSF) would receive around 350 to 390 Mtpa of waste rock and would be developed progressively by selectively placing potentially reactive mine rock into the RSF and encapsulating this material with non-acid forming material. A layer of non-acid forming material would be placed over the natural soils and sand dunes in the RSF area to provide a level surface and to further mitigate the potential for acid leachate (DEIS Figure 5.16).

At 40 years, the footprint of the RSF would be expected to cover 6720ha at a height of 150m. As the rock material would be dumped at its angle of repose the external slope would be in the order of 37 degrees. The placement of a series of benches and batters would result in an overall average slope angle of 30 degrees. The DEIS indicated that the RSF would be stable at any height, and that the design has incorporated the following design principles:

- Establishing a 500m buffer between the RSF and the Arid Recovery area located north of the Olympic Dam operations;
- Allowing for the construction of the expanded metallurgical plant and mine maintenance industrial area;
- Providing a separate area for the stockpiling of low-grade ore;
- Minimising haulage costs;
- Creating access corridors to allow haul trucks to travel to the edges of the RSF;
- maximising the distance between the RSF and Roxby Downs township and the proposed Hiltaba Village in order to minimise potential dust and noise impacts;
- Minimising the footprint of the RSF while maximising constructability, safety, operability and long-term stability;
- Encapsulating potential acid generating material within non-acid forming material; and
- Placing a 10m-thick layer of inert material (limestone) at the base of the RSF to provide an additional mechanism for neutralisation of any acidic material that may be generated.



PROPOSED ROCK STORAGE FACILITY (at 40 years)



CROSS-SECTION

DEIS Figure 5.16 Indicative cross-section of the rock storage facility

4.2.4 Chemical storage and use

Increased mining and ore processing activities would require the use and storage of larger quantities of chemical compounds. The reagents would be the same as currently used in the metallurgical operations. An indicative list of the annual requirements of chemicals and the methods of storage proposed to service the mine expansion is shown in the DEIS Table 5.14.

4.2.5 Processing plant

The metallurgical processes used in the current operation would continue to be used, with the addition of copper concentrate production to the existing suite of refined metal production. The combined throughput of the existing and proposed processing operations would equate to six times more ore than is currently processed. To process the additional quantities of material, a new concentrator and hydrometallurgical facility would be constructed, and the existing copper solvent extraction plant, smelter and refinery would be modified and optimised.

The new metallurgical plant is proposed to be located to the south and south-west of the existing tailings storage facility (TSF), and is expected to cover an area of about 690ha. Figure 5.19 in the DEIS provided an indicative configuration of the metallurgical plant at year 40. Tailings from the existing and expanded operations would be combined and pumped to an expanded TSF. The construction and operation of the new metallurgical plant would necessitate additional demands for water, electricity and workforce which are indicatively outlined below:

EXPANSION REQUIREMENT	PROPOSED EXPANSION
Water demand (ML/d)	175
Electricity consumption (MWh/a)	3,310,000
Peak construction workforce	3,000
Ongoing operational workforce	1,000
Total land disturbance – including TSF (ha)	4,690

The proposed metallurgical processes for the expansion project are proposed to operate as shown on Figure 5.21 of the DEIS.



DEIS Figure 5.20 Conceptual layout of the proposed metallurgical plant at Year 40

4.2.6 Tailings Storage Facility (TSF)

The DEIS indicated that the proposed expansion would generate approximately 58Mtpa of tailings at full production, which would require up to nine new TSF cells, each approximately 400ha in surface area. This would be in addition to the existing four storage cells that currently receive approximately 10Mtpa of tailings from the underground operation, and cover an area of 400ha (tailings storage) and 133ha (evaporation ponds).

BHPB undertook an assessment of alternative methods for managing tailings, including:

- A central thickened discharge. This option was rejected because storage of the tailings would have been inefficient and the footprint would have been much larger;
- Co-disposal of tailings with mine rock in the RSF. This option was rejected because there would have been poor structural strength and greater seepage to groundwater; and
- Locating the TSF within the RSF. This option was rejected due to operational inefficiencies and safety risks with the operation of the large haul trucks.

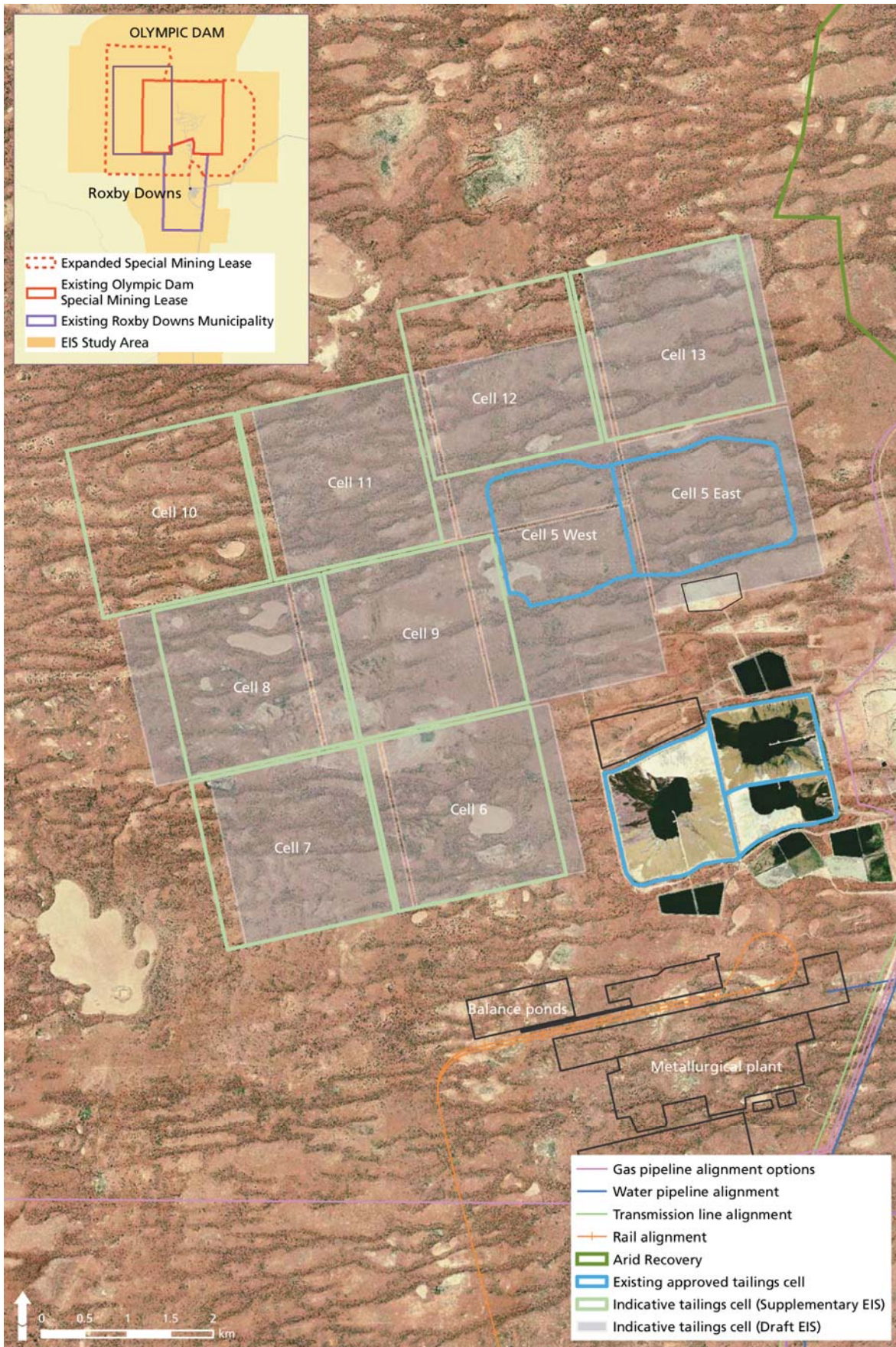
The DEIS stated that the preferred design seeks to minimise the footprint, protect fauna from acidic liquor and control seepage. To achieve this design a total footprint of approximately 4400ha, including liquor balance ponds would be required, incorporating the following design components:

- Centreline construction using non-acid forming mine rock from the open pit, which would provide a stronger and more stable facility, enabling the cells to be built higher (from the current 30m to 65m) and hence reduce the footprint;
- External slope angle of 25 degrees;
- 300m x 300m decant pond to capture seepage of tailings liquor;
- 1.5mm thick HDPE liner under the decant pond and extending to 100m outside the decant pond (400m x 400m);
- Sand drain over the HDPE liner to assist in drainage and consolidation of the initial tailings deposition
- Upstream and downstream embankment toe drains;
- Thickened tailings from the current average solids density of 47% to a target of around 55%, thereby avoiding the construction of additional evaporation ponds; and
- Four 60ha liquor balance ponds to recover and reuse water, that would be netted or covered to restrict bird access.

Construction of the cells would require tailings to be deposited sequentially from pipeline spigots (distribution points) around the perimeter of each cell in a process known as sub-aerial deposition. The tailings “beach” would be allowed to dry and consolidate prior to additional tailings being deposited in 10m rises. BHPB has indicated that a crust would develop on the surface which would minimise the potential for dust generation. The perimeter embankment of the cells would be progressively raised as each cell was filled with tailings. Tailings would be capped when their target design height was reached to reduce long-term release of dust and radon. A plan view and cross sections of a tailings cell within the proposed TSF is shown in the DEIS Figure 5.22. A detailed description of the TSF design is shown in the DEIS Appendix F1.

In the SEIS, BHPB revised the locations of the cells and reduced their number from 9 to 8 as it was considered that construction of a new cell, TSF Cell 5, as part of the existing operations to replace existing TSF Cells 1 to 4 would provide sufficient capacity so as to not require the 9th contingency cell for the proposed expansion. The proposed change results in an overall increase in vegetation clearance of 80ha over the DEIS proposal.

The DEIS indicated that the proposed TSF would have factors of safety against failure that exceed the Australian National Committee on Large Dams (ANCOLD) minimum requirements under normal operation, steady state seepage and earthquake loading.



SEIS Figure 1.8 Revised layout of the proposed tailings storage facility cells

4.2.7 Gas-fired power station

To maintain commercial and technical flexibility, BHPB has sought approval for two electricity options, including a new 275kV transmission line between Port Augusta and Olympic Dam to be serviced by the National Electricity Market (discussed in Chapter 10: 'Infrastructure corridors' of this AR), as well as a 600MW combined gas cycle turbine power station at Olympic Dam to be supplied by a pipeline from Moomba. The ultimate arrangement could comprise either option or a hybrid of both.

The power requirements for the mine expansion, as indicated in the EIS and not including off-site infrastructure, is summarised in the following table:

4.2.7.1 Indicative electricity demand

ELECTRICITY LOADS	EXPANSION MAXIMUM DEMAND (MW)	EXPANSION ANNUAL ELECTRICITY CONSUMPTION (GWH)
Open pit mine	95	283
New concentrator plant	300	2365
New hydrometallurgical plant	40	315
Expanded smelter	3	24
Expanded refinery	12	95
New on-site administrative	4	18
Acid plant	42	331
Process infrastructure	20	158
Total additional demand	516	3588

* Note: There would be a reduction in the load demand of 250MW at mine full production capacity with the proposed establishment of a co-generation plant (refer to section 4.2.8).

In order to reduce on-site labour, components of the gas fired power station are proposed to be pre-assembled off-site. Construction of the site would include vegetation clearing for the power station footprint, together with an area to be used as a temporary lay-down facility for the storage of equipment and plant.

The following table is a summary of the indicative major features of the power station:

KEY FEATURES	PROPOSED EXPANSION
Maximum electricity capacity (MW)	600
Annual generation capacity (GWh)	5,100
Fuel	Natural Gas
Maximum gas demand (PJ/a)	45
Number of gas turbines	3-4
Number of steam turbines	1-2
Number of exhaust stacks	2-4
Height of stacks (m)	35
Average availability	95% (5% for maintenance)

Construction and operation of the proposed power station would result in additional demand for water, electricity and labour, which are indicatively identified in the following table:

EXPANSION REQUIREMENT	PROPOSED EXPANSION
Water demand during construction (ML)	200
Water demand during operation (GL/a)	0.3
Electricity consumption during operation (GWh/a)	60
Area for gas fired power plant (ha)	25
Total land disturbance (ha)	30

The DEIS envisaged that construction personnel would start at 250 and build to a peak of 900. All personnel would be accommodated in either Roxby Village or Hiltaba Village, and 30 people would be required to operate the plant.

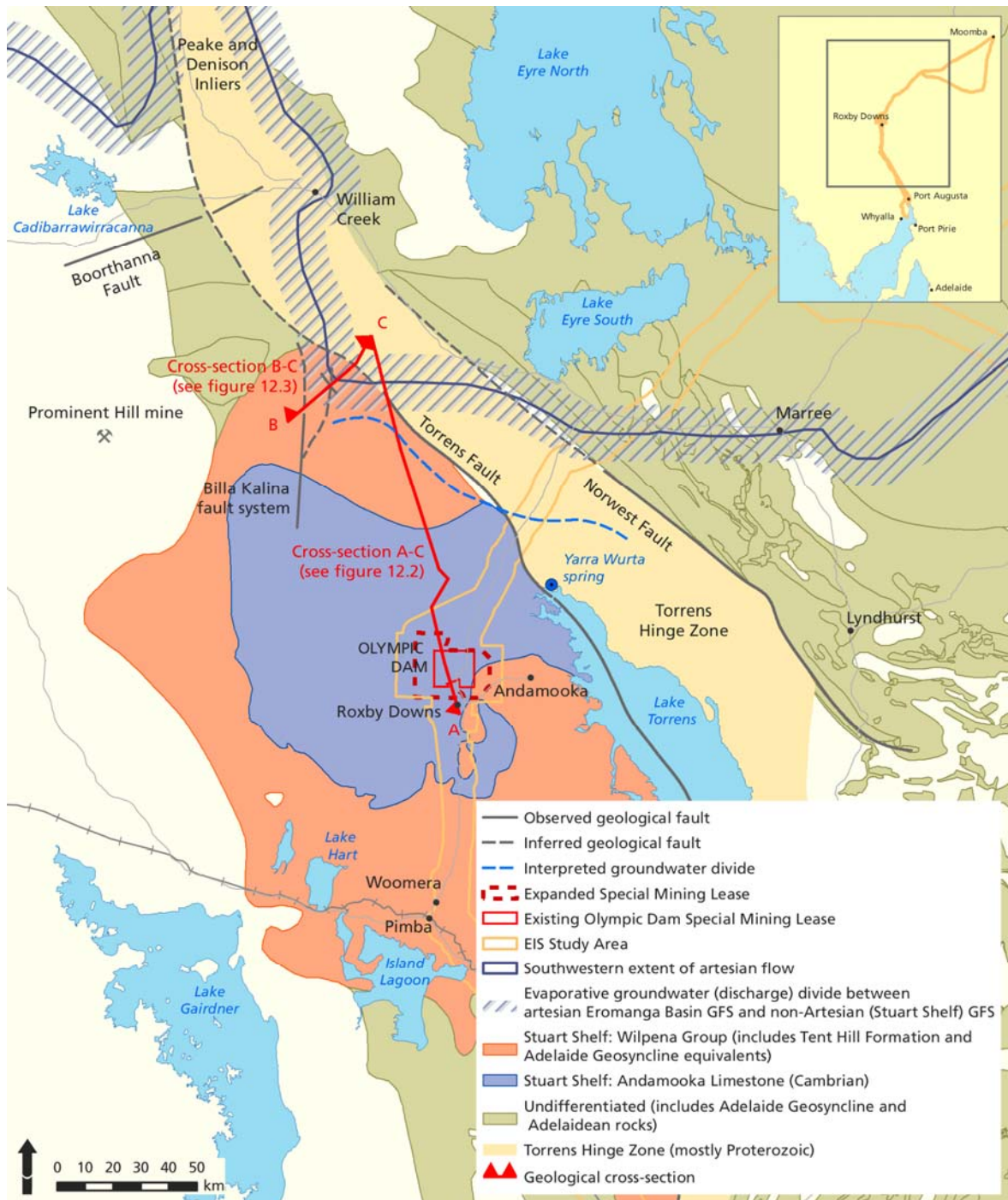
Chemicals, primarily used for water treatment and cleaning are proposed to be kept in limited quantities on-site and would be located within bunded areas to contain spillages, should they be required.

4.2.8 Co-generation power station

To supplement the primary electricity demand, BHPB has also proposed to construct a co-generation power station at Olympic Dam. This would capture waste heat, generated from the burning of sulphur to produce the sulphuric acid required for the new hydrometallurgical plant. Over time, and as the operation reached full capacity, the co-generation power station could generate up to 250MW of the 650MW of power required.

4.2.9 Water supply

The additional water required for the mining and processing operations would primarily be obtained from the coastal desalination plant combined with water from saline aquifers in the SML and the broader Stuart Shelf area. Water required for dust suppression for the open pit mine would be obtained from mine de-pressurisation and/or from saline wellfields. Water for construction and operational purposes at Olympic Dam would be obtained from a combination of sources. BHPB's existing Great Artesian Basin (GAB) allocation would be used for high quality water needs, and other wellfields for low-quality water needs.



SEIS Figure 12.1a Geological setting of the Stuart Shelf

A summary of water supply requirements for the mine expansion (not including off-site infrastructure), as determined by BHPB, is shown in the following table (DEIS Fig 5.26).

4.2.9.1 Indicative water source and demand

SOURCE	DEMAND	DESCRIPTION
Construction activities		
Potable – GAB and local saline wellfields	Up to 7ML/d	Current use averages 37 ML/d, with a current approved maximum limit of 42 ML/d which would be used to supply potable requirements
Saline – mine depressurisation and saline wellfields	25 ML/d	20% from open pit depressurisation and 80% from aquifers in the mine area
Operation (combined underground and open pit)		
Existing metallurgical plant – GAB	36 ML/d	From existing approvals
Existing underground mine – GAB	1 ML/d	From existing approvals
New metallurgical plant – Point Lowly desalination plant	151 ML/d	Direct use in the plant. Some further treatment at on-site desalination plant to meet de-mineralised water requirements
Open pit mine and associated facilities – Point Lowly desalination plant	7 ML/d	As above
Dust suppression and other operational needs – Point Lowly desalination plant	25 ML/d	Alternatively saline water from open pit depressurisation or saline wellfields would be used

4.2.10 Industrial and general waste

4.2.10.1 General

A waste management facility is proposed to the west of the open pit, adjacent to the current TSF. The facility would cover an area of approximately 560,000m², which at a maximum landfill height of 15m would accommodate 60 years of operational life, equating to an available volume of 7.5 million m³.

4.2.10.2 Tyres

The most significant increase in waste generated from the proposed expansion would be an increase in rubber tyres, from 25tpa to about 8090tpa, principally from haul trucks used in the extraction of the open pit. BHPB is considering several options for tyre disposal. The hierarchy of preferred practice for the expanded project is to:

- Reduce the volume of tyres by implementing programs to increase the life of tyres;
- Retread or repair tyres where possible;
- Use waste tyres for industrial purposes such as berms, road demarcation and fencing;
- Treat waste tyres using energy recovery technologies such as incineration, co-combustion, tyre-derived fuel, pyrolysis, gasification, shredding and granulation; and
- Disposal in the RSF.

BHPB's preference is to find a recycling solution for the tyres over disposal in the RSF, as the tyres may cause instability and potential for fire risk in the RSF. However, if disposal to the RSF is required, management practices to mitigate the risks would be applied.

4.2.10.3 Low level radioactive waste

Low level radioactive waste would continue to be produced at the expanded operation, mainly from laboratory waste (around 8m³/a) and used personal protective clothing (around 40m³/a). This waste is proposed to be disposed of in the TSF, as per current practices, consistent with relevant codes and legislation, including the *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing 2005*.

4.2.11 Closure and rehabilitation

4.2.11.1 General

The DEIS indicated that the closure of the open pit mine and associated processing facilities would be undertaken in accordance with BHPB's corporate Closure Standard. The following guiding principles would apply:

- Closure planning would be incorporated into the design, construction and operation phases;
- Rehabilitation and stabilisation of disturbed areas would be undertaken as soon as it is safe and practical to do so;
- Reuse and recycling of redundant assets would occur during operations and at mine closure; and
- Decommissioning infrastructure would be undertaken in accordance with environmental, health and safety objectives.

The following table outlines the post-closure options proposed by BHPB.

4.2.11.2 Post closure options proposed by BHPB

ITEM	POTENTIAL USES	RESPONSIBLE ENTITY POST CLOSURE
Open pit	Vacant Crown land with access restrictions for public and livestock. Research and education site for geological, environmental and engineering disciplines. A managed and regulated tourist attraction.	The SA Government would be responsible for the land, including, if relevant, the maintenance of viewing platforms and access to the pit by tourists, scientists and students
Rock storage facility	Vacant Crown land with access restrictions for public and livestock. A managed and regulated tourist attraction.	Not stated
Metallurgical plant	Research and education, tourism. Stock pasture or vacant Crown land.	Not stated
Tailings storage facility	Further mining and processing, if metal prices reach levels that made extraction of the residual metals economically viable. Vacant Crown land from which stock would be excluded.	Not stated
Underground operations	Decommission if no suitable future use is identified.	Not stated

4.2.11.3 Open pit

BHPB has indicated that the open pit would not be backfilled and would essentially remain as it was at the completion of mining activities (with minor slope correction undertaken). Haul roads would be blocked to prevent vehicle access and a bund and fence with warning signs would be installed around the perimeter of the void.

The open pit would be expected to fill with water due to recovery of the groundwater table. Modelling undertaken by BHPB suggests that the resultant hypersaline lake would be up to 350m deep. Over the very long-term it is expected that a salt crust (containing a wide range of concentrations of metals) would be formed on the surface of the lake due to increasing salinity.

4.2.11.4 Rock storage facility

BHPB has indicated that the RSF would remain as a permanent landform that would resemble natural mesas found near Coober Pedy and Port Augusta. The long-term aim would be to ensure that potentially reactive material remained contained within non-acid forming material. The following principles to achieve this have been proposed:

- No reactive material would be stored under the outer slopes;
- The outer slopes would be constructed using coarse non reactive material (such as durable sandstone, quartzite and limestone) that would be resistant to erosion by surface water run-off and wind;
- The outer slopes would be left at the constructed angle of repose (30 to 37°) to minimise the resultant surface area that is susceptible to erosion; and
- The upper surfaces would be covered with a coarse rock mulch layer that is stable and minimises the potential for wind and water erosion.

4.2.11.5 Processing plant

The DEIS suggested that the metallurgical plant post-closure could be used for research and education, tourism, and further mineral processing if the mining of ore from the RSF or TSF should become economic. BHPB also suggested that haul trucks could be used as a tourist exhibit near the open pit. If none of these options were feasible, the facilities would be decommissioned and demolished and the site could revert to stock pasture or become vacant Crown land. The reuse and recycling of plant and equipment would be a priority. Redundant material would be removed from the site by rail if benign, or buried on-site either in the RSF, TSF or in an appropriate landfill.

Any contaminated soils below the process ponds and from other parts of the site would be investigated and remediated in accordance with provisions of the *Environment Protection Act 1993*, *Radiation Protection and Control Act 1982*, the *National Environment Protection (Assessment of Site Contamination) Measure 1999*, and other relevant legislation. All surfaces would be re-contoured and deep-ripped to facilitate natural revegetation.

4.2.11.6 Tailings storage facility

The DEIS indicated that the TSF would remain as a permanent feature that resembles a low mesa typical of the regional landscape. The following broad concepts were provided in the DEIS:

- TSF cells would be rehabilitated as each cell reached the end of its operational life to ensure management of dust, surface water and radon gas;
- The TSF would be capped with sufficiently thick non-acid forming material to minimise the potential exposure of the public to acidic liquor and radioactive material;
- Access roads and tracks adjacent to the TSF would be ripped to restrict access;
- A fence would be constructed around the base of the TSF to prevent vehicle and stock access; and
- Signs warning the public of exposure to radiation and possible rock falls would be erected around the edge of the TSF.

4.2.11.7 Underground operations

The DEIS indicated that BHPB propose to assess future uses of underground facilities prior to closure of the mine. If no suitable future use is identified, it is proposed to decommission the underground facilities in accordance with BHPB's current Olympic Dam Closure Plan, which includes the following strategies:

- Subsidence risks would be investigated and addressed, if deemed necessary, by backfilling high-risk shafts with cemented aggregate fill (CAF);
- All surface infrastructure would be removed and recycled, or removed to an appropriate landfill site;
- All underground infrastructure would be removed if recyclable, or left *in situ*;
- The Whenan shaft, portals and raise bores would be sealed with pre-cast concrete;
- Soil would be mounded over the concrete seals; and
- The site would be re-contoured to reinstate natural contours and drainage lines, deep-ripped and allowed to naturally revegetate.

4.3 Summary of submissions

A significant number of submissions was received from the public, Non-Government Organisations (NGO's), other organisations and institutions and SA Government agencies on the proposed expansion. Submissions have been grouped under the following issues:

- Mining and processing operations
- Tailings Storage Facility (TSF)
- Rock Storage Facility (RSF)
- Noise and vibration
- Air quality
- Groundwater
- Waste management
- Terrestrial impacts
- Surface water and drainage
- Radiation
- Risks/hazards
- Rehabilitation and closure
- Greenhouse gases

Under each grouping, the key matters raised in the SA Government's submission and public submissions are listed as follows:

4.3.1 Mining and processing operations

4.3.1.1 SA Government submission

- Additional information required to justify not fully processing copper concentrate on-site and whether other minerals can be processed, e.g. iron ore;
- The potential options of partially backfilling the open pit as part of progressive development at the end of operations or fully backfilling were not discussed; and
- Insufficient information provided on potential risks of seismic events and impact on key infrastructure, including the impact of stress release induced seismic events due to establishment of the deep open pit.

4.3.1.2 Public submissions

- Further information required on future expansion scenarios (e.g. 1 million tonnes of copper) and not just 40 year life project (750,000 tonnes of copper);
- Additional information should be provided on the cost/benefit of only undertaking underground mining;
- There should be no processing of the uranium ore and the mine should only process copper and precious metals;
- Copper concentrate should be fully processed in South Australia and not exported overseas for processing;
- Use of electric vehicles versus diesel trucks in the mining process and its relationship to the diesel subsidy which BHPB should not receive; and
- Incorrect assessment of the seismic hazard/risk due to seismicity (particularly on Mashers Fault) stimulated by the planned open pit and potential impacts on mining infrastructure including the TSF.

4.3.2 Tailings Storage Facility (TSF)

4.3.2.1 SA Government submission

- Insufficient information provided on the parameters and material properties used to determine seepage rates and volumes from the TSF;
- Insufficient information provided and inconsistencies relating to the stability assessment for the TSF, including material strength parameters, location of the phreatic surface and failure modes;
- Impacts of the Tailings Retention System on avifauna and adequacy of monitoring methodology for assessing bird mortalities; and
- Feasibility of the proposed netting cover system for the decant and drainage area to withstand impacts from acid solution.

4.3.2.1 Public submissions

- The TSF should be fully lined to prevent seepage as contamination of the aquifer is unacceptable;
- Adequacy of the proposed TSF design in managing seepage and impacts on groundwater. Insufficient detail of modelling parameters and assessment of a fully lined TSF to enable comparison of seepage rates not undertaken;
- Additional information required on alternative tailings disposal options including disposal of tailings in the mine void or co-disposed with the waste rock, and disposal of waste rock in the mine void;

- The TSF should be isolated from the environment;
- Justification required as to why Olympic Dam should not meet the best practice standards for the Ranger Uranium mine;
- A detailed environmental risk assessment relating to establishment of the above ground TSF versus backfilling of the pit;
- Concern that radioactive tailings will migrate off-site and spill out of the TSF causing exposure to radon gas; and
- Look for non-water related dust suppression techniques.

4.3.3 Rock Storage Facility (RSF)

4.3.3.1 SA Government submission

- Insufficient information provided on the stability of the RSF during operation and following closure, including the failure modes that were considered and material strength parameters;
- Insufficient information provided on the development of the RSF, timing/schedule for establishing the non-acid forming cover on the batters and progressive rehabilitation; and
- Insufficient information provided on the parameters and material properties used to determine seepage rates and volumes from the RSF.

4.3.3.2 Public submissions

- Additional information required on disposal of waste rock in the mine void;
- A detailed environmental risk assessment relating to establishment of the above ground RSF versus complete backfilling of the pit;
- Incorrect calculation of the volume of waste rock which would result in a significantly larger RSF; and
- Look for non-water related dust suppression techniques.

4.3.4 Noise and vibration

4.3.4.1 SA Government submission

- Additional information required on noise impacts on Roxby Downs and Hiltaba Village from the mine and metallurgical plant and other infrastructure.

4.3.5 Air quality

4.3.5.1 SA Government submission

- Insufficient information provided on modelling of radon in the pit and potential impact on worker doses;
- More information required to estimate radiation dose for workers at the heavy industrial area;
- Additional information/modelling sought in relation to noise and air quality (including heavy metals, sulphur dioxide and nitrogen dioxide emissions) in relation to public health at Roxby Downs and Hiltaba Village; and
- Whether existing background levels of PM₁₀ were included in the modelling.

4.3.5.2 Public submissions

- Look for non-water related dust suppression techniques.

4.3.6 Groundwater

4.3.6.1 SA Government submission

- Insufficient information provided to support the conceptual groundwater models, particularly for the region north of the mine, across the Torrens Hinge Zone towards the GAB and the inferred divide to the south and west of Olympic Dam;
- Modelling of the final pit lake not undertaken to steady state conditions;
- Inadequate quantification of uranium series radionuclides in pit water, as a result of seepage from the RSF and TSF and the potential long-term impacts;
- The basis for the determination of the infiltration and seepage rates for the TSF and RSF not justified sufficiently to provide confidence in the outcome of the modelling;
- Further information required on the effectiveness of the Andamooka Limestone and sediments below the TSF to neutralise and attenuate seepage;
- Insufficient laboratory testing undertaken to determine geochemical properties of waste rock;
- Clarification required on the additional demand of water from the GAB associated with optimisation of the existing operations prior to any major expansion; and
- Monitoring Plan required to assess the impacts of drawdown on the Yarra Wurta Spring.

4.3.6.2 Public submissions

- No further extraction of groundwater from the GAB, use of GAB water to be phased out and BHPB should be required to pay the full cost of water;
- Details of current extraction rates, past performance in terms of volumes and drawdown and licence conditions should be provided; and
- Continued extraction of groundwater from the GAB is a risk to the mound springs and associated eco-systems.

4.3.7 Waste management

4.3.7.1 SA Government submission

- Insufficient information provided on the establishment of a new on-site landfill, including the storage and management of low level miscellaneous radioactive waste and consistency with current EPA Guidelines.

4.3.8 Terrestrial impacts

4.3.8.1 SA Government submission

Vegetation

- Potential impact that dewatering of the open pit will have on the Western Myall (*Acacia papyrocarpa*) and Mulga (*A. aneura*) in the vicinity of the open pit;
- Data on dust fall impacts on vegetation not included;
- The EIS does not clearly indicate that a key objective of the approach to the expansion should be to minimise vegetation clearance;
- Additional clarification required in the Significant Environmental Benefit (SEB) that confirms that rehabilitation will be undertaken of clearance areas (particularly infrastructure) post-construction and to ensure that relevant areas will be restored as near as practicable to original condition;
- Additional clarification to confirm that the impact upon groundwater dependent vegetation within the Yarra Wurta Springs will be minimised and
- Upgrade the existing Environmental Management and Monitoring Plan to cover declared weeds and pest and management provisions for kangaroos.

Fauna

- No discussion of potential impacts of seepage from the RSF and TSF on swales which support regional and in-situ ecosystems;
- Additional information required on monitoring methodology relating to birds and the TSF;
- Assessment of kangaroos grazing potentially contaminated soil has not been discussed;
- Inadequate discussion of land degradation by kangaroos and management measures that would be adopted;
- Monitoring required of the Lake Eyre Hardyhead populations within the Yarra Wurta Springs to ensure no negative impacts; and
- Appropriate management plans will need to be developed in consultation with the relevant Natural Resources Management Board to address vertebrate pests.

Soils

- Insufficient information provided on the current radionuclide distribution in surface soils across the SML;
- Insufficient information provided on the potential for increased land degradation due to increased numbers of off-road activities between Roxby Downs and Andamooka;
- Management measures to be developed for wind erosion control of disturbed areas;
- Inadequate coverage of the impact on soil due to the use of saline water for dust suppression and discharge of surface water run-off and seepage from the open pit; and
- Confirmation of the locations of all topsoil and sand stockpiles.

4.3.8.2 Public submissions

Vegetation

- The SEB design principles are consistent with the Native Vegetation Council SEB principles. However more information is required to enable an informed decision to be made;
- The amount of vegetation to be cleared has been underestimated by BHPB. SEB ratios used by BHPB and basis for off-sets not accepted;
- Concerns expressed at the extent of clearance that will be required for the proposed expansion and the adequacy of the SEB. Consideration should be given to loss of vegetation due to dust impacts and water run-off; and
- Concern at dust impacts on vegetation and the Arid Recovery.

Fauna

- Not acceptable that a large quantity of toxic liquor should be openly exposed to rare and migratory waterfowl;
- Risk assessment should be undertaken by BHPB of impacts of the TSF on wildlife compared with facilitating partial neutralisation and harvesting of recycled liquor and details provided;
- The TSF should be fully covered to prevent bird deaths and impacts on other fauna;
- Bird death counts from current tailings are underestimated and no effective solutions have been found to minimise this. Additional assessment required on the mortalities associated with the TSF;
- Queries relating to the netting proposed over the decant area of the TSF, whether durability testing has been undertaken, potential entanglement issues and procedures for deployment during extension of the decant structure, implication for OH&S. The results of bird netting trials and other proposed research should be provided. Other submissions indicated that the installation of netting should be a mandatory condition if approval is granted;
- Consideration should be given to neutralisation of the acidic liquor to minimise impacts on birds;
- Impact of radon gas on fauna and fish within 1000km of the site, and radon gas can attach to water which may be drunk by fauna which is not addressed in the EIS; and
- Need to consider ways to mitigate the impact on bird species due to the expanded tailings storage facility appearing like a wetland and attracting bird species.

4.3.9 Surface water and drainage

4.3.9.1 SA Government submission

- Insufficient information provided on surface water management measures proposed for the RSF, TSF, and low grade stockpile during establishment, operation and closure to ensure that potential impacts relating to acid drainage and sediment run-off on flora and fauna and groundwater are managed.
- Insufficient information provided on stormwater impacts from other operational areas.

4.3.10 Radiation

4.3.10.1 SA Government submission

Open Pit

- Clarification of the likelihood and concentration of radionuclides in the pit inflow water that may originate in the underground workings post-closure;
- Further details were requested regarding the modelling (including radon emanation rates for unbroken and broken ore) and proposed management of elevated radon decay product and dust exposures originating from the pit and the management of those exposures for employees and members of the public; and
- Risk that radon released from the pit may impact on radon decay product concentrations in the underground mine.

Rock Storage Facility (RSF)

- Clarification was requested on dust and radon releases from the RSF and of the long-term potential for seepage of uranium-series radionuclides from the base of the RSF to groundwater; and
- It was considered that the control measures for stormwater run-off from the RSF and low grade ore stockpiles did not address the potential for release of radionuclides.

Processing plant

- Additional information was requested regarding the typical radionuclide content of the process liquids and materials to support the requirements of the spill reporting criteria;
- Justification was sought for the selection of 9mSv as a maximum estimated dose received by workers in the smelter;
- Further information was requested regarding the monitoring program for airborne radionuclides in the smelter;
- Further information was requested to address the risks associated with non-routine exposures to radiation;
- Consider relocating administration staff that must currently comply with the 'Member of Public' dose limit; and
- Details were requested regarding the significance of the emissions from the calciner stacks as a pathway for exposure.

Transport

- Further information was requested regarding the radionuclide composition of the copper concentrate and the management options available to address build up of radioactive surface contaminants on transport, transfer points and transport corridors.

Tailings storage facility (TSF)

- Additional data was requested on Actinium-227 activity concentrations within the tailings and the movement of radionuclides via seepage from the base of the TSF to groundwater;
- Insufficient information provided on the baseline levels of radionuclides in groundwater; and
- Insufficient information provided on the radiation dose exposure risks and management of dust from the TSF.

Radioactive waste

- Additional details were requested on the management of low level radioactive wastes.

Radiation in the environment

- Additional data was requested supporting assumptions about project generated radionuclide distributions in soil.

Rehabilitation and closure

- Closure criterion for radiation protection of the environment required in addition to management strategies of ongoing radiological issues; and
- Additional information was requested supporting estimates of post rehabilitation doses to the public and environment.

4.3.10.2 Public submissions

Open pit

- Proposed mine and plant dust control measures were considered to be ineffective, and concern was raised over the distance that radionuclides may travel in airborne dust;
- Potential for pit releases of radon and radioactive dust presenting a significant hazard;
- Impact of chronic exposure to low levels of radiation where accompanied by requests for more details on monitoring;
- Further information was requested demonstrating how best practice in uranium mining will be incorporated into the project operations; and
- Suitability of current national radiation dose limits and BHP Billiton's ability to meet reduced limits, should they be introduced in the future.

Processing plant

- It was considered that the potential for increased radiation exposure to smelter workers was inadequately addressed. Comprehensive independent monitoring requested;
- Validity of current radiation exposure monitoring in the smelter disputed;
- Validity of dose calculations provided in DEIS Appendix S disputed; and
- Epidemiological follow up and annual exposure reports were requested for all workers, including long-term worker health monitoring.

Transport

- Radiation exposure arising from fugitive dust emissions and spills along the transport points and corridors

Waste management

- Proposed methods for the long-term management of radioactive waste considered insufficient to prevent radioactive contamination of the environment. Alternative waste management options requested to demonstrate isolation of all tailings for a minimum of 10,000 years.

4.3.11 Risks/hazards

4.3.11.1 SA Government submission

- Insufficient information on potential risks of seismic events and impact on key infrastructure and the impact of stress release induced seismic events due to establishment of the deep open pit.

4.3.11.2 Public submissions

- Concern that radioactive tailings will migrate off-site and spill out of the TSF causing exposure to radon gas; and
- Incorrect assessment of the seismic hazard/risk due to seismicity (particularly on Mashers Fault) stimulated by the planned open pit and potential impacts on mining infrastructure including the TSF.

4.3.12 Rehabilitation and closure

4.3.12.1 SA Government submission

- Insufficient information provided on the proposed program for progressive rehabilitation, in terms of elements of the project and timing;
- The effectiveness of proposed revegetation options not addressed sufficiently in light of saline soils due to use of saline water for dust suppression;
- Lack of modelling to assess options for final covers for the TSF and RSF and effectiveness of the covers;
- The rationale for the differing rehabilitation options, e.g. the variable application of topsoil and revegetation at different locations; and
- Consider the implications of climate change projections suggesting less frequent, but more intense rainfall events and implications on filling of the open pit following closure under a “worst case” scenario.

4.3.12.2 Public submissions

- Significant and detailed information required on the closure design for the TSF;
- Rehabilitation costs must be factored into a rehabilitation bond; and
- Significant and detailed information required on the closure design for the RSF. There appears to be no protection from erosion and no vegetation cover for the RSF.

4.3.13 Greenhouse gases

4.3.13.1 Public submissions

- Commit to processing all ore in South Australia to avoid greenhouse intensive process overseas;
- Approval sought for 1 million tonnes of Cu but EIS only estimates impact for 750,000 tonnes. Estimate emissions from full operating capacity;
- Need to expand assessment to the likely life of the mine possibly 100 years;
- Critical of diesel fuel rebate received by BHPB at the mine and concern about huge increase in diesel use given tightening supplies;
- Should evaluate the impact of the diesel fuel rebate on the choice of fuel used in the mine; and
- Should evaluate underground option to extract ore.

4.4 Key environmental, social and economic issues

The following are the key environmental, social and economic impacts associated with the proposed mining and processing operations:

- Alternative mining and processing operations, covering:
 - Mining method; and
 - Processing method.
- Air quality, covering:
 - Sulphur dioxide emissions from the existing and expanded operation;
 - Other emissions; and
 - Dust and particulates.
- Terrestrial impacts, covering:
 - Site contamination;
 - Impacts on vulnerable listed species reintroduced to Arid Recovery;
 - Impacts of the TSF on fauna and migratory species; and
 - Groundwater dependent ecosystems.
- Groundwater, covering:
 - Dewatering of the open pit;
 - TSF;
 - RSF;
 - Mine water supply; and
 - Risks
- Surface water and drainage;
- Solid waste;
- Wastewater from staff facilities;
- Noise and vibration;
- Visual amenity and landscape character;
- Radiation;
- Greenhouse gases;
- Hazards;
- Rehabilitation and closure; and
- Environmental management.

4.4.1 Alternative mining and processing operations

4.4.1.1 Issues

Mining method

The following issues have been assessed in relation to BHPB's proposal to develop a new open pit mining operation in conjunction with the existing underground mine:

- Whether the proposed open pit mining method would be the most effective, as opposed to continuation of just the underground operations;
- The potential for extracting iron ore and rare earth minerals for sale; and
- Whether partial or full backfilling of the open pit void, with tailings or mine rock would be feasible, as this approach could have the potential to reduce the footprint of the RSF and reduce potential impact on flora, fauna, surface water and groundwater environmental values.

Processing method

Issues relating to the proposed processing of the ore include:

- Whether the proposed mineral processing methods (including not fully processing the copper concentrate to copper metal) are optimal.

Detailed evaluation of the economic impact of the proposed expansion is included in Chapter 12: 'Effects on Communities' of the AR.

4.4.1.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** No specific commitments made in relation to this issue.

4.4.1.3 Assessment

Mining method

BHPB has sought approval to maximise its production of the metals currently mined at Olympic Dam, being copper, uranium, gold and silver. In its assessment of mining methods BHPB considered a number of mining methods, including:

- Expansion of its current underground operations;
- Ceasing the current underground operations and changing to open pit; or
- Operating both underground and open pit mining concurrently.

The latter of the options was selected by BHPB as it would provide maximum recovery of ores (potentially 98%), as opposed to 25% recovery for continuation of the underground operations. Continuation of the underground operations alone would result in sterilisation of ore and was not considered by BHPB or the SA Government to be the most efficient mining option.

On the basis of its assessment BHPB formed the view that other minerals such as iron and rare earths could not be processed economically using current technology. BHPB has indicated that it regularly reviews technologies to monitor the economic feasibility of processing additional minerals, and this approach is considered reasonable by the government.

Accordingly, the AR concludes that the mining methods proposed in the EIS are acceptable and consistent with global best practice, and will maximise the recovery of the Olympic Dam ore resource.

Backfill of open pit and underground

The SA Government sought further information about the potential to dispose of tailings within the underground mine towards the end of the 40 year mining period. In response, BHPB indicated that cemented aggregate fill would continue to be used to backfill the underground voids to maintain ground stability. BHPB further indicated that it was likely that the open pit would extend beyond 40 years and that the presence of un-consolidated tailings in the underground workings could present safety issues.

Additional information was sought from BHPB regarding its proposal to not backfill or partially backfill the open pit. In response, it stated in the SEIS that given the size of the resource - potentially greater than 100 years - it would take a similar timeframe to fully backfill the open pit, at both a significant economic cost, as well as increased greenhouse emissions. BHPB do not consider partial backfilling of the open pit to be a feasible option.

The proposed expansion would establish a single large open pit, which means that the opportunity that is presented in multi-pit mines for progressive backfilling during mining using tailings or overburden does not exist at Olympic Dam.

The AR concludes that the disposal of tailings within the underground workings is not feasible as it would put at risk worker safety and the exploitation of the ore body beyond the 40 year mine period.

Further, the AR concludes that the potential for the open pit mine to extend beyond 40 years negates the benefits of using the open pit for backfill. Specifically, the cost of total or partial backfill of the open pit has the potential to sterilise the mineral resource should mining continue beyond 40 years, and is unlikely to benefit the protection of environmental values - and could lead to increased environmental impact such as emission of greenhouse gases caused by the additional transportation of backfill material, increased dust emissions and increased radiation exposures.

Processing method

The DEIS indicated that the copper ore from the open pit would be processed by expanding the metallurgical plant to produce up to 350,000 tonnes of refined copper, and by the construction of a new concentrator and hydrometallurgical plant to produce 1.6Mtpa of concentrate for export. A common theme in the public submissions was the desire for the SA Government to require BHPB to undertake smelting and refining in South Australia to maximise the return to the State.

BHPB has indicated that processing all copper concentrate on-site would require both an additional smelter, which would not provide the optimal return on investment, and a different smelting technology due to differing ore composition, which would increase the complexity of its processing operations.

The processing of copper ores to produce a concentrate for off-shore smelting to a refined copper is common industry practice, and a decision made on a commercial basis. The State has a clear interest in ensuring that the project as proposed - which includes both metal refining and the production of concentrate - benefits the public. The economic and social impacts of the proposal are addressed in Chapter 12: 'Effect on communities' of this AR.

Many public submissions on the DEIS recommended that uranium should not be mined and processed. However, the extraction of copper alone was not considered to be economically feasible by BHPB. It is considered that it would not be possible to mine the copper alone, as uranium is intrinsically associated with the copper mineralisation and would be processed along with the copper.

Further, South Australia has a long history of safe and effective uranium mining, operating within a regulatory framework that is widely recognised as being effective and representing world's best practice.

RECOMMENDATION

The AR concludes that the mining method and mineral processing regime proposed by BHPB are acceptable, and consistent with international and national practice. No conditions are considered necessary.

4.4.2 Air quality

4.4.2.1 Issues

The DEIS indicated that the Olympic Dam operation is the only major source of emissions with the potential to affect air quality in the region (DEIS Section 13.3.1). Roxby Downs is the nearest sensitive receptor, which at its closest point is 14km from the existing operations.

Should the expansion be approved, both Roxby Downs and Hiltaba Village would be significantly closer to the proposed expanded operations, being 6km from the southern and south-eastern boundaries respectively of the proposed RSF (DEIS Figure 5.5).

The primary source of process emissions from the existing Olympic Dam operation is the metallurgical plant, with the main pollutant of concern being sulphur dioxide (SO₂). For the expanded operations, the upgraded metallurgical plant and the new metallurgical plant would be the primary source of process emissions, with the main process pollutant of concern also being SO₂. In addition there is potential for significant emissions of fugitive dust during construction activities, and in development of the open pit and formation of the RSF. The discussion below considers SO₂, particulates and other gaseous emissions.

Sulphur dioxide emissions

Existing operation

The main process air pollutant (by mass) emitted from the existing metallurgical plant at Olympic Dam is SO₂, which is primarily derived from the smelting of copper sulphide ore. About 99% of the SO₂ emitted by the smelting process is recovered and converted into sulphuric acid in the acid plant. The remaining 1% of emissions arises from:

- A continuous emission of SO₂ from the acid plant tail gas stack under normal operating conditions (this emission arises as the acid plant is about 99% efficient in converting incoming SO₂ to sulphuric acid; the remaining 1% is emitted);
- Bypass events (due to plant start-up, shut-down, emergency and abnormal situations) when smelter off-gases are vented to the atmosphere without SO₂ removal by the acid plant; and
- Minor sources in the smelter area, which are continuously collected and discharged through the main smelter stack.

The National Pollutant Inventory (NPI) data for the Olympic Dam facility indicates that in 2008-09, which was the most recent year without substantial smelter shutdowns, a total of 3700t of SO₂ was emitted to the atmosphere. This reported level of SO₂ emissions is relatively small when compared to the Mount Isa product smelters and Kalgoorlie nickel smelters, where NPI data indicates that SO₂ emissions in 2009-10 were 180,000t and 27,000t respectively.

As a condition of licence under the *Environment Protection Act 1993*, BHPB is required to continuously monitor SO₂ emissions from the main smelter stack and acid plant tails gas stack and report monthly on the timing, nature and duration of incidents that have led to non-compliance with licence conditions.

In association with this reporting, BHPB is also required to undertake computer modelling using the CALPUFF® model, to estimate the ground-level concentration of SO₂ arising from plant emissions and present these as figures that show 1-hour maximum and 24-hour maximum ground-level SO₂ concentration contours. BHPB's annual Environmental Management and Monitoring Report also shows the same ground-level SO₂ concentrations plus an annual average over a 12-month period.

Figures 13.14 to 13.16 in the DEIS showed the estimated 1-hour maximum, average 24-hour maximum and annual average SO₂ concentrations at Roxby Downs and the current Olympic Dam Village from March 2000 until June 2006, compared with the relevant SO₂ health standards contained in the National Environment Protection (Ambient Air Quality) Measure 1994 (Ambient Air NEPM) and the South Australian Environment Protection Authority (EPA) *Guidelines - Air Quality Impact Assessment Using Design Ground Level Pollutant Concentrations (DGLCs)* (2006) (hereafter referred to as SA EPA DGLC Guidelines).

It is noted that the DEIS (Tables 13.14 and 13.23; also pages 398 and 405) somewhat confuses the SO₂ 1-hour SA EPA DGLC Guidelines criterion and the 1-hour Ambient Air NEPM. The tables refer to a 1-hour SA EPA ambient air quality goal for SO₂ of 450 µg/m³, not to be exceeded once per year; however, this figure is the DGLC for use in computer modelling for new developments, and as such does not have an exceedence criterion. The SA 1-hour ambient air quality goal for SO₂ is the Ambient Air NEPM figure of 0.2 parts per million (570 µg/m³ at 25°C), not to be exceeded more than one day per year.

Figure 13.14 in the DEIS showed that there were two bypass events in 2001 and 2002; modelling predicted 1-hour maximum ground-level concentrations at the Olympic Dam Village of approximately 600 and 650 µg/m³ respectively, exceeding the SA EPA DGLC Guidelines criterion. However, as the Ambient Air NEPM allows exceedence of 570 µg/m³ one day per year, the Ambient Air NEPM goal may not have been breached in these events.

Figures 13.15 and 13.16 in the DEIS showed that the predicted 24-hour maximum and annual average SO₂ concentrations at Roxby Downs and the Olympic Dam Village have been well within the relevant Ambient Air NEPM goals in all of the years presented.

Expanded operation

Figure 5.5 in the DEIS showed that the proposed new metallurgical plant would be constructed about 3–4km to the south-west of the existing metallurgical plant.

The existing smelter would be upgraded to handle additional volumes of copper concentrate, from 600,000 tonnes per annum (tpa) up to 800,000tpa, to produce 350,000tpa of refined copper. Other modifications to the existing metallurgical plant include an additional anode furnace, additional concentrate drying capacity and an additional acid plant. This additional acid plant would be of capacity 1500 tonnes per day (tpd) compared with the existing acid plant capacity of 1800tpd.

The principal SO₂ sources in the new metallurgical plant include a further four new sulphur-burning acid plants each of capacity 3500tpd.

In relation to SO₂ emissions, the DEIS identified that the following mitigation and management measures would be used to minimise gaseous emissions from the expanded existing metallurgical plant and proposed new metallurgical plant:

- The existing main smelter stack would remain at 90m high, although the gas flow rate would increase from 475,000 to 635,000 Nm³/h;
- The existing acid plant tails gas stack and bypass stack would remain at 90m high;
- There would be two stacks serving the four new sulphur-burning acid plants. These two stacks, and also the stack for the additional acid plant at the existing metallurgical plant, would be 50m high. All five new acid plants would be similar in design and operation to the existing acid plant; and
- A gas cleaning system similar to that installed for the existing anode furnaces would be installed on the additional anode furnace. As is currently the case, in the event of a gas cleaning system failure, these furnaces would stop processing to minimise further gaseous emissions.

Other emissions

A number of other air pollutants are currently emitted from point sources at Olympic Dam, as outlined in the DEIS (Section 13.3.3), including oxides of nitrogen (NO_x, expressed as equivalent nitrogen dioxide [NO₂]), carbon monoxide (CO), lead (Pb) and fluoride (as HF). These emissions arise primarily from the metallurgical plant and associated operations, and are emitted as gases via stacks with associated pollution control equipment.

Emissions elsewhere include carbon disulphide (CS₂), which is emitted from the decomposition of xanthates within the flotation circuit, and Volatile Organic Compounds (VOCs) and Polycyclic Aromatic Hydrocarbons (PAHs), which are emitted primarily from the storage and usage of hydrocarbons such as diesel (SEIS Section 14.1.3). Gaseous pollutants are also released from mine ventilation raise bores and quarrying operations.

A new gas-fired combined cycle gas turbine (CCGT) power station with a capacity of 600MW, utilising gas from Moomba, is proposed to be built to the south of the new metallurgical plant (DEIS Figure 5.39). The CCGT stack height has been modelled at 35m. The primary emission from the CCGT would be NO_x.

Combined, these proposals would result in a net increase in point source emissions of all of the above pollutants. The following information has been provided in the DEIS and SEIS:

- Tables 13.18 and 13.19 in the DEIS provide summaries of proposed point source emissions and averaged emission rates;
- Table 13.23 in the DEIS provide the results of modelling of DGLCs for equivalent NO₂, CO, Pb, HF and CS₂ and contour plots are provided for each (Figures 13.20b, c, d, e, f); and
- Table 14.10 and Figure 14.7 in the SEIS provide details of predicted DGLCs and contours for selected VOCs and PAHs.

Based on the modelling details provided in the Final Environmental Impact Statement (FEIS), none of the pollutants discussed in this section are predicted to exceed applicable air quality criteria in the locations of Hiltaba Village and Roxby Downs township.

Dust and particulates

The DEIS stated that minimal dust is generated by the current underground mining operation, with some limited quantities of dust being generated by the extraction of limestone from the on-site quarry. Particulate matter, saline aerosols and radon (and radon decay products) are also released from mine ventilation raise bores and quarrying operations. Issues relating to radon gas and radon decay product emissions are specifically included in the Radiation section (4.4.9) of this chapter.

Data included in the DEIS indicated that dust storms are a naturally occurring meteorological phenomenon, and that Roxby Downs is affected by an average of two dust storms per year.

The DEIS indicated that the expanded processing plant would result in additional emissions of particulates, and that there would be potential for significant fugitive dust emissions to be generated during construction activities for the new metallurgical plant and TSF, and in development of the open pit and RSF. Fugitive dust emissions are estimated and modelled in the DEIS Appendix L2.8.

Modelling of fugitive dust was undertaken for total suspended particulate (TSP); particulate matter with an aerodynamic diameter less than 10 microns (PM₁₀); particulate matter with an aerodynamic diameter less than 2.5 microns (PM_{2.5}); and dust deposition. The resulting dust contours are shown in the DEIS Figures 13.18a to 13.18d. It is noted that mitigation measure effectiveness factors and a pit retention factor were applied to the fugitive dust emission estimates (DEIS Appendix L Tables L2.10 to L2.24).

The results indicate that the predicted dust levels would generally comply with ambient air quality goals, though 24-hour levels of PM₁₀ would exceed the ambient goal at Roxby Downs on 10 days per year, and Hiltaba Village for five days per year, compared with an allowable five exceedences in the Ambient Air NEPM goals. It is stated (DEIS page 403) that operational controls may be required to maintain concentrations of PM₁₀ dust within applicable compliance limits during the predicted five to ten days per annum of worst-case weather conditions.

Vegetation impacts

The DEIS indicated that dust, saline aerosols, SO₂ and other emissions from the mine and processing operations at Olympic Dam could have a compounding impact on native vegetation (DEIS Section 15.5.9) and that the impact of emissions on vegetation might reduce the habitat values of ecosystems for some animals. The DEIS noted that the effects of various emissions on plants are complex, and monitoring has established a footprint over which changes in the flora community and effects on plant health could be measured.

4.4.2.2 BHPB EM Program and commitments

Point source emissions

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 3.3:

- **Objective:** No adverse impacts to public health as a result of point-source emissions from BHPB's expanded operations at Olympic Dam.
- **Criteria:** Annual average SO₂ concentration of less than 57 µg/m³, 24-hour average of less than 228 µg/m³ and 1-hour average of less than 450 µg/m³ at sensitive receptors. Also annual average operational-contributed PM₁₀ concentration of less than 30 µg/m³, and a 24-hour average of less than 50 µg/m³ at sensitive receptors.
- **Management/monitoring plans:** No specific management plans are currently required. The existing Airborne Emissions Monitoring Program would be reviewed and updated where required.
- **Commitments:**
 - Sulphur dioxide (SO₂) emissions – to use real-time monitoring of sulphur dioxide in the smelter to assess the continuing adequacy and effectiveness of the ventilation system (SEIS Table 2.1 Commitments – page 59); and
 - Impacts from air emissions other than dust or sulphur dioxide – to ensure that emissions from the expanded operation do not adversely impact the health and wellbeing of nearby communities by adhering to relevant emissions criteria, and cooperating with the SA Government in the development of future emission limits as necessary to reflect the increasing body of knowledge surrounding the health impacts of pollutants (SEIS Table 2.1 Commitments – page 55).

Fugitive particulate emissions

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 3.1:

- **Objective:** No adverse impacts to public health as a result of fugitive particulate emissions from BHPB's expansion activities at Olympic Dam.
- **Criteria:** Annual average operational contributed PM₁₀ concentration of less than 30 µg/m³, and a 24-hour average of less than 50 µg/m³ at sensitive receptors.
- **Management Plan:** A (new) Dust Management Plan would be developed to record and monitor the following process of applying operational control:
 - A network of real-time dust monitors, which may include TSP, PM₁₀ and PM_{2.5} monitors, around the mining operation, at the sensitive receivers, and at intervals between these receivers and the mining operation. These would be integrated within the mining process control system as an early warning of rising particulate concentrations at the sensitive receivers;
 - A real-time meteorological system, integrated with the real-time dust monitors, which would permit mining operations to be planned and adjusted to ensure the particulate criteria would not be exceeded at the sensitive receivers; and
 - Additional monitoring sites would be placed north, east and west of the operation to determine the concentration of particulates contributed by the expanded operation (DEIS 13.3.5).
- **Commitments:** To manage dust from mining operations (SEIS Table 2.1 Commitments – page 57–58) by:
 - Meeting the National Environment Protection (Ambient Air Quality) Measure (NEPM, i.e. PM₁₀ and PM_{2.5}) ground-level dust concentration (applied to operational dust contribution at Roxby Downs and Hiltaba Village) through design and operational management controls of mining operations at Olympic Dam;
 - Building good-quality haul roads and maintaining them with regular applications of saline water and/or the application of suitable dust suppressants; and
 - Installing a real-time dust and meteorological monitoring system to predict dust concentrations which would provide information for operational control of dust.

4.4.2.3 Assessment

Sulphur dioxide

The emissions inventory presented in the DEIS predicted that the total load of SO₂ emissions from the expanded operation would be nine times that of the existing operation. The air dispersion modelling undertaken (DEIS Figure 13.20a; SEIS Appendix G Figure G1.5) shows the predicted maximum 1-hour, maximum 24-hour and annual average SO₂ ground-level concentrations, compared to the 1-hour SA EPA DGLC Guidelines criterion and the 24-hour and annual Ambient Air NEPM goals.

These figures showed that in the worst-case year, the contour of the SA EPA DGLC Guidelines criterion for SO₂ (450 µg/m³ 1-hour maximum average) lies across Roxby Downs (i.e. northern areas of Roxby Downs within the contour are predicted to slightly exceed the criterion). The DEIS also states that the next highest predicted 1-hour maximum SO₂ concentration at Roxby Downs was around 315 µg/m³, which is within the SA EPA DGLC Guidelines criterion.

In relation to the predicted 24-hour maximum and annual average SO₂ concentrations, the DEIS indicated that the Ambient Air NEPM goals would be easily met in Roxby Downs and Hiltaba Village in the worst case year.

RECOMMENDATIONS

The Environment Protection Authority's DGLC Guidelines 1-hour SO₂ criterion has been met for all but the worst case modelled scenario at the northern areas of Roxby Downs township, and the AR concludes this is acceptable. As part of its EPA licence review, BHPB should review the final design of the efficiencies of the new acid plants and stack heights, to comply with the SA EPA DGLC Guidelines in all parts of Roxby Downs township and also at Hiltaba Village. Accordingly the following conditions are recommended in relation to the management and monitoring of SO₂:

- The proponent must prepare and implement an Air Quality Management and Monitoring Program (AQMMP), for approval by the Indenture Minister with the concurrence of the EPA, that incorporates the following:
 - A Process Emissions Management Plan (including point and diffuse source emissions) prior to the commencement of processing; and
 - An Air Quality Monitoring Program, linked to the above management plan.
- The proponent must ensure the following criteria are contained in its AQMMP:
 - Ground-level SO₂ concentrations at Roxby Downs and Hiltaba Village derived from operational sources at Olympic Dam must not exceed the following criteria:

POLLUTANT	AVERAGING PERIOD	GROUND LEVEL AIR QUALITY CRITERIA
Sulphur dioxide (SO ₂)	1-hour	450 µg/m ³
Sulphur dioxide (SO ₂)	24-hour	228 µg/m ³
Sulphur dioxide (SO ₂)	Annual	57 µg/m ³

- The proponent must ensure the following requirements are addressed in its AQMMP:
 - The installation of four meteorological and air quality monitoring stations to be located in Roxby Downs, Hiltaba Village, and north and west of the Olympic Dam mine site and processing operations;
 - Each meteorological station to be sited and designed in accordance with relevant Australian standards and be capable of continuously monitoring wind speed and direction, temperature, and humidity, and at least one station to also monitor solar radiation, atmospheric pressure, rainfall and evaporation;
 - The meteorological and air quality monitoring stations to have real-time data download to a central location (preferably at Olympic Dam) so that necessary pre-emptive or responsive action can be taken to deal with likely or actual exceedences of ground-level air quality criteria arising from operational sources;
 - Real-time radon (or radon decay product) monitors to be located at each meteorological and air quality monitoring stations to better measure radon transport from the mine and mineral processing areas to Roxby Downs and Hiltaba Village;
 - Continuous monitoring of SO₂ concentrations must be provided for the main smelter stacks and the tail gas stack exit of each individual acid plant; and
 - Detailed information on the proposed pollution management measures to reduce SO₂ emissions during acid plant start-up, shutdown and abnormal conditions, and abnormal smelter conditions.
- Prior to the operation of additional metallurgical plant the proponent must install and operate monitoring stations to continuously monitor SO₂ at Roxby Downs and Hiltaba Village.

The AR also recommends the following notes to BHPB:

- The proponent in preparing the AQMMP should consider providing relevant detail on:
 - The detailed siting and design of meteorological and air quality monitoring stations;
 - Process management appropriate to air quality emissions;
 - Updated air emissions inventory for point, diffuse and fugitive dust emissions;
 - Air pollution control equipment and stack and vent configuration;
 - Point source air emissions test facilities and stack testing program to demonstrate compliance with the AQMMP;
 - Incident responses to exceedences or particular climatic conditions;
 - Community consultation and engagement;
 - Engagement with local health services for identifying and responding to any relevant health impacts (e.g. asthma management protocols); and
 - The continuing review of the literature on the impact of emissions to inform both monitoring and response.
- BHPB’s licence under the *Environment Protection Act 1993* would likely be amended to encompass changes that would be necessary to accommodate the expansion project.

Other emissions

The AR concurs with the assessment provided in the DEIS that the operations at Olympic Dam are the only significant point source air emissions, other than SO₂, in the context of the broader expansion proposal.

With respect to the information provided in both the DEIS and SEIS, it is considered that potential impacts arising from the other identified point source and diffuse emissions (NO₂, CO, HF, CS₂, Pb) should be successfully managed to the applicable standards administered by the EPA, including at the settlements of Hiltaba Village and Roxby Downs.

RECOMMENDATION

The AR recommends the following condition:

- The proponent must ensure the following criteria are contained in the AQMMP:

Ground-level air pollutant concentrations at Roxby Downs and Hiltaba Village derived from operational sources at Olympic Dam must not exceed the following criteria for design of the expansion:

POLLUTANT	AVERAGING PERIOD	GROUND-LEVEL AIR QUALITY CRITERIA
Nitrogen dioxide (NO ₂)	1-hour	158 µg/m ³
Carbon monoxide (CO)	1-hour	29 mg/m ³
Lead (Pb)	Annual	0.5 µg/m ³
Fluoride (as HF)	24-hour	2.9 µg/m ³

Dust and particulates

Modelling of fugitive dust was undertaken for TSP, PM₁₀, PM_{2.5}, and dust deposition, and the resulting dust contours are shown in the DEIS Figures 13.18a to 13.18d. Mitigation measure effectiveness factors and a pit retention factor were included in the modelling (DEIS Appendix L Tables L2.10 to L2.24).

The results indicated that the predicted dust levels in the modelling would generally comply with ambient air quality goals, however the predicted maximum 24-hour PM₁₀ ground-level concentrations (DEIS Figure 13.18b and SEIS Appendix G Figure G1.2) showed that in the worst case year the contour of the 24-hour PM₁₀ Ambient Air NEPM goal of 50 µg/m³ would extend to central Roxby Downs and beyond Hiltaba Village.

The DEIS stated (Section 13.3.5) that the maximum 24-hour PM₁₀ concentrations were predicted to exceed the Ambient Air NEPM goal at Roxby Downs on 10 days a year and at Hiltaba Village on five days a year, during the worst-case year. The Ambient Air NEPM permits up to five exceedences of the 24-hour PM₁₀ goal per year.

In order to minimise the potential for adverse health impacts associated with particulate exposures, BHPB has committed to manage operationally contributed particulate concentrations to levels as low as reasonably practicable ('ALARA') and no greater than the following criteria (SEIS Table 14.6):

PARTICULATE SIZE FRACTION	AVERAGING PERIOD	AMBIENT AIR QUALITY CRITERIA (µG/M ³)
TSP	Annual ¹	90
	Deposition (g/m ² /month) ²	4
PM ₁₀	24-hour	50
	Annual ³	30
PM _{2.5}	24-hour	25
	Annual	8

¹ Non-NEPM standard – rescinded NHMRC Goal

² Non-NEPM standard – 'Fallout' is not part of TSP

³ Not a NEPM standard

It is stated (DEIS Section 13.3.5) that operational controls may be required to maintain concentrations of PM₁₀ dust within applicable compliance limits during the predicted 5 to 10 days per annum of worst-case weather conditions. The AR considers that given mitigation measure effectiveness factors and a pit retention factor are already included in the modelling, dust management measures would need to be both comprehensive and effectively managed.

The AR also considers that detailed information on the proposed fugitive dust management methodologies would need to be provided to the EPA as part of the licence revision process for the expansion.

In the absence of a South Australian-based criterion for an annual average PM₁₀, BHPB has proposed using a New South Wales criterion of 30 µg/m³. The AR considers that for reporting purposes, the existing national standards provide sufficient information to gauge operational performance, and that the annual average PM₁₀ criterion adds little additional value to understanding the impacts of particles on residential areas.

BHPB has committed to the installation of a real time dust and meteorological monitoring system at Olympic Dam, which would provide information for the operational control of dust. It should be noted that 'Olympic Dam' is used in the broader context of the mine and would include Roxby Downs township and Hiltaba Village. This is considered an achievable and essential component of the proposed Dust Management Plan.

RECOMMENDATION

The AR considers that the proposed configuration of monitoring stations (DEIS Section 13.3.5) is a practical approach to facilitate ready discrimination between operational and ‘natural’ particulate events, and thereby provide for evaluation of performance in managing operational particulate emissions and off-site impacts.

The AR also considers that the criteria proposed in the SEIS (Table 14.6, reproduced above) consistent with the *National Environment (Ambient Air Quality) Protection Measure (2003)*, are adequate for the protection of the health of residents at Roxby Downs and the proposed Hiltaba Village.

The AR recommends the following conditions:

- The AQMMP must incorporate the following:
 - A Dust Management Plan; prior to the commencement of open pit mining;
 - An Air Quality Monitoring Program (AQMP), linked to the above management plan.
- The proponent must ensure the following criteria are contained in its AQMMP:
 - Ground-level PM₁₀ and PM_{2.5} dust concentrations at Roxby Downs and Hiltaba Village derived from construction and operational sources at Olympic Dam must not exceed the following criteria:

PARTICULATE SIZE FRACTION	AVERAGING PERIOD	GROUND LEVEL AMBIENT AIR QUALITY CRITERIA
PM ₁₀	24-hour	50 µg/m ³
PM _{2.5}	24-hour	25 µg/m ³
	Annual	8 µg/m ³

- The proponent must ensure the following requirements are met in its AQMMP:
 - The installation of four meteorological and air quality monitoring stations to be located in Roxby Downs, Hiltaba Village, and north and west of the Olympic Dam mine site and processing operations;
 - Each meteorological station to be sited and designed in accordance with relevant Australian standards and be capable of continuously monitoring wind speed and direction, temperature, and humidity, and at least one station to also monitor solar radiation, atmospheric pressure, rainfall and evaporation;
 - Each air quality monitoring station to be sited and designed in accordance with relevant Australian standards for the continuous measurement of PM₁₀ and PM_{2.5};
 - The meteorological and air quality monitoring stations to have real-time data download to a central location (preferably at Olympic Dam) so that necessary pre-emptive or responsive action can be taken to deal with likely or actual exceedences of ground-level air quality criteria arising from operational sources;
 - The meteorological and air quality monitoring system to be capable of differentiating the contribution that background TSP, PM₁₀ and PM_{2.5}, and operationally generated TSP, PM₁₀ and PM_{2.5} make to total TSP, PM₁₀ and PM_{2.5} concentrations over short periods (hourly and daily); and
 - Real-time radon (or radon decay product) monitors to be located at each meteorological and air quality monitoring stations to better measure radon transport from the mine and mineral processing areas to Roxby Downs and Hiltaba Village.

The following note is also recommended:

- The proponent in preparing the AQMMP should consider the following, in relation to preparing the Dust Management Plan (as part of the AQMMP) providing specific detail on:
 - pre-emptive particulate controls such as dust suppression on haul roads and conveyors, and best practice measures for minimising dust generation from unloading points, material stockpiles, crushers, rock storage facilities, and other potential fugitive dust emission sources; and
 - identification of remedial action at specific operational dust sources in response to actual or impending exceedences of the 24-hour average ground-level PM₁₀ and PM_{2.5} air quality criteria referenced above, as determined from an air quality monitoring program established in accordance with an approved AQMP.

The notes recommended under AR Section 4.4.2.3 in relation to SO₂ are considered relevant to meeting the above condition about dust and other particulates.

Vegetation impacts

Dust, saline aerosols, SO₂ and other emissions from the operations at Olympic Dam could have a compounding impact on native vegetation (DEIS Section 15.5.9). The DEIS noted that the effects of various emissions on plants are complex, and monitoring has established a footprint over which changes in the flora community and effects on plant health could be measured.

The DEIS reported that monitoring in 2006 established that an area of 2670ha surrounding the existing metallurgical plant (extending up to 7.5km from the plant) showed detectable foliage damage attributable to gaseous emissions. For most sulphide ore smelting operations, SO₂ is the principal air pollutant of concern in terms of vegetation impacts, however saline emissions from certain raise bores at Olympic Dam show very clear localised impacts, and fluoride can affect plants at very low levels. It is also noted that SO₂ emissions at Olympic Dam are relatively low compared with other major smelters (DEIS Figure 15.8).

There would be a predicted nine-fold increase in SO₂ emissions associated with the expanded operations, and thus SO₂ emissions could be a more significant factor in potential flora impacts for the expanded operation (DEIS Section 15.5.9). However, the DEIS notes that direct extrapolation is not appropriate as the effect is non-linear.

Section 15.5.9 of the DEIS stated: *“While the extrapolations for measurable effects to plants from gaseous emissions are not definitive, the available information indicates that the proposed expansion has the potential to increase the area over which impacts to vegetation may occur, and that this impact would be largely confined to the expanded SML. The residual impact is therefore categorised as moderate, reflecting a long-term impact to a common receiver.”*

The AR notes that BHPB would continue monitoring the effect of emissions on vegetation (DEIS Section 15.5.9).

RECOMMENDATION

Accordingly, the following condition is recommended:

- BHPB must undertake a research study to determine the threshold levels for effects of SO₂ on flora of the region. The scope of the research study must be agreed with the Indenture Minister within twelve months of the date of this decision.

RECOMMENDATIONS

While the undertaking to develop a Dust Management Plan by BHPB is acknowledged, and is appropriate for specific project components (such as the construction of the landing facility), it is considered that the potential health and environmental impacts of airborne emissions from an expanded mining operation would extend further than those arising solely from fugitive dust, and that management of these impacts would be a continuing and iterative process following commissioning and operation.

Accordingly, the AR considers that a key component of the EMP should be a broader Air Quality Management and Monitoring Program (AQMMP) as referred to in the recommended conditions above, that covers all relevant emissions during commissioning and operation, including process point source and diffuse emissions, consistent with the company goal of “zero harm”. The AR recommends the following notes to BHPB:

- The proponent’s licence under the *Environment Protection Act 1993* and the *Radiation Protection and Control Act 1982* would likely be amended to encompass changes that would be necessary to accommodate the expansion project.
- A requirement to implement, report on and update an approved AQMMP would likely be incorporated into BHPB’s licence under the *Environment Protection Act 1993* to conduct activities of environmental significance at Olympic Dam.
- A requirement to ensure compliance with the ground-level air quality criteria listed above would likely be incorporated into BHPB’s licence under the *Environment Protection Act 1993* to conduct activities of environmental significance at Olympic Dam.
- It may become a requirement of the licence issued under the *Environment Protection Act 1993* for periodic independent auditing of the AQMMP.
- A requirement to report on radon (or radon decay product) monitoring results for each of the meteorological and air quality monitoring stations would likely be a condition of the licence approval under the *Radiation Protection and Control Act 1982* for expanded mining and milling of radioactive ore at Olympic Dam.
- All particulate data to be reported with attribution of results, where clear evidence is available, to broad-scale natural events such as dust storms that might cause exceedences of the above standards. For other events, contributions from the mine/processing site would also need to be reported. The mechanism of apportioning particulates to mine/processing site will need to be resolved by BHPB in consultation with the EPA prior to any major earthworks associated with the expansion project commencing at Olympic Dam.

4.4.3 Terrestrial impacts

A comprehensive assessment of potential impacts on terrestrial ecology relevant to the whole EIS project area is covered in Chapter 13: 'Effects on the environment' of this AR, including:

- Soils;
- Native vegetation impacts;
- Impacts on threatened ecological communities;
- Impacts to State and Commonwealth "listed" flora and fauna;
- Introduction and/or spread of weeds;
- Impacts on threatened ecological communities; and
- Feral and abundant species.

Where the terrestrial impacts are considered to be specific to the mine and processing plant only, an assessment has been provided in this section.

4.4.3.1 Issues

Site contamination

The DEIS identified the potential for risks associated with the handling, storage, transport and use of significantly increased volumes of chemical substances and the potential for contaminated stormwater at the Olympic Dam site, as a result of flooding through the SML.

The chemical substances include diesel and other hydrocarbons, sulphur, acids, reagents and other chemicals (DEIS Appendix U, Section 2.1). While this has been the case throughout the 25 years of operation to date, the key difference between the current operation and the proposed expansion primarily relates to the significantly larger volumes of materials needing to be managed in many areas (DEIS Section 22.6.8). The potential for polluted stormwater to cause impacts at the site, generated from areas including the metallurgical plant, hardstand areas, haul roads and the rock storage facility, is also highlighted in the DEIS (Section 10.5.4).

The DEIS and SEIS referred to a number of measures to be implemented to manage site contamination, including:

- Ensuring all bulk storages of hazardous liquids comply with applicable standards and legislation for bunding. As a minimum SA EPA Guidelines for bunding would be applied (DEIS Section 22.6.8 and SEIS Section 5.4.6);
- Ensuring general deliveries of chemicals are managed at the stores warehouse under the control of trained personnel (DEIS Section 22.6.8);
- Requiring contractors to comply with standard procedures relating to the storage, use and disposal of chemical substances (DEIS Section 22.6.8);
- Ensuring collected stormwater is controlled within defined management areas with no discharge of stormwater permitted from the SML (SEIS Section 10.4);
- Ensuring current Olympic Dam spill management and reporting procedures are implemented and updated as required for the expansion (SEIS Section 10.4); and
- Ensuring any identified potentially contaminated soils are assessed and remediated post-closure (DEIS Section 10.5.4 and 23.8.3).

Impacts on vulnerable listed species reintroduced to Arid Recovery

Arid Recovery, located partially within and to the north of the current Olympic Dam SML, was established in 1997 to facilitate restoration of arid zone ecosystems and to monitor interactions between threatened species and a large scale mining operation (DEIS 15.3.10). 'Arid Recovery and associated threatened fauna' is listed as one of the main environmental values within the EIS study area (DEIS Section 15.4.1).

The DEIS assessed the impact of the proposed expansion on a number of protected fauna species which have been re-introduced to, or have self-established within, Arid Recovery since it was established. These are the Greater Stick-nest Rat, Burrowing Bettong, Greater Bilby, Western Barred Bandicoot, Numbat, Woma Python, Spinifex Hopping-mouse and Plains Rat. The main impacts assessed were behavioural impacts from noise and light, and indirect impacts to fauna from the impact of mine dust and other emissions on the vegetation within Arid Recovery.

The DEIS concluded that indirect impacts of mine dust and emissions posed a 'credible risk' to protected fauna species within the Arid Recovery. As a means of managing these impacts, BHPB recently extended the northern boundary of Arid Recovery and, as a result of this mitigation measure, assessed the overall residual impact to fauna as 'moderate' (DEIS Table 15.7).

In discussions regarding the impacts of noise and light on protected fauna species within Arid Recovery (DEIS Section 15.5.9 and Appendix N12), it was concluded that noise and lights effects would reduce habitat value within at least 2km of expanded mining operations. However, it was considered that the recent northerly extension to Arid Recovery would provide an opportunity for species to move to the north, which would lessen the impact from noise to a degree, and the use of screens and directional lights would mitigate the impact of increased lighting from expanded mining operations. In its consideration of the effectiveness of proposed mitigation measures, BHPB concluded the residual impact to these species from noise and light to be 'high' for the protected fauna species within Arid Recovery, reflecting a long-term impact to a sensitive receiver. The DEIS indicated that this issue would be an area of management focus for the proposed expansion (DEIS Sections 15.5.9 and 15.5.10).

Impacts of the TSF on fauna and migratory species

The DEIS stated that an objective of the expansion project is to protect listed threatened species (DEIS, Appendix U). It identified that the existing Tailings Retention System (TRS), which consists of 400ha of Tailings Storage Facility (TSF) and 133ha of evaporation ponds, attracts avian fauna due its resemblance to natural water bodies and the limited number of water bodies in the arid environment. The principal concern is the decant water in the TSF which is toxic, and consequently significant consumption of, or extended contact with the water may result in fauna mortalities.

In response to impacts of the TRS on fauna, monitoring, management and public reporting of fauna mortalities associated with the TRS commenced in 1996. Monitoring has determined mortalities from 49 bird species, have been reported, including six migratory waterbird species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, Cwlth) and four bird species listed under the *National Parks and Wildlife Act 1974*. Also reported are mortalities of flocking waterbirds such as the Banded Stilt. The DEIS noted few mortalities for flocking bush birds. In addition, mortalities for seven species of mammal and eight species of reptile and amphibian have been recorded and publicly reported by BHPB.

Several management measures have been trialled over the years (fencing, gas cannons, strobe lights) with varying degrees of success (BHP Billiton 2005b). BHPB continues to investigate wildlife deterrent devices and systems (refer to AR section 4.4.3.2 below).

The proposed expansion provides an opportunity to address the issue of bird mortalities at the TRS through improved design. A summary of the design modifications proposed to reduce the risk to birds from the TRS were provided in the DEIS Sections 5.5.6 and 15.4.2. These are:

- Reducing the volume of liquor stored in the TSF by modifying the expanded metallurgical plant design to increase the volume of liquor recycled;
- Avoiding new areas of open liquor (the primary attractant) by:
 - Not building new evaporation ponds;
 - Constructing larger TSF cells to increase evaporation rates of liquor;
 - Restricting fauna access to liquor by collecting liquor not evaporated from beaches into a central decant area and covering the decant area with netting or similar; and
 - Restricting access to open liquor on the 60ha stormwater/tailings water balance ponds by covering them with netting or similar.

This approach in TSF design is expected to reduce the attractiveness of the area, by removing large open water bodies in a dry landscape, and only exposing a less attractive wet, muddy surface. However this theory is yet to be tested (DEIS, Appendix N11.5) and would require rigorous monitoring.

The DEIS also introduced the potential to transfer liquor from the existing evaporation ponds to the new TSF cells, substantially reducing the area of open liquor accessible to birds over the longer term. This approach is considered feasible given the total area of the proposed TSF cells when compared to the volume of liquor in the existing evaporation ponds.

Impacts to waterbird species

The DEIS assessed that the net effect of these design changes to potential impacts on waterbird species would be an improvement over the longer term. The primary reason is the elimination of all new open liquor ponds and the eventual reduction of existing evaporation pond liquor, despite the increased reflective area of wet beaches possibly attracting more birds.

Impacts to shorebirds and other species

Two significant changes to the TSF design – a 3300ha increase in wet beach area containing small rivulets, and sheet flow of acid tailings – may result in increased mortalities of shorebirds and other species attracted to the tailings beaches area. BHPB considered that the creation of a rocky edge on the central decant pond, to eliminate the shore habitat on the new TSF cells, would lessen the expected mortality increase to a degree. With these proposed changes, the DEIS concluded that the risk of mortalities to common waterbirds would be expected to be ‘moderate’, and ‘high’ on two species of threatened or rare waterbirds. Due to any impact likely to affect only a small percentage of the local population, local viability of these species would not be expected to be adversely affected.

The Banded Stilt has been singled out as a waterbird species for further consideration because it is a species which is known to flock in the region in the thousands, so may be at occasional risk of large numbers of mortalities from the TSF. The DEIS assessed that there was a remote chance that a large flock may land on the tailings ponds, resulting in a significant one-off impact on the species’ population. A worst case scenario was that a potential loss of up to 15% of the species’ population could occur should a large flock be attracted to the TSF during a breeding event (DEIS 15.5.7).

Results of a risk assessment discussed in the DEIS determined the risk to the Banded Stilt population to be ‘high’, which is considered ‘tolerable’ under the Australian Risk Standards with ongoing management and research occurring to reduce the risk.

Impacts on Yarra Wurta Springs and resident Lake Eyre Hardyhead population

The DEIS recognised the Lake Torrens saline springs, in particular the Yarra Wurta Springs, as an environmental value to be managed (Appendix U, ID 1.4). In this regard, the DEIS considered the potential for the project to impact on the groundwater dependent ecosystem of the Yarra Wurta Spring group, and thus the resident Hardyhead population, located at the northern end of Lake Torrens.

While no listed species were identified, the DEIS contained a discussion of the genetic significance of the Hardyhead population. The AR considers that although there are two separate populations with some genetic differences, research has shown that they are not different species or subspecies. Further, there were no significant features of the microbial mats (that are the precursor to stromatolites) and fossilised stromatolites.

An assessment of the impacts of groundwater drawdown from the construction of the mine pit and extraction of groundwater from the Motherwell saline wellfield was undertaken in both the DEIS and SEIS. While the DEIS questioned the origin of the groundwater feeding the springs, the assessment of impacts assumed that the spring sources groundwater from the Stuart Shelf (DEIS Section 12.6.4). A groundwater risk assessment presented in the SEIS (Section 12.1.4) assessed the risk to the springs as moderate, reflecting a long-term impact on a common receiver.

Discussion regarding potential impacts to the springs provided in the both the DEIS and SEIS is summarised as follows:

- Drawdown from the mine is not expected to extend as far as the springs, however modelling of a worst case scenario indicated that impacts on the Yarra Wurta Spring complex were conceivable, but may only materialise after a long time, more than 500 years post closure. Drawdown at the spring has been modelled at up to 4m, however, BHPB have stated that buffers not included in the modelling, such as structural controls between the mine and the spring, storage buffering effects from Lake Torrens, and groundwater levels around the lake's edge (approximately 2m above spring water levels), may significantly reduce the predicted drawdown, and were not included in the worst case scenario modelling. In addition, the spring complex is believed to be fed from the north-east rather than the westerly direction of the mine (SEIS Section 12.1.4);
- Drawdown modelling included impacts from the Motherwell saline wellfield where extraction from the Motherwell saline wellfield would be expected to occur during the construction phase of the mine. While the outcome of modelling indicated that the drawdown would not extend beyond 25km and therefore would not affect the Yarra Wurta Springs, BHPB has made a commitment in the SEIS to monitor drawdown at the springs for the first six years, to determine whether ongoing extraction could continue without affecting the Yarra Wurta Springs. The residual impact to the spring and the Lake Eyre Hardyhead population was assessed as negligible in the DEIS; and
- Populations of Lake Eyre Hardyhead, microbial mats, and fossilised stromatolites at the Yarra Wurta Springs are not considered to be of significant scientific interest (DEIS Section 15.6 and Appendix N8).

4.4.3.2 BHPB EM Program and commitments

Site contamination

BHPB has set the following objectives and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 2.1:

- **Objective:** No significant contamination to soils, surface water or groundwater as a result of the storage, transport and handling of hazardous substances by BHPB during expansion activities.
- **Criteria:** No lasting significant contamination arising from uncontrolled loss of chemicals to the natural environment (area to be defined).
- **Management Plan:** indicated that the current management plans relating to emergency response (spill management) and hazardous materials would be updated to include the expansion, including the new components.
- **Commitments:** Transport, handling and storage of fuels and other hazardous material in the Special Mining Lease (SML) would be in accordance with the relevant state and Australian statutory requirements. As a minimum, the South Australian Environmental Protection Authority standards would be used, which require bund sizes and volumes to be 120% of the net capacity of the largest tank and 133% for flammable material (SEIS Table 2.1 Commitments, page 55).

Impacts on vulnerable listed species reintroduced to Arid Recovery

BHPB has set the following objectives and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.1:

- **Objective:** No significant adverse impacts to listed species (South Australian, Northern Territory, Commonwealth) populations in the expansion project area as a result of BHPB's construction activities.
- **Criteria:** Not applicable to Arid Recovery Area.
- **Commitments:** Concerning impacts of the expanded operation on Arid Recovery (SEIS Table 2.1 Commitments, page 58):
 - Arid Recovery would continue to be supported by:
 - Maintaining a distance of 500m between the RSF and Arid Recovery;
 - Ongoing financial support; and
 - Scientific, managerial and professional support by BHPB for Arid Recovery;
- BHPB commits, in principle, to supporting relevant research, including establishing a regional hub for natural resources and environmental management and research. The cost of the commitment is estimated to be approximately \$1.2m over three years.

Impacts of the TSF on fauna and migratory species

BHPB has set the following objectives and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.5:

- **Objective:** No significant adverse impacts to listed fauna (South Australia, Commonwealth) as a result of BHPB's expanded operations.
- **Criteria:** 1a) No significant adverse impact to listed migratory species; and 1b) No significant adverse impact on an important population of Banded Stilt.
- **Management Plans:** TSF Management Manual – the existing operating manual for the TSF would be reviewed to ensure expansion requirements were incorporated.
- **Commitments:** Concerning TSF and wildlife access (SEIS Table 2.1 Commitments, page 60):
 - The proposed expansion of the TSF would minimise impacts on birds, by:
 - Not building additional evaporation ponds;
 - Covering the central decant pond of each expansion TSF cell with netting or similar; and
 - Covering the balancing ponds with netting or similar

- BHPB is committed to ongoing avian research to inform management measures and controls, improve monitoring methods, to assess environmental performance, and to enable continual improvement. Research into bird deterrents would continue, including:
 - Investigation into more advanced radar;
 - Trials of sound identification software for use as part of an on-demand deterrent system; and
- Collaborative research with Deakin University and the SA Department of Environment and Natural Resources into aversive stimuli and bird movements. The total value of this research study is approximately \$5m over four years, and includes:
 - Research spectral sensitivity and flicker sensitivity to light of bird species found on the TRS;
 - Research, build and test prototype light sources, with the aim of being aversive to birds on the TRS;
 - Spatial, temporal and daily activities of birds in relation to the TRS and natural water bodies; and
 - Assessment of environmental, weather and celestial variability can predict spatial and temporal patterns of movement.

Impacts on Yarra Wurta Springs and resident Lake Eyre Hardyhead population

BHPB has set the following objectives and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.4:

- **Objective:** No significant adverse impacts to groundwater dependent ecosystems as a result of drawdown associated with BHP Billiton's expansion activities.
- **Criteria:** No significant decline in groundwater flow rate at Yarra Wurta Springs.
- **Management Plans:** Existing Water Management Plan would be revised for the expansion.
- **Commitments:** Water supply for the proposed expansion (SEIS Table 2.1 Commitments, page 52)
 - BHPB will provide the South Australian Government with a monitoring program, including contingency measures, for the proposed abstraction of groundwater from the Motherwell wellfield.

4.4.3.3 Assessment

Site contamination

A degree of localised potential pollution is considered almost inevitable with any development of this scope, scale and nature. The issue is to what extent the inherent risks can be managed, and the degree of rigour which is applied to the post-closure assessment and remediation process at the site(s). BHPB has characterised the potential for residual impact of site contamination as low for the storage of chemicals, fuel and collected stormwater (DEIS Section 10.5.4). Assumptions have been made based on the implementation of adequate containment (including bunding), contingency training of relevant personnel in spill management, and implementation of the requirements of an Environmental Management Program (DEIS Appendix U).

The AR considers the key expansion activity that poses the greatest potential for site contamination would be the expanded processing/metallurgical operations. There have been a number of spills of material at the existing operations, including spillages of hydrocarbons, sulphuric acid and various processing liquors and reagents. Whilst most have been successfully contained within the secondary (bunding) system or tertiary (stormwater collection and storage) system, there have been instances of spills and leaks which have occurred outside these systems, causing localised site contamination. Reporting of spills over 50m³ is currently undertaken by BHPB in line with the Bachmann Reporting Process.

RECOMMENDATION

Based on the measures proposed in the EIS, the AR considers that the pollution and potential site contamination risks associated with the proposed expansion at Olympic Dam are acceptable, and can be successfully managed to ensure the following outcome: that the proposed development does not compromise current and future land uses within the Special Mining Lease or adjoining areas, or cause adverse impacts on human health due to soil contamination. Accordingly, the following conditions are recommended:

- The hazardous and dangerous storages areas and/or activities within the SML must be designed to ensure that chemicals are stored in bunded and sealed compounds/areas capable of preventing the escape of material into the soil, surface waters or underground water resources.
- All stormwater retention ponds which are designed to constitute a component of a tertiary containment system⁴ for chemical spills must be designed and constructed to prevent the escape of material into the soil, surface waters or underground waste resources.

The following note to BHPB is also recommended:

- The EPA Guidelines *Bunding and Spill Management (2007)* and *Wastewater Lagoons (Draft, 2010)* contains information that can help the proponent comply with the chemical storage and containment requirements above.

Impacts on vulnerable listed species reintroduced to Arid Recovery

The AR considers that the information provided in the DEIS is an accurate representation of the potential impacts of the expansion on Arid Recovery. This AR accepts the assessment that the direct impact of the expansion to resident protected species will likely be mitigated by the recent extension of habitat to Arid Recovery and maintenance of a 500m buffer zone as committed by BHPB.

Accordingly, the AR concludes that impacts to listed species, reintroduced into the Arid Recovery area, can be appropriately managed.

Impacts of the TSF on fauna and migratory species

The AR considers the information provided in the DEIS to be an accurate representation and assessment of the fauna impacts that would result from the expanded TSF.

The liquor contained within the TSF facility is toxic to avifauna in terms of acidity (pH range from less than 2 to 3.5) and could lead to mortalities following extended exposure, ingestion and/or inhalation of gaseous sulphides. BHPB has acknowledged that the current comprehensive TSF monitoring contains a degree of uncertainty, in that it could underestimate the impacts due to scavenging and sinking of carcasses before they can be counted. Fauna mortality numbers are reported publicly on an annual basis. Summary data was included in the FEIS (DEIS Section 15.5.7 and SEIS Section 16.5).

It is considered that an expansion of the surface area of this facility (up to eight times larger than the current TSF) would cause an increased risk of mortality to wildlife, although it must be acknowledged that bird-impact mitigation design features have been proposed in the TSF expansion designs.

⁴ 'Tertiary containment system' means a system designed to contain chemical spills that may escape from primary containment in tanks and secondary containment in bunded areas.

BHPB considered a wide range of alternate methods and design options to reduce the risk of impact to avifauna. The costs, benefits and limitations for each option have been considered and reasons for selecting the preferred method and rejecting alternatives have been presented.

The AR considers the controls and management measures proposed by BHPB are appropriate to minimise the risk of impact to avifauna. Further, the AR supports the ongoing commitments to further research.

The AR considers that an updated monitoring program should aim to improve the accuracy of the measurement of bird impacts associated with the current and expanded TSF, and would benefit future avifauna management decisions by BHPB.

Given the risk posed to flocking migratory wader bird species such as the Banded Stilt by the TSF, and difficulty predicting when such large flocking events may occur, it is recommended that BHPB investigate the development of a real-time continuous monitoring system to monitor the arrival or presence of large flocks of listed migratory waterbirds landing on the TSF. Furthermore, a real-time continuous monitoring system would allow BHPB to rapidly respond to large scale flocking events should this be a proven, effective mitigation measure.

RECOMMENDATION

The AR recommends the following conditions:

- The proponent must prepare and implement a Bird Impact Management and Monitoring Plan (BIMMP) relating to listed migratory species and Banded Stilts, for approval by the Indenture Minister, prior to the commissioning and operation of the new tailings storage facility (TSF), that is designed to minimise, record and report actual and extrapolated/modelled bird mortalities as a result of exposure to the TSF. The BIMMP must:
 - Outline a process to identify, monitor and respond to potential impacts on birds. To this end the plan should include indicators and/or criteria that will be applied to measure success in achieving environmental protection objectives, and as far as possible mitigating any adverse impacts;
 - Consider knowledge gaps in scientific understanding, and associated key uncertainties;
 - Include a process for interim treatment, measures or controls to manage uncertainty and risk; and
 - Include processes and accountabilities for monitoring, analysing and contributing to adaptive management and continuous improvement processes.
- The proponent must annually prepare and submit a monitoring report to report against the actions and criteria contained in the BIMMP.
- The proponent must review the BIMMP in accordance with the EPMP required under clause 11 of the Olympic Dam Indenture or as required by the Minister.

The AR recommends the following note:

In preparing the BIMMP it is recommended that the proponent considers the following principles and actions:

- The use of best practicable technology to decrease attractiveness of tailings to avifauna, and to deter and disperse avifauna.
- A set of environmental protection objectives aimed at mitigating any adverse impacts to birds from the TSF.

- The development and implementation of a rigorous TSF monitoring program with the aim of reducing the degree of uncertainty around actual mortality numbers.
- The investigation, development and implementation, if practicable, of an ongoing real-time surveillance system, and automated deterrence/hazing systems, to detect the approach and arrival of flocking bird species and deter them from entering the TSF.

Impacts on Yarra Wurta Springs and resident Lake Eyre Hardyhead population

The AR considers that based on the assessment provided in the SEIS, impacts to the Yarra Wurta Springs from the proposed Olympic Dam expansion would be unlikely. Despite this, BHPB has chosen to apply precaution and apply management provisions to monitor the springs for effects. Details on the potential impacts on Yarra Wurta Springs are included in further detail in the groundwater section (4.4.4) of this AR.

While many aspects of the Yarra Wurta Springs are represented in springs with similar ecological characteristics, the ecological consequences of impacts, such as drawdown, are difficult to prove outside of modelling, so the precautionary approach taken by BHPB is supported by this AR.

Although the Yarra Wurta Spring contains a Hardyhead population that is separate to populations found elsewhere, and some genetic differences have been noted between the populations, research has shown that they are not different species or subspecies. BHPB has committed to update its existing fauna monitoring program to ensure the incorporation of groundwater communities/ecology that would include the Hardyhead species.

It was noted in the DEIS (Appendix N8) that this species has one of the highest salinity tolerances of any fish, but it should be noted that in other sites, low flow springs/waterholes have been observed to become so saline that the Hardyhead sub-population became extinct at some spring fed waterholes e.g. Billa Kalina springs (pers. obs. Travis Gotch, DENR). In these sites, there is a seasonal cycle of colonisation and extinction, with the fish easily able to recolonise from other sub-populations. In the case of Yarra Wurta, this is the source population, so a local extinction would conceivably be final, resulting in the loss of a unique population. This could also potentially impact the periodic (and very rare and poorly understood) colonisation of Lake Torrens.

Even less understood are the stromatolites and microbial mats present at these springs. No detailed studies are known to have been undertaken into freshwater stromatolite biology in this region, so attempting to assess the significance of flow reduction impacts on these organisms is difficult.

Monitoring has been proposed by BHPB for impacts to the spring from drawdown. Water chemistry and maintenance of flow are considered the key drivers for ecosystem health at Yarra Wurta. Any reduction in flow would see a reduction in habitat area – Population Viability Analysis would show this increases the chance of local extinction.

RECOMMENDATION

The AR considers that based on the assessment provided in the SEIS, impacts to the Yarra Wurta Springs and the Hardyhead population from the proposed Olympic Dam expansion would be unlikely. Accordingly, no specific conditions are recommended, as the AR considers that appropriate conditions have been recommended in the Groundwater section of this chapter, 4.4.4.

The AR, however, recommends the following notes:

- Detailed baseline information for the Yarra Wurta Springs should be developed with enough statistical power to account for natural variation and ‘noise’ including:

- Spring flow rate, wetland area and salinity;
 - An assessment of the flow would need to be carried out that accounted for local variations in barometric pressure, tidal influences and evaporation rates; and
 - Baseline data on the relative abundance/health of the Lake Eyre Hardyheads and microbial mats.
- The monitoring program would have to adequately account for the likely impact timeframe from the Motherwell Saline Wellfield and the mine open pit drawdown.
 - To enable the development of mitigation strategies in the event that potential impacts emerge at the Yarra Wurta Springs that are attributable to the operation of the Motherwell wellfield, the proponent should develop action triggers, based on the groundwater model and monitoring at key points.

4.4.4 Groundwater

The SEIS indicated that BHPB would seek to protect the following environmental values in relation to groundwater:

- Groundwater systems of the Stuart Shelf;
- Neighbouring groundwater systems of the GAB and Arckaringa Basin;
- Groundwater dependant ecosystems in the Stuart Shelf; and
- Users of the relevant groundwater resources.

For the purposes of the AR, the groundwater concerns raised and addressed during the EIS process have been grouped as follows:

- Drawdown impacts on the groundwater resources;
- Seepage impacts on the groundwater resources;
- Potential impacts on natural springs (Yarra Wurta and Great Artesian Basin springs); and
- Potential impacts on third-party users.

4.4.4.1 Issues

Drawdown impacts on the groundwater resources

The DEIS described two saline aquifers present in the area of the mine and processing operations, namely:

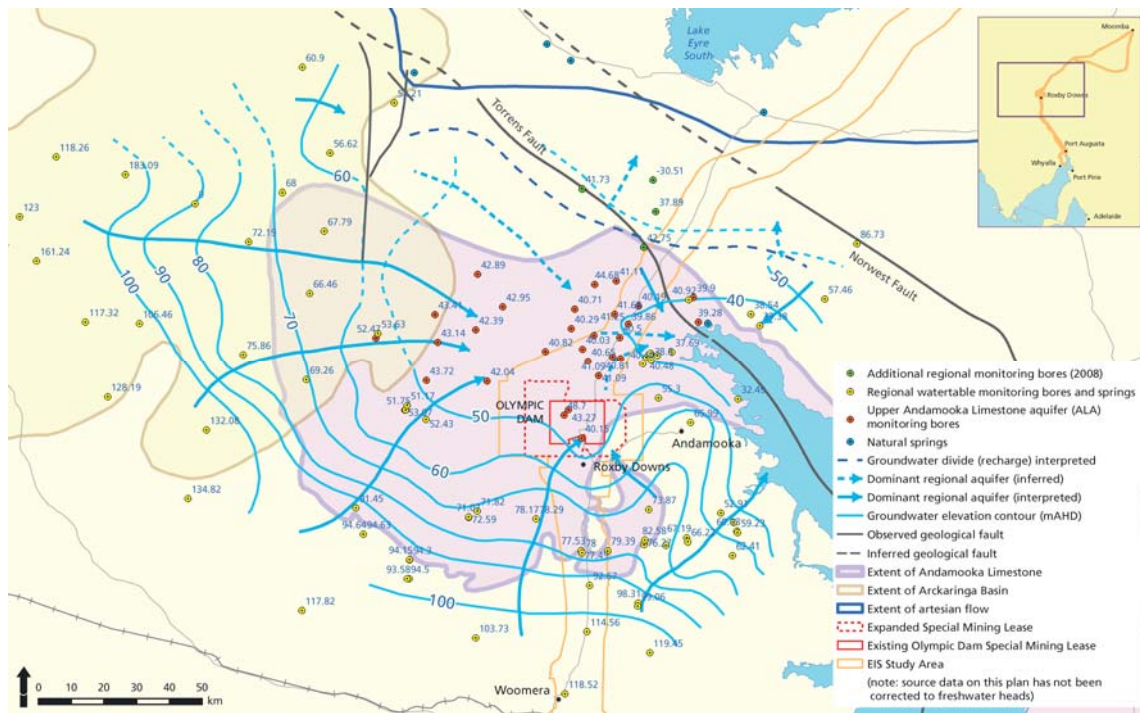
- The Andamooka Limestone which occurs about 50m below the surface and has a salinity ranging from 20,000 to 60,000 mg/L total dissolved solids (TDS); and
- The Tent Hill aquifer which consists of the Arcoona Quartzite and Corroberra Sandstone and occurs below the Andamooka Limestone between 160 to 200m below surface and has a salinity ranging from 35,000 to over 100,000 mg/L TDS.

The DEIS indicated that neither aquifer is connected to the GAB which at its closest point is located 90km north of Olympic Dam. A conceptual model provided in the DEIS suggested that the GAB aquifers are separated by geological and structural controls in the Adelaide Geosyncline and Torrens Hinge Zone. Springs associated with the GAB are supported by artesian flow and are not believed to be supported by groundwater flow from the aquifers at Olympic Dam.

Recharge to the Stuart Shelf aquifers occurs from the Arcoona plateau in the south and from the Arkaringa Basin in the west. Groundwater from the Tent Hill and Andamooka Limestone aquifers drains into the current underground mine and associated ventilation shafts and is extracted at rates varying from 1.3 to 2.1 ML/d. The extraction of groundwater has resulted in a 100m drawdown within the aquifers near to the mine and a cone of depression which extends 10km to the north-east of the existing mine and 5km to the south-west.

Groundwater for dust suppression is also extracted from four production wells completed in the Tent Hill aquifer for the current underground operation, at an average rate of 0.2 ML/d. Drawdown of up to 40m has been observed in the vicinity of the production wells.

BHPB developed a conceptual model of the groundwater system of the Stuart Shelf, in which the mine is located, which included its hydraulic interconnection with neighbouring groundwater systems. The understanding of the regional Stuart Shelf groundwater system was based on regional interpretation of available information and a program of new investigation wells drilled by BHPB. These wells have limited, short-term time series monitoring data available. Within these constraints, BHPB has predicted the potential long-term impacts of both the mine pit dewatering and the permanent pit beyond the mine life, on the Stuart Shelf aquifers, environmental receptors, users of the resources, and other inter-related groundwater systems.



SEIS Figure 12.8 *Interpreted regional watertable of the Arkaringa-Stuart Shelf groundwater flow system (GFS) overlain on geological provinces*

Due to the limited field data available to calibrate the groundwater model and the associated level of uncertainty in the model predictions, the Government requested BHPB undertake additional groundwater model sensitivity runs to enable a risk assessment of the potential impacts of the mine dewatering to be undertaken.

The following issues were considered relevant for assessment purposes:

- Potential that construction of the open pit would result in a decline in aquifer water levels within the Andamooka Limestone that in the long-term may cause the Yarra Wurta Springs to dry up;
- That construction of the open pit could, in the long-term, impact on the groundwater resources of the GAB and Arckaringa Basin; and
- That there could be depletion of local and regional groundwater resources within the Stuart Shelf.

Seepage impacts on the groundwater resources

Seepage from the existing TSF and evaporation ponds at an estimated rate of 0.5 to 1.5 ML/d has resulted in a groundwater mound in the Andamooka Limestone that has risen to about 30m below surface. The DEIS indicated that heavy metals in the seepage are attenuated by the sediments and limestone with the pH increasing to close to neutral. In addition, the DEIS indicated that BHPB's groundwater monitoring for the existing operation shows that water quality below the TSF is similar to the regional water quality, with the exception of slightly elevated uranium concentrations and slightly lower pH.

Groundwater flow from the Andamooka Limestone aquifer to the Tent Hill aquifer through the Arcoona aquitard is thought to occur in an area where a groundwater mound has occurred in the Andamooka Limestone beneath the TSF, and also in areas of increased drawdown in the Tent Hill aquifer.

Tailings Storage Facility (TSF)

The following issues were considered relevant for assessment purposes:

- Whether the proposed tailings management measures reflect best practice, and whether alternative methods such as thickened and paste technologies would be feasible;
- Contamination of groundwater in the Andamooka Limestone aquifer on both a local and regional scale;
- The attenuation capacity of the underlying sediments and limestone and the adequacy of geochemical modelling and testing that has been undertaken to demonstrate that the underlying sediments and limestone are effective in attenuating seepage;
- Potential surface expression of the fluids and impact on native vegetation resulting from seepage from the TSF entering shallow geologic sedimentary units adjacent to the TSF; and
- Potential instability of the TSF resulting from discharge of tailings and impacting environmental receptors.

Rock Storage Facility (RSF)

The following issues were considered relevant for assessment purposes:

- Potential contamination of groundwater in the Andamooka Limestone aquifer on both a local and regional scale;
- The attenuation capacity of the underlying sediments and limestone being effective in attenuating seepage; and
- Potential surface expression of the fluids and impact on native vegetation and fauna resulting from seepage from the RSF entering shallow geologic sedimentary units adjacent to the RSF.

Potential impacts on natural springs

The following issues were considered relevant for assessment purposes:

- Potential that operation of a supplementary saline wellfield could result in a decline in aquifer drawdown levels within the Andamooka Limestone that could impact on Yarra Wurta Springs; and
- Potential that groundwater drawdowns could impact on the GAB springs

On a regional scale, groundwater moves slowly in a west to south-west direction to discharge at the northern end of Lake Torrens. A number of hypersaline springs and seeps are located around Lake Torrens. Yarra Wurta Springs, the closest groundwater-dependent ecosystem to Olympic Dam, which are located on the northern extent of Lake Torrens, support an ecosystem with an obligate dependence on groundwater. Yarra Wurta Springs consists of two highly saline springs located approximately 1km apart, which support vegetation within and surrounding the pools and along the drainage line, a community of invertebrates, and the Lake Eyre Hardyhead.

At Yarra Wurta Springs a number of invertebrates have been previously recorded, including the brine shrimp, small cladocerans, several species of ostracods, chironomids and rotifers. The DEIS indicated that none were rare, threatened or otherwise significant. The Yarra Wurta Springs also supports a population of the Lake Eyre Hardyhead. The survey of additional springs in the Lake Torrens catchment did not detect additional populations of the species.

Microbial mats and rock formations at Yarra Wurta Spring were considered in the EIS to be precursors to stromatolites and fossilised stromatolites and were considered to be similar to those occurring throughout the world, and were considered in the EIS to be of minor scientific interest.

No stygofauna were identified in the 21 groundwater wells that were sampled - 15 within the area influenced by current mining operations and six outside this zone. The DEIS concluded that their presence was unlikely given the high salinity and low permeability of the aquifer.

A number of freshwater swamps and terminal drainage features occur on the Stuart Shelf. Coorlay Lagoon, the closest to Olympic Dam, is 25km to the south.

Potential impacts on third-party users

The following issues were considered relevant for assessment purposes:

- Potential that operation of a supplementary saline wellfield could result in a decline in aquifer drawdown levels within the Andamooka Limestone and Tent Hill aquifers that could impact on the ability of third-party groundwater users to extract water from their wells; and
- Potential impact on third-party users ability to extract water from their wells due to the construction of the open pit resulting in a decline in water levels within the Andamooka Limestone and Tent Hill aquifers.

The DEIS indicated the presence of 14 groundwater wells within a 60km radius of the current operations that are in use, of which seven are located on pastoral leases held by BHPB.

4.4.4.2 BHPB EM Program and commitments

Drawdown impacts on the groundwater resources

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 1.4:

- **Objective:** Not applicable to groundwater drawdown.
- **Criteria:** Not applicable to groundwater drawdown.
- **Management plans:** Revise existing Water Management Plan for the expansion.
- **Commitments:** No additional water for the proposed expansion would be obtained from the GAB beyond sustainable yields and that which is available under approvals from the SA Government (SEIS Table 2.1 Commitments, page 52).

Seepage impacts on the groundwater resources

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.2 and 4.3:

- **Objective:** Maintain structural integrity of the RSF and expanded TSF (ID 4.2).
- **Criteria:** No unplanned structural failures to the TSF or RSF.
- **Management Plans:** The existing TSF Management Manual would be reviewed to incorporate expansion requirements. RSF Management Manual (new) An operating manual for the RSF would be developed to include controls and contingencies as per this Plan.
- **Commitments:** Closure Plan for the TSF – tailings cells would be capped when they reach their target design height (SEIS Table 2.1 Commitments, page 59).

- **Objective:** No significant adverse impacts to ecological communities as a result of seepage from the RSF and expanded TSF (ID 4.3).
- **Criteria:** No loss of native vegetation outside bunded TSF area as a result of seepage to groundwater from the TSF.
- **Management Plans:** The existing TSF Management Manual would be reviewed to incorporate expansion requirements. RSF Management Manual (new) An operating manual for the RSF would be developed to include controls and contingencies as per this Plan.
- **Commitments:**
 - Impacts of seepage from existing and future TSF (SEIS Table 2.1 Commitments, page 59)
The design of the TSF incorporates controls to minimise seepage including:
 - Increasing the volume of liquor recycled from the TSF;
 - Constructing larger cells with greater evaporation capacity;
 - Collecting liquor through a central decant arrangement;
 - Installing a liner beneath the central decant systems; and
 - Recycling water from the mound beneath the TSF;
 - Impacts of seepage from the RSF (SEIS Table 2.1 Commitments, page 58). Potentially reactive mine rock would be enclosed with the RSF.

Potential impacts on natural springs

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 1.4:

- **Objective:** Not applicable.
- **Criteria:** No significant decline in groundwater flow rate at Yarra Wurta Springs.
- **Management Plans:** Existing Water Management Plan would be revised for the expansion.
- **Commitments:** Water supply for the proposed expansion (SEIS Table 2.1 Commitments, page 52):
 - BHPB will provide the SA Government with a monitoring program, including contingency measures, for the proposed abstraction of groundwater from the Motherwell wellfield.

Potential impacts on third-party users

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.4:

- **Objective:** No significant adverse impacts to the availability and quality of groundwater to existing third-party users as a result of groundwater drawdown associated with BHPB's expansion activities.
- **Criteria:** No material change in the availability and quality of groundwater bores operated by third-party users.
- **Management Plans:** Existing water management plan would be revised for the expansion.
- **Commitments:** Water supply for the proposed expansion (SEIS Table 2.1 Commitments, page 52):
 - If monitoring results indicate that third-party users are likely to be affected by declines in groundwater levels resulting from the proposed mine expansion, alternative water supply options would be investigated. These may include relocating or deepening existing groundwater wells, or providing an alternative water supply. Options would be considered in consultation with the third-party user.

4.4.4.3 Assessment

Drawdown impacts on the groundwater resources

Dewatering of the open pit and mine void

The DEIS indicated that the establishment of the open pit would result in the creation of a permanent evaporative sink within the regional groundwater system, which would lower water levels in the Andamooka Limestone and Tent Hill aquifers. It has been predicted that a permanent lake would form at the base of the open pit post mine closure. The lake has been estimated to be approximately 350m deep and 650m below ground level, which would be below both the Andamooka Limestone and Tent Hill aquifer systems. A salt crust would be expected to form on the surface of the lake more than 3000 years post closure of the mine.

The DEIS indicated that contamination of the Andamooka Limestone and Tent Hill aquifers with saline brine from the mine void is considered unlikely as the lake in the base of the mine void would be below the aquifer systems and the direction of groundwater flow would be towards the mine void.

BHPB has indicated that dewatering of the Andamooka Limestone and Tent Hill aquifers and other formations would need to commence prior to excavation to ensure safe mining conditions. Initially the volume of dewatering would be expected to be around 15 ML/d and reduce to an estimated 5 ML/d within five years (DEIS 12.4.2, SEIS 12.5.4). The groundwater produced from the dewatering activities would be used for dust suppression and engineering needs during the construction phase of the mining operation. Management options for potential excess water generated from the dewatering activities presented in the SEIS include managed aquifer recharge (MAR). Should BHPB choose to undertake this option, an approval would be required under the *Natural Resources Management Act 2004*.

The FEIS indicated that post-closure, groundwater would be expected to flow into the open pit at a rate of 3.5 ML/day. The current conceptualisation of the groundwater flow regime and the modelling results indicated that regional impacts on the groundwater resources of the Stuart Shelf would not occur until after the 40 year planning horizon adopted for the DEIS.

Modelled drawdown impacts

The conceptualisation by BHPB of the Stuart Shelf, Arckaringa Basin and GAB groundwater flow systems presented in the SEIS is considered acceptable by this AR.

Calibrated groundwater model

The AR considers it acceptable that modelling be undertaken to provide an indication of the impacts that may result, from the proposed expansion of the Olympic Dam mine. It would be unrealistic to expect BHPB to undertake an extensive field investigation program to further/enhance their knowledge of the groundwater regimes, prior to approval of the Project.

There is limited, pre-existing, regional, long-term monitoring data with which to calibrate the groundwater model and this data is primarily restricted to the existing operation where monitoring data have been collected since 1983. As part of the EIS process BHPB has undertaken a regional investigation program where 154 drillholes have been completed to enable ongoing monitoring in the future. Field investigations have focussed on:

- Yarra Wurta Springs;
- Motherwell Wellfield and extension investigations; and
- Mine pit dewatering and depressurisation.

In the absence of long-term regional monitoring data it is essential that sensitivity analyses be run on the groundwater model to highlight potential drawdown impacts. Impacts to groundwater resources within the Stuart Shelf and adjoining groundwater flow systems have been assessed using the regional groundwater model.

The current conceptualisation and modelling results indicate that the regional impacts on the groundwater systems would not occur until after the 40 year planning horizon adopted for the EIS. At the year 2050, within the Andamooka Limestone, the 1m groundwater level drawdown contour would extend 5km to the north of the open pit, and 20km to the south (SEIS Appendix F4 – Section 5.2 and Figure 5.2). Greater drawdowns have been predicted within the Corraberra Sandstone at the year 2050 (SEIS Appendix F4 – Section 5.2 and Figure 5.6). Drawdowns are expected to extend more radially with the 1m contour occurring at a ~25km radius from the open pit. Drawdowns of ~100m are expected within the open pit. Recharge to the calibrated model occurs from rainfall and inflow from the Arckaringa Basin on the western margin of the model domain. Inflow from the Arckaringa Basin is based on values determined from the Prominent Hill groundwater flow model. There is currently no understanding as to how this inflow would change the groundwater level drawdown in the Stuart Shelf (Andamooka Limestone aquifer).

The Prominent Hill mine is located to the west and outside of the model domain. Groundwater for that mining operation is sourced from two wellfields constructed in the Arckaringa Basin. Prominent Hill has an expected mine life of approximately 10 years and the BHPB calibrated model predicts a drawdown of <1m at the year 2050 at the western edge of the model domain. Therefore any drawdown impacts on the western margin of the model domain and subsequent changes to inflow from the Arckaringa Basin are unlikely to impact on the Prominent Hill operation.

Indications are that the regional Stuart Shelf groundwater system may not reach equilibrium for some thousands of years post mining. The implications of this are that water levels in the Andamooka Limestone and Tent Hill aquifers would continue to decline (for at least 1000 years) which may result in:

- Dewatering of the Andamooka Limestone and Tent Hill aquifers to such an extent that it would no longer be a viable water supply option for future developments that require large volumes of water. The Andamooka Limestone and Tent Hill aquifers are currently used by pastoral and mining industries (including the dewatering of current Olympic Dam mine), and have a groundwater salinity in the range of 10,700 mg/L to 260,500 mg/L (Table 12.2 SEIS). The high groundwater salinity limits the beneficial uses of the groundwater; and
- Possible flow reductions at Yarra Wurta Springs.

Calculated groundwater drawdown impacts at various points within the groundwater model domain have been determined from regional contour diagrams⁵ (SEIS Appendix F4). A summary of the drawdown impacts as determined by the calibrated model is presented in the table below. The extent of drawdown contours used by BHPB was set at the 1m drawdown contour and drawdown values from the calibrated model have been used.

Summary of drawdown impacts as determined by the calibrated model

FEATURE	AQUIFER	DRAWDOWN @		
		40 Years	500 Years	Long-term (>500 years)
Open Pit	Andamooka Limestone	10m	>30m	>30m
	Arcoona Quartzite / Corraberra Sandstone	100m	110m	
SML Boundary (expanded)	Andamooka Limestone	<1m on the W boundary to 10m on the SE boundary	<4m on the NW boundary to >20m on the SE boundary	
	Arcoona Quartzite / Corraberra Sandstone	<1m on the N boundary to >20m on the S boundary	~5m on the N boundary to 40m on the S boundary	
Yarra Wurta Springs		<0.25m	1m	>1m (sensitivity analyses indicate drawdowns in the order of >4m could occur at the springs)
GAB Springs	Cadna-owie / Algebuckina	No impact is expected	No impact is expected	No impact is expected
Third-party Users	Andamooka Limestone	<1m		
	Arcoona Quartzite / Corraberra Sandstone	<1m	1 to 4 m	
Torrens Hinge Zone		<1m	<1m	>2m may occur at the Andamooka Limestone / Torrens Hinge Zone interface
Western boundary of model domain	Andamooka Limestone	<1m	>2m	

⁵ The drawdown values are approximate

The following is a summary of the key modelling results (SEIS Appendix F4):

- Indications that drawdown would be expected to occur in the Andamooka Limestone aquifer over much of the groundwater model area. Drawdown would be greatest at the open pit and to the south of the pit with drawdown levels of over 30m expected at the open pit. Over the remainder of the area drawdown levels of less than 4m are anticipated;
- Drawdown levels within the Tent Hill aquifer would be expected to extend approximately 50km to the south and 80km to the west of the open pit;
- Indications that the groundwater model has not reached equilibrium at 500 years and would be unlikely to have done so by 1000 years (SEIS Section 12.2.1);
- Groundwater levels in the Andamooka Limestone and Tent Hill aquifers would have a gradient towards the open pit mine void during the operation of the mine and post closure; and
- Indications that the decline in groundwater levels would not have a significant impact on groundwater receptors within the Stuart Shelf.

Sensitivity analysis: summary of the aquifer parameters determined from field results and used in calibrated groundwater model

HYDROGEOLOGICAL UNIT	MODEL LAYER	HYDRAULIC CONDUCTIVITY (KH) (M/DAY)		Ss (/M)	
		In Model	Pumping Tests	In Model	Pumping Tests
Andamooka Limestone (ZAL)	2	8.6×10 ⁻⁶ to 22	2 to 700 (less than 0.5 occurs in mining site)	10 ⁻⁴ to 5×10 ⁻⁴	10 ⁻⁶ to 2×10 ⁻³
	3				
	4				
Arcoona Quartzite (ZWA)	6	8.6×10 ⁻⁶ to 8.6×10 ⁻⁴	5×10 ⁻⁴ to 0.2	5×10 ⁻⁶	-
Corraberra Sandstone (ZWC)	7	8.6×10 ⁻⁶ to 0.2	6×10 ⁻⁴ to 30	5×10 ⁻⁵	10 ⁻⁶ to 6×10 ⁻⁴
Adelaide Geosyncline Rocks (Torrens Hinge Zone)	8	9×10 ⁻⁶	1×10 ⁻⁴ to 1×10 ⁻²	5×10 ⁻⁴ to 1×10 ⁻⁶	-

It should be noted that many of the aquifer parameters used in the calibrated groundwater model are within the range of values measured in the field, however hydraulic conductivities in the Andamooka Limestone are in the lower range of values from field analyses; and aquifer storage is in the higher extent of the range.

Sensitivity tests were undertaken by BHPB to determine levels of uncertainty in the groundwater model predictions and the range of aquifer parameters tested in sensitivity tests is provided below in the Table below.

Range of aquifer parameters tested in sensitivity tests

HYDROGEOLOGICAL UNIT	MODEL LAYERS	HYDRAULIC CONDUCTIVITY SENSITIVITY ANALYSIS RANGE (M/DAY)	SPECIFIC STORAGE SENSITIVITY ANALYSIS RANGE (/M)	PARAMETER CHANGES COMPARED TO CALIBRATED MODEL
Andamooka Limestone (ZAL)	2	50 and 20 (conductivity values only changed for the 2 zones north and northeast of the mine site (additional sensitivity test requested by DFW).	1x10 ⁻⁴ (sensitivity scenario II – excluding mine area) 2.5x10 ⁻³ (sensitivity scenario III – excluding mine area) 1x10 ⁻⁶ (additional sensitivity test requested by DFW)	Reduction in specific storage. Increase in specific storage. Reduction in specific storage and increase in hydraulic conductivity
	3			
	4			
Arcoona Quartzite (ZWA)	6	8.64x10 ⁻⁴ (sensitivity scenario IV – Kv only)	-	Increase in hydraulic conductivity.
Corraberra Sandstone (ZWC)	7	0.43 (sensitivity scenario V - Kh) 0.043 (sensitivity scenario V - Kv)	-	Increase in both vertical and horizontal hydraulic conductivity.
Adelaide Geosyncline Rocks (Torrens Hinge Zone)	8	8.64x10 ⁻³ (sensitivity scenario VIII - both Kh and Kv) 8.64x10 ⁻² (sensitivity scenario IX - Kh but for only a thin high permeable channel N-NNE of Olympic Dam, layers 1 & 2 only)	-	Increase in both vertical and horizontal hydraulic conductivity.

In total, 12 sensitivity analyses were conducted as part of the SEIS, as follows:

- 6 sensitivity analyses were conducted on the groundwater model, each varying only a single parameter (K or Ss) for a single geological unit: two each for the Andamooka Limestone, Torrens Hinge Zone and one each for the Arcoona Quartzite and Corraberra Sandstone;
- 3 sensitivity analyses were conducted varying recharge and inflow into the groundwater model domain;
- 3 sensitivity analyses were conducted on TSF and RSF seepage rates and configuration; and
- 1 sensitivity analysis was conducted with no Motherwell Wellfield extraction..

No sensitivity analyses were undertaken for a decrease in the specific storage for the Corraberra Sandstone or Torrens Hinge Zone.

The sensitivity analyses as presented in the SEIS Appendix F4 show that groundwater level drawdown impacts increase to all groundwater receptors within the Stuart Shelf groundwater system with changes to aquifer storage and conductivity, and also recharge, with the following indicated:

- Sensitivity analyses indicated changes in the amount of drawdown would be commensurate with the volume and availability of groundwater in the model. Regionally, increases in drawdown, would be in the order of <1 to 6m within the Andamooka Limestone aquifer and in the order of <1 to 10m within the Tent Hill aquifer. These increases in drawdown levels indicate the groundwater model is sensitive to changes in aquifer storage and conductivity;
- A maximum drawdown of up to 4m (at 500 years) may occur at Yarra Wurta Springs, which would be an increase of 3m drawdown over the calibrated groundwater model;
- A maximum drawdown of up to 9m (at 500 years) may occur at 19 Mile Bore, which would be an increase of 7m drawdown over the calibrated groundwater model;
- A maximum drawdown of up to 5m (at 500 years) may occur at Loch Well, which would be an increase of 4.5m drawdown over the calibrated groundwater model;
- Negligible changes in aquifer drawdown were reported at bore RT-9, which is completed in the Brachina Formation aquifer and located in the Torrens Hinge Zone;
- A drawdown of >8m may occur along the western margin of the model domain (at 500 years), which would be an increase of 6m over the calibrated groundwater model;
- Increased seepage beneath the TSF and RSF (5% of rainfall) would still result in seepage flowing towards the open pit; and
- Many scenarios show that the groundwater model is not approaching equilibrium at 500 years and therefore drawdown may be greater than reported.

RECOMMENDATION

The AR concludes that the magnitude of water level declines as determined by the calibrated model is considered to be acceptable. However, modelling long-term groundwater changes on this scale is difficult and carries a degree of uncertainty. The AR recommends the following condition:

- The proponent must review and update on a 3 yearly basis the regional groundwater model presented in the EIS and used to predict regional groundwater drawdowns. Review of the groundwater model is to be undertaken by an independent expert in accordance with the Murray-Darling Basin Commission Modelling Guidelines (as the nationally recognised groundwater modelling guidelines), as amended from time to time. In reviewing and updating the regional groundwater model a report must be prepared that includes at least the following specific items:
 - Updated understanding of the hydrogeology of the Torrens Hinge Zone;
 - Updated aquifer parameters for the Torrens Hinge Zone to be used in modelling upgrades;
 - Updated understanding of the recharge mechanisms to the Stuart Shelf, including recharge from rainfall and inflow from the Arckaringa Basin; and
 - Updated understanding of impacts to the regional groundwater system resulting from the open pit void.

Mine water supply

The DEIS indicated that no additional water would be sourced from the GAB beyond the current special water licensing arrangements under the Olympic Dam Indenture. Current licensing arrangements provide for the management of extractions from the two wellfields (Wellfield A and Wellfield B), with current extraction rates in the order of 35 ML/d.

Supplementary water supplies would be required during the construction phase of the proposed expansion providing an estimated 35 ML/d from local saline wellfields (10 ML/d) and the Motherwell Wellfield (25 ML/d). It is not explicitly stated in either the DEIS or SEIS how long the Motherwell Wellfield would be used, however the project configuration has been based on an 11 year construction phase (and modelling of Motherwell Wellfield covered a period of 8 years).

BHPB propose to use the Motherwell wellfield during the construction phase of the expansion, however the wellfield could be used for a longer period as a low quality water resource, subject to the aquifer response to extraction. The operation of the Motherwell Wellfield has been incorporated into the regional groundwater model and the results indicate that drawdowns in the order of 2–4m would be expected at the wellfield, with the drawdown expected to extend up to ~23km regionally. Yarra Wurta Springs are located approximately 45km to the north-east of Olympic Dam and approximately 40 to 45km to the north-east of the proposed position of the Motherwell Wellfield.

Extended operation of the Motherwell Wellfield may present a greater risk to Yarra Wurta Springs during the mine operation than dewatering activities, but the extent and magnitude of impact would be dependent on production rates from the wellfield. It is recommended that monitoring should be undertaken to identify potential impacts to Yarra Wurta Springs.

RECOMMENDATION

Extraction of water from the Motherwell Wellfield and other saline wellfields, not associated with mine dewatering, are to be managed in accordance with the Olympic Dam Indenture, and would require the granting of a Special Water Licence. The AR recommends the following notes:

- The proponent will be required to establish a monitoring program required for the Motherwell Wellfield and other water supply wellfields in accordance with requirements under the Olympic Dam Indenture (Special Water Licence), and that monitoring data would include as a minimum:
 - Total abstraction and individual well abstraction on a monthly basis;
 - Water pressure and levels in monitoring and production wells; and
 - Water quality at monitoring and production wells on an annual basis.

Impacts to vegetation from groundwater drawdown

The DEIS indicated that Coorlay Lagoon, 25km south of Olympic Dam, is the only place in the EIS study area where the water table is close to the surface; however due to the salinity levels, it is unlikely that there is any vegetation reliant on the groundwater. Monitoring would be undertaken, of the Acacia woodlands in particular, to monitor for impacts from drawdown, and contingency options considered if impacts became evident (DEIS Sections 12.3.6 and 15.5.8 and SEIS Sections 12.2.3 and 12.5.5).

Seepage impacts on the groundwater resources

Thickened tailings and water balance

BHPB has indicated that the proposed expansion would generate approximately 58Mtpa of tailings at full production, with disposal of the tailings at between 52–55% solids. The EIS indicated that establishment of a tailings storage facility (TSF) would include nine new cells - eight operational and one for contingency - each approximately 400ha in surface area with a total footprint, including liquor balance ponds, of 4400ha. As TSF Cell 5 has been constructed as part of the current operations, this was amended in the SEIS to eight new cells.

The selection of tailings density and the ultimate design of the TSF impacts on key environmental values include:

- Water usage;
- Local groundwater;
- Long-term landform stability;
- Avifauna; and
- Native vegetation.

The mineral extraction process can be considered in two parts – firstly the concentrator and thickeners, and secondly the hydrometallurgical plant leading to the TSF. In the first area the water is treated as “clean” into which is fed the primary “make up” water and the thickener overflow from the deep cone thickeners is suitable for putting back into the process. The unrecoverable water contained in the tailings voids is the principal form of clean water leaving the process and is minimised by the extent of thickening undertaken.

Once the range of minerals is recovered from the primary ore in the concentrator they are processed in the hydrometallurgical plant. The water recovered from the various parts of the plant is mineralised and can no longer be reused economically and this water is injected back into the tailings stream for delivery to the TSF from which it is evaporated. This means all reusable water is retained in the plant, the tailings and reject water are disposed of in a single stream.

The EIS indicated that it was not optimal to produce higher solids content tailings or to produce tailings to a paste consistency. In addition it indicated that the establishment of a paste disposal facility would require a larger surface area with more clearance of native vegetation, and that unlike the lower solids-content tailings, water recycled from paste disposal could not be used to supplement process water due to its chemistry and salinity levels.

In its submission on the DEIS the SA Government requested additional information to justify why tailings could not be thickened to a higher density than the proposed 52–55% solids.

In the SEIS, BHPB indicated that it rejected the options of paste thickened tailings and conveyance and stack disposal methods because it would:

- Impact the water balance for the process plant;
- Result in a larger TSF footprints due to steeper beach angles;
- Result in less efficient drying of the tailings; and
- Require high energy consumption due to difficulty in pumping the paste tailings.

BHPB indicated that the operational tailings density was selected in order to optimise the process water balance, enabling the maximum of 26 ML/d being returned back into process. BHPB also indicated that thickening beyond the proposed design level would have no benefits as no additional recovered liquor could be re-used in the processing operations and would therefore need to be disposed in evaporation ponds. The establishment of further large evaporation ponds was not desirable.

BHPB indicated that thickening the tailings to 60% solids content would result in an additional 13 ML/d of liquor requiring evaporation.

While BHPB’s experience with the current operations indicates that the proposed water balance could be achieved, to maintain flexibility it proposed to incorporate a covered balance pond for short-term water balance disruptions.

The information provided by BHPB confirms that the tailings could be produced at a higher consistency than 55% solids, and indeed that the thickener underflow is designed to have an optimum consistency of 70% solids that will then be diluted by liquor emanating from various parts of the metallurgical process back to 55% at discharge. The information indicates a practical design constraint for the thickener arises beyond 70% solids, as the tailings consistency would result in a viscosity in the underflow that could provide operational difficulties.

The information indicates that the deep cone thickener design has been based upon the following criteria:

- Design is based on 70% solids at an ore Specific Gravity (SG) of 3.2.; and
- The key intent is to reduce primary water consumption, which also drives:
 - Acidic liquor recycling demand from the TSF facility;
 - Reductions in volumes of liquor that the TSF has to manage; and
 - Acid balance – in this case an acid credit of 2.8 kg/t;
- The key performance measure is to achieve a constant unit volume of water advancing into the hydromet circuit regardless of ore SG.

The size of the TSF cells and the number of cells planned to be in operation at any time has been designed to provide sufficient beach area to enable the excess process water to be evaporated such that no additional evaporation ponds will be needed to get rid of the water unsuitable for reuse.

RECOMMENDATION

The AR considers that the tailings design takes into account the needs of the entire process, and on the basis of the water balance data provided by BHPB, the consistency of the tailings at discharge is as high as is practical while optimising the whole of process water balance and minimising the consumption of clean primary water.

Seepage from TSF and RSF

Seepage is expected to occur from both the TSF and RSF into the local groundwater system resulting in the creation of a local groundwater level mound which, if not properly managed, could impact on groundwater dependent vegetation.

The DEIS indicated that in the initial stages of operation, seepage from the TSF would be about 4 cubic metres/hectare/day. The seepage is expected to reduce to about 1 cubic metre/hectare/day when steady state conditions are developed. These modelled seepage rates are less than the current TSF Cells 1–4 and this is considered to be related to the higher tailings solids content for the expansion (52-55%), when compared to the existing operations (47%), and the higher surface area for evaporation of liquor. The EIS indicated that seepage rates would reduce to a long-term rate equivalent to about 1% of the total rainfall following closure.

Modelling by BHPB indicates that a mound in the order of 6–8m would be formed 40m beneath the TSF in response to seepage. In comparison, mounding in the order of 17m occurs beneath the existing TSF operations. Modelling results also indicate that aquifer water levels are likely to fall 15–30m at the boundary of the SML both during operations and post closure.

The proposed TSF design incorporates measures to minimize infiltration and enhance neutralization of seepage fluid. These include the establishment of larger storage facilities to encourage evaporation of the liquor, proof-rolling the clay base of the storage facility and establishment an HDPE liner and drainage collection system in the decant area where the highest hydraulic heads occur. In addition, the proposed designs incorporate toe and heel drains which would intercept near surface seepage, to be returned to the storage area.

An updated model was provided in the SEIS to test the sensitivity of seepage predictions from the TSF. BHPB has indicated that the groundwater model is regional in scale and while it does provide information on the local scale it does not simulate the variability in the subsurface geological features. BHPB has indicated that its experience from the operation and management of the existing TSF system suggests that lateral seepage does not occur beyond the vicinity of the TSF. Groundwater monitoring data indicates that this comment is reasonable.

As the TSF and RSF are located in close proximity to the open pit dewatering prior to and during operation, combined with the natural dewatering post closure of the mine, would create a cone of depression in the Andamooka Limestone and Tent Hill aquifer systems. The direction of groundwater flow in both aquifers would be towards the open pit, therefore any seepage from the TSF and RSF would eventually flow into the open pit. Natural attenuation of the seepage is also expected to occur within the sediments and Andamooka Limestone located below the TSF and RSF.

Groundwater below Olympic Dam is unsuitable for domestic and stock use due to its high salinity and elevated concentrations of metals. The *Environment Protection (Water Quality) Policy 2003* indicates that groundwater affecting activities should not alter the groundwater chemistry even if the existing water quality exceeds the specified criteria. An exemption from the Policy (and associated attenuation zone) or amended criteria to reflect the existing natural water quality would likely be required should the expansion proceed.

Public submissions have indicated that the entire TSF should be lined to prevent seepage and groundwater impact. BHPB proposes to install a lining system in the drainage area below the liquor decant pond. The groundwater environmental values determined for the site relate to the protection of groundwater users and ecological communities. The impacts on existing groundwater users and the ecological communities were discussed in the preceding section of this chapter and it was concluded that significant impacts attributable to seepage were unlikely to occur.

BHPB proposes to install additional groundwater monitoring bores around the perimeter of the expanded TSF and RSF to monitor groundwater quality and the groundwater mound. The current monitoring and reporting program would also be extended to include the additional bores.

In the event that the base seepage is higher than estimated the result would be an increase in the elevation of the groundwater mound below the TSF. Groundwater extraction (pumping) could be undertaken should the groundwater mound approach a maximum level that will ensure no impact to native vegetation.

BHPB proposes to include management measures to minimise infiltration into the RSF and enhance neutralisation of seepage fluid. These include incorporating acid neutralising rock (limestone) at the base of the RSF and the mixing of non-acid forming rocks with potential and actual acid-generating rock. The assessment by BHPB indicates that there are sufficient volumes of rock to neutralise acid-generating waste rock that would be disposed in the RSF. In addition, attenuation of any seepage would also be expected to occur within the sediments and Andamooka Limestone located below the RSF.

RECOMMENDATION

The AR concludes that the seepage issues can be appropriately managed using the approach proposed in the FEIS.

Neutralisation of acid drainage from TSF and RSF

BHPB has undertaken analysis and modelling to assess the overall risk for acid generation and the impact of acid mine drainage (AMD) on groundwater, and potential neutralisation capacity of the sediments and limestone below the TSF and RSF. The DEIS indicated that the very high neutralising capacity of the soils and strata underlying the TSF would be more than sufficient to account for any long-term acid generation from the sulphide content of the tailings.

A number of issues were raised by the SA Government in relation to the composition of seepage from the proposed TSF, RSF and low grade stockpile and the capacity for acid neutralisation, including:

- The nature of downward movement of acidic seepage from the storage facilities and its interaction with potentially neutralising rocks, especially the Andamooka Limestone (the mechanism of neutralisation);
- The objectives of the kinetic testing, rationale for selection of test samples, and the reasons for early cessation of a number of the tests;
- Explanation of test methods and inconsistency of nomenclature and data reported; and
- The fate of ammonia present in tailings process water

The SA Government review of the FEIS questioned details regarding the location and mechanisms of acid neutralisation by rocks incorporated in the RSF, as well as aspects of the proposed interaction of acid seepage from the RSF and TSF with the underlying Andamooka Limestone. The AR accepts BHPB's conclusion that while some uncertainties remain concerning the interaction of seepage with the sediments and limestone below the TSF and RSF, such as through the formation of preferred flow channels, there would be excess acid neutralising capacity provided by the limestone and other rocks.

The information provided in relation to the fate of acid seepage from the existing TSF - indicating that acid neutralisation occurs within approximately the upper metre of the Andamooka Limestone - provides support to the modelling that suggests acid neutralisation would occur within approximately 3m of the limestone boundary. As the future tailings would have a similar composition to the tailings from the current operations, the information provides credible evidence of the future behaviour of acidic drainage for the proposed expansion.

Information was requested regarding the nature of the test rocks (core sections and samples from underground workings), and the selection criteria for the 19 test samples. BHPB indicated that the primary objectives of kinetic testing was to obtain indicative estimates of the steady-state oxidation rates and concurrent solute release rates from each of the major lithological units that would be placed in the RSF. BHPB has indicated that the kinetic test objectives were set conservatively in light of the low risk environment.

BHPB has undertaken significant testing to determine the geochemical composition of the cover sequence rocks and provided a series of diagrams illustrating their content of wt % CO₂ (as a measure of potential acid neutralisation capacity) and wt % S (as a measure of potential acid generation). These diagrams include maximum and minimum values, as well as the average for each lithology, as intercepted in 20 diamond drill holes. It would have been beneficial if similar diagrams were presented for the basement lithologies that would comprise major proportions of the future RSF. Nevertheless, the diagrammatic and other compositional information relating to the 5 cover sequence rocks involved in the kinetic testing provide support to BHPB's position relating to the geochemical homogeneity and dolomitic nature of the Andamooka Limestone, and the overall acid neutralising potential of the lithologies.

The BHPB Olympic Dam geochemical database indicates a low potential for the generation of AMD from storage of rocks of the basement and cover sequence in the RSF. The average reported total S content of all lithologies is <1.0 wt % and below the values normally associated with a significant risk of AMD production. The rocks predicted to comprise the largest proportions of the RSF have very low total S content. For example, the Arcoona Quartzite – Red (ZWAR) of the cover sequence is predicted to comprise 26 wt % of the RSF has average Sulphur content of only 0.04 wt %, and the Granite-Hematite rock (GRNH) of the basement has average Sulphur content of 0.22 wt %. These equate to maximum sulphide (as pyrite) contents of no more than 0.1 and 0.4 wt %, respectively. Accordingly, the Maximum Potential Acidity is minimal.

Static testing of Net Acid Generation confirms the very low potential for acid development and further suggests that a significant proportion of the Sulphur content in the waste rocks is in the oxidised (sulphate) form, able to contribute little to the overall acidity of the drainage.

Taking together the low potential for AMD generation and the appreciable Acid Neutralisation Capacity (ANC) present in most of the cover sequence lithologies, especially the major unit of Andamooka Limestone (average ANC 481 kg H₂SO₄/t), the balance is strongly towards effective neutralisation of any acidic solutions that might arise within the RSF. In view of the slow rates of groundwater movement, the naturally saline nature of the groundwater, and flow of groundwater in the mining area ultimately to the open pit, there appears to be very little risk to regional groundwater from the future storage of waste rock in the RSF.

Given the low average sulphide content of the waste rocks, any AMD development in the RSF is likely to be localised and result from any 'unusual' rock types of small volume. The proposed measures to prevent lateral escape of surface water would minimise the risk of environmental impact from such limited AMD production. The ability to track the sulphur content of waste delivered to the RSF and to envelope any particularly acid-generating mine rock with rocks of elevated ANC is an additional option not present in most mining operations, which provides a further safeguard against AMD production.

The Kinetic testing undertaken by BHPB indicates there is a low risk posed by the leaching of solutes from the waste rock and hence a minimal risk of acid mine drainage conditions.

Ammonia would also be present in the tailings. The form in which ammonia occurs is pH-dependent - it becomes more mobile as the pH rises, not less, as for all of the other components of the potential TSF seepage. At the pH 8–9 that is anticipated to occur in the underlying limestone/dolomite, it will be largely in its most mobile form of dissolved ammonia. Consequently, ammonia should also be included as a routine component of the water quality analysis suite.

The groundwater modelling indicated that groundwater drainage would be towards the final mine void, which coupled with the limited lateral movements of shallow groundwater during periods of maximum water loss to seepage, would further diminish the risk to groundwater from acid drainage.

Infiltration through TSF and RSF post-closure

Following the review of initial information on the proposed TSF and RSF post-closure encapsulation provided in the DEIS, further information was sought in the SEIS in relation to the basis for the determination of infiltration rates through the proposed TSF and RSF, including modelling based on currently available information from the site, or literature on soil and rock geotechnical and permeability parameters and site climatic conditions. This information was sought as the final covers would influence the amount of rainfall that would enter the TSF and RSF and contribute to the potential for ongoing seepage.

The SEIS provided a report indicating the results of modelling of the infiltration rate through a range of alternative encapsulation materials for the RSF. A review of this information indicated that the model methodology used for the RSF in the SEIS was reasonable. However, it is noted that the analysis considered sand and gravel sized material, whereas the SEIS and Appendix N referred to the use of coarse rock mulch as the uppermost layer.

The SEIS indicated that for the coarsest material assessed (sandy gravel) the infiltration rate would vary from 7.3–12% of rainfall, and that the average percolation rate, assuming additional silt and sand material, would be about 4.6% of rainfall.

BHPB indicated that the groundwater model showed that any seepage from the TSF and RSF would be captured by the open pit, and that there would be a rapid decline in solute release over time, the nature of capping would not be the controlling factor in the management of seepage.

RECOMMENDATION

The AR considers that it is important to ensure that appropriate closure strategies are developed for the TSF and RSF which minimises ongoing seepage post-closure. The issue of capping design and modelling is one of many control strategies that would be relevant to mine closure and rehabilitation. Refer to section 4.4.12 of this chapter for assessment of rehabilitation and closure of the mine.

Stability of TSF and RSF

It is important that the TSF is stable to ensure that impacts on flora, fauna, surface water and groundwater are acceptably low.

In its assessment of the DEIS, the SA Government requested additional stability analysis for a potential block sliding mechanism with a failure surface located in low strength clay material that may be located in the foundations. The stability assessment undertaken by BHPB considered both static conditions and seismic conditions. The AR considers that the properties and parameters of construction materials, foundation soils and tailings proposed to be used by BHPB in the conceptual design and in the stability assessment are acceptable.

The revised stability assessment provided in the SEIS indicated factors of safety for circular and block failure respectively of 1.5 to 1.72 for static conditions and 1.14 to 1.15 for pseudo-static conditions (seismic loading). These factors of safety meet or exceed the normally accepted lower bound values of 1.5 and 1.1 for static and pseudo-static conditions respectively as established by the Australian National Committee on Large Dams (ANCOLD) Guidelines, widely used for determining whether dam structures have acceptable stability.

The construction and operation of the TSF will require authorisation under the *Radiation and Protection Control Act 1982* and this would require BHPB to provide detailed site-specific design and engineering information to confirm the structure is appropriate to minimise seepage.

The AR makes the following conclusions in relation to the TSF and RS) and potential impacts to groundwater:

- The proposed TSF design which seeks to balance tailings density and water management is considered acceptable for the site conditions that are experienced at Olympic Dam;
- Fully lining the TSF facility is not warranted on the basis of protection of the indicated environmental values and existing industrial beneficial use of groundwater;
- Seepage from the TSF which enters the groundwater system will ultimately be captured by the open pit;
- The underlying sediments and limestone are expected to neutralise acidity of any seepage and attenuate heavy metals and radionuclides;
- The storage of tailings, mine rock and low grade ore both during mining and after closure would pose little risk to regional groundwater, existing groundwater users and other environmental receptors;
- The TSF (and RSF) have been designed with appropriate material properties and have acceptable stability; and
- Implementation of a rigorous monitoring program complemented by regular analysis of the time series monitoring data are expected to provide progressive validation of the model predictions.

RECOMMENDATION

The AR recommends the preparation and implementation of a site Monitoring Program by BHPB to monitor TSF and RSF seepage impacts. The AR recommends the following conditions to address groundwater impacts:

- The proponent must prepare and implement a Site Groundwater Monitoring Program designed to achieve the following outcomes as measured against the respective approved criteria, for approval by the Indenture Minister, before commencing construction of the RSF or TSF:

OUTCOME	CRITERIA
No adverse impact on vegetation as a result of seepage from the tailings storage facility and rock storage facility.	Compliance criteria: Groundwater level outside the perimeter of the tailings storage facility must not be higher than 80 metres AHD or as otherwise agreed by the Minister.
No compromise of current and future land uses on the Special Mining Lease or adjoining areas as a result of seepage from the tailings storage facility and rock storage facility.	Compliance criteria: A numerical groundwater simulation model confirmed by monitoring that continues to demonstrate that all movement of TSF and RSF seepage is captured by the final open pit. A numerical geochemical model confirmed by monitoring that continues to demonstrate that all TSF and RSF seepage is attenuated within the Special Mining Lease.

- The proponent must provide a report by a suitably qualified independent consultant which certifies that the final designs for the TSF and RSF are likely to achieve the outcomes contained within the Site Groundwater Monitoring Program, when measured against the respective approved criteria must be provided to the Indenture Minister prior to commencement of construction of the TSF and RSF.

The AR also recommends the following note:

- The proponent will need to apply to the EPA for an exemption to the *Environment Protection (Water Quality) Policy 2003* or seek to have the current environmental values applying to groundwater at Olympic Dam modified in the *Environment Protection (Water Quality) Policy 2003*.

Potential impacts on natural springs

Yarra Wurta Springs

Modelling results show that drawdowns in the range of 1m up to 4m may occur at Yarra Wurta Springs 500 years post closure of mining operations (SEIS Appendix F4 - final groundwater model Figure 5.9 and sensitivity analyses – Figure 6.25). Drawdown is not anticipated to occur at Yarra Wurta Springs during the operation of the mine (40 years) as a result from mine dewatering activities or operation of the Motherwell Wellfield.

Water levels would not approach stabilisation at the end of groundwater model run, therefore the long-term (>500 years) impact at Yarra Wurta Springs is unknown based on the sensitivity analyses. The regional groundwater model has been constructed such that the Yarra Wurta Springs are fully reliant on groundwater flow from the Andamooka Limestone (from the west). This is a conservative approach that accentuates potential impacts on the springs. Water chemistry samples collected during field work undertaken to date indicate that the springs may in fact be supported, fully or partially, by groundwater flow from the east to north-east of the springs (from the

Adelaide Geosyncline (Torrens Hinge Zone)). In addition, structural features (e.g. the Torrens Fault) that exist between the mine and Yarra Wurta Spring and the effect of storage buffering by Lake Torrens, have not been incorporated into the groundwater model.

Whilst additional work to determine the hydrogeology of Yarra Wurta Springs may show that the springs are fully supported by groundwater flow from the east to northeast, groundwater level drawdown within the Andamooka Limestone may still have an impact on the Yarra Wurta Springs due to a new equilibrium being formed in the local water regime.

Assessment of the potential impacts of the proposed expansion on the Yarra Wurta Springs would benefit from long-term regional groundwater monitoring data to refine the calibration of the transient groundwater model in the area.

For an assessment of the groundwater dependent ecosystems-specific impacts on the Yarra Wurta Springs, see Section 4.4.4 of this chapter.

In conclusion, the AR considers there is a low risk that declines in the regional groundwater level in the Andamooka Limestone from the proposed expansion would have an impact on the Yarra Wurta Springs. However ongoing work should be undertaken to further understand the spring's hydrogeology and regional groundwater monitoring should occur to identify and manage any potential impacts.

Great Artesian Basin (GAB) Springs

Information presented in the SEIS, along with other relevant technical information shows that the hydrochemistry of groundwater from the artesian portion of the GAB, which supports the GAB Springs, has a different signature to the groundwater hydrochemistry in the Stuart Shelf, Arckaringa Basin and non-artesian portion of the GAB.

Conceptualisation of the regional groundwater regime has the Torrens Hinge Zone acting as a divide/buffer between the Stuart Shelf and the GAB. Aquifer parameters used in the modelling have been set to reinforce this concept. Modelling results, including sensitivity analyses, show that the proposed development would have negligible drawdown impact on the Torrens Hinge Zone and subsequently the GAB Springs.

Field work was presented in the EIS to support the determination aquifer parameters for the Torrens Hinge Zone and provide support for the existence of the groundwater divide separating the flow patterns of the Stuart Shelf from the artesian portion of the GAB. Regional groundwater contours (SEIS Figure 12.8) indicate that the inferred direction of groundwater flow is from the Torrens Hinge Zone northwards to the GAB, as groundwater elevations for the GAB aquifer are up to 10m lower than the inferred groundwater contours.

BHPB modelling results indicate that a drawdown of >2m may occur in the Andamooka Limestone abutting the Torrens Hinge Zone 500 years after mine closure, thereby maintaining a positive flow pattern towards the GAB. Sensitivity analyses for the Andamooka Limestone aquifer parameters indicate that declines in water levels in the order of >8m could occur at the Andamooka Limestone/Torrens Hinge Zone interface, whilst still maintaining a positive flow towards the GAB. In addition, sensitivity analyses for Torrens Hinge Zone aquifer parameters indicate minimal change in drawdown across the Torrens Hinge Zone. The 'impermeable' nature of the Torrens Hinge Zone prevents the drawdown levels in the Andamooka Limestone extending to the GAB.

In conclusion, the AR considers that a low probability exists for hydraulic effects on the Great Artesian Basin springs located to the north, northeast and east of this area to be impacted by the drawdown of groundwater levels in the Stuart Shelf aquifers as a result of Olympic Dam Expansion activities. However, regional groundwater monitoring should be undertaken to validate the model predictions and identify any potential impacts that need managing.

RECOMMENDATION

The AR recommends the following conditions to manage potential impacts to the Yarra Wurta Springs and GAB from the proposed Olympic Dam expansion:

- The proponent must prepare a Regional Groundwater Management and Monitoring Program (RGMMP) for the GAB and Yarra Wurta Springs to manage potential impacts from the Olympic Dam Expansion, for approval by the Indenture Minister, within 12 months of the date of this decision. The Regional Groundwater Management and Monitoring Program must include the following:
 - Ecological monitoring, measured spring flow rates (taking into account local variations in barometric pressure, tidal influences and evaporation rates), open pit dewatering volumes resulting from both the dewatering activities and pit inflows, groundwater levels, salinities and water chemistry and comparison between baseline measurements and ongoing monitoring;
 - The proponent must implement the approved Regional Groundwater Management and Monitoring Program;
 - Monitoring data must be used to update the Regional Groundwater Management and Monitoring Program, the regional model (as required above) and to develop trigger points for action; and
 - If an update of the regional groundwater model and/or monitoring indicates that a trigger point is reached, the proponent must develop mitigation strategies and, if necessary, contingency options, such as a possible relocation of Lake Eyre Hardyheads to an alternate habitat.

The following notes are also recommended:

- If the action triggers are exceeded during extraction from the Motherwell Saline Wellfield, and, in the opinion of the Indenture Minister the exceedence constitutes a significant risk to the environmental values of the Yarra Wurta Spring complex, the Minister may direct the proponent to cease extraction from the Motherwell saline wellfield, or to take action to maintain pressure levels.
- In order to achieve the requirement for the preparation and implementation of the RGMMP, the results of monitoring within the Yarra Wurta Springs and GAB Springs, should be reported in the annual Environmental Management and Monitoring Report, including updated research as follows:
 - The significance that declines in groundwater levels in the Andamooka Limestone may have on the Springs;
 - The groundwater processes supporting the Yarra Wurta Springs;
 - Regarding the structural controls that exist between Yarra Wurta Springs and the open pit; and
 - The storage buffering of Lake Torrens to the drawdown of groundwater levels within the Andamooka Limestone.

Potential impacts on third-party users

A total of 14 groundwater wells were identified by BHPB within the extended study area surrounding Olympic Dam, of which:

- 7 are located on pastoral leases held by BHPB;
- 4 are located on Parakylia Station; and
- 3 are located on Parakylia South Station.

All wells have been constructed in either the Andamooka Limestone or Tent Hill aquifers. All non-BHPB wells are located to the west of Olympic Dam, 50km-plus of the SML boundary.

Groundwater level drawdown, as determined by the calibrated groundwater model, within the Tent Hill and Andamooka Limestone aquifers would be expected to develop slowly and extend between 20km to 45km from Olympic Dam during operation and 500 years post closure (SEIS Section 12.5.7). Modelling results indicate that no third-party groundwater users would be expected to be influenced by the expanded operation at Olympic Dam up to the year 2150 (SEIS Section 12.5.7)

Groundwater modelling to 500 years post closure shows that drawdown impacts ranging from less than 1m to up to 4m could potentially occur at the 12 private (non-BHPB) wells (SEIS Section 12.5.7). However, sensitivity analyses indicate that declines in aquifer water levels in the order of up to 9m could occur at these wells 500 years post closure. Declines in aquifer water levels of up to 1m could be expected 50 years after commencement of operations (SEIS Appendix F4 – Figures 6.25 – 6.27). No salinity changes are anticipated at any of the private wells.

Well life expectancies are in the order of 50–100 years, therefore drawdown impacts are not anticipated before wells are due to be replaced. The significance of this is that the replacement wells (if they are to be replaced) could be drilled and constructed according to the groundwater conditions at the time of construction. Therefore there is a low probability that the proposed expansion would impact on the ability of existing third-party users to take water from their wells.

BHPB has committed to monitoring groundwater quality and quantity within a selection of operating wells within the Olympic Dam region. If monitoring results indicate that third-party users are likely to be affected by drawdown resulting from the proposed expansion, alternative water supply options would be investigated, in consultation with the affected party. Options would include:

- Relocating or deepening the affected well; and/or
- Providing an alternative water supply.

RECOMMENDATIONS

The AR considers only a low probability exists for drawdown impacts to affect pastoral usage from private wells resulting from the proposed expansion. To ensure the protection of third-party water users, the following condition is recommended:

- Outside of the Designated Areas prescribed pursuant to the Olympic Dam Indenture, the proponent must offset drawdown impacts to existing third-party users identified in the EIS resulting from the proposed expansion during the operational phase of the mine.

The AR also recommends the following note:

- Clause 13 of the Olympic Dam Indenture makes special provision for the company to maintain water supply to existing third party users within the Designated Area around the water supply wellfields.

4.4.5 Surface water and drainage

4.4.5.1 Issues

The DEIS seeks to protect existing surface water quality. It is considered that the key issue would be the potential impacts to flora and fauna before final closure as a result of surface water run-off containing acid drainage, heavy metals and radionuclides from the surface of the RSF, low grade ore stockpile and TSF into adjacent surface swales.

While surface water is scarce, when available it is used by pastoralists for stock, by native fauna, opportunistically for recreational activities, and also supports aquatic ecosystems that have inherent biodiversity value (DEIS Section 11.4.). BHPB has stated that the design and operation of the proposed expansion has been modified to provide protection of the surface water quality (DEIS Section 11.4.2).

4.4.5.2 BHPB EM Program and commitments

Stormwater discharge

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.4:

- **Objective:** No significant adverse impacts to environmental receptors as a result of stormwater discharges to soil, surface water or groundwater associated with BHPB's expansion activities.
- **Criteria:** All contact stormwater maintained within designated stormwater management areas.
- **Management plan:** To prepare a Stormwater Management Plan, with plans for the construction and operation of the proposed expansion (mining, processing, desalination plant, infrastructure corridors, Roxby Downs and Hiltaba Village) that would incorporate relevant controls, monitoring requirements and mitigation measures (DEIS Section 11.5.1, 11.5.3).

Major storage seepage

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.3:

- **Objective:** No significant adverse impacts to ecological communities as a result of seepage from the RSF and expanded TSF.
- **Criteria:** No loss of native vegetation outside bunded TSF area as a result of seepage to groundwater from the TSF.
- **Management plan:**
 - TSF Management Manual – The existing operating manual for the TSF would be reviewed to ensure that expansion requirements were incorporated; and
 - RSF Management Manual (new) – An operating manual for the RSF would be developed to include controls and contingencies as per this Plan.

4.4.5.3 Assessment

Rock Storage Facility (RSF)

It is considered that the DEIS provided limited information about the potential impacts of run-off from the RSF into the surrounding swales. It is considered likely that these swales would support regional and in-situ ecosystems. In response to these concerns, follow-up hydrological and pollutant transport studies were completed for the SEIS. This work used two separate modelling approaches to examine infiltration and run-off from the RSF, both of which applied a conservative approach to the generation and mobilisation of potentially contaminated run-off/leachate. The outcome of these studies states that run-off would be possible to surrounding swales, with the potential to impact on the water quality from elevated pollutant concentrations.

Some mitigation strategies were discussed in the SEIS including progressive treatment of the RSF surface to enhance ponding and delay run-off. The most effective strategy proposed by BHPB is an engineered structure to retain 1-100 year stormwater flows. Such structure(s) are proposed to be constructed at suitable points that will avoid contaminated runoff leaving the area of the Special Mining Lease.

Tailing Storage Facility (TSF)

The DEIS presented detailed design reports and analysis of the potential for near surface lateral seepage through TSF walls and potential impacts on surface water quality (Appendix F1). These designs incorporated both upstream and downstream toe drains around the TSF to enable capture of near surface lateral seepage. Furthermore, the embankment would include an internal limestone barrier/cut off drain and basal collector to mitigate seepage, should a high water level occur in the TSF pond.

BHPB has acknowledged that the geotechnical investigations used to predict seepage control of the TSF only represent areas of the TSF that would have similar or better conditions to that determined from the geotechnical investigations undertaken (DEIS Appendix F1). Further, given the large scale of the TSF there would be areas that would differ in seepage, which would require closer supervision during construction. It is considered that operational monitoring of the TSF would be required, and where necessary mitigation of any near surface lateral seepage through TSF walls.

The current Olympic Dam Environmental Management Program provides that areas of lateral seepage are identified during regular inspections around the perimeter of the TSF, with this seepage captured in interception systems and returned to the TSF or evaporation ponds. In this regard, the proposed draft Environmental Management Program (DEIS Appendix U, ID 4.3) states that ongoing monitoring of the TSF and RSF would be necessary to ensure controls are functioning properly and the environment is not at risk.

This AR considers that the impacts of the TSF and RSF on surface waters and sub-surface waters will be acceptable, subject to the measures proposed in the FEIS and the conditions recommended below.

RECOMMENDATION

The AR recommends the following conditions to address surface water impacts:

- The proponent must prepare and implement a Site Groundwater and Surface Water Monitoring Program designed to achieve the following outcomes as measured against the respective approved criteria, for approval by the Indenture Minister, before commencing construction of the RSF or TSF:

OUTCOME	CRITERIA
No adverse impact on local drainage patterns and water quality that would compromise existing users or water dependent ecosystems.	<i>Compliance criteria: Any surface water outside of containment structures designed to manage runoff must comply with the Environment Protection (Water Quality) Policy 2003</i>

- A report by a suitably qualified independent consultant which certifies that the final designs for the TSF and RSF are likely to achieve the outcomes contained within the Surface Water Monitoring Program, when measured against the respective approved criteria must be provided to the Indenture Minister prior to commencement of construction of the TSF and prior to the placement of rock within the RSF.

The AR also recommends the following notes:

- Each portion of the RSF, including the proposed low grade ore stock pile, should incorporate an engineered structure designed to capture all the run-off from the RSF during a 1-in-100 year rainfall event and avoid contaminated runoff leaving the area of the Special Mining Lease.
- Each TSF cell should include upstream and downstream toe drains to manage near surface lateral seepage (i.e. capture the seepage). Measures should be put in place to manage any observed seepage from the toe drains for the TSF cells, to reduce the potential for surface water impacts. These measures should include the transfer of captured seepage in interception systems to be returned to the TSF or evaporation ponds.
- Licence conditions that relate to monitoring and management of such surface water containment facilities may be imposed under the *Environment Protection Act 1993*.

4.4.6 Solid waste

4.4.6.1 Issues

New waste management centre

An area of around 560,000m² would be assigned for the future development of a new waste management facility which would be suitable for around 60 years of the operation life of the mine at the predicted waste generation rates (DEIS Section 5.6.2 and SEIS Section 5.4.1). The DEIS stated that the new waste management facility would consist of:

- A transfer station to be used for waste segregation;
- A recyclable/reusable materials store located near the rail head; and
- A general waste landfill facility of approximately 56ha for industrial wastes with a small content of putrescibles. Cover to the landfill would be provided on a daily basis with construction of waste cells in accordance with EPA guidelines.

The proposed landfill facility would be designed and operated in accordance with the relevant sections of the EPA Guidelines: *Environment Management of Landfill Facilities (Municipal solid waste and commercial and industrial general waste)* dated January 2007 (SEIS Section 5.4.1). Potential risks are proposed to be reduced through the:

- Negligible proportion of putrescibles;
- Low rainfall climate;
- Separation from ground and surface water bodies by a greater margin than that specified in the SA EPA Guideline;
- Largely inert composition of the waste stream;
- Significant current and proposed resource recovery activities; and
- Promotion of waste management practices that divert the hazardous waste stream to alternative locations, and appropriate methods for recovery, treatment and disposal.

General waste and used tyres

Approximately 8000tpa of waste tyres, principally from haul trucks required for the open-pit operation, would be generated from the proposed expansion - currently 25/tpa - when operating at full capacity (DEIS Section 5.6.3 and SEIS Section 5.4.3). The waste tyres have the potential to cause adverse environmental impacts if they are not properly managed and disposed of.

The DEIS and SEIS stated that the preferred practice for the management of waste tyres would be to:

- Implement programs to increase the life of tyres;
- Retread or repair, where possible;
- Use waste tyres for industrial purposes such as berms, road demarcation and fencing;
- Treat waste tyres using energy recovery technologies such as incineration, co-combustion, tyre-derived fuel, pyrolysis, gasification, shredding and granulation; and
- Disposal in the RSF in a documented location.

The SEIS identified that if a recycling solution for the used tyres could not be found, disposal to the RSF would be required. Appropriate management practices would be applied to mitigate the following risks, including:

- Stability issues in the RSF if tyres are stacked too high;
- Metal leaching if the tyres are shredded before disposal; and
- Potential fire hazard if tyres are not covered with inert material.

The draft General Waste and Used Tyre Management Plan identifies the need for a waste monitoring program to ascertain volumes of waste for each waste type generated and volumes of waste avoided/reduced and recycled as part of monitoring performance of utilising the waste hierarchy (SEIS Appendix N6). This would include the amount of reused tyres versus tyres encapsulated in the RSF.

Acid plant catalyst fines

Approximately 225,000 L of acid plant catalyst fines, which would include approximately 6–9% vanadium pentoxide, would be generated by the acid plant gas converters every three years as part of the expanded operation (DEIS Section 5.6.6. and SEIS Section 5.4.2). The waste catalyst fines have the potential to cause adverse health and/or environmental impacts if they are not properly managed and disposed.

The EIS stated that the acid plant catalyst fines would initially be transferred to lined steel drums and stockpiled prior to disposal or recycling. Recycling or reuse options are being investigated by BHPB, however if no suitable recycling or reuse option is found, catalyst fines for the expanded operation would continue to be disposed of in trenches excavated into the TSF, and their location documented, as is the current practice.

The SEIS further stated that BHPB waste management practices, in line with the waste hierarchy, have investigated (and in some cases continue to investigate) several recycling and reuse options for the treatment of catalyst fines, including:

- on-site amalgamation of fines into a useable product suitable for reuse in a gas converter;
- reuse of the catalyst fines in a smaller capacity gas converter;
- return of spent catalyst to the manufacturer for re-manufacturing into catalyst;
- transport of the catalyst to a vanadium producer for processing into a saleable vanadium product;
- two methods of fixation, modification and stabilisation, whereby the vanadium pentoxide base material would be rendered inert through either the modification, or phase change of vanadium pentoxide to vanadium oxide, or the encapsulation of the catalyst material in a non-leachable matrix; and/or
- burial in landfill, or charged into slopes as backfill material together with cement aggregate fill (CAF).

Radioactive waste

Management of low level radioactive waste is considered in the radiation section of this chapter (refer section 4.4.9).

4.4.6.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.6:

- **Objective:** Minimise general waste generated by BHPB's expansion activities and maximise the re-use of general waste where practicable.
- **Criteria:** Increase the proportion of general waste reuse/recycling.
- **Management plan:** BHPB has proposed management plans that include:
 - Landfill Management Plan (new) – the existing waste management plan would be reviewed and would incorporate plans for management of the landfill and the various waste types generated during operation of the expansion, and would incorporate controls, monitoring requirements and contingency measures; and
 - Used Tyre Management Plan (new) – with the large volume of waste tyres to be generated by operations, a specific Used Tyre Management Strategy would be developed for investigations into technology options for strategic use of used tyres.

4.4.6.3 Assessment

New waste management centre

The design and operation of the proposed landfill facility aligned with EPA Guidelines: *Environment Management of Landfill Facilities (Municipal solid waste and commercial and industrial general waste)* would ensure that adverse impacts upon the environment as a result of the management and disposal of waste are minimised. In particular the locality, design and construction of the landfill would enable the impacts associated with the generation and control of landfill gas and leachate to be assessed and managed.

The establishment of the waste management facility is a prescribed activity of environmental significance as per Schedule 1, Part A, 3(3) Waste or Recycling Depot of the *Environment Protection Act 1993*. In accordance with Section 36 of the Environment Protection Act an authorisation in the form of a licence is required to undertake a prescribed activity. Therefore, should the proposed expansion be approved, the company would be required to obtain an EPA licence prior to the receipt of waste at the waste management facility.

In the SA Government's assessment of the DEIS, concern was raised that the proposed location of the solid waste disposal area would be adjacent to the northern part of the existing TSF Cells 3 and 4 in an area where seepage from the TSF is currently being collected and returned to the TSF. Establishing a new solid waste depot at the proposed location has the potential to impact the existing management and monitoring of seepage that is occurring in this area. This issue would need to be considered in the EPA licensing process.

RECOMMENDATION

The AR supports the location of a landfill facility at the minesite and notes that a secondary authorisation under the *Environment Protection Act 1993* would be required. Accordingly, the AR recommends the following notes:

- The landfill facility will require authorisation under the *Environment Protection Act 1993*. As part of the licensing process the EPA will likely require detailed designs, drawings and specifications for the proposed on-site solid waste landfill facility at Olympic Dam prior to such a facility being constructed. Specifically, the EPA will require the following details:
 - Design and proposed construction of new landfill cells in accordance with the SA EPA Guidelines: Environmental Management of Landfill Facilities (Municipal solid waste and commercial and industrial general waste) including:
 - Detailed design drawings;
 - Landfill Construction Quality Assurance Plan;
 - Landfill Construction Management Plan; and
 - Landfill Environmental Management Plan incorporating details of the closure and post closure management.
- Any application for licensing of the new on-site waste landfill should include a risk assessment that considers the location and management requirements of the adjoining TSF.
- 'As construct' reports of the on-site landfill cells must be provided to the EPA for approval prior to waste being deposited within any landfill cell. Refer to the draft SA EPA Guideline *Construction specifications and reports: For landfills, leachate ponds, composting facilities and wastewater lagoons* (2009).

General waste and used tyres

The draft General Waste and Used Tyre Management Plan (SEIS, Appendix N6) states that it would contain strategies to reduce, reuse and recycle all waste material streams where environmentally and commercially satisfactory arrangements are possible. The draft General Waste and Used Tyre Management Plan does not clearly outline which of these strategies would be implemented for which waste streams and how this would align with the management of the solid waste landfill facility.

The AR considers the final General Waste and Used Tyre Management Plan should incorporate all waste streams received at the waste management facility. The final plan would require approval by the EPA prior to construction of the new waste management centre.

The AR considers the proposed preferred practice of implementing programs to increase the life of tyres, retread or repair where possible, reuse tyres for civil engineering applications or as tyre derived fuel are acceptable.

The investigation into the feasibility by BHPB for an on-site recycling process for used tyres (by mechanical or thermal means) during the definition phase of the expansion project, with disposal within the RSF if recycling or reuse is found to be unviable is deemed an acceptable approach by the AR.

In the event that a recycling solution for the used tyres is not found, disposal to the RSF subject to the instigation of management practices to mitigate the risks associated with stability issues, metal leaching and potential fire hazard are acceptable.

RECOMMENDATION

The AR recommends the following note:

- It is likely that a requirement to prepare a General Waste and Used Tyre Management Plan which incorporates all waste streams for the waste management facility prior to receipt of waste at the waste management facility would become a condition of licence under the *Environment Protection Act 1993*.

Acid plant catalyst fines

The AR considers the proposed investigation into the recycling and reuse options for the management of catalyst fines including amalgamation into a useable product suitable, reuse in a gas converter, the return of spent catalyst for re-manufacturing or processing into a saleable vanadium product and treatment to render it non-leachable are acceptable.

In the event that a recycling, reuse or treatment solution for the catalyst fines is not found, disposal to the TSF in excavated trenches with their location documented (as is the current practice) is considered acceptable.

4.4.7 Wastewater from staff facilities

4.4.7.1 Issues

The DEIS indicated that the operation of the open pit mine would require approximately 2500 workers and a 3000 person peak construction/shutdown workforce. Part of the infrastructure required to cater for the workforce would be a sewage system. It is anticipated that a workforce of this size would generate large volumes of wastewater, up to 0.4 ML/d.

The DEIS indicated that wastewater would be handled by a new on-site sewage treatment plant to be located to the north of the concentrator. Class B treated water is proposed to be produced and would be recycled into appropriate process uses.

4.4.7.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EM Program in relation to this issue.
- **Commitments:** No specific commitments made in relation to this issue.

4.4.7.3 Assessment

The DEIS provided limited detail regarding the proposed 2500 equivalent person (EP) on-site sewage treatment plant (Section 5.6.4). Given the location of the proposed sewage treatment plant, and the other activities also being undertaken at the site, environmental issues such as noise and odour are unlikely to be an issue for the proposed sewage treatment plant. The wastewater and solid waste generated from the sewage treatment plant does however have the potential for adverse health and/or other environmental impacts (such as site contamination) if it is not managed appropriately, or not treated sufficiently for their intended use.

The AR supports the development of the sewage treatment facility at the mine site and notes that a secondary authorisation will be required under Schedule 1 of the *Environment Protection Act 1993*, from the EPA. Approval would also be required from the SA Department of Health under the *Public and Environmental Health Act 1987*.

RECOMMENDATION

The AR recommends the following note:

- The wastewater facility will require authorisation under the *Environment Protection Act 1993*. As part of the licensing process the EPA will require detailed designs, drawings and specifications for the on-site sewage treatment system at Olympic Dam and must be provided to the EPA for approval prior to the on-site sewage treatment plant being constructed. Specifically, the EPA will require the following details:
 - Type of wastewater inflows (including an outline of on-site sources) to be accepted into the treatment plant;
 - Maximum design capacity of the treatment plant in ML/d and population equivalents;
 - Type of wastewater treatment plant to be used;
 - Standard of treatment to be achieved;
 - Where and how treated wastewater reuse will occur; and
 - Schematic plans showing location and design of the proposed treatment plant and reuse areas including pipework layout.

4.4.8 Noise and vibration

4.4.8.1 Issues

Noise from the existing underground mining and processing operations was inaudible 14km away at the Roxby Downs township during the baseline noise study (DEIS Section 14.3.1). During the baseline noise study, noise measurements in Roxby Downs township showed that the night-time background noise level is currently approximately 35 decibels (dB(A)).

As noise from the existing mining and processing operations is inaudible, and background noise levels are approximately 35 dB(A), noise from the existing operation comfortably meets the night-time noise criteria of 45 dB(A) in Roxby Downs, as determined in accordance with the *Environment Protection (Noise) Policy 2007* (Noise Policy). Noise from the existing operations was audible at the site of the proposed Hiltaba Village with recorded background noise levels (L_{Aeq}) of between 31 dB(A) and 42 dB(A) (DEIS Section 14.3.2) which were also well within the noise criteria applicable to such an area under the Noise Policy.

Should the project be approved, the closest part of the proposed open pit mining and rock storage facility would be located around 6km from Roxby Downs and 6km from the proposed Hiltaba Village, while the expanded ore processing plant would be located several kilometres further away from both population centres. The AR considers that significant potential noise and vibration issues associated with the proposed expansion include:

- Impact of noise on the proposed accommodation facility at Hiltaba Village and the town of Roxby Downs, particularly with respect to sleep disturbance; and
- Potential impact of ground vibrations associated with blasting operations for the open pit.

4.4.8.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 3.2:

- **Objective:** No adverse impacts to public health as a result of noise emissions from BHPB's expanded operations.
- **Criteria:** Maintain noise from the expanded operations at Olympic Dam to less than 30 dBL_{Aeq} (24 hour) within residential dwellings.
- **Management plan:** A new Noise Management Plan, involving:
 - BHPB has extensive experience in open pit mining operations and managing noise emissions within compliance limits. To achieve compliance from the Olympic Dam open pit during the worst-case weather conditions – as in night-time temperature inversions - operational response plans would be developed for noise generation from mining activities (DEIS Section 14.6); and
 - Existing operational management plans would be updated to confirm the findings of the noise modelling, including:
 - Development of a refined and validated acoustic model based on the as-built mining and metallurgical operations;
 - Installing a meteorological system that incorporates climatic conditions such as wind speed and direction into the acoustic model so that noise levels contributed during operations at Roxby Downs and Hiltaba Village could be predicted;
 - Monitoring of sound at key receptor locations to assess compliance with the adopted criteria and to ensure the reliability of the acoustic model; and
 - Implementing an operating response plan for situations where noise levels were predicted to exceed the compliance criteria (DEIS Section 14.5.2).
- **Commitments:** BHPB would maintain noise levels generated from the expanded mining and processing operations to below 45 dB at the exterior of residential dwellings in Roxby Downs and Hiltaba Village (SEIS Table 2.1 Commitments, page 55).

4.4.8.3 Assessment

Noise

The AR seeks to ensure that the proposed development achieves an outcome of no measurable health or amenity impacts to Roxby Downs and Hiltaba Village residents from noise. BHPB are obligated to meet the requirements of the *Environment Protection Act 1993* and *Environment Protection (Noise) Policy 2007* (Noise Policy), and any subsequently updated versions. This includes criteria for industrial noise (noise sources associated with the operation of the mining and metallurgical operations), as well as requirements for construction and site preparation noise. Due to the unique circumstances of Hiltaba Village, it has been agreed by the SA EPA and BHPB that World Health Organisation (WHO) Guidelines for Community Noise 1999 should be adopted 24 hours per day in recognition of the requirements of shift workers (DEIS Section 14.2).

Under temperature inversion conditions, noise levels from the expanded operation would reach 43 dB(A) and 42 dB(A) L_{Aeq} at Roxby Downs and Hiltaba village respectively (DEIS Section 14.5.2). Based on these predictions, noise from the expanded operation at Hiltaba Village would comply with the selected criteria, whilst noise at Roxby Downs would exceed the selected criteria under temperature inversion conditions. Under all other meteorological conditions, the DEIS indicated that compliance would be achieved at both Roxby Downs and Hiltaba Village.

Subsequent to the publication of the DEIS, a number of minor modifications were made to the expanded operation layout (SEIS Section 15.1). Under the proposed configuration, the SEIS stated that noise from the expansion would exceed the selected noise criteria at both Roxby Downs and the proposed Hiltaba Village. Noise levels would reach 44 dB(A) at Roxby Downs and 48 dB(A) at Hiltaba Village under temperature inversion conditions (SEIS Appendix A6, Attachment C). The SEIS further stated that conditions conducive to the formation of temperature inversions would be expected to occur about 95 nights per year, for a few hours each night. In accordance with the *Guidelines for the use of the Environment Protection (Noise) Policy 2007*, this weather pattern is significant enough to warrant further consideration.

The predicted noise levels for Roxby Downs and Hiltaba would be in excess of the relevant night-time noise criteria applicable under the Noise Policy by 4 dB(A) and 3 dB(A) respectively. The SEIS noted that the most significant potential contribution to noise in Roxby Downs and Hiltaba would be generated by the horn on the CAT797B trucks. In response, the SEIS recommended that CAT797B horns not be operated in the Mine Maintenance Industrial Area (MMIA) during night-time hours under adverse weather conditions, or a temperature inversion (SEIS Appendix A6, Attachment C).

Alternatively, it was recommended in the SEIS that an acoustically treated workshop be constructed for the testing of loud equipment (such as the CAT797B horn). Without the operation of the horn, the SEIS stated that noise levels of 43 dB(A) and 44 dB(A) under temperature inversion conditions are predicted for Roxby Downs and Hiltaba Village respectively.

The AR supports the mitigation measures proposed in the SEIS.

Assuming compliance with the above recommendation, compliance with the Noise Policy and the WHO Guidelines for Community Noise (assuming attenuation across the building façade of greater than 15 dB(A)) would be achieved at Hiltaba Village, and the night time criteria exceeded in Roxby Downs would occur on some occasions by up to 3 dB(A).

The overall time during which this exceedence is likely has been predicted to comprise approximately 10% of the year (by duration). In situations where criteria are predicted to be exceeded, noise predictions show that the WHO Guidelines for sleep disturbance would still be met at both Roxby Downs and Hiltaba Village. Clause 20 of the Noise Policy allows for certain considerations to be made where predictions indicate a likely exceedence of the relevant noise criteria.

RECOMMENDATION

The AR considers that such a minor level and frequency of exceedence of the relevant noise criteria is acceptable in this situation. No condition has been recommended. However, the following note has been recommended:

- In order to achieve relevant criteria prescribed in the *Environment Protection (Noise) Policy 2007* truck horn testing within the mine maintenance and industrial areas at Olympic Dam may require a warehouse-type building with suitable acoustic insulation to reduce noise emissions.

Hiltaba accommodation

In response to queries regarding the noise attenuation to be achieved inside the Hiltaba Village accommodation, as well as the modelling criteria (and whether it considered all noise sources), the SEIS stated that it had been demonstrated that, with the windows closed, the proposed accommodation units would reduce external noise levels within the accommodation by between 24 and 30 dB(A) (SEIS Section 15.1). Based on the predicted external noise levels at Hiltaba Village, this would ensure that noise levels within the accommodation units would not exceed 30 dBL_{Aeq}, in accordance with the WHO Guidelines for Community Noise.

The AR considers that this approach is appropriate given the harsh weather conditions anticipated at Hiltaba Village, and the likelihood that an employee or contractor suffering sleep disturbance would not leave the window open.

RECOMMENDATION

The AR recommends the following condition be attached to the approval for Hiltaba Village:

- Accommodation units at Hiltaba Village must be designed and constructed so that external noise sources do not exceed 30dB(A) when measured within sleeping areas at all times of the day when windows are closed.

Vibration

The DEIS indicated that vibration levels for the proposed operation have been assessed in accordance with the provisions in AS 2187.2 (Storage and Use of Explosives). This standard specifies ground vibration limits (peak particle velocity (PPV)) for residential zones of 5 mm/s for 95% of blasts, and 10 mm/s for the remaining 5% of blasts. The PPV is used to represent the intensity of the ground vibration.

It should be noted that the human body typically can detect PPV of 0.2 mm/s with levels of 1.0 mm/s being clearly perceptible (International Standard Organisation ISO10137 1992). The PPV needed to cause cosmetic building damage to ordinary structures varies in worldwide standards from 5–50 mm/s (*Effects of Mine Blasting on Residential Structures*, EF Gad, et al, 2005). The assessment presented in the DEIS indicated that ground vibrations at Roxby Downs and Hiltaba Village would be expected to be 0.5 mm/s, which is well within the limits. Therefore ground vibrations may be felt by persons at Roxby Downs and Hiltaba Village despite being within the acceptable levels.

Blast overpressures at Roxby Downs and Hiltaba Village would be expected to be 109 dBL, which are below the standard of 115 dBL for 95% of blasts per year with a maximum of 112 dBL.

The AR seeks to ensure that the proposed development achieves an outcome of no damage to public infrastructure and buildings that compromises their safety and utility or public amenity in accordance with applicable Australian Standards.

RECOMMENDATION

The AR concludes that blast vibration and overpressure levels are expected to be within the applicable Australian Standard. It recommends the following condition:

- The proponent must achieve the human comfort criteria defined in the Australian Standard AS2187.2 (2006) (or as amended) and monitor and report air blast overpressure and vibration levels in Roxby Downs and Hiltaba Village to demonstrate ongoing compliance with that standard.

4.4.8 Visual amenity and landscape character

4.4.8.1 Issues

The DEIS described the existing landscape character surrounding the mine site as mainly desert landscape of open woodland and shrubland on dunes and sandplains, and low shrubland on inter-dune swales and gibber plains, gently undulating in parts.

The current mine has several visual features, including the metallurgical plant, TSF, associated infrastructure including roads, office and workshop buildings and electricity transmission lines. The existing TSF is visible from at least 5km away and the metallurgical plant and smelter stacks create tall industrial features that are visible from Roxby Downs and up to 30km away in Andamooka.

The DEIS considered a number of key viewpoints in assessing the visual amenity of the proposed mining expansion, including:

- To the east on Andamooka Road (approximately 12km away), and from the Andamooka township;
- The northern fringe of Roxby Downs approximately (10km away);
- The Olympic Dam Village and existing airport;
- Roxby Township;
- Sunset Picnic Ground (a community recreation area); and
- The Arid Recovery which abuts the proposed RSF area to the north.

The DEIS assessment looked at the ability of the landscape or existing infrastructure to absorb the visual impact of the proposed expansion. It stated that when siting the Roxby Downs expansion area, some of the natural dunes and vegetation would be retained to minimise the potential impacts on visual amenity from the mine and processing facility, in particular the visually dominant RSF and TSF. A number of measures were discussed in the DEIS (Section 20.5.3) to minimise potential visual impacts from the mine and processing plant expansion, including:

- Encouraging the selection of appropriate building colours for infrastructure that suit the surrounding landscape;
- Establishing appropriate landscaping to provide screening; and
- Rehabilitating access tracks, lay-down areas and construction worksites as soon as possible after construction activities.

4.4.8.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** No specific commitments were made by BHPB in relation to this issue.

4.4.8.3 Assessment

The metallurgical plant and associated infrastructure would be an extension of, or adjacent to existing facilities with the tallest smelter stack being 90m in height. It is considered that the expansion would be a continuation of an existing large industrial site in an arid environment, and as such the AR concurs with the DEIS that the residual visual effect would be negligible, as the proposed expansion to the plant would blend with the existing industrial nature of the environment.

The AR concurs with the assessment provided in the DEIS that the proposed RSF and expanded TSF would be not dissimilar in shape to a mesa, which are characteristically flat topped with relatively steep sides, and are a natural occurrence in the arid zone of South Australia. The closest examples of mesas to the site are those located at the Breakaway Reserve near Coober Pedy. The visual effects from the proposed RSF and TSF would be quite substantial making them the most

dominant feature in the local and regional landscape, with a visibility of up to 30km from the site. This would largely be due to the contrasting variation in the series of extremely large horizontal terraced forms of the RSF and TSF to the open flat/undulating expanses surrounding them. Viewed at ground level the TSF would have a low flat profile, the red sandy colour of which would be similar to the surrounding sands and earth. The RSF colours would vary from red to white to grey depending on its geological composition. From an aerial perspective the RSF, TSF and open pit would be highly visible, expanding the extent of the existing landmark location.

Despite the visual intrusion, the AR considers that the open pit, RSF and TSF have the potential to become attractions for tourists interested in viewing the operations or final land forms post closure.

The Arid Recovery area would be 500m from the RSF at its southern edge and when viewed from the viewing platform within the Arid Recovery, the RSF would have significant visual impact. From close up, the surface of the RSF would appear unnatural. However, it would provide an effective screen to the industrial infrastructure, which may assist in improving views from the Arid Recovery area.

The DEIS refers to the preservation of numerous dunes and natural vegetation around Roxby Downs, with dune heights in some locations being up to 6m high. The overall visual aspect would be one of a succession of low ridgelines. Roxby Township is in effect moderately screened from the visual prominence of the mine infrastructure, RSF and TSF due to this and its many trees. Hiltaba Village and the new airport would be closer to the mine than Roxby Township and as such the distant views of the vertical infrastructure of the mine would be visible as the landscape is more open with less vegetative cover and smaller dunes.

RECOMMENDATION

In conclusion, the continuing presence of the mine as a dominant visual feature of the landscape results from the fact that it is in a visually exposed location, comprising man-made elements in a natural landscape of open and vegetated expanses. It has existed there for many years, and the AR considers that the additional infrastructure would be consistent with the existing industrial landscape.

The AR concurs with the DEIS that when viewed from a distance it would be possible that the RSF and TSF mounds would not be dissimilar to a natural mesa landform, and that the open pit, RSF and TSF could become potential tourist attractions both during operations and post closure of the mine. No conditions have been recommended.

4.4.9 Radiation

The DEIS (Table 6.4) outlined the role of the *Radiation Protection and Control Act 1982* (RPC Act) in relation to other legislation applying to the expansion proposal and the requirement for a licence to conduct the activities.

The primary condition of the RPC Act licence (known as LM1) is compliance with the *Commonwealth Code of Practice on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)*. A requirement of the Code is that the operator must have an approved occupational Radiation Management Plan (RMP) and an approved environmental Radioactive Waste Management Plan (RWMP) to protect the environment and ensure radiation doses to workers and members of the public are not only below relevant limits, but also are as low as reasonably achievable as low as reasonably achievable, economic and societal factors being taken into account (ALARA). The DEIS Sections 2.11.6 and 24.4.6 noted the incorporation of the RWMP within the Olympic Dam Environmental Management System (EMS).

4.4.9.1 Issues

The proposed expansion has raised a number of issues relating to the possible impact of major project components on occupational, environmental and public radiation exposures, during the operational and post-closure stages. The following is an assessment of the significant radiation issues raised in submissions on the DEIS, and proponent responses associated with new, or changed, major project components and impact areas.

Occupational exposures

Open pit

The proposed expansion will involve the construction of a pit, which in 40 years time will be approximately 4km in diameter and 1.2km deep. Workers involved in the mining and movement of the low grade uranium ore and waste rock from the pit would be exposed to radiation via the same exposure pathways as workers in the underground mine. That is, exposure to external gamma radiation through working on the ore body on the pit floor, inhalation of long lived alpha emitting dusts, and inhalation of radon decay products (RDP). However, as there are no existing open pit uranium mines of this scale, there is some uncertainty in estimating the resulting worker radiation exposures. There is therefore a risk that maximum radiation exposures of workers in the pit may exceed the 10 millisievert per year (mSv/y) dose constraint.

In particular, there is a risk of insufficient pit ventilation to routinely remove radon and its radon decay products and ensure annual doses to workers are kept below the 20mSv annual limit, or below the 50% dose constraint target value.

There is also a risk that the anticipated increase in RDP dose conversion factor, indicated by the ICRP in its statement of November 2009, may result in estimated doses to workers in the pit exceeding the annual dose limit, or dose constraint

The DEIS stated that real-time RDP, dust and gamma monitors could be employed, along with mechanical ventilation of targeted areas, PPE, the use of filtered air in mobile equipment and shift controls, could be used to further minimise dose as required.

Exposure to gamma radiation

The annual doses to workers in the proposed Olympic Dam pit from gamma exposure are expected to average less than 2mSv, ranging up to about 4mSv (DEIS Appendix S 2.2.2). This estimate is based on geometry of the ore body, ore grade and exposure times. The maximum gamma dose (approximately 4mSv/y) is found in the Ranger pit where the ore grades are five times higher and hence, the maximum value estimated for the Olympic Dam pit would be a very conservative estimate (SEIS Appendix M1.2.1).

Exposure to radioactive dust

Exposure to long lived alpha emitting dusts arises from any ore breaking activity and from the crushing, movement and stockpiling of the ore and the lower activity overburden material. Dust generation in the pit, and particularly the movement of dust within the pit atmosphere, was discussed and modelled in the DEIS Section 13.3.5 and Appendix L2.

Dose estimates were based on comparisons with other open pit operations around the world, conservative assumptions including average ore grade, reduced particle size (1µm AMAD compared with 10µm measured in the underground mine), and near maximum probable dust concentrations (0.3mg/m³) (DEIS Appendix S and SEIS Appendix M1.2.2). The SEIS stated an estimated average dose from dust exposure in the pit could be up to 0.4mSv/y. Based on the above assumptions the 'worst case' or maximum dust dose for a full time pit worker was estimated to be around 1.7mSv/y.

Exposure to radon decay products

This AR considers the greatest uncertainty in total dose estimation for pit workers lies in radon decay products (RDP) exposure as this strongly depends on variable factors such as pit geometry (i.e. area of exposed ore), ore grades, radon emanation rate from ore, overall pit air changes, local air movement within the pit itself, and available control options.

The DEIS stated pit worker RDP doses would be at most, 2.3mSv/y. Additional supporting information on the theoretical basis for radon emanation rate estimates and the modelling methods used to estimate RDP doses was provided in SEIS Appendix M1.2.3.

Based on presumed pit dimensions at 40 years and radon emanation rates for different uranium ore grades, the DEIS determined a total radon production rate for the pit. The DEIS then examined potential RDP exposures to pit workers under three ventilation conditions.

First, the average radon concentration was calculated for the entire pit. The DEIS (Appendix S 2.2.2) and SEIS (Appendix M1) then used a simple air change model (Thompson) to predict air change in the pit, gross radon and RDP concentrations, and hence worker doses. This indicated an average RDP dose for workers of 0.14mSv/y. This figure was then doubled to 0.3mSv/y to further account for possible poor ventilation in the pit.

Second, an estimate of RDP concentrations was made assuming temperature inversions form in the pit on 25% of the nights of each year. The modelled inversions effectively placed a 'lid' at 100m over the workers in the base of the pit for a period of 12 hours. The SEIS (Section 26.2) stated that under these conservative assumptions and expected work rosters, workers in the pit might receive an additional dose of 1.8mSv/y. The SEIS implied that this would result in an average RDP dose of around 2mSv/y (1.8mSv/y + 0.3mSv/y).

Third, the SEIS (Section 26.4.2) noted a 'worst case' estimate in which the pit ventilation rate was 10 times lower than expected, resulting in average RDP doses of 1.4mSv/y. With inversion conditions added (1.8mSv/y), the total average dose would be around 3.2mSv/y.

An additional factor to be considered is the proposed doubling of the RDP dose conversion factor as outlined by the ICRP⁶ in its 2009 statement on radon. This would imply that the estimated average RDP doses for pit workers under the 'worst case' conditions noted above, could reach 6.4mSv/y.

The SEIS (Section 26.4.2) stated that the impact of the proposed RDP conversion factor changes would be low, and the predicted total pit doses from all sources would still be below the annual 20mSv dose limit although reaching approximately the 10mSv/y dose constraint under the most conservative conditions.

Underground mine

The DEIS states that the major exposure pathways in the existing underground mine are inhalation of radon decay products (RDP) and external gamma ray exposure. Inhalation of radioactive dust contributes around 5% of total dose. The average dose for the period provided in the DEIS was stated to be 3.5mSv. The DEIS states that the most exposed work group was raise drillers, with an average dose of 5.9mSv, and the highest annual dose for an individual for this period was 9.9mSv.

There is a risk that radon released at the surface from the open pit and RSF may enter the underground mine via the ventilation intakes thereby significantly impacting on levels of radon decay products in the underground mine.

⁶ *International Commission on Radiological Protection (ICRP)*

The SEIS (Section 26.2.1) considered the possibility that overall RDP exposures may increase slightly through radon from surface facilities being drawn into the underground mine ventilation system. The SEIS stated that modelling predicts surface radon concentrations in the vicinity of the plant will increase to approximately 100Bq/m³. Assuming this air is in equilibrium when drawn underground, average doses underground may increase by up to 1.4mSv/y, assuming no change to existing controls underground.

The SEIS stated that the current method of exposure control (i.e. to restrict access to areas of temporarily elevated radon levels) will be sufficient to manage any such increase in RDP concentrations, although this may result in an increased number of area activity shutdowns.

Processing plant

The DEIS (Appendix S 2.3) states that doses to workers in the existing plant averaged 2.4mSv for the 2001 – 2007 period. The DEIS examined plant radiation exposures in two parts: exposures to smelter workers and doses to other plant workers due to distinct differences in exposure pathways between the two groups. The DEIS states that radon decay product (RDP) exposures were consistently low for all plant workers and contributed less than 10% of the average dose for the period.

The DEIS states that gamma exposures are more significant in the remainder of the plant and average doses for the period consist of approximately 2mSv/y in the concentrator, 1.4mSv/y in the hydromet section, 1–2mSv/y in maintenance and services work groups, 0.9mSv/y in the refinery and 0.5mSv/y for administration workers.

The proposed expansion will require the optimisation of the existing smelting to process around 800kt/y copper concentrate to produce 350kt/y refined copper. The existing metallurgical plant will be optimised, and when combined with an additional metallurgical plant, will eventually produce and export 1.6Mtpa of copper concentrate. Uranium oxide production on-site is expected to increase to approximately 19kt/y, via the additional calciners in the new metallurgical plant.

The following risks related to increased radiation exposure have been identified in relation to an expansion of processing activities in the plant as a whole and the smelter in particular:

Increased exposures from large- scale operations

There is a risk of greater worker radiation exposures from additional large gamma, dust and radon sources arising from the increased scale of operations.

The DEIS (Appendix S Section 2.3.2) stated that the proposed expansion would not result in any significant change to the methods of processing ore derived from the open pit compared to current operations, and therefore the sources of occupational exposure to radiation in the proposed metallurgical plant were expected to be similar to those in the existing plant.

The DEIS predicted a slight increase in the average doses to plant workers due to the additional dust and radon sources associated with the pit, RSF and associated facilities (<1mSv/y combined). Gamma doses were not predicted to change significantly. The predicted average doses to hydrometallurgical and refinery workers were stated to be between 3mSv/y and 5mSv/y.

As part of the expansion there would be new ore crushing and transfer areas located on the pit rim. The DEIS stated that, allowing for dust suppression and other control methods, workers in this area are expected to receive a maximum of 1.6mSv/y from dust.

The Village and HIA will be demolished to make way for the pit. Doses to workers in the new HIA (to be relocated to 3km south of the current Village), are estimated to be 0.5mSv/y– 0.6mSv/y (SEIS Section 26.4.4).

The DEIS stated that the Administration area (currently subject to the public dose limit) would possibly receive an additional 0.7mSv/y, as a result of dust and radon from the expanded operations, resulting in an approximate average dose of 1.2mSv/y.

Increased exposures in the smelter

The DEIS states that doses to existing smelter workers are dominated by inhalation of polonium-210 (^{210}Po) released in fume from the furnaces during tapping operations (Gamma exposures were generally below 20% of total dose). The annual average smelter dose varied, but reached a maximum of 5.5mSv in 2005 and individual doses reached a maximum of 17.7mSv. The DEIS states that the doses attributed to inhalation of ^{210}Po are 'worst case' estimates as they did not include the effect of wearing respiratory protection, which is mandatory during tapping operations.

The DEIS (Section 22.6.5 and Appendix S 2.3.2) stated that an increase in fugitive dust and fume emissions in the expanded smelter would occur due to the substantial increase in production rate. Additional ventilation systems and other radiation protection measures will be installed around the new facilities (e.g. around tap holes & launders). The SEIS also stated real time sulphur dioxide monitoring equipment would be installed as sulphur dioxide (SO_2) is a good surrogate for ^{210}Po . A ^{210}Po monitor would be installed when available and the SEIS (26.4.1) also outlined a series of design and administrative controls to manage dust and fume in the smelter.

The DEIS stated that it is probable that doses will be higher than recent optimal conditions and an average dose of 5mSv/y and individual maximum of 9mSv/y is predicted. The SEIS (26.4.1) stated that this dose estimate does not incorporate respiratory protection and hence is an overestimate.

Risk of an increase in number of environmentally significant spills and accidental exposures

The SEIS (26.4.5) stated that the number and size of spills may be expected to increase, simply due to the expanded size of the operation. The method used to predict the number of spills was the use of simple scaling from the current frequency of events.

The DEIS Section 22.4.5 outlined the design and operational controls used to prevent spills and the procedures to manage the spills should they occur. The DEIS also stated that hazard and operability (HAZOP) reviews would be conducted for all new and expanded plant during the detailed design stages.

The DEIS also committed to have adequate incident response procedures in place and to comply with existing reporting requirements

Transport

Refer to Chapter 10: 'Infrastructure corridors' for a full assessment of the issues associated with transporting radioactive product.

Environmental exposures

Dust is released from the existing underground mine via the ventilation raises, and from the surface via ore and mullock transport and stockpiles. Process dusts and fume are released from the processing plant. Radon is released to the environment from the underground mine workings, rock stockpiles, plant and TSF. Radionuclides are released to the environment via seepage from surface stormwater ponds and seepage from the TSF. The Annual Licence (LM1) Report provides estimated radon and particulate emission rates for the existing operations.

Air and waterborne transport are two main pathways by which radioactive materials might enter the general environment, as external gamma exposures, such as from stockpiles and tailings, are considered negligible (DEIS Appendix S Section 2.5.1). The receptors are people living nearby exposed through inhalation of dusts and RDP, and flora and fauna exposed via inhalation of particulates and RDP, or their deposition to surface soils and vegetation and subsequent uptake of radionuclides.

Radionuclides from the expanded operation may enter the natural environment via three main pathways; radioactive dust in the air, or via transport in surface water or groundwater. Spills of materials containing radionuclides may also result in localised soil contamination within the SML area. As a result, there would be a risk of unacceptable radiation impacts on flora and fauna arising from the expanded operations.

The SEIS (Section 26.6.1) provided a compilation of data reported over the previous 25 years, and included results from additional fieldwork conducted specifically for the preparation of the EIS. The DEIS (Appendix S Section 2.5.1) notes that waterborne pathways are either non-existent or insignificant in the arid Olympic Dam environment. Groundwater is very saline and does not reach the surface. The DEIS (Appendix S Section 2.5.4) stated that the major pathway for ecological exposure results from long-term dust deposition.

In summary, the DEIS (Section 15.5.9) stated that there is currently evidence of an increase in radionuclide concentrations in soils within and around the SML to the extent of approximately 3km of the operation. Soil radionuclide concentrations beyond that zone were stated to be generally within the range found in the local area and worldwide. The one exception was ²¹⁰Pb where there was an indication of a slight increase in soil concentration over background levels but still within natural background variations observed worldwide.

The maximum predicted soil concentrations within the SML boundary were estimated using an air dispersion model accepted by the EPA and also conservative dust deposition and soil mixing assumptions.

The potential effects of the observed environmental radionuclide concentrations on non-human receptors were investigated using the ERICA screening method⁷ with screening levels derived from doses that have been demonstrated to have a slight impact in most sensitive plant species (based on UNSCEAR levels) and also using the default ERICA screening level.

In conclusion, the DEIS (Section 15.5.9) stated that the radiological risks to non-human biota as a result of increased dust deposition from the expanded Olympic Dam operation will be negligible.

Air transport

The SEIS (Section 26.6) states that recent monitoring confirmed radon levels were elevated near the current operations and fall to background levels at a distance of 4km. Radon levels measured at Roxby Downs between 1987 and 1995 are in the range 5–55 becquerel per cubic metre (Bq/m³). Dust (and fume) is released from both ore handling and subsequent processing activities. A comparison of dust measurements taken at Roxby Downs (SEIS Table 26.19) indicates no significant increase in airborne dust levels since the project began.

Radon and dust releases from the RSF

There is a risk that during operation, radon and dust emissions from the RSF will significantly impact on exposures to people and the environment.

The DEIS (Appendix S 2.5.2) stated that the RSF would be the major source (~73%) of radon released from the expanded operations. The DEIS (5.4.6) stated the RSF would contain non-mineralised and low-grade material with the low-grade material placed so as to permit recovery for future processing should that become economic.

The SEIS noted that modelling of radon release from the RSF assumed a worst-case situation involving open storage of low-grade material with no covering with non-acid forming rock.

⁷ *Environmental Risk from Ionising Contaminants: Assessment and Management (ERICA) developed by the European Commission.*

The SEIS (26.2.2) stated that the radiological impacts of dust emissions from the RSF would be low and that due to the low-grade material involved, dust produced by the operation of the RSF would become primarily a nuisance long before becoming a radiological issue.

The DEIS stated that radon and RDP will be the major source of radiation exposure at Roxby Downs. The DEIS noted that BHP Billiton has committed to a dust management program and will install a real time dust and meteorological system around the mine and towards Roxby Downs and Hiltaba (Appendix U1, ID 3.1) to predict dust concentrations and where necessary, direct remedial action at specific dust sources.

Closure of the TSF and RSF

There is a risk of human radiation exposure post closure arising from inadequate rehabilitation of the TSF and RSF. The SEIS (Section 26.5.1) provided a summary of expected radiation levels based on current closure design objectives aimed at ensuring doses to members of the public would be consistent with existing background levels and less than 1mSv/y.

Final containment of the tailings (and rock storage facility) would be via capping with a suitably thick barrier of non-acid forming mine rock. Ongoing test-work is occurring to determine the optimum depth of material required to minimise radon emanation, minimise water ingress and maintain maximum stability of the resulting landform.

The DEIS (Appendix F1) and the SEIS (Section 26.5.1) indicated that the assessment of radiation doses to people arising from potential failure scenarios for the RSF and TSF post-closure cannot be definitive, as this is dependent on final post-closure cover design and the standards and techniques acceptable at the time of closure. As noted above, BHP Billiton has committed to undertake a structured radiation risk assessment for the TSF (known as a Features, Events and Processes study) in conjunction with relevant regulatory agencies.

The DEIS summarised the potential risks associated with the failure to successfully rehabilitate the TSF and RSF and achieve stable landforms. The risks identified the effects slope erosion and water infiltration for the TSF and RSF and in addition, wind scour for the RSF. The basic design of both the TSF and RSF is intended to ensure long-term stability and thus post closure slope failure was rated as a low risk.

Groundwater

The DEIS (Appendix S Section 2.5) states that around 8Mt of tailings solids and up to 9GL of processing liquor are currently discharged to the TSF annually from the existing operation. The DEIS (Section 5.6.5) also states that some low level radioactive waste (including laboratory waste) is also disposed of in the TSF.

The tailings and processing liquids are held in specially constructed TSF cells (solids) and evaporation ponds (liquids). Around 1.2–3.1 ML/d of liquor is recycled back to the metallurgical operations and around 0.5–1.5 ML/d from the TSF seeps to groundwater where a groundwater 'mound' has formed below the TSF.

The chemical and radiological characteristics of the existing solid and liquid wastes are described in the DEIS (Section 5.5.6, Tables 5.18 - 21). The chemical characteristics (including uranium) of groundwater existing in the mound below the TSF are also summarised in the DEIS (Appendix K4 Table 2.5). The DEIS (Appendix K4, 2.5.3) states that the observed 20m mound in the Andamooka Limestone below the TSF contains uranium at levels higher than surrounding regional groundwater. The DEIS further states that the uranium levels decrease to background values outside the immediate influence of the TSF and evaporation ponds.

In summary, although there is the potential for radionuclides to enter groundwater below the current operations, the DEIS states that this is not a possible source of exposure for the surface environment. Waterborne pathways are subsequently described as negligible.

Seepage from TSF and RSF

Regarding the risk of lateral and vertical seepage of radionuclides from the TSF and RSF eventually leading to impacts on the human and non-human environment during operations and after closure, the DEIS and SEIS (Section 26.2.3) stated that despite seepage expected to occur from the base of the TSF, the contaminants would precipitate within 5m of the base. The SEIS provided evidence that this is due to the neutralising effect of the acidic seepage interacting with underlying alkaline sediments in the underlying geology resulting in precipitation.

The SEIS stated that there would be no impact on workers, members of the public or biota from seepage from the TSF. That is, there will be no surface expression of any potentially contaminated groundwater during operation of the TSF. The maximum lateral movement of groundwater from the area of the TSF is predicted to be 500–1500m before being drawn into the pit.

Lateral seepage through the tailings cell walls is minimised through the construction techniques used and exterior drainage will collect any seepage that did occur for recycling to the TSF. The proposed construction of the RSF involves encapsulation of low grade and more reactive material to minimise acid generation.

The proposed construction of the RSF also requires a base of non-acid forming or acid-neutralising rock to neutralise any acid bearing pore water generated within the structure by percolation of rainwater. The SEIS (Section 26.2.2) stated any resulting seepage from the base of the RSF could occur in very localised areas. It was expected that the radiological contaminants would be strongly attenuated in the calcareous clays and limestone beneath the RSF. The effects of liquor neutralisation and contact with clays and sediments on radionuclide attenuation were discussed in the SEIS Section 26.2.3. The SEIS stated that the RSF seepage rate is expected to be a small fraction of that expected from the TSF for which the DEIS test work has indicated minimal long-term impacts.

Open Pit post-closure

There is a risk that radionuclides in tailings liquor seeping from the base of the TSF during and after operation, and from the underground mine workings post-closure, may accumulate in the pit and present a radiological hazard to people and the environment.

The DEIS predicts that any seepage that does occur from the base of the TSF post closure, will diminish over time and flow to the pit to be captured within a hypersaline lake that is predicted to form in the pit base within 100 years of mine closure. The DEIS (Section 11.5.4) predicts the lake will be several hundred metres deep and in the long-term - more than 3000 years - form a salt crust, isolating the water underneath.

An estimate of pit water quality out to 3000 years, noting that uranium concentrations remained low, is provided in the DEIS Table 11.3. Uranium was the only radionuclide represented in the estimate as it was considered the most soluble of the uranium decay series, and hence the best indicator of radionuclide build up in the pit water (SEIS Section 26.2.4).

The potential impact of water from the closed underground mine workings was not included in the DEIS. However, the SEIS used current uranium concentrations in the groundwater mound below the TSF, and uranium and radium in mine water, to revise the radionuclide estimate for the pit lake. On the basis of conservative assumptions regarding the amount of mine water entering the pit, the SEIS concluded that the resulting radionuclide content of the pit water would be low. The resulting uranium and radium levels to be expected in the salt crust were determined to be equivalent to soil with a concentration of 10ppm uranium-238 (^{238}U). This is within the range of 'normal soils' although slightly higher than the world average (3ppm)⁸.

⁸ UNSCEAR 2000 (*United Nations Scientific Committee on the Effects of Atomic Radiation*)

Radioactive waste management

The existing Waste Management Centre receives relatively small volumes of very low-level radioactive waste in the form of lightly contaminated steel, tyres, plant and equipment, PPE, etc. Potentially recyclable lightly radioactively contaminated material is currently held separately from other waste material. There is a risk of environmental impacts arising from the disposal of low-level radioactive contaminated solid wastes in the proposed landfill.

The 2009 Environmental Management and Monitoring Report (EMMR) notes that low-level radioactively contaminated waste is disposed of in the landfill whereas the DEIS stated (5.6.5) that low-level radioactive waste will continue to be disposed of on the TSF.

The DEIS (Table 5.22) outlined several categories of waste that would be disposed of in a new waste management facility. The DEIS noted that recycling of metal waste would continue provided surface contamination levels for removal from site were met.

Receptors

Members of the public

Doses to people living at Roxby Downs are estimated to be 25 μ Sv/y, consisting of approximately 20 μ Sv/y from RDP and less than 5 μ Sv/y from inhalation of dust (DEIS Appendix S 2.5).

There is a risk that the expanded operations may result in a significant increase in dose to members of the public living at Roxby Downs.

The main pathways for exposure to mine based radiation in Roxby Downs and Hiltaba are inhalation of RDP from radon gas released from the pit workings, ore stockpiles, tailings and from the RSF, and inhalation of dust blown from the pit, processing plant, and RSF.

The DEIS and SEIS confirmed that the expansion of the Olympic Dam mine is likely to result in increased levels of radiation exposure to members of the public in Roxby Downs, Andamooka and the new Hiltaba Village.

The CALPUFF model was used to predict doses at Roxby Downs and Hiltaba Village from dust and RDP exposures arising from the expanded operation (DEIS Appendix S Section 2.5.3). The resulting estimates of total dose were approximately 0.13mSv/y for both locations. Of this, approximately 0.12mSv/y was from the inhalation of RDP. The estimated total dose is well below the public exposure limit of 1.0mSv/y.

The total dose estimated for Andamooka residents resulting from the expansion is 0.015mSv/y (SEIS Section 26.5.1).

Inhalation of RDP

This AR used two alternative air transport models (TAPM and Ausplume) to assess the predicted radon levels (and hence RDP exposures) at Roxby Downs. These models incorporated the same conservative inputs as reported in the DEIS. The models indicated annual average radon concentrations at Roxby Downs of 1.8 Bq/m³ and 2.8 Bq/m³ for the TAPM and Ausplume models respectively. This is less than that predicted in the EIS (3.4 Bq/m³).

RDP dose estimates at Roxby Downs and Hiltaba Village derived from the predicted radon levels, suggest the approximate doses reported in the DEIS are reasonable and suitably conservative.

One additional factor that will influence future member of the public (and worker) doses is the RDP dose conversion factor as recommended by the ICRP. As noted earlier, there is the possibility that the dose conversion factor will change in the foreseeable future.

Inhalation of dust

Annual average dust concentrations at Roxby Downs and Hiltaba Village were estimated in the DEIS (Section 13.3.2) using a standard air dispersion model. The AR considers the assumptions used in the dose estimate (DEIS Appendix S Section 2.5.2) are suitably conservative and the estimated doses (approximately 0.003mSv/y). Although the estimated doses are some 10 times greater than that currently measured, they remain at the limit of detection of the current monitoring methods used⁹ and are a very small fraction of the annual dose limit of 1.0mSv/y.

Ingestion of rainwater and home-grown foods

The SEIS (Appendix M4.2) states that in 2005 and 2006, radionuclide surveys were conducted in the region of the Olympic Dam mine and processing plant. Flora and fauna were sampled and analysed.

The SEIS (Table 26.20) states results for pre-operational flora surveys and noted results of recent surveys in 2005 and 2006. While these studies suggested elevated levels of ²¹⁰Po and lead-210 (²¹⁰Pb) in mulga (*Acacia aneura*) out to a distance of 25km, these results were not confirmed in a subsequent 2009 survey.

The SEIS (Tables 26.21 and 26.22) states that soil radionuclide concentrations (although inherently variable) have not changed markedly over the period of the current operation as a result of dust deposition. The SEIS states that there is no evidence of a trend to increasing soil concentrations over time, indicating minimal impact from the existing operation.

The SEIS (Section 26.6) stated that ingestion of rainwater collected from rainwater tanks at Olympic Dam and Andamooka would result in doses to people that were well within the relevant guidelines¹⁰ and no different to background radiation doses arising from drinking Murray River water.

Consumption of locally grown produce, and native plants and wildlife that contain radionuclides is an additional but minor pathway that has been calculated to result in doses that were no different from background levels.

Ingestion of bush food

Fauna monitoring was originally conducted early in the Olympic Dam project's operation to assess member of public exposure from consumption of animals (SEIS Section 26.6.1). Another survey was carried out in 2006 to specifically examine radionuclide concentrations in kangaroos from within and outside the mine lease area.

The SEIS (Appendix M 4.7) states that only two of 15 cases examined indicated significantly higher radionuclide concentrations in 'mine' kangaroo tissues. The SEIS concluded that no significant differences could be observed between 'control' and 'mine' kangaroo tissues in the majority of samples and that consumption of the fauna would have no effect on human health.

⁹ For example, see the Olympic Dam Environment Management & Monitoring Report - 2010

¹⁰ Australian Drinking Water Guidelines (NHMRC, 2004).

4.4.9.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 3.5 and 4.7:

- **Objective:** No adverse impacts to health of employees or members of the public from exposure to radiation from BHP Billiton's expansion activities
- **Criteria:** Radiation doses to members of the public less than 1 mSv/y above natural background and 20 mSv/y above natural background for designated workers
- **Management plan:**
 - Radioactive Waste Management Plan - there are specific requirements under the Mining Code and these are currently incorporated within the EMS. These requirements are being reviewed and updated to incorporate any additional requirements of the expansion. It is intended that the current RWMP would be updated to encompass the expanded activities.
 - Dust Management Plan (new) – a dust management plan would be developed to record and monitor operational control (ID 3.5).
 - Incident Response Plan – the existing Olympic Dam Corporation Incident Response Plan would be modified to address aspects of the transport of concentrate (ID 3.5).
- **Commitments:** Regarding workforce exposure to radiation (SEIS Table 2.1 Commitments, page 54):
 - BHPB would comply with internationally accepted radiation limits for workers and the public, and would set a goal of maintaining doses at less than 50% of the internationally acceptable annual average limit for workers (20mSv/y – that is, maximum doses to workers should not exceed a dose constraint of 10mSv/y. A dose constraint is a level set as part of the dose optimisation process. It marks the upper value of predicted doses and acts as an operational limit, as opposed to a regulatory limit);
 - BHPB would conduct an International Commission on Radiological Protection ALARA optimisation study during the detailed design phase of the open pit and metallurgical plant;
 - A real-time dust and meteorology monitoring system would be installed at Olympic Dam to predict dust concentrations, which would provide information for operational control of dust;
 - Potentially reactive mine rock would be enclosed within the RSF; and
 - The design of the TSF would incorporate controls to minimise seepage, including:
 - Increasing the volume of liquor recycled from the TSF;
 - Constructing larger cells with greater evaporation capacity;
 - Collecting liquor through a central decant arrangement;
 - Installing a liner beneath the central decant system; and
 - Recycling water from the mound beneath the TSF;
 - Tailings cells would be capped when they reach their design height and when it was safe for vehicles to access the TSF surface; and
 - BHPB would conduct a formal post-closure radiation risk assessment.

4.4.9.3 Assessment

The assessment has been conducted by verifying the estimated radiation doses and environmental impacts using the information provided in the Draft EIS and SEIS or reported elsewhere, by comparison with other similar situations, and through the use of alternate exposure models where possible.

Occupational radiation exposures

Open pit

The three exposure pathways have been assessed separately to determine if total doses to pit workers can be expected to remain below the 10mSv/y dose constraint.

Exposure to gamma radiation

Dose data reported in the 2009 Annual Radiation Report¹¹ confirms that currently, the most exposed underground workers at Olympic Dam are production chargers and raise rig operators with an average gamma dose of around 2.2mSv/y. The DEIS (Appendix S Section 2.2.2) has referenced underground production chargers with an average gamma dose of 3mSv/y. It can be expected that external gamma radiation exposures in the open pit will be approximately half those for the underground mine, as workers will not be surrounded by ore. In addition, the predicted average dose 1.4mSv/y for pit workers is considered reasonable given that open pit gamma exposures are more amenable to control than underground as worker locations have greater flexibility and high-grade areas can be avoided.

The use of a theoretical gamma exposure model¹² (DEIS Appendix S 2.2.2) clearly overestimated actual gamma dose observed in operating pits. When applied to the Ranger mine, the model indicates doses several times higher than those actually observed. However, this model is useful in that it can place a maximum value (around 6.5mSv/y) on gamma dose that might be expected in the Olympic Dam pit.

Allowing for differences in exposure times and significant difference in ore grades, the maximum doses received under similar conditions at Ranger (4.3mSv/y) indicates the maximum predicted gamma dose for Olympic Dam pit workers(4mSv/y) given in the DEIS Appendix S Table S2 is a reasonable estimate (SEIS Section 26.6.1).

This AR considers the predicted gamma dose range estimate to be acceptable given the ore grade, pit geometry, worker exposure times, potential for shielding by large equipment items, comparison with the results from standard exposure geometry models, and comparison with gamma doses from the Ranger open pit uranium operation.

Exposure to radioactive dust

This AR considers that the estimates of radioactive dust exposure within the pit, based on the expected dust composition, assumed dust concentrations and particle size, are considered suitably conservative and demonstrate that exposures from this source will be acceptable. It is noted that no allowance was made for respiratory protection or filtered air in mobile equipment in the dose estimates. These factors would greatly reduce actual dust exposure.

Exposure to radon decay products

This AR considers that the DEIS and SEIS provided sufficient detail, incorporating a number of conservative exposure assumptions, for a cautious RDP dose estimate to be made for workers in the pit.

For the purposes of this assessment, the total radon production rate for the pit at 40 years was calculated using the basic assumptions provided in the EIS regarding pit geometry at 40 years and emanation rate data in Table 3 (SEIS Appendix M1.5). These calculations verified the EIS estimates. In particular, using these assumptions, the predicted average RDP concentration in the pit and under 'normal' and inversion conditions were also verified.

It is noted that the DEIS dose estimates do not assume any respiratory protection provided for individuals on the ore body or when working inside filtered air-conditioned equipment. Such protection would result in a reduced exposure to RDP.

¹¹ Annual Radiation Protection Report: 1 July 2008 – 30 June 2009

¹² Thomson & Wilson (1980)

However, under the unlikely 'worst case' conditions (in which pit ventilation is 10 times lower than expected), the AR notes total doses - combined maximum RDP, gamma and dust doses - would rise to around 12mSv/y without the use of any respiratory protection or other controls.

Ensuring maximum doses always remain below the 10mSv/y dose constraint as the pit develops, will depend on operational controls coupled with real time monitoring of gamma, dust and RDP levels, and the setting of pit specific 'action levels' associated with these exposure pathways. It is important that the exposure controls for the pit be developed and implemented in parallel with an ongoing and comprehensive occupational and environmental monitoring program. These controls must be specified in the approved Radiation Management Plan prior to the commencement of the pit operations.

In conclusion, based on the information presented, the AR considers that the predicted RDP exposure for workers to be an acceptably conservative estimate. The conservative dose estimates also demonstrate that the potential impact of a doubling of the RDP conversion factor by the ICRP will be manageable. The use of real time monitoring of RDP, gamma and dust levels in the pit can be expected to further reduce total doses to pit workers to below the 10mSv/y dose constraint.

Underground mine

It is noted that BHPB expects existing control mechanisms would be sufficient to manage possible impacts of any increase in levels of dust and radon drawn into the underground mine as a result of the expanded surface operations.

The AR considers the estimated potential increase in dose to underground workers is reasonable given the projected average radon concentration of surface air. It considers that BHPB will be able to manage the projected impacts of the surface operations on existing underground mine air quality conditions without additional controls.

Processing plant

Increased exposures from larger scale operations

Existing controls have maintained average and maximum doses, reported for non-smelter workers, to well below 10mSv/y. Given there will be no change to the nature, or general scale of individual plant components of the processes in the metallurgical plant, the AR considers that assumptions underlying the predicted doses to workers in the plant are reasonable

This AR considers that workers in the Administration area must become classified as radiation workers as their average doses are expected to be slightly above 1mSv/y. BHPB will need to make provision for relocating members of the public and pregnant workers off-site as required. It may be appropriate that a lower dose constraint, 3mSv/y for example, could be applied to this group of workers.

In conclusion, this AR considers sufficient information has been provided to determine that non-smelter worker doses can be expected to remain below the 10mSv/y dose constraint with the controls as described. In addition, the proposed ALARA study should further refine the effectiveness of the plant design and proposed controls, prior to authorisation to construct any new or expanded plant.

Increased exposures to workers in the smelter

Publicly reported dose summaries indicate smelter workers are the work group with the greatest potential routine exposures in the plant (although all doses have been less than the annual dose limit). It should be noted that the doses reported for smelter workers assume no respiratory protection is worn, and hence doses are considered 'worst case' estimates.

^{210}Po levels in the existing smelter should be carefully monitored during the process of increasing production rate to ensure additional controls are effective and exposures are kept as low as reasonably achievable. While monitoring should include the installation of a real time ^{210}Po monitor as soon as available, the AR considers the use of a real time SO_2 monitor is an acceptable interim monitoring measure, as SO_2 is a surrogate for ^{210}Po . SO_2 can be used as a surrogate as both ^{210}Po and SO_2 are generated and released together from the same high temperature sources (i.e. molten copper and slag in the furnaces, or when poured from the furnaces).

In addition, the use of accurate respiratory protection factors would greatly assist dose assessment in the smelter and elsewhere in the plant.

A sub-group of smelter workers are involved in slag crushing and recycling. Slag has the potential to generate significant gamma dose rates due to its radium-226 (^{226}Ra) content. The AR considers that any potential for increased exposures due to greater slag production would be manageable and would be addressed during the operational approvals stage.

Given that the expansion would involve maximising the output of the existing smelter, the AR recommends that improvements to the design of the existing smelter are included in the proposed optimisation study.

Risk of an increase in number of environmentally significant spills and accidental exposures

None of the publicly reported spills or incidents involving radioactive materials from the current operations has resulted in any significant impacts on people or the environment. The AR considers this reflects both the low specific activity of the materials themselves, and the development of suitable plant design, operational controls and clean-up procedures.

The AR considers the use of design, operational controls and response procedures would adequately manage any accidental releases or spills. It should be noted that all design and control measures must satisfy a further detailed construction and operational authorisations process for the expanded operation, and must be operated and monitored in accordance with the approved RWMP.

Environmental exposures

The DEIS (Appendix S2.5.4) described the results of using the ERICA tool for estimating potential radiological risk to the terrestrial environment surrounding the Olympic Dam expansion area. The major pathway for ecological exposure was stated to be from long-term dust deposition.

The AR considers that in the absence of formal guidance on the protection of non-human species, the use of the ERICA tool is appropriate for estimating impacts on the non-human environment. While other tools are available, the ERICA framework is the only approach currently being investigated for use in the Australian context. While there are uncertainties in the use of ERICA in the Australian context, the results of the ERICA assessment indicate a negligible impact would be expected for non-human biota.

Radon and dust releases from the RSF

The AR considers that radon and dust radiation exposures associated with the operation of the RSF could be managed with the controls as proposed. The estimates of radon and dust release from the RSF are suitably conservative, and BHPB has committed to real-time dust and atmospheric monitoring during the operation of the RSF to assist with the development of dust control strategies associated with different dust sources.

Given the non-acid forming and low grade material involved (and hence generally low gamma dose rates), the open ventilation of the RSF surface, and potential for use of filtered air mobile equipment, doses to workers involved in the operation of the RSF are expected to be a less than those for workers in the pit. It should also be noted that actual construction and operation of the future RSF would be subject to authorisation requiring specific controls on radon and dust exposures.

The AR considers that real time radon monitoring would similarly assist with the development of radon emission controls. Radon emissions could be further reduced by the selective coverage of low-grade material if required.

Closure of the TSF and RSF

This AR considers that the DEIS and SEIS have provided sufficient information and a suitable indication of the possible closure criteria and closure risk assessment process, including a commitment to conduct a Features, Events and Processes study, to have confidence that post closure radiation exposures can be kept to below the 1mSv/y public dose limit.

There will clearly be enough non-acid forming material available to supply the cover required to minimise radon emanation, gamma dose rates and dusting from the surface of both the TSF and the RSF. However, these exposures are controlled only for so long as the containment retains its integrity. This then becomes an engineering question that is discussed in greater detail elsewhere in the AR (e.g. Section 4.4.12.3).

There are elements of the final post-closure design that depend on the outcome of further test work. This AR considers that the impending closure of the existing TSF Cells 1, 2 and 3 should be used as a test bed for closure assessment to evaluate identified risks including, water infiltration, slope erosion and wind scour processes. Further work should also evaluate the 'worst case' movement of released material and radiological impacts in the event the TSF and RSF containments eventually fail. This test work (and the Features, Events and Processes study) should form part of a comprehensive decommissioning and rehabilitation plan for the TSF and RSF to ensure international best practice is established.

It should be noted that actual decommissioning and rehabilitation of the future TSF and RSF will be subject to authorisation under the RPC Act licence. These authorisations will require detailed site-specific design and engineering information to confirm each structure is appropriately constructed, stable, and will minimise radiological impacts of future seepage and other releases to the environment.

Seepage from TSF and RSF

This AR considers that the TSF and RSF, as proposed, can be constructed and operated satisfactorily with minimal radiological impact on local aquifer systems. Sufficient information has been provided to indicate that seepage from the RSF would be significantly less than seepage from the TSF. In addition, the EIS has provided sufficient information to determine that groundwater impacted by seepage from the TSF would not travel far from the TSF itself before flowing to the open pit.

Post-closure, the DEIS predicts that any seepage that does occur from the base of the TSF, will diminish over time and flow to the pit to be captured within a lake that is predicted to form in the pit base.

The AR considers that, to ensure the long-term stability of the TSF and RSF structures and minimise future seepage, a comprehensive decommissioning, rehabilitation and closure plan for both the TSF and RSF is required. This AR also recommends that the existing TSF Cells 1, 2 and 3 closures be used to conduct long-term (decades) testing of seepage rate decline, modelled rehabilitation structures, and processes.

Actual construction and operation of the future TSF and RSF would be subject to authorisation under the RPC Act licence. These authorisations would require detailed site-specific design and engineering information to confirm each structure is appropriate and will minimise radiological impacts of seepage.

Open pit post-closure

The SEIS (Section 26.2.4) makes the assumption that 25% of all future groundwater entering the pit comes from the mine workings and has uranium and radium levels as currently observed in mine water. This is considered a reasonable approach. In a more extreme situation where seepage from the base of the TSF occurred to the extent that 50% of groundwater entering the pit resembled mine-water, the resulting salt crust uranium and radium concentrations would still fall within the range natural variations observed in soils worldwide¹³. It is noted that other factors that would tend to either dilute or cover the salt crust, such as wash-down of surface soil and non-acid forming cover sequence material, have not been included.

This AR considers that the EIS has provided sufficient information to assess this risk. Assuming significant input from either mine or seepage from the base of the TSF, the long-term pit water and salt crust radionuclide content should not represent a significant radiological hazard to people or the environment. However, it is expected that this issue will be considered as part of the overall rehabilitation and closure plan to ensure future exposures can be minimised.

Radioactive waste management

If contaminated metals and other low level radioactive wastes are to be disposed of in the TSF and the new waste management facility, these materials must be placed in specific locations to ensure appropriate containment and rehabilitation.

Some low level radioactively contaminated material could be safely recycled with appropriate controls provided the process meets legislative requirements. As contamination is often minor and restricted to the surface of an item, the bulk activity of the material is negligible. Recycling of such lightly surface contaminated items is possible after careful consideration of contamination limits, measurement protocols and intended future use. The EMMR notes that remaining low level radioactively contaminated waste is currently disposed of in the landfill.

The AR considers that low level radioactively contaminated waste can continue to be buried within the landfill provided an appropriate rehabilitation and closure plan is developed for the site. This plan should form part of the greater rehabilitation and closure plan for the TSF and RSF to ensure long-term containment consistent with international best practice.

Receptors

Members of the public

The current inhalation dose estimated for people at Roxby Downs was reported in the DEIS (Appendix S Section 2.5.1) as less than 0.025mSv/y, of which 0.005mSv/y is from inhalation of dust. It should be noted that both values are below the minimum level of detection (MDL) of the methods used and hence can only give an indication of the small scale of the doses currently received from RDP and dust¹⁴. Simply scaling up from these results based on current and predicted radon and dust emissions, would lead to large errors in predicted doses from the expanded operation, hence modelling was undertaken.

¹³ UNSCEAR 2011

¹⁴ For example, see the Olympic Dam Environment Management & Monitoring Report - 2010

Inhalation of RDP

To ensure doses are minimised, the AR concurs with BHPB's commitment to set an operational dose constraint of 0.3 mSv/y for public doses. In addition, appropriate radon and dust emission controls should be in place (primarily on the RSF) prior to the intersection of ore at the base of the pit.

Inhalation of dust

This AR considers the dose estimate for the inhalation of radioactive dusts at Roxby Downs and Hiltaba Village is reasonable.

Ingestion of rainwater and home-grown foods

The AR accepts that the analysis of rainwater from tanks at Roxby Downs and Woomera confirms that there would be little difference in dose received via the ingestion of rainwater from these sources, compared to the ingestion of tap water from the GAB and the River Murray.

Based on the EMM Annual Report 2010 analysis of water supplies, the predicted dose (S5.2.3) from the consumption of locally grown vegetables and the consumption of tank water at Roxby Downs (0.01mSv/y) is low and is considered acceptable.

Ingestion of bush food

The AR accepts that the predicted low frequency of consumption of scarce bush food in the region would result in very small annual doses - approximately 0.01mSv/y – as noted in the DEIS (Appendix S 2.5.3). Nevertheless, the operational Environment Management and Monitoring Plan will continue to monitor radionuclides in the environment.

To minimise exposures in accordance with the ALARA principle, appropriate environmental radon and dust emission controls must be in place (primarily on the RSF) prior to the intersection of ore grade material at the base of the pit. In addition, BHPB has indicated that a network of meteorological sites would be established across the SML to provide more detailed information on environmental factors affecting dust transport (e.g. wind speed and direction, and temperature inversions) and how they interact with mining operations, and public doses.

In conclusion, the AR considers that sufficient information has been provided to provide confidence that BHPB understands the radiation protection issues for members of the public at Roxby Downs and Hiltaba, arising from the proposed expansion.

Further, the AR considers that BHPB has demonstrated that radiation exposures estimated for members of the public living at Roxby Downs and Hiltaba during the operational phase of the expanded mine and plant, are based on conservative assumptions and indicate actual doses would be a small fraction of the annual limit for members of the public.

RECOMMENDATIONS

This AR considers that the estimates of radiological impacts arising from the proposed operation are based on suitably conservative assumptions and indicate that with appropriate controls and monitoring, the environmental impacts would be acceptable, and radiation doses to workers and members of the public would remain below appropriate limits. In addition, with appropriate controls, average doses to workers and members of the public would remain below the respective dose constraints set by BHPB of 10mSv/y and 0.3mSv/y for the duration of the operation, and well below the dose limits prescribed within the National Code of Practice For Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005).

This AR notes that the proposed expansion construction works, operational controls and associated monitoring programs would be subject to additional authorisations. Under RPC Act licence conditions, BHPB would be required to seek authorisation to commence each stage of the project; that being construction, commissioning and operation, and decommissioning and rehabilitation of the site. Each authorisation would require a Radiation Management Plan and Radioactive Waste Management Plan applicable to the project stage and approved by the EPA. These detailed plans would address all risks of radiation exposure to workers, the environment and the public and the control methods and monitoring that would be employed to ensure that doses would be as low as reasonably achievable.

The AR recommends the following condition of approval:

- The proponent must achieve the following outcomes as measured against the respective approved criteria:

OUTCOME	CRITERIA
Radiation doses to the public arising from the expanded Olympic Dam operations and radioactive waste management are below internationally agreed levels and are as low as reasonably achievable.	<p><i>Compliance criteria:</i> Radiation doses to the public must be within the dose limits recommended in the Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA 2005 or, as amended).</p> <p><i>Leading Indicator:</i> A reference level must be set for public doses at Roxby Downs and Hiltaba. The reference level must be 0.3mSv/yr unless otherwise agreed by the relevant Minister.</p>
Radiation doses to non-human biota arising from the expanded Olympic Dam operations and radioactive waste management area as low as reasonably achievable.	<p><i>Leading Indicator:</i> The proponent must set a reference level for impacts on non-human biota (interim criteria for non-human biota may be set until such time as an agreed national approach is determined).</p>
Radiation doses to the public and non-human biota arising from the transport of radioactive material are below internationally agreed levels and are as low as reasonably achievable.	<p><i>Compliance criteria:</i> Transport of radioactive material complies with the Code of Practice for the Safe Transport of Radioactive Material (ARPANSA 2008 or, as amended).</p>

The AR also recommends the following notes:

- When seeking authorisation from the SA EPA to construct (as required under the conditions of the *Radiation Protection and Control Act 1982* licence), the proponent must submit a summary report on the results of the radiation protection optimisation program. This report will be in addition to the Radiation Management Plan and Radioactive Waste Management Plan that need to be submitted though it is expected that the findings of the radiation protection optimisation program will be incorporated into those plans. The radiation protection optimisation program should include consideration of the current design of the smelter and other relevant plant infrastructure to determine engineering controls to support the increase in production rate.
- When undertaking the radiation protection optimisation study during the design phase of the new plant and open pit mine, the proponent must also consider the design of the existing smelter and other relevant existing plant infrastructure to determine engineering controls to support the increase in production rate.

- In keeping with the EPA's regulatory practice to enact national codes of radiation protection, the proponent will be required to seek authorisation to commence each stage of the project; that being construction, operation and decommissioning and rehabilitation of the site. Each authorisation will require a Radiation Management Plan and Radioactive Waste Management applicable to the project stage and approved by the EPA. These plans must address all risks of radiation exposure to workers, the environment and the public and the control methods and monitoring that will be employed to ensure that doses will be as low as reasonably achievable.
- The proponent is reminded of its routine reporting requirements under licence conditions and radiation accident or emergency reporting pursuant to Regulations 31 and 32 of the *Radiation Protection and Control (Ionising Radiation) Regulations 2000*.
- It is expected that the proponent will incorporate the following requirements within the Radiation Management Plan (RMP) that must be approved by the EPA as conditions of the licence under the *Radiation Protection and Control Act 1982* to conduct expanded mining or milling of radioactive ore at Olympic Dam:
 - The proponent will conduct radon emanation measurements on the overburden, waste rock and exposed ore as the pit develops. This data should be used to model Radon Decay Product exposures within the pit;
 - The proponent will undertake real-time gamma, radon, dust and pit atmospheric monitoring during the development of the pit and Rock Storage Facility to assist the development of control strategies associated with different sources of dust and radon;
 - The Radon Decay Product dose assessments must be re-modelled for the pit and underground mine, should the International Commission on Radiological Protection introduce a change to the recommended RDP dose conversion factor; and
 - The proponent must develop a program to derive realistic respiratory protection factors for use in the smelter and elsewhere in the Plant to provide an accurate estimation of dose.
- It is expected that the proponent will incorporate the following requirements within the Radiation Waste Management Plan that must be approved by the EPA as conditions of the licence under the *Radiation Protection and Control Act 1982* to conduct expanded mining or milling of radioactive ore at Olympic Dam:
 - A comprehensive rehabilitation and closure plan for the landfill containing low-level radioactive contaminated material, to ensure it meets international best practice for disposal (either in situ, or moved to a more appropriate location);
 - A plan to address the recycling where appropriate, of large lightly contaminated equipment items in accordance with international best practice; and
 - The conduct of regular (e.g. 5 – 10 years) soil surveys within and outside of the Special Mining Lease as part of the RWMP, to assess the radiological impacts of dust deposition for the expanded operations using appropriate models (e.g. ERICA).
- It should be noted that any Radiation Management Plan and Radioactive Waste Management Plan that is approved by the EPA under the *Radiation Protection and Control Act 1982* for the expanded Olympic Dam operation will be subject to regular review to ensure monitoring and control methods demonstrate best practice and exposures are as low as reasonably achievable (ALARA).

4.4.10 Greenhouse gases

A general assessment of the greenhouse gas impacts for the whole project (and not just the mine and processing plant) has been provided in Chapter 13: 'Effects on the environment' of this AR. Where a greenhouse gas matter is specific to the mine and processing plant, it has been included in this chapter.

4.4.10.1 Issues

The DEIS indicated that in terms of emissions intensity, BHPB predict that the increased size of the operation would result in a decrease from around 105kg of CO₂e per tonne of ore milled to around 79kg of CO₂e per tonne of ore milled over the long-term, following an initial increase to 119kg of CO₂e per tonne of ore milled during the early mining operations when large quantities of mine rock but little ore would be moved.

Justification for the use of a truck fleet for the transport of ore and waste rock instead of a conveyor system, and the implications of using vehicles on power use and greenhouse emissions was raised in a submission.

There is legitimate government and community interest in understanding how BHPB would meet its emission reduction goals. It is considered that the project could achieve significant emission reductions compared with a business as usual approach while remaining an economically productive opportunity.

4.4.10.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 3.6:

- **Objective:** Contribute to stabilising global atmospheric gas concentrations to minimise environmental impacts associated with climate change.
- **Criteria:** Apply a management goal of reducing greenhouse gas emissions (reportable under the *National Greenhouse and Energy Reporting (Measurement) Determination 2008*) to an amount equivalent to at least a 60% reduction (to an amount equal to or less than 40%) of 1990 emissions, by 2050.
- **Management plan:** Develop a Greenhouse Gas and Energy Management Plan for the proposed expansion. The plan would:
 - Establish modelling to project the likely emissions from the expanded Olympic Dam operation from commencement to 2050;
 - Establish targets and timelines for greenhouse gas reduction;
 - Identify greenhouse gas reduction strategies and projects (DEIS Section 13.2.5); and
 - Be reviewed annually.
- **Commitments:** Greenhouse gas emissions from the expanded project (mining and processing plant) would be addressed by (SEIS Table 2.1 Commitments, page 52):
 - Constructing an on-site cogeneration power station (250MW capacity) for recovering waste heat;
 - Producing an annual 'road map' that quantifies emission reduction opportunities and achievements (applies to whole project);
 - Supporting government in the development of a sector agreement on greenhouse gas and use of renewable energy (applies to whole project); and
 - Including the effects of an emissions trading scheme on the viability of greenhouse gas abatement projects, and hence the projected emissions trajectory for the expanded operation in Olympic Dam's Greenhouse Gas and Energy Management Plan (applies to whole project).

4.4.10.3 Assessment

The AR considers that the combination of the 2050 goal, the Greenhouse Gas and Energy Management Plan (GG&EM Plan), and future expectations on carbon pricing provide an appropriate framework within which BHPB would make design and operational decisions around the management of its greenhouse gas emissions, should the expansion project be approved.

BHPB considered the option of installing an in-pit crusher and transportation of the crushed ore using a conveyor system (instead of trucks) in order to minimise the significant volumes of fuel required, and hence minimise emission of greenhouse gases. This option was rejected as it would require the final pit slopes to be established at the outset, otherwise there would be a need to relocate the infrastructure as the open pit was developed. BHPB has indicated that it would review the option of installing an in-pit crusher and conveyor system during development of the resource.

The AR concludes that this is a reasonable approach.

Further analysis, modelling and projections of greenhouse gas emissions have not been provided, and BHPB has indicated that such work would be carried out through the GG&EM Plan. Where material has not been provided or lacks sufficient detail, it is not considered to affect the adequacy of the FEIS, provided that the GG&EM Plan:

- Be used to incorporate the issues raised;
- Provides a successful vehicle for managing greenhouse emissions on an ongoing basis; and
- Provides public accountability for project performance.

RECOMMENDATION

Refer to Chapter 13: 'Effects on the environment' for the full suite of recommended greenhouse and sustainability conditions.

4.4.11 Hazards

4.4.11.1 Issues

The DEIS Section 22.5 addressed the areas of site security, policies for mine site traffic, and risk management of stored hazardous materials and explosives. The following issues in relation to hazards have been specifically addressed in the AR:

- The proposed storage, transport, handling and use of chemical compounds used for processing and mining operations (including explosives, fuels and additives);
- Potential impact on occupational safety from instability of the open pit, the RSF and seismic activity;
- The potential impact on humans, building structures, and mining and processing plant and equipment as a result of seismic events caused by the release of in-situ rock stresses by deep mining activities; and
- Potential hazards associated with road and rail transport during construction and operations (this matter has been addressed in Chapter 11: 'Road transport' of this AR).

The DEIS Section 22.6.8 dealt with "hazardous substances" – specifically the requirement to comply with regulatory requirements for the storage of dangerous goods and the construction of bulk storage facilities in accordance with relevant legislation and standards.

The DEIS also discussed the use of “ANFO” (ammonium nitrate and fuel oil) as the preferred explosive for the proposed open pit expansion. Ammonium nitrate (AN) is classified as a security sensitive substance and an explosive in South Australia by Governor’s proclamation of 25 January 2006. It is BHPB’s intention to deliver large quantities of bulk AN to the Olympic Dam mine site for conversion into ANFO. BHPB does not currently have a storage licence or security management plan for bulk AN at Olympic Dam. Refer to Chapter 11: ‘Road transport’ of this AR for further details regarding the transport and storage of AN.

4.4.11.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 2.1 and 4.2:

- **Objective:** No significant contamination to soils, surface water or groundwater as a result of the storage, transport or handling of hazardous materials by BHPB during expansion activities (ID 2.1). Maintain structural integrity of the RSF and expanded TSF (ID 4.2).
- **Criteria:** No lasting significant contamination arising from uncontrolled loss of chemicals to the natural environment (area to be defined) (ID 2.1). No unplanned structural failures to the TSF or RSF (ID 4.2).
- **Management plan:** To update the Emergency Response Plan to ensure additional requirements of the proposed expansion were incorporated, particularly for accident spills associated with possible derailment, truck accident or vandalism. The Management of Hazardous Materials Document and Operational HSEC Plan would also be updated. (ID 2.1)
- **Commitments:**
 - Occupational health and safety (SEIS Table 2.1 Commitments, page 54) – A “safety case” for the current operations is being conducted and would incorporate all components of the proposed expansion, and would include:
 - Identification of the hazards and risks of the proposed expansion;
 - A description of how the risks would be controlled, and
 - An outline of the safety management system and its implementation, monitoring and review of its effectiveness.
 - Transport, storage and handling of fuels and other hazardous materials in the SML would be in accordance with the relevant state and Australian statutory requirements. As a minimum, the SA EPA standards would be used, which require bund sizes to be 120% of the net capacity of the largest tank and 133% for flammable material (SEIS Table 2.1, page 55).

4.4.11.3 Assessment

The issues concerning hazards at the Olympic Dam mine site are subject to regulation under South Australian law, including the following Acts and associated regulations and codes of practice:

- *Explosives Act 1936;*
- *Dangerous Substances Act 1979;*
- *Occupational Health, Safety and Welfare Act 1986; and*
- *Mines and Works Inspection Act 1920.*

Storage/handling of dangerous goods and explosives

It is considered that the expansion of the mining operations at Olympic Dam requires a review of the hazards and associated risks that the increased mining and processing operations would present. An increase in mining and ore processing would result in increased storage and use of explosives and other hazardous materials, and increased volumes of these materials transported around the mine site. The review procedure should include updating emergency management procedures for unintended escape of hazardous materials at the mine site; and review of site and personnel security policies as a result of increased quantities of explosives and chemicals.

The DEIS outlined the following measures to manage the storage and handling of dangerous goods including:

- Specific operational procedures have been developed for spills and accidental release of a range of hazardous materials (DEIS Section 22.5). A process to notify external agencies if a spill triggers external reporting requirements is currently in place. In particular, Regulation 8 of the *Dangerous Substances Regulations 2002* specifies when such notification is to be given to the Competent Authority of an accident involving dangerous substances;
- BHPB's commitment to addressing specific legislative requirements for spillage prevention, control and management during the detailed design stage of the proposed expansion (DEIS Section 22.4.5);
- Development of a 'safety case' for the existing operation that would incorporate the proposed expansion (DEIS Section 22.5). The 'safety case' approach should reveal the need for protocols to mitigate the risks associated with the storage and use of hazardous materials and explosives as the mining program expands; and
- A Security Operations Plan, which refers to persons requiring authorisation to enter the mine site, with further authorisation required for the solvent extraction area, and the gold, silver and uranium production areas (DEIS Section 22.4.5). Security functions related to explosives and AN stores were not specifically discussed in the DEIS.

The AR considers the measures proposed, in addition to legislative requirements outlined above would be sufficient to manage hazards at the mine site.

RECOMMENDATION

The AR recommends the following note:

- Detailed planning for the storage and transport of bulk ammonium nitrate will be required to be undertaken prior to construction occurring at the mine site, and in consultation with the South Australian explosives regulatory authority, SafeWork SA to satisfy licensing requirements under the South Australian *Explosives Act 1936*.

Major hazard facilities

From a major hazard facilities (MHF) regulatory perspective, the expansion would increase the overall aggregate threshold level of hazardous chemicals to be used or stored on-site, and the overall risk profile for the site would increase correspondingly.

The 'design for safety' of hazardous chemical processing/storage plants, process integrity, safety and controls, including physical layout should be considered during the project design and planning stage for the purpose of consequential risk analysis to determine appropriate risk control measures to prevent a MHF-related catastrophic incident.

RECOMMENDATION

The AR recommends the following notes:

- In order to achieve compliance with clause 24 of the State Emergency Management Plan, pursuant to Section 9(e) of the South Australian *Emergency Management Act 2004*, the proponent would be required to update the Emergency Response Plan in consultation with SafeWork SA. The MHF-related operational hazards and risks should be reviewed during the pre-commissioning, commissioning and operational phases, in consultation with SafeWork SA.
- There may be a requirement for Major Hazard Facility licensing under SA *Work Health and Safety (WHS) Regulations* (to be effective as from 1 January 2012) when Schedule 15 chemicals threshold quantity level is triggered.

Potential impacts of simultaneous work

Simultaneous construction of the new mining, processing and storage facilities plant, equipment and infrastructure in conjunction with existing operations is considered by the AR to pose risks to workers for tasks that could impact on each other.

For hazards promulgated by simultaneous work, the SEIS indicated that risks would be controlled by the provision of exclusion zones and effective barriers, adequate coordination between activities, (including contractor management and coordination), and by undertaking risk assessment in consultation with workers. Further controls that would be implemented include detailed work planning prior to commencement, constructability reviews, workshops and construction (training) modules. Extended shutdowns have also been proposed by BHPB to achieve separation.

RECOMMENDATION

The AR concludes that the approach proposed by BHPB is acceptable. No conditions have been recommended.

Increased hazards and risks

The DEIS foreshadowed an increase in hazards and risks associated with the construction phase and the ongoing operations of all four major components of the existing metallurgical plant. Given that BHPB propose to continue to use the existing metallurgical processes as per the current operation, it is anticipated that there would be no significant change in hazard level (or a low likelihood of new hazards being introduced). However, the overall workplace incident occurrence may increase due to the increased activities on-site and the addition of new employees. Therefore, it is recommended that BHPB review the hazard and risk matrix/register for any potential shift in risks from 'tolerable' to 'intolerable' prior to commencing the expanded operations (SEIS Chapter 31 Hazard and Risk).

In the event that BHPB was to modify or optimise the existing copper solvent extraction plant, smelter and refinery to process the additional ore from both the existing and expanded operation, a risk assessment of the modified or optimised processes must be conducted as part of the project risk management to ensure new hazards and unintended consequences are appropriately addressed/controlled before and during the process changes.

The AR considers that operational hazards and risks should be reviewed by BHPB prior to commissioning and operational phases in consultation with SafeWork SA. In addition, the expansion of mining and ore processing activities would require BHPB to have the capacity to respond to an emergency with support from State-funded emergency services agencies. If the project proceeds, the South Australian Fire and Emergency Services Commission (SAFECOM) would require BHPB to involve SA emergency services agencies in all phases/processes of risk assessment where there is an expectation that the SA government would be required to assist, to ensure appropriate planning and coordination for an emergency response.

RECOMMENDATION

The AR concludes that the approach proposed by BHPB is acceptable. No conditions have been recommended.

Stability of the open pit

The AR considers that the open pit mining development must deliver the following outcomes:

- A safe working environment;
- Continuity of economic return to the State and community from the mine and related industries; and
- Stability during operation and post closure, particularly in terms of interaction with adjacent project components. (e.g. the RSF in terms of the potential for failure to lead to the exposure of acid generating or radioactive rock)

BHPB has indicated that stability studies for the proposed open pit have been undertaken since 2006 and are ongoing. The key aim of the geotechnical investigations and associated preliminary designs undertaken by BHPB was to minimise the potential risk of significant failure of the pit walls, and thus minimise related occupational health and safety risks. It was recognised by BHPB that the area in the vicinity of the open pit would require depressurisation to control groundwater inflows and to ensure that significant pore pressures did not build up behind the excavated slopes leading to slope failure.

In response to submissions in relation to the stability of the open pit (including in relation to material strength parameters, rock mass characteristics, groundwater characteristics, failure mechanisms and factors of safety), the SEIS provided information on the underlying rock materials obtained from extensive drilling and reference to the existing borehole database, resulting in the geotechnical logging of more than 500 boreholes to enable information to be compiled for ten cross sections across the proposed open pit. The determination of the conceptual design for the open pit slopes included the collection and analysis from:

- Detailed logging and data collection – acoustic televiewer, core orientation, geotechnical logging, point load strength testing and sampling;
- Laboratory testing;
- Uniaxial compressive strength tests, 152 in cover sequence, 509 in basement;
- Young's Modulus, 435 tests;
- Brazilian tensile strength tests, 163;
- Direct shear tests, 44 in cover and 74 in basement;
- Triaxial strength testing, 40 cover sequence, 43 basement;
- Mineralogical analysis, Plasticity testing (Atterberg Limits), particle size distribution of the shear infill in cover sequence;
- Direct shear of natural rock defects, 40 in cover sequence and 43 in basement of the shear infill;
- Rock mass assessment;
- Probabilistic evaluation of rock mass properties;
- Statistical evaluation of structural data in the cover sequence and basement rock units;
- Collation of information on in-situ rock stress;
- Collation of geological and geotechnical information from the underground operation;
- Modelling of underground and open pit infrastructure interaction;
- Development of a structural geological model for specific domains around the open pit;
- Development of a geological and alteration models; and
- Hydrogeological investigations.

The SEIS stated that BHPB established four geological structural domains for the cover sequence and thirty two structural domains (representing volumes of rock with similar defect orientation and spacing) for the basement sequence. In addition, the analysis by BHPB determined specific rock mass models for the cover sequence and basement rocks, based on the lithological and structural differences. For the cover sequence consideration was also given to the distribution and degree of fracturing and deformation.

Rock mass parameters - uniaxial compressive strength, point load strength index, rock quality designation and geotechnical strength index - were determined for cover sequence materials, both undeformed and deformed, and for the basement materials. This information was used to determine appropriate rock mass shear strengths for the cover sequence and basement using the Hoek & Brown Failure Criterion.

Hydrogeological investigations were undertaken in parallel with the geotechnical investigations and included:

- Collation of existing measurements and abstractions of groundwater;
- Installation of 89 vibrating wire piezometers;
- Pump tests; and
- Borehole permeability tests.

Calibrated three dimensional and quasi three dimensional models were developed to predict pore pressures during pit development for a range of potential intervention options, including:

- No groundwater intervention;
- Perimeter ground water well in the cover sequence; and
- Depressurisation drain hole in the cover sequence and the basement rocks in addition to perimeter groundwater wells in the cover sequence.

Pore pressure grids were developed for all of the above scenarios, though the third option was adopted for use in the stability modelling.

BHPB undertook an extensive assessment of the stability for the proposed open pit which included using a range of rock mass properties, pit geometries, groundwater conditions, and investigation of a range of potential failure modes in order to assess:

- Bench slope angles;
- Inter-ramp slope angle;
- Overall slope angles;
- Impacts of pore pressures and depressurisation requirements;
- Interaction with the existing and proposed underground workings; and
- Impacts and interaction of key infrastructure including shafts and surface infrastructure.

The stability analysis included Limit Equilibrium techniques for circular failures and failure through the rock mass and along a discrete geological structure. In addition, BHPB also undertook Finite Element modelling to confirm failure mechanisms, to compare the estimate of factor of safety of the limit equilibrium methods, estimate displacements and estimate the impact of underground development and stability. Three dimensional modelling of the open pit and underground operations was also undertaken.

The stability of the open pit slopes were assessed in terms of either a factor of safety or probability of failure for a factor of safety being less than 1 in accordance with the following criteria:

SLOPE SCALE	FACTOR OF SAFETY	PROBABILITY OF FAILURE FOR FACTOR OF SAFETY ≤ 1
Bench	1.1	30-50%
Inter-ramp	1.2-1.3	3-5%
Overall	1.3	1%

BHPB proposes to install real-time geotechnical monitoring equipment to determine ground movement and slope stability in both the underground operations and open pit.

RECOMMENDATION

The AR concludes the following:

- The methodology used by BHPB to determine material properties for input into the assessment of the stability of the open pit slopes is consistent with leading industry practice.
- The assessment criteria used for determination of pit wall stability is consistent with leading industry practice and on the basis of the assessment by BHPB the proposed slope angles for the open pit have acceptable factors of safety against instability, assuming the implementation of depressurisation drain holes in the cover sequence and the basement rocks, in addition to perimeter groundwater wells in the cover sequence.

Stability of the RSF

The AR recognises that the RSF design is preliminary and subject to change, however it is important that BHPB has demonstrated that stability of the RSF is achievable both during operation and post-closure for the protection of environmental values including flora, fauna, surface water, groundwater and human health and safety. Loss of stability of the RSF, particularly post closure, could lead to the exposure of material that is acid generating and/or radioactive. As the DEIS acknowledged, the immediate proximity of the RSF to the open pit also emphasises the importance of demonstrating that the RSF stability would not be impacted by major failures in the adjacent open pit.

Further information was sought in the SEIS to confirm that the RSF would be geotechnically stable during operation, and in the long-term in terms of erosion.

The SEIS provided a stability assessment of the proposed RSF at its full height of 150m and assessed whether any failures of the RSF could impact the stability of the open pit, and whether any failures in the open pit could impact the RSF. In addition, the SEIS provided information on the potential for long-term erosion to impact the final landform of the RSF.

The assessment by BHPB considered conceptual design slopes and use of typical strength parameters in the published literature, including:

- Rock fill – unit weight (18 kN/m³), cohesion (50 kPa), angle of friction (35 degrees); and
- Foundation soils (sands and sandy clay) – unit weight (18 kN/m³), cohesion (5 kPa), angle of friction (25 degrees).

The conceptual design included the following parameters:

- Waste rock slopes angles varying between 35–40 degrees;
- Lifts during deposition of 50m, with the exception of 20–30m for the poorer rock units; and
- Berms installed to ensure an overall slope angle of 30 degrees.

BHPB indicated that overall factors of safety would be greater than 1.2. As the RSF would be expected to be free draining, BHPB has indicated that it is unlikely there would be a build up of pore pressures within the RSF. Other assumptions made in the analysis include:

- The water table is below the foundations of the RSF;
- The foundations comprise predominantly sand with discontinuous sandy clay to depths ranging from 1–20m; and
- Design earthquake loading would cause some displacement (predominantly settlement) and this would be within tolerable limits.

The assessment also considered the potential for a total failure of the RSF to result in a surcharge load on the open pit and the potential for a failure of the open pit slope to impact the RSF. Rock mass strength parameters for the various materials were consistent with those determined for the open pit assessment.

The construction and operation of the RSF would require authorisation under the *Radiation Protection and Control Act 1982* (RPC Act), which would require BHPB to provide detailed site-specific design and engineering information to confirm the structure is appropriate to minimise seepage.

RECOMMENDATION

The AR concludes the following:

- The methodology used by BHPB to determine the material properties for input into the assessment of the stability of the RSF is consistent with current industry practice.
- The assessment criteria used for determination of the RSF stability is consistent with industry practice.
- The risk of exposure of either low grade ore containing radionuclides and acid forming materials as a result of instability of the RSF is acceptably low.

Further discussion on the RSF can be found under Section 4.4.12 'Rehabilitation and Closure' of this chapter.

Seismicity

The EIS indicated that seismic events with acceleration coefficients of 0.09 could occur within the Olympic Dam area, with the probability of exceeding these figures considered to be low, at 10% in 50 years. BHPB has indicated that building structures would be designed and built in accordance with the Australian Standards for Earthquake Actions (AS1170.4). On this basis, BHPB concluded that the risk of the predicted seismic events causing environmental impact throughout the life of the project would be considered low.

Current underground stoping areas experience some induced seismicity caused by de-stressing of rock generally after blasting. Underground blasts at the existing operations are monitored for seismic activity, with the risk to workers controlled by putting in place a time dependent exclusion zone to prevent persons entering affected areas after blasts.

BHPB has assessed the potential for earthquakes to be generated as a result of de-stressing rocks during development of the open pit, using 3D finite element modelling of the proposed and existing operations and existing and future underground workings (SEIS Section 8.1). In the SEIS (Appendix D1) BHPB's consultants concluded that:

- The modelling indicated that seismicity as a result of the proposed open pit would be expected to be similar to the seismicity that has occurred in the past as a result of the current underground operations; and
- The zone of influence would grow proportionally, relating to the shape and size of the open pit, resulting in release of energy in smaller more frequent increments. For a significant seismic event to occur, the mine would need to isolate a large area of Masher's Fault with a very high confinement, generate large amounts of strain, and cause an instantaneous release of the stored energy by inducing damage related to the release of the stored energy.

The growth of the open pit would be relatively slow - large blasts over a large area- compared to current underground stoping - large blasts in an isolated and confined area. Under these circumstances, the de-stressing of rock that follows after an open pit blast would likely be more widely distributed than an underground blast.

BHPB has indicated that some low magnitude mining induced seismicity would occur, however it was unlikely that these events would be noticed by the public or on-site, and it is expected there would be little if any damage to the mine or associated infrastructure.

The AR notes that in the SEIS (Appendix O) vulnerability analysis is proposed for specific pit scenarios in final design stages where dynamic loading could exist. A detailed design is required for the analysis, and the AR recommends geological structures be included in such analysis.

The open pit design will change over time and the current modelling has been done for the proposed pit. If designs are changed, re-modelling must be done.

BHPB has made provision for all proposed new infrastructure, including the TSF, to be designed to withstand a 1-in-10,000 year earthquake event loading.

RECOMMENDATION

The AR concludes that the approach by BHPB to modelling in relation to seismic impacts is acceptable, and that the proposed development of the open pit will result in similar levels of seismicity to the current underground operations. The AR further concludes that it is not likely that mining-related seismicity would lead to any impact on the community, or damage to the mine or any third-party infrastructure.

4.4.12 Rehabilitation and closure

4.4.12.1 Issues

The DEIS outlined the following rehabilitation and closure strategies proposed by BHPB:

- The open pit would not be backfilled and would essentially remain as it was at the completion of mining activities. Some slope correction would be undertaken and a bund and fence with warning signs would be installed around the perimeter of the void;
- The RSF and TSF would remain as a permanent landform that would contain potentially reactive - chemically and radiologically - material, with a self-sustaining final cover which minimises the potential for infiltration of water;
- The metallurgical plant post-closure could be used for research and education, tourism, and further mineral processing if the mining of ore from the RSF or TSF becomes economic;

- All surfaces would be re-contoured and deep ripped to facilitate natural revegetation;
- Shafts, portals and raise bores would be sealed with pre-cast concrete and soil would be mounded over the concrete seals;
- All surface infrastructure would be removed and recycled, or removed to an appropriate landfill site; and
- All underground infrastructure would be removed if recyclable, or left *in situ*.

The DEIS indicated that mine closure would be undertaken in accordance with the BHPB Corporate Closure Standard and in accordance with the overriding principles of the current Olympic Dam Rehabilitation and Closure Plan.

4.4.12.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.1:

- **Objective:** No significant adverse impacts to listed threatened species (South Australia, Northern Territory, Commonwealth) populations in the expansion project area as a result of BHPB's construction activities.
- **Criteria:** Not relevant to rehabilitation and closure.
- **Management plan:** BHPB has committed to developing a new Rehabilitation and Closure Plan that would cover:
 - Pit water quality and quantity;
 - RSF and TSF rehabilitation trials;
 - Characterisation of the mine rock;
 - Optimising revegetation and rehabilitation;
 - Metal uptake by vegetation; and
 - Rehabilitation success.
- **Commitments:**
 - The existing Rehabilitation and Closure Plan for the current Olympic Dam operation would be updated to include the expanded components of the proposed expansion after the detailed design phase of the project has been completed. BHPB would continue to consult and engage with relevant government departments and other stakeholders to further develop and refine closure criteria, including final land uses, rehabilitation, management and ongoing monitoring. The Plan would be reviewed annually and updated if required (SEIS Table 2.1 Commitments, page 57);
 - Erosion-control measures would be installed to mitigate the risk of open-pit wall instability post-closure (SEIS Table 2.1 Commitments, page 57); and
 - Tailings cells would be capped when they reached their target design height, and when it was safe for vehicles to access the TSF surface (SEIS Table 2.1 Commitments, page 59).

4.4.12.3 Assessment

The AR considers that the relevant receptors for assessing the risks associated with closure (including post closure) are:

- Human and environmental users of groundwater and surface waters;
- Any remaining residents of the township of Roxby Downs, Hiltaba and Andamooka and surrounding pastoral areas;
- Flora and fauna of the mine and adjacent areas;
- The landowner (SA Government); and
- The public.

The potential risks for these receptors would broadly involve the following issues:

- Impacts on human and fauna health and safety associated with radiological and chemical emanations (e.g. radon, metals etc) and physical hazards (e.g. dust, voids and faces);
- Contamination of groundwater by leaching/seepage, particularly from the tailings and rock storage facilities;
- Long-term stability, sustainability and erosion of structures and the effects from these factors, such as sediment loading in local watercourses;
- Potential long-term liability for the landowner - and ultimately the public - associated with monitoring and maintenance of the pit, TSF and RSF in perpetuity;
- Long-term ecological sustainability of the site and surrounds; and
- Visual amenity for residents and visitors.

Assessment of risks

In the DEIS (Section 7.5 of Appendix C) and SEIS (Section 28.1.1) BHPB provided initial information on the anticipated rehabilitation and closure risks for this project, including a risk assessment covering the decommissioning and rehabilitation phase of the operations. Department of Primary Industries and Resources of South Australia (PIRSA) has compared the broad environmental risks associated with the mine closure based on that information, and in accordance with the PIRSA 'Guidelines for Miners: Preparation of a Mining Lease Proposal or Mining and Rehabilitation Program (MARP) in South Australia'.

The AR considers that the BHPB commitments generally cover the main issues relevant to rehabilitation and closure. As the project develops, additional information will become available to inform the decommissioning, rehabilitation and closure strategies for the project. Additional risk assessment should be undertaken progressively as more information arises. The updated risk assessment should be informed by:

- The likelihood of early, unplanned closure;
- Environmental values to be protected, established with relevant stakeholders. These should drive the development of appropriate closure outcomes and strategies;
- The need to avoid inheritance of any ongoing liability for the mine by the landholder (ultimately the SA Government via the pastoral lease);
- The potentially latent nature of residual impacts post-closure; and
- Expectations that rehabilitation should be undertaken progressively wherever practical.

It is expected that the updated risk assessment would establish clear outcomes for the rehabilitation and closure phases. An outcome is a statement of the acceptable impact on the environment caused by the proposed mining activity, for example 'No reduction in the quantity and or quality of groundwater for existing users and environmental receptors'.

The AR considers that the anticipated long-term risks posed by the proposed expansion can be managed by BHPB.

Long-term stability of the TSF and RSF

The proposed cover for the TSF would be required to resist degradation from erosion post-closure in order to ensure that the acid-forming and/or radioactive waste materials stored in these facilities would not be exposed and discharged into the receiving environment at a rate that would cause unacceptable impact.

The SEIS detailed:

- Natural rates of erosion for the proposed capping material;
- The climatic environment at Olympic Dam and the general lack of erosion from the existing 20 year old TSF; and
- Calculations of erosion rates, capping depths and timeframes.

The SEIS referred to the 9758Mt of overburden material to be mined from the proposed open pit that would become available for constructing a cap over the 4000ha TSF, at an assumed thickness of 10m. On the basis of the likely broken density of 2 t/m³ there would be more than adequate quantities of suitable material to construct a cap designed to ensure long-term coverage of the surface of the TSF.

Information concerning rates of erosion under various climatic conditions and a simple estimation of the time taken for a 10m cap of quartz to erode were also provided in the SEIS. The indicative erosion rate information used by BHPB was sourced from other literature and not from test work carried out on specific rock material from Olympic Dam.

The AR considers the long-term erosional stability of the TSF and RSF, to ensure that the encapsulation strategy is effective, should be informed by further modelling as closure planning proceeds.

Financial assurance for rehabilitation

BHPB should note that the SA Government will require, through the Indenture legislation, a rehabilitation bond or similar financial assurance to ensure the Mine Rehabilitation and Closure Plan liability is not passed to the landholder - ultimately the SA Government - following closure of the mine and associated project components.

The AR concludes that the potential long term risks associated with closure and rehabilitation have been adequately understood and can be managed through the application of best practice rehabilitation methods. Further refinement and updating of the post closure risk assessment and development of a detailed mine closure plan is needed as the project progresses to ensure that rehabilitation success can be demonstrated and that no long term liabilities for the community are created.

RECOMMENDATION

The AR recommends the following conditions.

- The proponent must develop and submit to the Indenture Minister for approval a Mine Closure and Rehabilitation Plan within 2 years from the date of this decision, or prior to construction of the TSF, whichever date is the earliest. The plan must:
 - Include a set of environmental outcomes that are anticipated to be able to be achieved indefinitely post mine closure. An outcome is a statement of the acceptable impact on the environment caused by the proposed mining activity;
 - Include assessment criteria that are clear and unambiguous and are specific to the achievement of the agreed environmental outcomes and should include:
 - Specific parameters to be measured and monitored;
 - Specification of the locations where the parameters will be measured, or how these locations will be determined;
 - Clear statement of the acceptable values for demonstrating achievement of the outcome, with consideration of any inherent errors of measurement;
 - The frequency of monitoring; and
 - Identification of what background or control data is to be used or specifying how these will be acquired if necessary.

- Include an updated risk assessment of the project developed in consultation with relevant stakeholders, to determine the long-term risk to the public and the environment from the mining and processing operations, tailings storage facility and rock storage facility, including radioactive emissions. The updated risk assessment must inform the potential environmental outcomes that can be achieved indefinitely post mine closure, must consider the potential for and impacts resulting from early, unplanned closure or suspension of operations and demonstrate that all practical options for progressive rehabilitation have been addressed.
- The proponent must implement the approved Mine Closure and Rehabilitation Plan.
- The proponent must review the Mine Closure and Rehabilitation Plan as required by the Indenture Minister.

The AR also recommends the following notes to BHPB:

- The existing TSF Cells 1, 2 and 3 closures should be used to conduct long-term (decades) testing of seepage rate decline, modelled rehabilitation structures, and processes.
- The existing TSF Cells 1, 2 and 3 should be used as a test bed for closure assessment to evaluate identified risks including, water infiltration, slope erosion and wind scour processes.
- During operation the proponent should undertake site trials of the preferred covers that have been determined from the modelling on the completed Tailings storage facility Cell 1-3 of the existing operations in accordance with a program detailed in the approved Closure and Rehabilitation Plan.

4.4.13 Environmental management

4.4.13.1 Issues

Issues related to environmental management for the proposed expansion relate to whether:

- Appropriate environmental values been established for the project through a consultation process with relevant stakeholders;
- Residual risks have been appropriately determined;
- The outcomes/objectives for the identified environmental impacts are reasonable and achievable, are acceptable to relevant stakeholders, and meet applicable legislative requirements;
- Clear and measurable assessment criteria to demonstrate the achievement of outcomes have been defined; and
- The management and monitoring programs have been developed on the basis of the outcomes and assessment criteria.

4.4.13.2 BHPB EM Program and commitments

The DEIS Appendix U provided an outline of the proposed Environmental Management Program for all activities relevant to the proposed expansion, which included:

- A description of the 'Objectives' (or outcomes) relating to the environmental values;
- 'Assessment criteria'; and
- 'Management plans'.

These have been based on the Environmental Management Program for the existing operations. Further, BHPB indicated in the EIS that it currently implements an Environmental Management System (EMS) that is ISO 14001 certified. The EMS would be revised and updated to incorporate the proposed expansion components, outcomes of the environmental impact assessment, its commitments and approval conditions.

BHPB indicated that a number of environmental management plans would need to be prepared as final planning for the project occurred and in advance of construction (DEIS Section 24.4.2 and Table 24.1). This information was re-iterated in the SEIS Section 29.8.

Table 2.1 in the SEIS provides a consolidated list of conditions.

4.4.13.3 Assessment

The current requirements for environmental management of the Olympic Dam operations are governed by the Olympic Dam Indenture, a schedule to the *Roxby Downs (Indenture Ratification) Act 1982* (the Indenture). In particular, Clause 11 of the Indenture requires BHPB to prepare a program for the protection, management and rehabilitation of the environment every three years and annual reporting.

For the current underground operation, BHPB has established an Environment Protection and Management Program (EPMP) as the Program to comply with Clause 11. The EPMP comprises the Environmental Manual, Environmental Management Program and Monitoring Program.

The EPMP is prepared by BHPB and reviewed by SA Government agencies every three years. The Indenture Minister can:

- Approve the EPMP as submitted by BHPB; or
- Refuse to approve the EPMP; or
- Approve the EPMP with conditions.

Clause 11 does not provide details of:

- What should be included in the program;
- Provisions for enforcing compliance with the program;
- Any requirement for independent audits; and
- The requirements for public release of the program and annual reports.

The AR considers that a new program for the proposed expansion must include agreed environmental outcomes and assessment criteria. The assessment criteria must be clear, unambiguous and specific to demonstrate achievement of the agreed outcomes and should include:

- Specific parameters to be measured and monitored;
- Specification of the locations where the parameters will be measured, or how these locations will be determined;
- Clear statement of the acceptable values for demonstrating achievement of the outcome, with consideration of any inherent errors of measurement;
- The frequency of monitoring; and
- Identification of what background or control data is to be used or specifying how these will be acquired if necessary.

It is important that any monitoring program indicates:

- What will be measured, the accuracy of measurements if applicable and who will be responsible for them;
- Where will it be measured - including controls and baseline - and how;
- Frequency of measurement;
- Record keeping; and
- Frequency of reporting to external stakeholders.

An outline of BHPB's proposed Environmental Management Program for all activities relevant to the proposed expansion was provided in the DEIS Appendix U. The SEIS indicated that management programs and monitoring plans are being developed to manage the environmental aspects and potential impacts for the various components of the project. BHPB has provided a list of management plans and monitoring programs that would be developed, should the project be approved. In addition, the SEIS provided examples of interim draft management plans for some of the components of the project. In the main these indicated BHPB's intent and framework for establishing the relevant plans.

RECOMMENDATION

The AR recommends the following condition:

- The proponent must prepare an Environment Protection Management Program (EPMP), in accordance with Clause 11 of the Indenture, for approval by the Indenture Minister and must include the following:
 - The scope of the area and proposed operations covered by the EPMP;
 - Environmental outcomes relating to potential environmental impacts;
 - Compliance criteria, to demonstrate the clear and unambiguous achievement of the environmental outcomes;
 - Leading indicator criteria to provide an early warning that compliance criteria may not be met;
 - Target criteria to reflect a level of impact that is as low as reasonably achievable;
 - The specific parameters to be measured and monitored;
 - Information about the strategies and other measures BHPB intends to implement to achieve the outcomes or to investigate and respond to any non-compliance with the compliance, leading indicator, or target criteria, without limiting the measures that may be implemented to those specified in the plan;
 - Information on BHPB's management systems that will be relied upon to ensure compliance with the compliance criteria, leading indicator criteria, and target criteria;
 - Protocols for reporting to the Indenture Minister any non-compliance with the compliance criteria as soon the approval holder becomes aware of the non-compliance; and
 - Any other specific obligations and management or monitoring plans specified by these conditions or required by other State legislation.
- All criteria in the EPMP must specify:
 - The specific parameters to be measured and monitored;
 - The locations at which monitoring will take place, or how these locations will be determined;
 - The acceptable values for demonstrating achievement of the outcome, with consideration of any inherent errors of measurement;
 - The frequency of monitoring or how it will be determined; and
 - The baseline or control data to be used or how it will be acquired (if necessary).
- The proponent must prepare an annual environmental management and monitoring report, in accordance with Clause 11 of the Indenture, for public release to report on compliance with the EPMP.
- The proponent must implement the approved EPMP.

The AR recommends the following general notes:

- The proponent is reminded of its general environmental duty, as required by Section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities associated with the construction and operation of the mine and mineral processing facilities do not pollute the environment in a way that causes or may cause environmental harm.
- An environmental authorisation in the form of a licence issued under the *Environment Protection Act 1993* is required for the operation of the open cut mine, rock storage facility, metallurgical plant and tailings storage facility components of the project approved via this notice. The proponent is advised to contact the EPA before acting on this approval to ascertain licensing requirements.
- The following activities are likely to require a licence under the *Environment Protection Act 1993* in relation to the components of the development application hereby approved and/or requiring future approval:
 - Chemical storage and warehousing facilities;
 - Chemical works – inorganic;
 - Petroleum production, storage or processing works of facilities;
 - Abrasive blasting;
 - Concrete batching works;
 - Ferrous and non-ferrous metal melting;
 - Metallurgical works;
 - Mineral works;
 - Waste or recycling depot;
 - Activities producing listed wastes;
 - Crushing, grinding or milling: rock, ores or minerals;
 - Fuel burning: rate of heat release exceeding 5 megawatts;
 - Extractive industry;
 - Sewage treatment works; and
 - Fuel burning.
- As many of the above activities are listed on the current licence under the *Environment Protection Act 1993* for BHPB's operations at Olympic Dam, BHPB should contact the EPA to ensure that the current licence is appropriately amended to reflect any additional activities and/or expansion of existing activities prior to such activities commencing operation.
- The proponent is reminded of its notification requirements pursuant to section 83 of the *Environment Protection Act 1993* if serious or material environmental harm from pollution is caused or threatened in the course of an activity.
- The proponent is also reminded of its notification requirements pursuant to section 83A of the *Environment Protection Act 1993*, if the proponent becomes aware of the existence of site contamination at the site or in the vicinity of the site (whether arising before or after the commencement of this section) that affects or threatens water occurring naturally under the ground or introduced to an aquifer or other area under the ground.
- If polluted soils and/or groundwater are identified at the site during the detailed design or construction stage, then an assessment must be carried out by a suitably qualified and experienced environmental consultant to ensure that the site is suitable for the proposed use. Any such assessment must be undertaken in accordance with Schedules A and B of the *National Environment Protection (Assessment of Site Contamination) Measure 1999*. The assessment must be in a form of an environmental assessment report and include a definitive statement that the site is suitable for the proposed use.

Chapter 5

Desalination plant



Chapter 5: Desalination plant

5.1 General

5.1.1 Site and locality

BHP Billiton Olympic Dam Corporation Pty Ltd's (BHPB) proposed desalination plant to supply water for mineral processing at Olympic Dam would be located at Port Bonython near Point Lowly, approximately 35km north-east of Whyalla. Access to the site from Whyalla is from the Port Bonython Rd, off the Lincoln Highway.

The adjoining land at Port Bonython supports industrial activities, including the Santos-operated Port Bonython hydrocarbon processing plant, jetty and terminal facilities, and Clean Seas Aquaculture Pty Ltd's kingfish farming plant.

The Point Lowly area is also a recreational destination for locals and tourists, with attractions including the historic Point Lowly Lighthouse, and snorkelling and diving opportunities. There are 55 residential properties on the coast near Point Lowly, 1–1.5km from the proposed site of the desalination plant, with the nearest residential properties 600m from the site boundary.

There is a sealed road to Point Lowly from Whyalla, and the area includes a breakwater and boat ramp, playground, barbecue, toilet and shower, surf lifesaving facility, lighthouse and some visitor accommodation (DEIS Plate 19.9).

5.1.2 Existing environment

5.1.2.1 Terrestrial environment

The terrestrial environment of the EIS Study Area is described in this Assessment Report (AR) in Chapter 13: 'Effects on the environment', as the descriptions are common across the various components of the proposed expansion of Olympic Dam. The descriptions are not repeated in the individual project component chapters, except for the following description of non-Indigenous cultural heritage and surface water and drainage.

Non-Indigenous cultural heritage

Point Lowly Lighthouse

The Point Lowly Lighthouse was built in 1883 and increased in height in 1909. The lighthouse complex, which included the lighthouse, two keepers' cottages, the power house, oil store, signal flag mast and 2.14ha of reserve, is listed in the South Australian Heritage Register as a State Heritage Place. It is also listed in the Register of the National Estate.

Historic shipwrecks

Three historic shipwrecks are listed on the SA Historic Shipwrecks Register as being in the vicinity and due south of Point Lowly - the *Sarah* (1876), *Parara* (1882) and *Angler* (1913). Records indicate the *Parara* was salvaged soon after wrecking in 1882, however, the remains of the *Sarah* and *Angler* are suspected to remain *in situ* and are protected under the *Historic Shipwrecks Act 1981*.

Surface water and drainage

Point Lowly is part of the Tent Hill land system, which was characterised by steep escarpments and plateaus separated by alluvial plains, and intersected by well-defined drainage paths (DEIS Section 11.3.2). Minor creeks from elevated areas joined to form large incised creeks as they entered the broad, flat floodplains. Water levels were high during storms, and overland and creek flows were often highly turbid and of low salinity. Myall Creek was the most extensive catchment in this part of the study area, terminating in a broad floodplain that discharged into the sea via a floodway across the Point Lowly access road.

5.1.2.2 Marine environment

General

Spencer Gulf is a large and relatively shallow semi-enclosed water body 100km west of Adelaide. At 300km long, 60km wide, and with a mean depth of 22 m, its key area of interest for the Environmental Impact Study (EIS) was Upper Spencer Gulf (USG), broadly defined as being north of a line between Port Pirie and Whyalla (DEIS).

The USG is an embayment (broad bay) that becomes more narrow and shallow as it extends north towards Port Augusta. Its mean depth of 13m drops to 7m north of Point Lowly. The region is dominated by large areas of tidal flats, deep water channels and seagrass habitats and, where conditions allow, rocky macroalgal reef or sponge communities dominate. The warm to hot climate, low rainfall, minimal terrestrial run-off and high evaporation result in the gulf being progressively more saline, approaching 48 g/L towards Port Augusta in autumn.

Seawater circulation and exchange in the gulf is relatively limited, particularly north of Point Lowly, though there is significant exchange with the Southern Ocean in winter. The principal mechanisms for water exchange are a combination of tidal, wind driven and density driven currents. USG is the only location in southern Australia where shape and depth profiles result in significantly greater than expected tides, with ranges of more than 4m occurring at Port Augusta and 3m at Point Lowly, compared with less than 2m at the mouth of the gulf at Port Lincoln.

USG's relatively uncommon tidal patterns include 'dodge tides', periods where neap (weak) tides are quite pronounced resulting in a period where the tidal currents are reduced for one to two days (twice monthly). Spencer Gulf (& St Vincent Gulf) is one of the few places in the world where such a periodic lack of tidal movement takes place. An extreme dodge tide occurs every six months when both the semi-diurnal and diurnal tidal constituents cancel one another simultaneously, making the effect more pronounced. Monitoring showed that in the USG, this phenomenon occurs in late May and November. The combination of small tidal ranges and the longer duration of the diurnal tide during dodge tides typically results in limited water movement for short periods.

The ambient salinity of southern ocean seawater is typically 35 – 36 g/L. Previous work in the region has shown that the annual salinity range at Point Lowly is 40 – 43 g/L depending on the time of year, with late autumn being the peak. In winter, thermohaline (density) currents created by the stratification of Gulf waters result in the flow of 'slugs' of higher salinity water along the seafloor towards the mouth of the Gulf along the eastern shore. Oceanographic research suggests that this is the principal means by which the more saline water in the northern reaches moves out of the Gulf. In summer, these density gradients reverse and the movement of salt from the Gulf in this way is reduced.

Nutrient concentrations are typically low throughout Spencer Gulf, with only limited inputs from terrestrial runoff, small townships, wastewater treatment plants and stormwater flows. There is some evidence of nutrient impacts on marine habitats throughout the gulf but these are generally centred on coastal towns and near industrial or aquaculture activities.

Water clarity is fundamental for plants and algae to photosynthesize. Clear water could also influence behavioural cues in some organisms which could be important for mating, predation and avoidance. Turbidity and suspended solids are measures of water clarity. The water clarity of a region can vary depending on a number of factors, including riverine or freshwater input, stormwater or industrial runoff, nutrient loads supporting phytoplankton blooms, water currents and depth, and natural variability in water clarity due to wind and wave action and re-suspension of sediments.

Monitoring of the Point Lowly region suggested naturally elevated turbidity levels because of strong currents and tidal action. The DEIS stated that turbidity varied with water depth and offshore locations were less turbid than inshore.

Spencer Gulf has a very high proportion of marine species endemic to the region and the relatively warm water, high salinity and sheltered conditions has resulted in the unusual presence of some communities with tropical and subtropical affinities. State and nationally listed species occur or potentially occur in USG, including whale species, the Australian Sea Lion, Great White shark, dolphin species seahorses and pipefish.

The region supports lucrative commercial and recreational fisheries and significant aquaculture. It is home to the Southern Bluefin Tuna aquaculture industry which is worth between \$100-million and \$300-million a year depending on market forces. Within 5km from Point Lowly in Fitzgerald Bay there is the valuable sea-cage aquaculture for Yellowtail Kingfish.

The Point Lowly region is generally recognised to be the world's largest-known breeding aggregation of Australian Giant Cuttlefish (*Sepia apama*). The ecological significance was recognised in 2004 when the SA Government declared a permanent fishing closure for all cephalopods in the False Bay to Point Lowly region. The region has also become a significant tourist attraction in South Australia, being visited and studied by scientists and scuba divers from around the world.

The closest Aquatic Reserve under the *Fisheries Management Act 2007* to the proposed Point Lowly desalination plant is the Blanche Harbor–Douglas Bank Aquatic Reserve, located 20km to the north. The area around Point Lowly is in the Upper Spencer Gulf Marine Park, part of South Australia's marine park network established under the *Marine Parks Act 2007*. Ten sanctuary zones have been proposed for the marine park, with one located near Point Lowly to include part of the cuttlefish spawning area.

Sanctuary zones are being established by the government so that specific areas within marine parks can be managed to provide protection and conservation for habitats and biodiversity, especially by prohibiting the removal or harm of plants, animals and marine products. Marine park sanctuary zones, management plans and the *Marine Parks (Zoning) Variation Regulations 2011* are expected to come into force by mid-2012 when the consultation and submission process are finalised.

Ecological surveys undertaken in the region for the DEIS and SEIS identified distinct marine habitat types or communities in the vicinity of Point Lowly, comprising:

- Sandy intertidal;
- Rocky intertidal;
- Rocky subtidal reef;
- Sparse seagrass;
- Silt/sand;
- Dense sponge; and
- Jetty pile.

The DEIS stated that the distribution and extent of each of the marine communities at Point Lowly are influenced primarily by the substratum type, water depth and water movement. A more detailed schematic profile of the communities inhabiting the seafloor, from the reef habitat near the shore at Point Lowly to the deepwater channel habitat 750m off-shore is shown in the DEIS Figure 16.8.

Fisheries

Spencer Gulf supports commercial and recreational fisheries of economic and social significance, with the zone between Port Pirie and Whyalla being recognised as being particularly productive. The main species caught are Snapper (*Chrysophrys auratus*), King George Whiting (*Sillaginodes punctata*), Blue Swimmer Crab (*Portunus pelagicus*), Western King Prawn (*Melicertus latisulcatus*) and Southern Calamari (*Sepioteuthis australis*). Many of these species use the seagrass meadows and/or mangroves within part of their life cycle and many are caught within or near the seagrass areas. Two important species, Snapper and the Western King Prawn, use and are caught in the deep water channels.

Aquaculture

The sheltered and relatively clean waters of Spencer Gulf provided ideal conditions for aquaculture, with commercial species including the Yellowtail Kingfish and the Pacific Oyster. The economic value of the Yellowtail Kingfish industry on Eyre Peninsula - grouped with abalone, mussel and other aquaculture, excluding tuna and oysters - was reported to be \$29-million in 2008-09.

Leases for the culture of Pacific Oysters have been established 50km south of Point Lowly off Cowell and Port Broughton. The economic value of the Pacific Oyster industry on Eyre Peninsula was reported to be \$32-million in 2008-09.

5.2 Project description – key elements

5.2.1 General

BHPB would mainly source water for the operation of the proposed expanded mine from the proposed desalination plant. It would be supplemented by saline groundwater extraction for dust suppression and water from the Great Artesian Basin (GAB) under existing approvals from the SA Government (DEIS Section 5.7).

BHPB considered a coastal desalination plant to be the best water-supply option. Alternatives to a coastal desalination plant that were considered and rejected (DEIS Section 4.10) included:

- A third wellfield in the GAB;
- Using River Murray water; or
- Adelaide treated wastewater

Further, the plant could also potentially create a new water supply option for the USG and Eyre Peninsula (DEIS Section 4.8)

BHPB chose the Point Lowly site (DEIS Section 4.9) over potential sites in the USG and at Ceduna, based on a set of criteria that included:

- Length of water supply pipeline;
- Distance to a water depth >20m; and
- Suitable available land and infrastructure.

The SEIS analysed a substantially expanded range of alternative sites in Spencer Gulf, lower Eyre Peninsula and the West Coast against an expanded list of criteria. The analysis confirmed Point Lowly as the preferred site because:

- Dispersion of return water would be greater there than at any of the other alternative sites due to the high average current speed;
- Costs would be lower and there were fewer logistical issues than at most of the alternative sites; and
- Alternative sites provided limited net environmental benefit.

BHPB also determined that discharging return (waste) water into the gulf was the best option, compared with land-based discharge to evaporation ponds or an inland salt lake, or injection into underground aquifers.

The reasons for not discharging return water onto the land involved cost and adverse environmental impacts, including having to clear 12,000ha to create evaporation ponds and the need for lining to prevent leakage into the groundwater (SEIS Section 4.3.2). The response to suggestions raised in public submissions that BHPB should source its additional water from the River Murray and/or SA Water's sewage treatment plants in Adelaide was provided in SEIS Section 4.3.3.

BHPB has sought approval for a 280 ML/d desalination plant at Point Lowly. Of that, 200 ML/d would be needed as supply for the proposed new open-pit mine pit, metallurgical plant and associated infrastructure, and 80 ML/d could potentially be made available to another user for supply. The water would be pumped 320km through an underground pipeline to Olympic Dam. Construction of the plant would occur in stages, increasing capacity over time to match the needs of the mine expansion up to full production capacity of 200 ML/d.

The proposed plant would use reverse-osmosis (RO) technology to produce water from seawater taken from the Spencer Gulf. Seawater would be pumped through fine membranes to produce low-salinity supply water and high-salinity return water. The return water would be a combination of brine with twice the salt content of seawater, and small quantities of anti-scalant chemicals used on the membranes of the plant. The return water would be discharged through a diffuser, where it would be mixed with seawater by the strong currents experienced off Point Lowly. A conceptual layout of the proposed desalination plant was shown in DEIS Figure 5.27.



DEIS Figure 5.27 Conceptual layout of the proposed coastal desalination plant

While BHPB would not determine detailed design and construction methodology for the intake and outfall pipelines until it appointed the construction contractor, the conceptual layout provided in the SEIS allowed for the outfall pipe to be buried for its full length or buried in the land-based sections and laid on the seabed in the deeper waters. This could involve blasting, depending on the strength of the underlying rock.

In response to concerns raised in submissions on the DEIS, and geotechnical and engineering investigations conducted after the DEIS was released, BHPB proposed in the SEIS that:

- The outfall pipeline would be installed by means of tunnelling rather than trenching; and
- The total length of the outfall pipeline would be extended by 200m to reduce potential impacts of return water to a regionally significant sponge community.

The intake pipeline would be installed by way of seabed trenching as originally proposed.

5.2.2 Desalination Plant

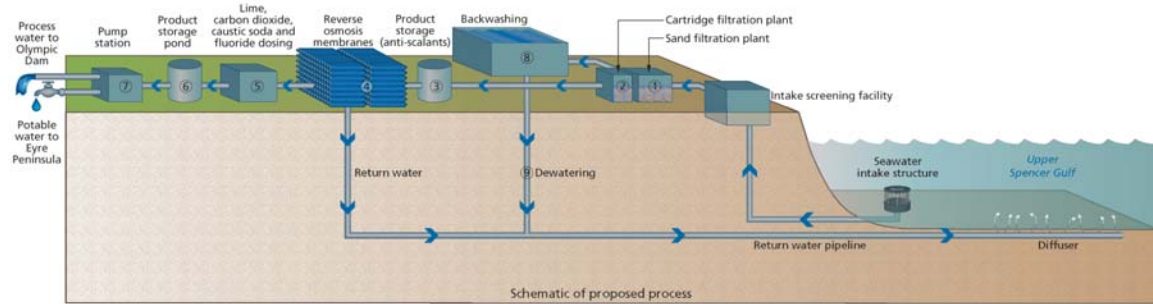
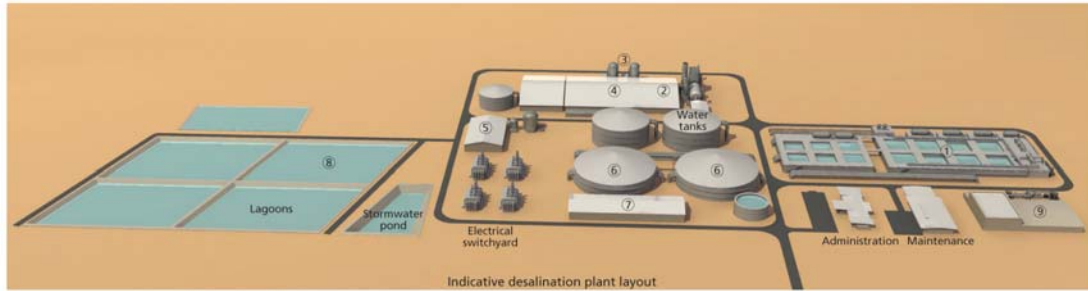
5.2.2.1 Construction

The design for the plant's foundations would be based on the geotechnical investigations of the site and construction methods to be employed by the preferred contractor. Options could include bored piles, driven piles or strip footings. The desalination plant would require reinforced concrete tanks cast on-site, lined earth storage areas, and mechanical components such as pumps, pressure vessels, filter elements and chemical dosing systems. Specialised components would be imported and assembled on-site or pre-assembled overseas and erected on-site.

Construction would take approximately 33 months and would require 400 workers who would live in existing accommodation at Whyalla and be taken to and from the work site by bus. On-site lunch rooms and basic sanitation facilities would be provided.

5.2.2.2 Operation

The operation of the plant would require seawater to be pumped to a number of membrane elements, with around 45% of the water passing through the membranes, to produce low-salinity product water. The remaining water and the salt rejected by the membranes would form a concentrate stream with a salinity double that of the seawater. The low-salinity water (300 mg/L salt) would be treated with chemicals and stored ready to be pumped to Olympic Dam.



DEIS Figure 5.32 Proposed desalination process

The RO membranes would be cleaned every three to four months using agents such as acids, bases and surfactants (chemicals that stabilise mixtures of oil and water), and the wastewater discharged into managed evaporation lagoons. Membranes would typically need replacing after 3-7 years of operation.

5.2.2.3 Intake/outfall structures

Intake pipeline

The intake pipeline would be 3m in diameter, 1.5km long and extend 400m offshore. It was proposed that the end of the pipe would be fitted with a bar-screen and intake structure. The latter would be designed to limit flow velocities to 0.2 m/s and the inflow rate would average about 560 ML/d, with 650 ML/d at peak demand. The average salinity of the intake water was expected to be between 38 g/L and 42 g/L, depending on the season. The proposed location of the intake pipeline is shown on SEIS Figure 1.7.

Outfall pipeline

The outfall pipe tunnel would start from a launch shaft 87m below ground level at the desalination plant and follow an alignment close to the Port Bonython Rd, under the rocky foreshore just north of the Point Lowly Lighthouse, and into the sea 1.1km south-east of Point Lowly (SEIS Figure 1.7). It would run at between 87m and 35m below ground level.

Tunnelling and excavation of the launch shaft was predicted to produce up to 53,000 tonnes of spoil and water at the desalination plant site. The spoil would be used on or close to the site, or taken away. Water would be used to remove spoil from the head of the tunnel and would be stored temporarily, treated and reused for tunnelling before being discharged into Spencer Gulf.

Diffuser

BHPB initially proposed discharging return water under pressure through a 200m-long diffuser on the sea floor in at least 20m of water and orientated at right angles to the prevailing currents. For the purpose of hydrodynamic modelling it was proposed that 50 risers would be used along the diffuser to discharge the return water 2-7m above the diffuser ports. It would be carried by the currents before falling to the sea floor between 11m and 47m from the diffuser.

On subsequently deciding to tunnel the outfall pipe BHPB determined that rosette diffusers were better suited than the linear arrangements considered initially. The optimal diffuser design shown in the SEIS (Drawing No ODP3672-D0-0023), involved four 5-port rosettes spaced at 50m intervals along the alignment of the proposed original linear diffuser but 200m further offshore.

5.3 Summary of submissions

Concerns about the discharge from the proposed desalination plant at Point Lowly was the most prominent issue raised in public submissions on the DEIS. More than 95 per cent, or 3800 submissions, commented about the desalination plant proposal. Of those, 90 per cent (3400 submissions) were based on the Australian Conservation Foundation (ACF) and Wilderness Society form letters, with the latter focusing solely on desalination issues.

5.3.1 Public submissions

The concerns and requirements of the public included:

- Site selection and consideration of alternative locations to Point Lowly, including greater consideration of sites along active coast lines, including the West Coast;
- The threat posed by return water discharge to marine life, including the Australian Giant Cuttlefish and aquaculture/fishing in Upper Spencer Gulf (USG);
- USG was an unsuitable location because of existing salinity levels, warmer water and dodge tides;
- BHPB needed to consider alternative brine-disposal methods, including pumping it into salt lakes such as Lake Torrens;
- Property owners and property values could be adversely affected by noise, vibration, visual impacts and discharges affecting swimming beaches;
- USG already had naturally elevated salinity, and it was predicted that climate change could increase it. Desalination plant discharges could compound the predicted increase;
- Contingency plans if the gulf was adversely impacted, including potential to close the desalination plant during cuttlefish breeding;
- Uncertainty about the effects of dissolved oxygen levels on marine organisms due to the saline return water discharge;
- Adverse water quality impacts from blasting to install intake and outfall pipelines;
- Accuracy of modelling, especially around dodge tides;
- Extent of baseline water quality and marine ecology data;
- The intake pipe could suck up significant quantities of marine life from USG;
- Ecotoxicity testing results and methods used to estimate a safe dilution factor to protect marine species
- Potential for upwelling to occur, with adverse impacts on cuttlefish;
- Quality of the equipment used for salinity measurement and the potential errors this could have introduced in the modelling’;
- Further surveys/future monitoring would be required; and
- Clarification of whether the pumping of desalinated water would use renewable energy.

5.3.2 Government submissions

The concerns and requirements of the SA governments included:

- Insufficient consideration of alternative water-supply options, including use of treated wastewater from Adelaide;
- Adequacy of marine surveys of existing habitats and species that could be adversely impacted by the desalination plant discharge;
- Duration of continuous water quality and hydrodynamic monitoring used to validate the hydrodynamic model and model outputs;
- BHPB should undertake further ecotoxicity testing using brine that was representative of the final effluent from the proposed desalination plant. All testing needed to be either chronic or sub-chronic and carried out using a consistent salinity throughout all tests;
- Problems with the Australian Giant Cuttlefish ecotoxicity tests and results;
- Different diffuser designs and configurations needed to be modelled to try to improve the near-field mixing/dilution and avoid re-entrainment (carried by currents) of the discharge brine;
- Greater documentation was required to justify the rationale for not pursuing alternative sites for the desalination plant, including west coast sites;
- Far-field modelling needed to be run over a much longer period than five years to review the potential build-up of salt in the USG;
- Greater consideration required to minimising impacts on the sponge community located near the proposed point of discharge;
- Site-specific risk assessment required to assess the risk of entrainment of species that spawned in the area
- Preference should be given to under-seabed tunnelling of intake and outfall pipelines versus trenching to avoid adverse water quality impacts and damage to rocky foreshore areas;
- Further clarity required on whether BHPB's commitment to using renewable energy to power the desalination plant extended to Scope 3 emissions and pumping energy;
- Evidence was required that the desalination plant, pumping and pipeline would be designed and assessed against best-practice standards for minimising greenhouse gas emissions; and
- Expert advice was required to ensure that proposed blasting techniques would not pose a threat to the Point Lowly lighthouse complex.

5.4 Key environmental, social and economic issues

The key environmental, social and economic issues associated with the proposed desalination plant include:

- Site selection and consideration of alternatives;
- Ecotoxicity testing and suitable dilution factors;
- Hydrodynamic modelling;
- Mixing and dispersion of return water and potential ecological effects;
- Listed/significant species and commercial species;
- Ecological monitoring and water quality;
- Pipeline construction impacts;
- Entrainment/entrapment of marine life;
- Hazard and risk;
- Air quality;
- Terrestrial impacts;
- Surface water;
- Noise and vibration;
- Heritage impacts;

- Social impacts;
- Visual amenity and landscape character;
- Waste management;
- Greenhouse gases and sustainability; and
- Traffic impacts.

The issues, assessment and recommendations are provided under each of these headings.

5.4.1 Site selection and consideration of alternative sites

5.4.1.1 Issues

Of the 391 unique submissions (not form letters) made on the DEIS, 154 or 39 per cent raised concerns about the proposed siting of the desalination plant in Upper Spencer Gulf (USG) and its close location to the Australian Giant Cuttlefish breeding grounds. Most wanted BHPB to investigate alternative locations on active coastlines such as the west coast of Eyre Peninsula. The Friends of the Earth and the Spencer Gulf & West Coast Prawn Fisherman's Association were concerned that the DEIS only considered sites in the USG, where all such sites would present similar conditions with unsuitably low flushing rates.

University of Adelaide researchers Associate Professor Bronwyn Gillanders et al¹⁵ were concerned that the criteria used to assess the six locations focused on infrastructure and cost factors, such as the length of water supply pipeline, distance to deepwater, suitable available land and infrastructure, and not on the most ecologically sound option for the region. Hon Mark Parnell MLC was concerned that the sensitivity of the area around Point Lowly and impact on the marine environment was not one of the criteria used to assess the appropriate location of the plant.

The August 2009 Environment, Resources and Development (ERD) Committee of Parliament Report on Port Bonython Desalination Plant, which was received as a submission on the DEIS, recommended the need for BHPB to conduct further investigations into alternative sites for the desalination plant because of the high potential risk to the marine environment at Point Lowly.

Flinders University researchers Dr Kirsten Benkendorff et al suggested that alternatives to discharging waste brine into the gulf, such as directing the brine into evaporation pans on land and harvesting the salt product, should also have been considered further.

Further, the SA Government submission said the DEIS provided insufficient discussion about why the potential locations of Ceduna and south of Port Pirie or any other site in the general vicinity were excluded, as these could present lower risk options for impacts on the marine environment. In particular, further detail was requested on the rationale for not pursuing alternative West Coast sites, based on data to assess the likely ecological and economic impacts. The SA Government questioned the conclusion that a desalination plant located at Point Lowly was the only one that met the criteria necessary for return water dispersion, particularly as data had only been presented for two sites in the DEIS.

In response to the issues raised, BHPB conducted a further review of the previously identified potential sites, including Point Lowly, Port Augusta, Whyalla, south of Whyalla, south of Port Pirie and Ceduna, against the following assessment criteria:

- Proximity to Olympic Dam, with clean, deep and fast flowing water to adequately dilute and disperse return water. This criterion also included consideration of pipeline construction costs, the number of pump stations, ongoing energy requirements and greenhouse gas emissions;

¹⁵ A/Professor Gillander's views are her own and do not represent those of the University of Adelaide.

- Accessibility and ability to construct the water pipeline taking account of land ownership, land use, vegetation clearance, terrain and soils; and
- Availability of land and utilities such as power, roads and telecommunication infrastructure.

The assessment was extended to a further 14 locations, bringing the total number of potential sites assessed to 20, comprising:

Upper Spencer Gulf

- Port Augusta
- Point Lowly
- Fitzgerald Bay

Yorke Peninsula

- Port Victoria
- Hardwicke Bay
- Corny Point

West Coast

- Fowlers Bay
- Ceduna
- Laura Bay
- Streaky Bay
- Elliston
- Point Drummond
- Port Lincoln (Cathedral Rocks)

Eastern Spencer Gulf (south of Port Pirie)

- Wood Point
- Tickera
- Wallaroo

Eastern Eyre Peninsula

- Arno Bay
- Whyalla
- Cowleds Landing
- Lucky Bay

The sites and the potential alignment of pipelines to carry water to Olympic Dam were shown in the SEIS Figure 4.5. A detailed comparative analysis of the sites against the selection criteria was provided in the SEIS Tables 4.1, 4.2, 4.3 and 4.4.

On the basis of this analysis, BHPB concluded that the alternative locations did not provide any additional benefit over Point Lowly and the constraints associated with the alternative sites would pose the potential for greater environmental impact and greatly increased capital and operating costs. The average speed of the currents off Point Lowly (48 cm/sec) was more than double that predicted for most of the other locations, including sites on the west coast. This meant the dispersion of return water provided by the currents at Point Lowly was much greater than at any of the alternative sites evaluated.

Many of the alternative sites would have a greater environmental footprint than the Point Lowly site based on an assessment of inherent environmental values at each site and the consideration of mitigation measures to reduce impacts on these values. Many of the evaluated sites elsewhere in Spencer Gulf required the construction of very long return water outfall pipelines - typically two or more kilometres - to get into deep water (>20m). The cost of under-seabed tunnelling over such a distance was prohibitive, and trenching would require increased clearance of mangrove and/or seagrass which would have adverse impacts on ecology and water quality.

With the exception of the Port Augusta, Fitzgerald Bay and Whyalla sites, the capital and ongoing operating expenses and environmental impacts associated with running a pipeline from a desalination plant were greater for all the sites evaluated than for Point Lowly. BHPB said that if it obtained electricity to operate the desalination plant and associated pumping stations from traditional non-renewable sources, all of the alternative sites bar Port Augusta would generate considerably greater greenhouse gas emissions over the life of Olympic Dam project. However, given BHPB's commitment to using renewable sources of energy drawn from the National Electricity Market (NEM) to power the proposed desalination plant and pump water to Olympic Dam (SEIS Section 2), such arguments in support of the Point Lowly site were only relevant if renewable sources of energy were unavailable.

5.4.1.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** No specific commitments have been made by BHPB in either the DEIS or Supplementary Environmental Impact Statement (SEIS) about the location of the desalination plant.

5.4.1.3 Assessment

The AR considers that the SEIS presented a comprehensive evaluation of alternative sites for the desalination plant which included consideration of an appropriately wide range of environmental, financial and logistical considerations. The AR concludes that the Point Lowly site had been justified as the preferred location for the desalination plant because it:

- Provided for a greater level of dispersion for return water into the marine environment than at any of the alternative sites evaluated;
- Reduced potential environmental impacts compared to many of the alternative sites, particularly those elsewhere in Spencer Gulf;
- Reduced logistical issues, including zoning, land ownership, land-use constraints, workforce availability and power supply capacity, compared to most of the alternative sites; and
- Reduced capital expenses, including pipeline, road and power supply construction, and operating expenses, including pumping costs, compared to most of the alternative sites.

While the AR is satisfied with the rationale for the choice of Point Lowly as the preferred location of the proposed desalination plant, the EIS process was also required to demonstrate that there were unlikely to be significant environmental impacts on the marine environment. To achieve this BHPB undertook detailed toxicity studies of key species to determine safe dilution levels for return water discharge from the desalination plant. In parallel, it developed a hydrodynamic model to determine if the dilution levels could be achieved at the cuttlefish breeding ground and other marine communities potentially affected by the discharge.

In this regard, the following chapter sections provide an assessment of BHPB's EIS studies and conclusions.

5.4.2 Ecotoxicity testing and suitable dilution factor

5.4.2.1 Issues

The toxicity of the proposed discharge needs to be assessed in conjunction with a well-validated hydrodynamic model to assess the likelihood of a biological or ecological effect. These factors are pertinent in assessing whether:

- Ecological communities would be exposed to brine from a desalination plant; and
- Concentration of the brine would exceed the species sensitivity to brine.

This section considers the results of testing undertaken to determine the brine concentration, measured as dilution, where an effect could be seen. The process follows the methodologies described in the 2000 ANZECC/ARMCANZ 'Guidelines for Fresh and Marine Water Quality' (ANZECC/ARMCANZ).

A desalination plant discharge contains saline water twice as salty as seawater and a mixture of chemicals that do not pass through the RO membranes or are not otherwise removed from the effluent before it is discharged. Other chemicals in the discharge will typically include chemicals designed to prevent the build-up of precipitates, such as anti-scalants and acids, which can reduce the efficiency of the plant and cause blockages. Biocides such as chlorine are also commonly used to kill biofouling of the intake pipes or in the pre-treatment processes. When chlorine is used, sodium metabisulphide (SBS) is added to neutralise the chlorine in the pre-treatment process to avoid damaging the RO membranes. Cleaning chemicals are commonly used at varying frequencies (anywhere from daily to monthly) depending on the need of each individual plant. These chemicals can be toxic to a receiving environment.

The 2000 ANZECC/ARMCANZ details the process that needs to be followed to assess the potential impact of a complex mix of chemicals in an effluent to be discharged. This approach takes into account complex processes that could aggregate or add toxicity of the mixture that single-constituent testing often overlooks, therefore more closely resembling the situation in the natural environment.

A further method is to include as many-site specific test variables as possible, including test species that inhabit the discharge location and test water sourced from the discharge area. This is particularly important in USG because of its inherently higher ambient salinity. Unfortunately test species selection is often limited by the species and test protocol availability at commercial laboratories. The toxicity of a mixture or threshold where a biological effect could occur is not outlined by a concentration of pollutant, as with single-toxicant criteria, but a dilution factor from the effluent's starting concentration. A dilution factor of 1:50 means that the effluent needs to be diluted at a ratio one part effluent with 50 parts clean seawater. This discharge dilution factor would be used, by way of hydrodynamic model, in determining the potential for areas of possible impact and proximity to sensitive habitats.

The process of calculating a dilution factor that would be protective of the receiving environment is outlined in the 2000 ANZECC/ARMCANZ Guidelines (Chapter 8.3.4-6). The guidelines say that the minimum number of test organisms should be five species from a minimum of four different taxonomic groups. They also recommend chronic tests using ecologically relevant end-points in preference to acute tests which would require the use of arbitrary acute to chronic ratios.

The USG has a higher ambient salinity than lower gulf waters or open southern marine waters, which will affect the toxicity threshold within the tests undertaken. Therefore, the starting salinity of the test dilutions are of utmost importance, particularly as previous testing has shown that salt in desalination plant effluent is the major contributor to toxicity.

The rigor of the ecotoxicology studies was raised as a concern, though the methodology was generally considered to be appropriate and reliable. In this regard, BHPB has stated it would undertake additional ecotoxicological studies in the event that return water chemical characteristics changed, in conjunction with the establishment of pre-construction and pre-operational monitoring programs.

5.4.2.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.1:

- **Objective:** No significant adverse impacts to specified marine environmental values of the USG from the construction of, or as a result of discharges from, the desalination plant at Point Lowly.
- **Criteria:**
 - No long-term adverse impacts on the breeding success of Australian Giant Cuttlefish as a result of construction or operation of the desalination plant; and
 - Maintain return water dilution at aquaculture leases greater than the species protection level identified by ecotoxicology tests.
- **Management/monitoring plan:** Undertaking the following monitoring programs:
 - A new Marine Water Quality Monitoring Program; and
 - A new Marine Flora and Fauna Monitoring Program.
- **Commitments:** BHPB made the following commitments (SEIS Table 2.1 - commitments, pgs 50-51):
 - The return water diffuser would be designed and operated to deliver, as a minimum, the dilution predicted in the DEIS at 100m from the diffuser and the dilution required to mitigate significant impacts at the nearest cuttlefish breeding habitat;
 - BHPB would ensure that chlorine was neutralised prior to discharge or disposal of on land, with only traces of common water treatment chemicals being present in the return water and within compliance limits;
 - BHPB would undertake appropriate monitoring to identify significant changes to marine flora and fauna communities and water quality and
 - If the return water discharge did not meet agreed regulatory thresholds for return water dispersion or monitoring identified unacceptable impacts, BHPB would cease discharging return water from the desalination plant into the USG until the issue was resolved.

5.4.2.3 Assessment

The DEIS outlined the results of ecotoxicity testing performed on 15 species of marine flora and fauna, including the Australian Giant Cuttlefish (*Sepia apama*), using a simulated brine with a salinity of 79 parts per thousand (ppt) including the anti-scalant NALCO PC-1020T dosed at 3.6 milligrams per litre (mg/L), which concentrated to approximately 7mg/L through the RO process. Chlorine was not included because it would be neutralised and other chemicals were not included as they would be disposed of on land, such as ferric chloride. The SEIS detailed the development of an ecotoxicity test using a species of sponge (*Aplysina lendenfeldi*) to assess the possible impacts on the sponge community close to the proposed outfall site. This brought the total number of test species to 16. The testing undertaken was a combination of chronic, sub-chronic and acute tests and test diluent water ranged in salinities between 35–45ppt.

BHPB engaged Dr Michael Warne of the CSIRO to undertake a critical review of the data that highlighted a 'primary data set' based on the site relevance for species, chronic or sub-chronic tests, quality of test results and endpoint relevance (DEIS Appendix O10.5). The primary data set was the result of ecotoxicity testing for 7 of the 16 species tested, which were deemed to provide the best dataset to generate a dilution factor according to the ANZECC/ARMCANZ Guidelines (2000) (Table 1).

Table 1: Primary Dataset of Exotoxicity Testing Data

TEST SPECIES	TAXONOMIC GROUP	PRESENT IN USG	EC ₁₀	STANDARDISED EC ₁₀
<i>Isochrysis galbana</i>	Diatom	Genus Yes, species unknown	84.4	83.6
<i>Ecklonia radiata</i> (Kelp)	Macroalga	No	27.6	27.6
<i>Crassostrea gigas</i> (Pacific Oyster)	Bivalve	Yes	3.3	3.3
<i>Chrysophrys auratus</i> (Pink Snapper)	Fish	Yes	22.2	18.2
<i>Argyrosomus japonicus</i> (Mulloway)	Fish	Yes	11.0	6.4
<i>Melicertus latisulcatus</i> (Western King Prawn)	Crustacean	Yes	7.5	2.7
<i>Sepia apama</i> (Australian Giant Cuttlefish)	Cephalopod	Yes	6.3	6.3
Dilution Factor (SPTV) –Output			1:85	1:70
Percentage of species protected			100%	99%

This review highlighted the challenges associated with testing species from a naturally variable saline environment resulting in uncertainty in some of the results. One option to mitigate this was to increase the level of protection which Dr Warne did to theoretically protect 100 per cent of species, rather than the default of 95 per cent protection or 99 per cent for highly valued areas. His proposed dilution factor in the DEIS was 1:85. In a subsequent review to inform the SEIS, Dr Warne undertook a re-calculation of toxicity to standardise the salinities across all tests (Table 1). This review concluded that a dilution factor of 1:70 could be applied to protect 99 per cent of species.

An independent review commissioned by the SA Environment Protection Agency (EPA) raised some concerns about the tests undertaken in the ‘primary data set’, including questions about experimental design, quality and ambiguous response. However these concerns did not exclude all of the results of the tests. Accordingly, the AR concludes that to accommodate the uncertainty in the existing ecotoxicity data, a dilution factor of 1:70 beyond 100m from the diffuser should be used as a design criterion for the diffuser.

While the AR concludes that the wider marine ecology would be protected, there is an opportunity to collect further data before construction of the proposed plant proceeds. The data would be used by the EPA to develop licence conditions and by BHPB to optimise the design, if required. The AR considers that further ecotoxicity testing would have to be undertaken on a minimum of five species from four different taxonomic groups, and the results and their integration with previous testing should be reviewed by the EPA and a panel of ecotoxicity experts.

As a consequence of the additional testing there would need to be adequate flexibility in the design of the plant and diffuser to meet any updated dilution factor that could be higher than 1:70. If the resulting ecotoxicity analysis determined a dilution factor less protective than 1:70 beyond 100m from the diffuser, the dilution factor of 1:70 would be the final minimum design dilution criteria to ensure the best possible outcome for the marine environment.

RECOMMENDATION

While the AR concludes that the wider marine ecology would be protected, there is an opportunity to collect further data before construction of the proposed plant proceeds. The data would be used by the EPA to develop licence conditions and by BHPB to optimise the design, if required. Accordingly the following conditions are recommended:

- To demonstrate that the final design of the return water diffuser and alignment are optimised at the time of construction, the proponent must undertake further ecotoxicity testing on at least five (5) species from at least four (4) taxonomic groups (one of which must be the Australian Giant Cuttlefish *Sepia apama*) using simulated effluent representative of the effluent that will be discharged from the operational desalination plant (i.e. including all water treatment chemicals and anti-scalants that will be discharged from the final plant). As part of the work to be undertaken the proponent must undertake the following:
 - Prior to commencing further ecotoxicity testing, a panel of ecotoxicity experts (approved by the SA EPA, but at the cost of BHPB) must provide recommendations on the appropriateness of the species selected, the necessary experimental design to be used, and acceptable criteria for quality assurance/control for those species tests that do not have existing standards or, where an existing standard test is being used, they must confirm that the accompanying quality assurance/control criteria are adequate.;
 - A copy of the expert panel recommendations must be provided to the SA EPA and the laboratory or laboratories that will conduct the ecotoxicity testing prior to testing commencing;
 - The required ecotoxicity tests must be conducted by a commercial and/or research laboratory that has experience in conducting ecotoxicity tests on, or laboratory-based experiments with, Giant Cuttlefish or similar species;
 - Immediately on completion of the additional ecotoxicity test, the panel (approved by the SA EPA, but at cost to BHPB) must review the data and the quality of procedures adopted to ensure the experimental design and data acceptability criteria have been met. The ecotoxicity data must be analysed, a dilution factor calculated to theoretically protect 99% of species and a report written by a scientist employed (or contracted) by BHPB; and
 - The report required and the raw data generated by the ecotoxicity testing must be provided to the SA EPA for independent review.
- The proponent must design and construct the outfall infrastructure in general accordance with SEIS figure 17.13 within the zone shown on SEIS Figure 1.7 (unless modified by the EPA through licensing conditions). The return water discharge diffuser must be designed to achieve the following:
 - A dilution of 1:70 beyond 100 metres from the diffuser as demonstrated by nearfield modelling;
 - The discharge plume must not interact with the water surface at any time and dilution of the plume is maximized when it reaches the seabed;
 - The use of bypass flows or other measures to ensure the achievement of the approved dilution factor, particularly under low discharge flow rates; and
 - Shall be capable of being extended and modified to achieve the approved dilution rates.

5.4.3 Hydrodynamic modelling

5.4.3.1 Issues

The DEIS and the SEIS considered two proposed diffuser configurations. The first was a 200m-long, 50-port linear arrangement which was modelled to be perpendicular to the current. The second was the Computational Fluid Dynamic (CFD) model that incorporated four rosettes, each with five ports, spaced 50m apart along the same geometry as the linear diffuser but located 200m further offshore. This was the preferred diffuser design as a result of the decision to tunnel the outfall pipeline.

To demonstrate that a hydrodynamic model would be well validated, comparisons must be made to monitored data to show that the model adequately represented the 'real world'. The closeness of the modelled results to the monitored data would determine how well the model could describe the possible dispersion in a real-world situation.

5.4.3.2 BHPB EM Program and commitments

- **EM Program:** as per section 5.6.2.1.2 above. In addition the following BHPB commitment is considered relevant.
- **Commitments:** BHPB commits to retrieving operational monitoring data in real-time (using live telemetry) enabling appropriate management responses to be initiated should dilution targets be exceeded (SEIS Table 2.1, page 51).

5.4.3.3 Assessment

Near-field modelling

BHPB presented three different models which though linked, need to be assessed separately. The first model was the 'near-field' model which described how water was ejected from the individual diffuser jets, rose through the water column and then fell to the seabed, and the resulting dilution during the process. The near-field model was useful to describe the initial mixing from the diffuser structure to approximately 100-150m either side of the diffusers. The model presented in the SEIS used CFD modelling to describe the complex fluid flows from the discharge of brine from the diffusers. The set-up of the flow domain and computational mesh in the CFD model paid particular attention to the area near the diffuser risers where a refined mesh increased resolution.

Single-port diffuser model results were validated against other model outputs, including Roberts & Toms (1987) (hereafter RT87) and Roberts et. al, (1997) (hereafter RFD97). Together with the qualitative agreement between the CFD simulation and the experimental results, the validation of the CFD model against the experiments reported in RT87 and RFD 97 indicated that the results of the CFD simulations captured the true dynamics qualitatively and that quantitative agreement was good, with an estimated average discrepancy of 10 per cent. The results also indicated that the CFD model had been adequately validated against results from the CORMIX modelling package.

The AR concludes that the CFD model is well validated for a single-port diffuser. This finding would allow the implementation of the CFD modelling to a complex multi-port diffuser configuration with confidence that the results would be qualitatively similar to the real flow situation. The CFD modelling presented in the SEIS represented state-of-the-art modelling for complex negatively buoyant plumes and the validation process had been done adequately to understand the inherent uncertainty.

Re-entrainment of brine is a natural consequence of the behaviour of negatively buoyant plumes. Re-entrainment occurs where the dilution of the discharge is reduced because the discharge is pulled back into water that has already been discharged. Re-entrainment is exacerbated when there is a low flow and low throw heights and/or a stagnant bottom layer of mixed brine. The CFD

modelling for Point Lowly showed that re-entrainment was possible, but the brine layer on the seabed would naturally form a bottom density current that would accelerate the flow away from the diffuser and increase dilution within the near-field. This suggested that re-entrainment should decrease or, in a worst-case scenario, attain a steady state over time.

Accordingly, this AR concludes that the near-field model is adequately presented and validated to represent the likely real flow situation.

Mid-field modelling

The 'mid-field' model is a separate model but inherently linked to the near-field model, described as the likely footprint of water from the near-field to approximately 4km from the diffuser. This model showed whether there were likely to be any interactions with nearby sensitive communities and how the footprint size and extent changed with various wind and tidal factors. Comparison with ecotoxicity data allows for assessment of potential biological impacts to be quantified.

For a model to be useful in prediction, it needs to be robust and validated against real marine data. SARDI Aquatic Sciences reviewed the model developed by BHPB's consultant and concluded that it appeared to be robust and showed good predictive capability for tidal and monthly averaged currents, and both low and high-pass filtered temperature variations. The former is an important result because tidal currents would likely be the primary mechanism by which mixing and dispersion of the discharged brine occurred. However, it should be noted that the comparison was made with 40 and 70 day data sets (SEIS Section 17.5.3).

SARDI found that the model's in-ability to predict long term (40 day) background salinity changes of about 1 ppt could be attributed to a number of factors. Salinity is determined by currents, mixing, and dispersal and the tidal currents have been well validated. However, model salinity also depends on the initial values adopted, which were obtained from historical data sets, rather than immediately prior to the year of simulation, as such data was not available. In addition, evaporation is also very important to determining salinity but can be difficult to accurately estimate.

SARDI also found that while the model was able to get the timing of salinity variability correct, the amplitudes underestimated the observations by about 60 per cent (or 0.3 ppt) under spring tide conditions. SARDI's explanation for this was that the salinity gradients along the gulf were under-represented in the model. The AR notes however that better results were achieved under critical neap/dodge tide conditions. This underlined the need to collect 12 months of additional data for further model validation studies.

RECOMMENDATION

The AR considers that the mid-field model has been validated for currents and temperature, and sufficiently robust to assess the impact of modelled brine dilution on the marine environment to enable prediction of potential impacts on significant species. Further, the AR acknowledges BHPB's commitment to collect further data before construction of the proposed desalination plant and to installing real-time monitoring systems and plant controls to ensure the required dilutions would be achieved.

Accordingly, the AR recommends BHPB undertakes additional modelling incorporating a minimum of 12 months of salinity, temperature and current data from the Point Lowly region, before any plant commissioning, with the aim of refining the model and optimising the diffuser design should it be required. The AR also recommends BHPB install a live telemetry observing system, to allow appropriate management response to any unexpected salinity events. The following conditions are recommended:

- To demonstrate that the final design of the return water diffuser is optimised the proponent must undertake further near-field and mid-field modelling to describe dispersion and mixing of return water under a range of flow scenarios with each of the production stages (e.g. 70ML/d, 135ML/d and 200ML/d). If the 1st percentile exceeds the dilution factors described in condition 5, mitigation measures must be included in the final design that improved dilution to meet the approved dilution factor. The outputs from this work and associated mitigation measures must be approved by the Indenture Minister with the concurrence of the EPA prior to the outfall infrastructure being constructed.
- The proponent must establish a salinity and current monitoring system at Point Lowly and in the Upper Spencer Gulf to collect a minimum of 12 months continuous data in order to further refine the near-field and mid-field hydrodynamic models.

Far-field modelling

The issue of the overall salt balance of the gulf was addressed through the 'far-field' model, which was designed to look at regional-scale effects of a desalination plant discharge. The model incorporates three main gulf processes:

- Gravity currents which provide the mechanism for salt ejection;
- Annual salt exchange across the model's ocean boundary; and
- Gulf flushing time.

The salt balance of the Spencer Gulf is mediated by a flow of slightly more dense and saline water flowing along the seabed south and east down the gulf exiting between Cape Spencer and Wedge Island. The far-field model adequately reproduced this dense water flow during late autumn and early winter, consistent with field studies documented in literature including Lennon et al (1987) & Nunes-Vaz, (1990).

The efficacy and seasonal nature of the salt ejection mechanisms in Spencer Gulf were also reflected in salt balance equations presented in the DEIS Appendix O11.4. This described the average salinity increases over summer through evaporation, with an average 1.09 gigatonnes per annum of salt entering the system at the mouth, replacing fresh water lost through evaporation, predominantly in the northern reaches of the Gulf.

The SEIS made the assumption that the annual seasonal cycle of the salt-ejection mechanism and the salt balances over the same time scales implied that Spencer Gulf flushed annually. To validate this, BHPB's consultants used the far-field model to test e-folding (a modelling method to show water exchange) and water retention times, to examine how long it took water to exchange in the northern gulf. Both methods returned a flushing time of less than 12 months and both exhibited the same salt-ejection mechanism. Calculations in the DEIS suggested that annually 78 per cent of water north of Point Lowly would need to be exchanged with water from further south to maintain salinity gradients. Calculation of water exchange in the SEIS suggested that on an annual basis 90 per cent of the water would be exchanged north of Point Lowly and between 66–80 per cent of water would be exchanged in 2-4 months.

RECOMMENDATION

Accordingly, the AR considers it unlikely there would be any long-term increases in salinity in the northern Spencer Gulf as a result of a desalination plant. To provide ongoing data to demonstrate this finding, long-term accurate in-situ monitoring of salinity and temperature would be required. The monitoring would also need to take climate change into account. Such monitoring requirements would likely be a condition of any licence under the *Environment Protection Act 1993* to operate the proposed desalination plant. The AR recommends the following outcome as a condition:

- No change to the long term salinity in the USG attributable to the desalination plant beyond that predicted in the Final EIS (DEIS and SEIS).

5.4.4 Mixing and dispersion of return water and potential ecological effects

5.4.4.1 Issues

The mixing and dispersion of return water from a desalination plant outfall is paramount in assessing potential environmental impact and risk. Ecotoxicity testing describes the concentration of brine that may cause an effect to different representative biota. A well-validated hydrodynamic model will predict the likely footprint of a brine discharge under various tidal and weather scenarios in order to show whether sensitive habitats or communities will be exposed to brine above the dilution factor predicted to cause an effect.

This section assesses the possible impact of a desalination plant discharge over various wind and tide scenarios on nearby marine biological communities around Point Lowly. This assessment is made using the ecotoxicity testing data and the hydrodynamic model results provided in the DEIS and SEIS to infer possible impacts. The assessment assumes a species protection design dilution factor of 1:70 and that the hydrodynamic model is accurate (see sections 5.4.2 and 5.4.3 of this AR).

5.4.4.2 BHPB EM Program and commitments

As per the EM Program and commitments outlined in section 5.4.2.2 above.

5.4.4.3 Assessment

Ecotoxicity testing uses a range of representative species that are likely to inhabit the region or can be used as a surrogate for local species. Using the recommended dilution factor of 1:70, the model outputs can be interrogated to see whether the discharge footprint would intersect with any communities and possibly have an effect. Given the diversity of species tested the dilution factor can be seen as being protective of a sub-lethal effect (e.g. growth) for 99 per cent of species.

Numerous possible diffuser designs were considered in the DEIS and the SEIS. Modelling has shown that some would be effective in dispersing and diluting the brine while others would be less effective. Diffuser design is critical in the assessment of the possible brine dispersion footprint and, therefore possible ecological impacts.

The SEIS showed significant modelling undertaken to optimise the diffuser design to achieve the best dilution in the smallest area. Under zero current conditions the preferred rosette-style diffuser would achieve a worst-case scenario of brine mixing at a dilution of 1:107 using Roberts (1997) equations; or 1:97 using the CFD model at 100m (SEIS Table 17.7). CFD modelling showed that near-field dilutions greater than 1:70 at 100m from the diffuser would be achieved under all tidal scenarios (SEIS Table 17.8).

Modelling showed that the Western King Prawn was unlikely to be adversely impacted by return water discharge, as larval prawns were known to occur in areas of significantly higher salinity of up to 55ppt (SEIS Appendices H7.2 and H7.3). Additionally, the juvenile prawn EC₁₀ was 53.9 per cent brine or a dilution factor of 1:1.85, indicating a very high tolerance to elevated salinities. The adult prawns were shown to be more sensitive than the juvenile prawns, with a chronic EC₁₀ of 11.8 per cent brine or 1:8.5. However, the modelling showed that this dilution would be achieved at all times, even in close proximity to the diffusers.

The modelling presented in the SEIS stated that the nearest Kingfish aquaculture facilities in Fitzgerald Bay would not be affected, with a minimum dilution of 1:274 and 1:285 for the 4.3 m³/sec (280 ML/d scale plant) and 3.1 m³/sec (200 ML/d scale plant) flow scenarios respectively.

The maximum footprint of the plume (0th percentile) was estimated from the mid-field model over a full 12 month modelling scenario and outputs compared to a base case run without a desalination plant discharge, to compare the increase in brine the desalination plant discharge would cause. The maximum footprint (0th percentile) of the proposed discharge at 4.3 m³/sec was large at approximately 10.5km², but the direction of the plume dispersion indicated that it would be unlikely to intersect with any particularly sensitive habitats, other than the sponge garden.

The closest cuttlefish habitat located on the point of Point Lowly had a minimum dilution, or worst-case scenario, of 1:107 or 0.33ppt above background. 95 per cent of the time the dilution would be better than 1:258 or 0.14ppt above background, giving a significant safety margin from the predicted 99 per cent protection value of 1:70 (0.51ppt above background) and the predicted EC₁₀ for Giant Cuttlefish of 1:55 (0.64ppt above background).

The AR considers that adequate return-water dilution at the rocky reef areas supporting cuttlefish, among other species, would be vital for the ongoing biodiversity and ecological value of the USG. The AR concludes that a dilution factor of 1:85 at all cuttlefish breeding areas during all tidal conditions (including dodge tides) and all operating conditions, including under low discharge flow rates.

The modelling indicated that the sponge garden would be exposed to brine above the 1:70 dilution threshold for between 1-5 per cent of the time under the 4.3 m³/s scenario and between 10-25 per cent of the time under the 3.1 m³/s scenario. The toxicity testing undertaken on the sponge was unreliable and no conclusions have been drawn from this work. However, the SEIS presented evidence of sponge gardens in the northern Spencer Gulf at Two Hummock Point which are naturally exposed to significantly higher salinities than Point Lowly, suggesting a high tolerance to elevated salinity. Anecdotal reports of sponges of similar species have been observed growing on the diffusers of the Cockburn Sound desalination plant in WA which were likely to be exposed to much higher brine concentrations. There was also concern for any other organisms using the sponge garden for food or shelter as they might not be as tolerant to the elevated salinities as sponges.

This AR concludes that in order to determine whether the desalination plant discharge was having a detrimental effect on the sponge garden, BHPB would have to implement a BACI monitoring program before construction began. This program should not only focus on sponges, but diversity and abundance of other biota. Conditions have been recommended to this effect.

Comparisons of the different diffuser configurations (SEIS Table 17.6) revealed that high return water flows delivered better near field dilutions than low flows because higher exit speeds provided more dilution due to the larger distance the water was ejected from the ports. The table provided an analysis of a number of combinations of parameters affecting dispersion, including the number of ports, port diameter exit velocity and discharge volume. The discharge volumes tested included 4.3m³/sec, 3.1m³/sec and 2.2 m³/sec, but there was no information provided on discharge volumes lower than these figures, such as 25 per cent and 50 per cent peak discharge flows which would be possible under low water demand or start-up scenarios. Analysis indicated that at higher flows dispersion could be effective but little information was provided on dispersion during low-flow scenarios where dispersion could be poor. BHPB propose a number of measures to mitigate poor dilution, including duckbill valves and, for longer-term low flows, potential capping of a number of ports to increase discharge exit speed.

RECOMMENDATION

Accordingly, the AR considers that the dilution and dispersion at low flows is a critical issue in demonstrating that a desalination plant discharge at Point Lowly would not affect the marine ecology of the area.

The AR recommends the following conditions:

- An operational dilution factor of 1:85 to be achieved at all cuttlefish breeding areas during all tidal conditions (including dodge tides) and all operating conditions, including under low discharge flow rates.
- No significant decline in the condition and extent of known native species or their associated ecological communities attributable to the desalination plant beyond 100m of the diffuser.
- The proponent must develop contingency plans to increase dilution from the diffusers at 100m to ensure diffuser performance remained acceptable under all conditions. Contingencies must include measures to shut down all discharges to the marine environment if dilution factors were exceeded at EPA-specified locations.
- A condition has been recommended in section 5.4.2.3 of this chapter that sets dilution rates and requires the design of the outfall infrastructure to be capable of being extended and modified to achieve the approved dilution rates and to shut down if not in compliance.

5.4.5 Listed/significant species and commercial species

5.4.5.1 Issues

Australian Giant Cuttlefish

The area around Point Lowly attracts the only known mass aggregation of spawning cuttlefish in the world. At the peak of the breeding season between May and September, the density of the species can reach more than one cuttlefish per square metre. The rocky substrate provides the appropriate environment for the females to lay their eggs, which hatch four months later. It is believed that while the cuttlefish grow rapidly, they reproduce only once in a lifetime. Cuttlefish have a low tolerance to changing environmental variables, including salinity, making it likely to be more vulnerable to the impacts of desalination plant return water. Impacts could occur through affecting eggs or acute mortality to the juveniles or adults in the deeper water channels during the migration to Point Lowly.

BHPB has committed to continue annual surveys of cuttlefish, and to construct the intake pipeline during the period 1 November to 1 May to minimise the impacts on cuttlefish breeding during construction

Sponge community

Sponge fauna of Spencer Gulf are largely unknown. Sponges are filter feeders that rely on water movement. Two locations in northern Spencer Gulf have dense communities of sponge, Point Lowly and Two Hummock Point, 30km north of Point Lowly. Both areas are characterised by high current speeds and exposed rocky substrates that enabled the dense growth. The Point Lowly sponge community is considered to be of regional importance. BHPB has committed to place the final outfall pipe location to minimise impacts on the sponge communities.

Australian and SA Government listed species

Forty-five species of listed flora and fauna have been identified as potentially occurring in the USG, including eight species classified as threatened. Sixteen of the listed species have never been recorded in or near the USG. Of 29 recorded species, 12 are highly mobile and 17 are sessile or less mobile. The sessile or less-mobile species would be considered to be the most at risk from a desalination plant discharge because they would be less able to move away from unsuitable water. These species comprise the seagrass *Zostera mucronata* and 16 species of seahorse and pipefish sygnathid.

Commercial/recreational fishing and aquaculture

The discharge of desalination brine has the potential to affect fish populations through acute toxicity on eggs, larvae or mature fish, as well as chronic effects on reproduction, growth and behaviour. Spencer Gulf supports important commercial and recreational fisheries, with the zone between Port Pirie and Whyalla recognised as being particularly productive (refer DEIS Appendix O6 for full details of fishery). Many species use the seagrass meadows and/or mangroves during their lifecycle and many are caught within or near the seagrass areas. Two important species, Snapper and the Western King Prawn, frequented the deep water channels, which raised questions about increased risk to these species from a desalination plant discharge.

Over the past 20 years the aquaculture industry in Spencer Gulf has expanded rapidly to become a significant export market for SA. The northern Spencer Gulf is particularly important for Yellowtail Kingfish (*Seriola lalandi*) and the Pacific Oyster (*Crassostrea gigas*), with sea-cage fish farms at Port Augusta and Fitzgerald Bay and oyster farms at Cowell and Port Broughton.

5.4.5.2 BHPB EM Program and commitments

- **EM Program:** as per section 5.4.2.2 above. In addition the following BHPB commitments are considered relevant.
- **Commitments:**
 - BHPB has committed to undertaking an annual survey of the Australian Giant Cuttlefish population at Point Lowly to establish a suitable baseline for the population before construction and operation of the desalination plant.
 - BHPB has committed to financing surveys of cuttlefish abundance and biomass, which would continue to improve the understanding of natural population variability.
 - BHPB would undertake appropriate monitoring to identify significant changes to marine flora and fauna communities and water quality, which would include:
 - A detailed marine monitoring and management plan, incorporating habitat maps, would be developed in liaison with relevant stakeholders;
 - Future monitoring of salinity levels would be undertaken for comparison against species protection trigger values (SPTV);
 - Monitoring would occur two years before the start of construction;
 - Monitoring would occur during the construction period; and
 - Monitoring would occur during operations to verify the return water dispersion modelling results, and this would include times of dodge tides (SEIS Table 2.1, page 51).

5.4.5.3 Assessment

Australian Giant Cuttlefish

The conservation significance of the Australian Giant Cuttlefish in the USG is recognised by a total ban on cephalopod fishing in the Point Lowly/-Whyalla region under the *Fisheries Management Act 2007*. The rocky substrate provides the appropriate environment for females to lay their eggs, and there is a lack of other suitable such habitats in the region. The only similar area of rocky substrate is 10km north of Point Lowly at Backy Point, which is also a dense cuttlefish breeding habitat.

The SEIS stated that the interaction of return water with the shallow cuttlefish breeding habitat was expected to be minimal as the more-dense return water plume from the diffuser would tend to fall to the seafloor and be entrained by tidal currents, which would take the plume away from Point Lowly. During periods of no current, gravity would take the return water away from the near-shore reef habitat toward the deeper sections of the gulf.

Throughout the ecotoxicity testing the most sensitive test was the Australian Giant Cuttlefish post hatch survival endpoint which demonstrated a 10 per cent sub-chronic effect at 1.86 per cent brine (1:55 dilution) (DEIS Table 16.8). Although the data was generated using an unrealistically high salinity of 45 ppt, and therefore likely to overestimate the toxicity, the results were similar to those reported in independent studies conducted by Dupavillion & Gillanders (2009).

During the worse-case conditions of a dodge tide the minimum dilution in the closest cuttlefish habitat (SEIS Figure 17.15) would be 1:107, which was equivalent to a salinity increase of 0.3 g/L. At Backy Point, 10km north, where the density of cuttlefish was very high during the breeding season, the salinity was on average 0.35 g/L higher than Point Lowly, suggesting that cuttlefish could tolerate this level of salinity increase. However, there could be large differences between the hatching success from eggs incubated at a constantly higher salinity and the hatching success of eggs exposed to sudden fluctuations of salinity.

The ecotoxicity testing focused on the survival and condition of eggs and post-hatch juveniles as these were considered the most sensitive stages of the life cycle. Adult cuttlefish are likely to be exposed to higher concentrations of brine, including those naturally occurring, while migrating into the breeding habitats along the deepwater channels. The SEIS stated that cuttlefish also bred further north, where salinity was elevated, and that the natural saline plumes that moved down the gulf at the start of the breeding season were more likely to be significant than the plumes modelled to be associated with the desalination plant discharge. The SEIS concluded that the discharge plumes would not interfere with migration, and the AR agrees with this finding.

The Final EIS documented the variability in cuttlefish populations at Pont Lowly and Backy Point and the apparent decline in abundance since 2001. Neither the documents nor other researchers could account for the apparent decline, and the AR supports the BHPB commitment to continue the ongoing monitoring of cuttlefish abundance and biomass.

RECOMMENDATION

Accordingly, the AR considers there should be no impact of return-water discharge on the Australian Giant Cuttlefish. However, it recommends that BHPB implement an annual BACI-designed monitoring program to assess the biomass and abundance of cuttlefish throughout the Point Lowly region, including Backy Point. The following conditions are recommended:

- No measurable adverse impacts on the abundance and distribution of the Australian Giant Cuttlefish as a result of construction and operation of the desalination plant.
- The proponent must continue to undertake an annual survey of the Giant Cuttlefish during the breeding season to record numbers and distribution between Black Point and Backy Point.
- All monitoring required by conditions must be designed in accordance with the principles of a Beyond BACI sampling methodology, or as approved by the EPA.

Sponge community

The AR considers that the nearby sponge community, extending over 2ha of the channel 200-300m from the outfall pipe, would be unlikely to be affected by water above the specified dilution factor for a significant period of time during plant operation. Following release of the DEIS the positioning of the outfall pipe was realigned and extended an extra 200m by BHPB to ensure protection of the sponge community. BHPB stated that further attention would be paid to minimising impacts on this community during detailed design phase and when selecting the ultimate location of the outfall pipe. There was considerable uncertainty in the salinity tolerance of sponges within this sponge community. BHPB provided information in the SEIS on a trial ecotoxicity test using the local sponge *Aplysina lendenfeldi*. While the test had limitations and could not be used in calculating the dilution factor, it did suggest that the sponge community was reasonably tolerant to changes in salinity.

The SEIS also showed the presence and diversity of sponges on the diffuser pipes of the Cockburn Sound Desalination plant in Western Australia (WA), and a second regionally significant dense sponge community at Two Hummock Point, north of Backy Point, which would be exposed to higher ambient salinities than the Point Lowly population would experience from the proposed desalination plant. This indicated that sponges were likely to have a high tolerance to elevated salinity.

RECOMMENDATION

Accordingly, the AR considers that while it was likely that the sponge community located close to the outfall diffuser pipe would be exposed to elevated salinities, it was likely that sponges were tolerant to increases in salinity and it was unlikely they would be affected. To ensure this, the following conditions are recommended:

- For at least three years prior to operation of the desalination plant, the proponent must undertake an annual quantitative and qualitative survey of marine ecology within the sponge garden community near the proposed return water outfall.
- All monitoring required by conditions must be designed in accordance with the principles of a Beyond BACI sampling methodology, or as approved by the EPA.

Australian and SA Government listed species

Threatened marine species have been recorded in the USG, however they are highly mobile and it is considered they would move away from the discharge point and construction impacts to other abundant suitable habitat areas in and beyond the USG. BHPB stated in the DEIS that it considered the risk to these species from a desalination discharge would be low. BHPB has committed to make an SEB payment into the Native Vegetation Fund to offset the loss of 1.5ha of seagrass (DEIS Section 15.5.1)

The nearest recorded community of the seagrass *Zostera mucronata* occurred at least 15km from the proposed outfall, well beyond the zone where effects on water quality would be detectable. With the exception of the Tiger Pipefish, syngnathids (seahorses etc) generally occurred within relatively low-energy seagrass environments, such as Fitzgerald Bay and False Bay, which modelling indicated were well beyond the zone where effects on water quality would be detected. The Tiger Pipefish inhabits sandy/muddy substrate adjacent to channels. The species had been recorded in very low numbers in USG and it was considered that only a very small proportion of its habitat would exceed the specified dilution factor. The Tiger Pipefish was widely distributed in USG so any impacts at the desalination plant site would affect only a very small proportion of their population.

RECOMMENDATION

The AR considers that the effects of any reverse-water discharge on listed species are unlikely to be significant.

Commercial/recreational fisheries and aquaculture

Spencer Gulf supported one of the largest prawn fisheries in Australia and commercial trawling occurred within 1km of Point Lowly. Much of the USG was considered a prawn nursery area. Very high densities of prawn larvae occurred between Whyalla and Germein Bay, and high densities of juvenile prawns occurred on tidal flats, such as at False Bay (DEIS Table 16.5).

The BHPB hydrodynamic model and SEIS demonstrated that at the nearest prawn trawling grounds (SEIS Table 17.9 'u, m') would be exposed to a maximum (0th percentile) brine dilution of 1:72. The ecotoxicity testing of adult and juveniles of the Western King Prawn (*Melicertus latisulcatus*) indicated that adult prawns were less tolerant of salt changes than juveniles and had an EC₁₀ (10 per cent effect on growth over 28 days) of 11.8 per cent brine (1:14) compared to 53.9 per cent brine (1:1.86) for juveniles. This indicated that adult and juvenile prawns had a substantial protective buffer from the brine discharge at the two modelled locations. Even at locations 100m from the outfall (Table 17.9 'x, b, c & d'), it would be unlikely the prawn EC₁₀ value would be exceeded.

The Pacific Oyster farms located at Cowell and Port Broughton were more than 50km from Point Lowly and would be highly unlikely to be impacted by any brine discharge.

The southern-most Kingfish farms located in Fitzgerald Bay are approximately 3.5–4km from the proposed outfall location. Ecotoxicity testing using Yellowtail Kingfish indicated an EC₁₀ of 10.6% brine or 1:9. However, this was tested with a lower than desired salinity (EC₁₀ recalculated by Dr Warne SEIS Appendix H4.3) and as such is in the 'second best' data set. The hydrodynamic modelling undertaken for the SEIS indicated that the worst case brine dilution at the nearest Kingfish farm is 1:272 which is significantly higher than the individual Kingfish EC₁₀.

The SEIS detailed the log_{KOW} for the anti-scalant in the brine mixture to assess whether there was any likelihood of chemical residue accumulation as a result of the brine discharge. The assessment indicated that the anti-scalant in the proposed brine had a log_{KOW} of 0.54, which was significantly lower than the ANZECC/ARMCANZ Guidelines recommended investigation level of 4, making it unlikely that the Kingfish aquaculture farms would be affected by the brine discharge.

The Point Lowly area had historically provided the largest and most consistent commercial catch of Snapper up until the 2003-04 season. Since then the southern Spencer Gulf region had surpassed the northern region. Rather than a drop in fish biomass, it appeared that this trend reflected a change in fishing area by the commercial sector not by a reduction in fish biomass as the Fisheries Assessment report for Snapper detailed (Fowler et al, 2010). Only small recreational and commercial quantities of Mulloway (*Argyrosomus japonicus*) were caught in the USG, and no larvae of the wild Mulloway and Kingfish had been recorded in the USG.

The ecotoxicity testing undertaken by BHPB demonstrated that the Snapper (*Chrysophrys auratus*) was reasonably tolerant to elevated salinities with a chronic EC₁₀ (10 per cent effect on larval growth over 7 days) of 22.2 per cent brine or 1:5. Similarly, Kingfish and Mulloway test results showed EC₁₀ values of 11.6 per cent and 11.1 per cent brine respectively, corresponding to 1:8.6 and 1:9. The hydrodynamic modelling indicated that this dilution factor would be exceeded at all locations modelled, including right next to the diffuser. Impacts on fish from a brine discharge at Point Lowly would be extremely unlikely.

RECOMMENDATION

The AR considers that the effects of any reverse-return water discharge on commercial or recreational fisheries are unlikely to be significant.

5.4.6 Ecological monitoring and water quality

5.4.6.1 Issues

Monitoring

Submissions on monitoring and water quality were received from groups such as the SA Recreational Fishing Advisory Council, Spencer Gulf & West Coast Prawn Fishermen's Association; Australian Conservation Foundation, Field Naturalists Society SA, Cuttlefish Coast Coalition, Friends of the Earth, Port Augusta Coastal Homes Association and SARDI. The DEIS and SEIS provided some monitoring data appropriate for the basis of an impact assessment, however it was not a suitable baseline on which to assess future potential changes and should be further developed.

Dissolved oxygen

Dissolved oxygen is critical to marine life for respiration and critical chemical and biological processes. Long-term depletion leads to behavioural changes, such as mobile species avoiding certain areas, impacts on sessile species and changes in biological and chemical processes such as nitrification/denitrification and metal solubility in sediments. There is limited data assessing ambient dissolved oxygen in the Point Lowly region.

5.4.6.2 BHPB EM Program and commitments

As per the EM Program and commitments outlined in section 5.4.2.2 above.

5.4.6.3 Assessment

Monitoring

Marine communities are extremely variable through space as well as time. Numerous biotic factors, such as type of organism and predation/prey relationships, and abiotic factors such as water movement, light availability and substrate, influence where and how successful a marine community might be in a given area. Monitoring marine communities is difficult due to this variability and assessing change over time needs to take this variability into account in order to differentiate between natural variability and changes because of an anthropogenic input, such as a desalination plant discharge. The best scientific method to undertake this assessment is known as 'Beyond BACI' (Underwood, 1991, 1992, & 1994). Fundamental in any assessment of potential impact is a comprehensive baseline assessment (Before) which details the natural variability so that changes can be compared to this baseline over time (After). Additionally, communities need to be assessed at multiple sites, not only the site in question to be able to account for regional scale variability or site specific differences (Controls versus Impact).

Most of the monitoring undertaken and presented in the FEIS could contribute to the existing 'Before' data for Point Lowly and Spencer Gulf. However, it is not sufficient in both temporal and spatial resolution to be considered 'Before' data. BHPB has committed to undertake considerable further monitoring before construction. All monitoring recommended in this AR would need to take into account, and adhere to, where practical, the methodologies of Underwood and others who describe the advantages of a Beyond BACI approach.

Throughout all monitoring programs developed for the BHPB desalination plant, trigger levels and contingencies must be developed and implemented in the event that it was considered the desalination plant construction or operation was having an adverse effect on a specified receptor. These contingencies would need to rectify the observed adverse impacts to the extent that was reasonable and practical.

Dissolved oxygen

The proposed desalination plant would discharge effluent which was aerated most of the time. However, there would be short periods when there was zero dissolved oxygen while chlorine dosing was occurring. Chlorine added into the intake pipes as a biocide would subsequently be neutralized with sodium metabisulphite, resulting in periods of zero dissolved oxygen in the effluent stream. The DEIS proposed to re-aerate the effluent stream using weirs but, because of the hypersalinity and slightly elevated temperature, while the percentage saturation could be raised the actual oxygen concentration would still be lower than ambient conditions.

There is limited information regarding ambient dissolved oxygen concentrations in the waters around Point Lowly, particularly near the seabed in deepwater channels. The DEIS detailed extensive sediment oxygen-demand calculations based on research undertaken for aquaculture in the region. The calculations indicated that consumption from sediment-dwelling organisms was unlikely to reduce oxygen levels in the water. However, the DEIS stated that extreme natural conditions had previously caused dissolved oxygen levels in deepwater channels in Cockburn Sound, WA, to fall below Kwinana desalination plant regulatory thresholds, and there was convincing evidence to suggest that this could not be attributed to the desalination plant. There was also a lack of good baseline dissolved oxygen concentrations in these areas before the desalination plant became operational. Spencer Gulf waters are naturally susceptible to stratification because of the north-south salinity and temperature gradients.

BHPB undertook a simulation of the duration, severity and extent of oxygen depletion associated with return-water discharge, using a three-dimensional Estuary and Lake Computer Model (ELCOM) coupled with the Computational Aquatic Ecosystem Dynamics Model (CAEDYM). Dissolved oxygen concentrations, without desalination (base case) and with the desalination plant operating (desalination case), were found to be virtually the same on the seafloor and at mid-depth during the normal tide components of the 10-day simulation (SEIS Figures 17.26a and b).

RECOMMENDATION

Accordingly, the AR considers that BHPB must establish a good baseline of dissolved oxygen monitoring in deepwater channels possibly affected by any desalination plant discharge before construction of the proposed plant, to provide a comparison of return-water effects to the baseline condition. The following condition is recommended:

- The proponent must monitor dissolved oxygen at the seabed in natural bathymetric depressions close to the proposed return water discharge diffuser to adequately establish a minimum 12 month baseline condition for dissolved oxygen in these locations prior to any construction work commencing on the desalination plant.

5.4.7 Pipeline construction impacts

There are two pipelines associated with construction of the desalination plant – return water outfall pipe and intake pipe. The return water outfall pipe will be tunnelled under Pont Lowly while the intake pipe will be laid in a trench and covered.

5.4.7.1 Issues

Turbidity

Construction of the intake pipe will require dredging which will cause localised turbidity.

Turbid waters are caused by high levels of suspended and/or dissolved materials in the water column which can be made up of sediment discharged from dredging activities or discharges such as from dewatering (the natural, chemical, or mechanical removal of water from sludge). There are often naturally elevated suspended solids in some areas due to re-suspension of sediment from the sea floor by wind, currents and wave action.

Turbid waters result in a reduction of light penetrating the water column and can cause sedimentation on seagrasses, reefs and other benthic habitats. Turbid waters have been highlighted as a possible factor in seagrass loss in the nearshore environment of Adelaide (Westphalen 2005) and other locations (Longstaff & Dennison 1999; Ruiz & Romero 2003). Sedimentation can result in smothering of seagrass (Shepherd et al. 1989) or coating leaves with silt, reducing photosynthetic ability (Duarte et al. 1997).

Elevated turbidity in the water column or sedimentation coating algal fronds can reduce the photosynthetic ability of macroalgae (Turner & Cheshire 2002). Macroalgal reefs can be adversely affected by sedimentation through competition with algal spores for space on a substrate, or the spore settling on sand, with both actions likely to result in recruitment failure on a reef (Turner & Cheshire 2002). In extreme cases, sedimentation can smother macroalgal species and cause a decrease in recruitment, growth and survival rates (Eriksson & Johansson 2005; Umar et al. 1998). Turfing algae, small tuft-like algae usually more than 5mm tall, can withstand large sediment deposits. Reefs affected by high sedimentation can change to a spatial dominance by turf-forming algae, which can exclude canopy-forming species (Gorgula & Connell 2004).

Turbid waters can also have adverse effects on higher organisms, particularly fisheries where turbidity can reduce feeding (Benfield & Minello 1995). Studies have shown that fish may avoid turbid areas (Boubee et al. 1997; Bisson & Bilby 1982) and turbidity could potentially affect visual spawning cues (Engström-Öst & Candolin 2006).

Vibration and blasting

Building the intake and return water pipelines involve some inherently noisy processes, such as tunnelling, blasting, drilling, dredging, rock removal and pile-driving.

The FEIS stated that a number of marine animals, including whales and dolphins, could be in the vicinity of the proposed desalination plant construction site. Marine animals rely on sound for almost all aspects of their life, including reproduction, feeding, predator and hazard avoidance, communication and navigation (Ocean Studies Board 2003; Weilgart 2007). These aspects could be affected by rapid pressure changes associated with loud noises. Studies had demonstrated that sudden pressure changes were generally at the root of injury or mortality in marine fauna, especially affecting gas-filled organs such as lungs, sinuses, ears and swim bladders (SA Water 2009).

Noise could mask environmental sounds that marine animals relied on for identification, communication and navigation purposes. The masking could lead to behavioural changes as man-made noise could interfere with detection of calls, echolocation sounds, and environmental sounds at frequencies similar to the noise.

Construction is likely to generate the greatest noise impact on marine fauna, specifically pile-driving associated with construction of the intake pipe trench. Noise from blasting had the capacity to injure and kill marine mammals, fishes and even invertebrates. Broad-band pulsed sounds, from pile driving and blasting, compared to continuous pure tones, had a greater impact on fish behaviour (WSDOT, 2006 in SA Water, 2009). Drilling, dredging and tunnel-boring could mask important sounds and induce behavioural changes which could still be defined as an impact in certain circumstances.

Sensitive habitats

Building the desalination plant pipelines would result in the clearance of a small proportion of some marine habitats. The trenching of the intake pipeline would remove a section of intertidal reef and an area of seagrass habitat, though the change to tunnelling of the outfall pipe would reduce habitat disturbance.

Invasive species

The introduction of invasive marine species through ballast water or biofouling on vessels or in construction equipment has the potential to impact the regional marine ecology of the USG. The sources could include dredges and associated equipment, support boats, monitoring vessels, jack-up and dumb barges. Invasive species such as *Caulerpa taxifolia* could dominate local native species which in turn could alter food webs, biodiversity, productivity and fishery production.

5.4.7.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.2:

- **Objective:** No significant adverse impacts to specified marine environmental values of the USG from the construction of, or as a result of discharges from, the desalination plant at Point Lowly.
- **Criteria:** No long-term adverse impacts on the breeding success of Australian Giant Cuttlefish as a result of construction or operation of the desalination plant.
- **Management plan:** To prepare a new Marine Silt and Sediment Management Plan and a new Marine Blasting Management Plan for the construction of the intake and outfall pipes.
- **Commitments:** as per the commitments outlined in section 5.6.2.1.2 above

5.4.7.3 Assessment

Turbidity

BHPB originally proposed two potential methods for installing the intake and outfall pipelines, detailed in the DEIS. The first was trenching, where the pipe would be buried under the seabed, and the second method involved burying the pipe where it crossed the tidal zone and laying the rest on the seabed with adequate armouring.

In the SEIS it proposed to tunnel the outfall pipe using a tunnel-boring machine which would result in minimal dredging during the installation. The 400m intake pipeline, to be located north of Point Lowly in Fitzgerald Bay, would be trenched as originally proposed.

The DEIS stated that the trenching method would be finalised when a construction contractor had been selected, but the likely method would be to use a clamshell bucket operated by a crane on a floating barge or a temporary jetty. The pipes would then be laid and the trench backfilled with excavated material from a 250m³ hopper. This would create a sediment plume and reduced light penetration, which has been modelled using the ELCOM and CAEDYM packages (Appendix O12). Modelling showed that sediment plumes could reach up to 2km north of the intake pipe but were likely to be focused on a relatively small area down-current of the pipe. Within 1-2km of construction activities the sediment plume would be more than 2mg/L higher than ambient for a cumulative total of approximately 24 hours per fortnight - for minutes 2km from the construction site, to hours or possibly days within 100m. Suspended solid levels would typically be higher in the inshore areas than offshore.

Modelling sediment deposition indicated that within 200m of the construction site there was likely to be sediment deposition of 10mm over two weeks, though wave re-suspension (not modelled) was likely to resuspend fine sediment deposited in rocky habitats.

The AR considers that the proposed trenching method could result in significant turbidity plumes 1-2km in length in the water column and sediment deposition on shallow subtidal reefs down-current of the intake pipe construction activities. Excessive sediment deposition in rocky reef habitats would result in potential short-term smothering of algae. Importantly, sediment deposition has the potential to fill cracks and crevices in the reef which would inhibit macroalgal recruitment (Turner & Cheshire, 2002). There was also the potential for sediment plumes from the intake pipeline to interact with the significant Kingfish aquaculture fishery. BHPB modelling showed that the southern-most aquaculture lease was located within the modelled zone of increased suspended solids. Limitations within the model were that the scenarios had been modelled to show an increase from background levels, while BHPB's monitoring in the region, though limited in quantity and quality, showed that there was significant suspended solid load in the water column to start with (median 7.7 & 8.9 mg/L). This high ambient load suggested that a 2 mg/L increase would not be significant. However, it was likely that there were plants and organisms that were under light stress due to the elevated loads and a relatively minor increase could exceed their threshold for light dependence.

This AR considers that the proposed method of trenching is acceptable subject to BHPB using the best available practice to minimise release of suspended solids, particularly fine particles. Additionally, extensive 'before', 'during' and 'after' turbidity and total suspended solids monitoring needed to be undertaken, acknowledging that this would be a condition of any EPA dredging licence.

Vibration and blasting

BHPB stated in the DEIS that the proposed dredging, trenching, possible blasting and pipe-laying processes would result in elevated noise and vibration levels in the marine environment. If blasting was required the charges would be set in holes drilled 1.5-2.0m into the seabed to dampen the concussive effect. Numerous small charges would be used rather than fewer larger charges, reducing effects on marine fauna to 'marginally detectable' 600m from the blast site (DEIS Appendix O12). BHPB used trained personnel to observe dolphins in the vicinity of the proposed desalination plant.

The study was incomplete and there were limitations that affected dolphin observations, particularly around the proposed intake pipe. From the limited data set it was observed that dolphins not only frequented the Point Lowly region but often remained in the area feeding, resting, socialising, milling and transiting. Observers also concluded that all life stages of dolphins were present in the area, including calves which could be more susceptible to underwater noise than the adults (SEIS Appendix H9.4).

It was also critically important to ensure that divers, both recreational and those servicing aquaculture sites, were not adversely affected by any blasting. There had to be coordination among recreational divers, aquaculture farms and marine-blasting operations.

BHPB stated in the DEIS that marine blasting would not occur in the cuttlefish breeding season or if whales or dolphins were observed in the area. Prior to each blast a 600m exclusion zone would be established and monitored to minimise the risk of marine mammals or listed species entering the blast zone. It also committed to preparing a blast management plan to minimise the concussive effects of blasting and the potential for sediment mobilisation. Such a plan should be approved by the EPA prior to finalisation and should include marine mammal surveys by trained personnel from a significantly elevated position to ensure that no marine mammals are located within an exclusion zone from the blast zone of 600m for whales and other marine mammals. The AR recommends a condition that there are no adverse impacts from noise on cetaceans, including the establishment of a marine mammal exclusion zone of no less than 600m from significant underwater noise.

Sensitive habitats

BHPB had stated that the construction activities would likely result in the loss of 1.5ha of seagrass from the area of the proposed intake pipeline, constituting a small proportion of the total seagrass communities in the region. Their intention to off-set this through the SEB package is noted, and would require the approval of the Native Vegetation Council.

Invasive species

Although there is some risk of invasive marine species being introduced into Upper Spencer Gulf through ballast water or biofouling on vessels or within equipment used for construction work in the marine environment, the AR considers that such risks are low and can be further minimised through good operational practice adopted by contractors and suitable monitoring and reporting by BHPB.

RECOMMENDATION

The AR recommends that impacts from construction can be adequately managed subject to compliance with BHPB commitments and the following recommended conditions, including the requirement for further monitoring, and the preparation and implementation of a Construction Environment Monitoring and Management Plan (CEMMP):

- The proponent must monitor light levels, turbidity, and suspended solids concentrations in waters near the proposed intake pipeline at the nearest down current shallow subtidal reef habitat for a minimum three (3) month period (outside of the Giant Cuttlefish breeding season), prior to construction commencing on the desalination plant.
- The proponent must annually survey the intertidal and subtidal reef condition in the area of the proposed intake pipeline at least three years prior to construction.
- The proponent must prepare a Construction Environmental Management and Monitoring Plan (CEMMP) which must be developed in consultation with the SA EPA and approved by the Indenture Minister with the concurrence of the EPA before the commencement of construction activities. The CEMMP must be implemented by the proponent and include measures that at a minimum address the following:
 - Groundwater management and monitoring, including storage, treatment and disposal of groundwater if dewatering is required during construction.
 - Trenching or blasting in the marine environment must not occur during the 1 May to 31 October period as this is the Giant Cuttlefish breeding period. Should any areas of Australian Giant Cuttlefish breeding habitat be disturbed during construction activities, they must be reinstated following construction activities.

- An update on intake pipeline construction methods, including an analysis of construction techniques using best available technology and management methods to avoid adverse ecological impacts, including potential impacts on nearby aquaculture operations and Giant Cuttlefish breeding grounds.
 - Management of noise and vibration, including:
 - Identification of all construction activities with the potential to have an adverse noise or vibration impact on nearby sensitive receivers;
 - Identification and details of noise mitigation measures, preventative maintenance programs and operational protocols proposed to secure compliance with the requirements for construction noise as outlined in Part 6 of the *Environment Protection (Noise) Policy 2007* (Noise EPP);
 - Identification and details of how vibration impacts arising from construction of the proposed facility and associated pipeline infrastructure will be managed to meet the requirements of the following standards:
 - Integrity of buildings: DIN 4150
 - Human Exposure: AS 2670.2-1990;
 - Management of underwater noise to ensure that there are no adverse impacts on cetaceans and other marine fauna. Management must use the best available information and include a marine mammal exclusion zone of no less than 600m from significant underwater noise sources; and
 - A communication plan identifying how all nearby sea cage aquaculture operators, local dive shops and affected residents will be notified prior to and during construction and how concerns raised will be addressed and managed.
- Management of soil erosion and drainage, including:
 - Minimising areas disturbed;
 - Rainfall landing upstream of disturbed areas to be diverted around the site;
 - Installation and maintenance of erosion control measures; and
 - Progressive rehabilitation and stabilisation of disturbed areas.
 - Dust and odour management, including:
 - Minimising the area and extent of earthworks required and ensuring disturbed areas are protected and revegetated in a timely manner;
 - Specific measures to manage dust and limit emissions, including covered construction vehicles to prevent any loss of load; and
 - Management of any odours from any organic and other sources.
 - Minimisation and management of wastes, including: management of spoil generated from the outfall shaft/tunnel and intake pipeline trench construction, including:
 - Suitable location and design of spoil stockpiling areas to avoid pollution of surface water and/or groundwater;
 - Use of a suitably qualified and experienced environmental consultant to sample and classify spoil as it is generated to enable appropriate stockpiling, reuse and/or disposal;
 - Suitable sampling and analysis program (including laboratory analysis) to assess the extent and nature of any contaminants within the stockpiled spoil; and
 - Details of stockpile management and characterisation of spoil should be specified in accordance with the SA EPA *Standard for the production of Waste Derived Fill* and the EPA *Guideline for Stockpile Management: Waste and Waste Derived Products for Recycling*.

Note 1: Spoil from construction of the outfall and intake pipelines has the potential to be contaminated or to contain acid sulphate material. Such materials will need to be contained, classified, treated and/or disposed of in accordance with relevant SA EPA standards and guidelines. In preparing the CEMMP, the proponent should consider the following:

- Mixed construction and demolition wastes should be stored in an undercover area or within skip bins with removable lids capable of preventing the infiltration and ponding of stormwater within that waste and timeframes for removal to an appropriately licensed waste depot;
- Describe the on-site waste storage facilities;
- Identify waste loading and offloading areas;
- Describe routes taken by waste disposal vehicles;
- Identify locations for off-site waste disposal; and
- Describe steps taken to minimise waste generation and maximise reuse and recycling.

Note 2: Waste oil to be stored and any other substance that may have the potential to pollute surface or groundwater must be stored in accordance with the SA EPA Guidelines for Bunding and Spill Management.

- Identification of exclusion zones for construction in order to protect areas of high conservation value and/or high erosion potential.

Additionally the AR recommends the following outcome as a condition:

- No introduction of marine invasive organisms attributable to the construction, operation or maintenance of the desalination plant.
- Avoidance of any trenching or blasting in the marine environment during 1 May to 31 October as this is the Giant Cuttlefish breeding period.

The following note is also recommended:

Note: The discharge of any excess water associated with construction of the outfall pipeline tunnel must comply with the *Environment Protection (Water Quality) Policy 2003*.

5.4.8 Entrainment/entrapment of marine life

5.4.8.1 Issues

Entrapment was where larger organisms could become trapped and held against the mesh of the intake structure through the velocity and force from the water drawn through the screen. Species potentially affected would vary depending on mesh screen size, intake location and water intake velocity. Survival of the organisms would also vary depending on the use of collection structures. Generally survival of entrapped organisms was low.

Entrainment occurred when smaller organisms passed through the intake screen and into the treatment facility with the intake water. Species that were entrained would vary depending on intake velocity and the individual organisms' ability to swim away from the water intake. Organisms most at risk from entrainment were non-motile (no power of movement) larval stages of nearby communities because they could not swim away from the intake water stream. Entrained organisms could not survive. Options to reduce entrainment included very low intake velocities, very fine mesh screens and intake structure location.

Significant entrainment of larval stages could result in a reduction in recruitment of nearby populations and potentially reduce longer-term survival.

5.4.8.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U:

- **Objective:** No significant adverse impacts to specified marine environmental values of the USG from the construction of, or as a result of discharges from, the desalination plant at Point Lowly.
- **Criteria:** No criteria provided for this issue.
- **Management plan:** No management plan provided for this issue.
- **Commitments:**
 - To design the intake structure to avoid fish and larvae entrainment; and
 - To undertake monitoring during the first year of operation to determine the effectiveness of the measures.

5.4.8.3 Assessment

Entrapment

The DEIS stated that a number of operators of established power stations had assessed entrapment and concluded that occurrences for fish and crustaceans were small and affected relatively few economically important species. An intake velocity of less than 0.6 m/sec would minimise the effects. BHPB had proposed an intake velocity is 0.2 m/sec that would reduce the potential for entrapment on the intake structure. However, the same report stated that intake structures with an intake velocity of 0.1 m/sec also did not entrap larger fish and animals.

Entrainment

The most critical factor in managing and minimising entrainment is the appropriate siting of intake structures. The DEIS provided an indicative location for the intake pipe. The SEIS stated it would be located in Fitzgerald Bay in 13-14m of water in a channel dominated by sand and silt habitat, away from seagrass and in-shore rocky reef habitats. BHPB used particle-tracking models and seasonal monitoring of fish and crustacean larvae to determine that the proposed intake location was no more susceptible to larval entrainment than other nearby locations sampled.

The most frequent species found in the larval monitoring was the Australian Anchovy (*Engraulis australis*) which accounted for 69 per cent of all larvae collected. The Australian Anchovy spawned throughout the shelf, gulfs and bays, with highest concentrations in Gulf St Vincent and Spencer Gulf (SEIS Appendix H10.2). The Australian Anchovy populations competed with the Sardine (*Sardinops sagax*) resulting in lower anchovy numbers when the sardine population was high, and vice-versa. Sardines were limited to lower gulf and shelf waters and the northern gulf regions were critical for Anchovy egg production. While the area was critical the region was nevertheless large and the desalination plant was likely to entrain 0.05 - 0.07 per cent of larvae originating from the waters north of Port Broughton.

The potential impact on the Western King Prawn was highlighted as a concern. An estimated 0.2 per cent of prawns would be entrained during their larval life of 40 days resulting in one in 1500 not reaching adulthood. The SEIS considered this a negligible impact.

Particle modelling undertaken for the SEIS predicted that strong gradients of larval pathways existed in the region of the intake pipe, particularly just inshore of the proposed intake, and slight changes in the intake pipe location or the larval pathways could reduce the presented predictions. Given this conclusion, and only one sampling event, the AR considers that further monitoring should be required to look at the seasonal variability of larvae and its relationship with intake structure distance from shore.

Intake velocity was a key factor in the number of organisms that could be entrained. The speed at which larvae could avoid the intake was fundamental to whether they would be entrained. The AR considers that the lowest possible intake velocity should be used to minimise entrapment and entrainment.

RECOMMENDATION

The AR concludes that if design controls aimed at minimising impingement and entrainment were fully adopted the impact of the proposed desalination plant on entrapment and entrainment would not likely be significant. However, as construction of the desalination plant is not expected for some years there is an opportunity for BHPB to collect further data to use in optimising the design and location of the intake pipe, including further site specific quantitative monitoring of marine organisms. The results of this work would be used by the EPA to develop licence conditions, and by BHPB to optimise design and location of the intake if required. The following condition is recommended:

- The proponent must design and construct the intake structure in general accordance with DEIS Appendix F2 Drawing Nos ODP3672-D0-0022 and ODP3672-D4-0004 within the location shown in DEIS Figure 5.30. To demonstrate that the final design and alignment are optimised at the time of construction, the proponent must undertake:
 - Further site specific quantitative monitoring of marine organisms (particularly planktonic larvae) and habitats in the proposed water intake area with the aim of optimising the intake location to minimise impingement and entrainment of marine organisms;
 - An updated analysis of best available technology to achieve the lowest practically possible flow rates between the bars and into the intake pipeline to minimise entrainment and entrapment; and
 - The results of this work must be provided to the EPA to inform licensing.

5.4.9 Hazard and risk

5.4.9.1 Issues

Storing and transporting hazardous materials

Building and operating the proposed desalination plant would require BHPB to transport and store explosives and large quantities of Class 8 dangerous goods (corrosive and acidic solutions) requiring licences from SafeWork SA. The explosives may be used in the construction of the intake trench and the solutions in the daily maintenance of the plant.

Construction and operation of the plant would be undertaken by a contractor (SEIS Section 29.1.11) and BHPB said it would ensure the contractor complied with EPA requirements and appropriate legislation, and ensure all personnel would be trained, spillage control kits would be available and emergency response plans developed.

Chemicals that could be required for operation of the desalination plant, included:

- Anti-scalants (organophosphonate compounds or other, sulphuric acid);
- Biocides (chlorine, sodium metabisulphite);
- Coagulants/flocculants (cationic polymer, ferric chloride);
- Lime;
- Ammonia;
- Hydrofluosilicic acid; and
- Carbon dioxide.

This list is indicative only and could change as a result of ongoing testing and design modifications before detailed design of the plant was completed. The chemicals would be kept in a bundled storage facility or, in the case of chlorine, carbon dioxide and ammonia, in a purpose-designed building.

Blasting

Submissions by the SA Government and public expressed concern about the potential noise and vibration hazard impacts to houses, commercial divers and marine life from blasting required for construction of the intake and outfall system. As well, flying rock could harm people and cause damage to nearby homes, industrial facilities and sea-going vessels.

Potential vibration impacts were assessed by a blasting expert who concluded that adverse effects were unlikely (DEIS). Impacts could be readily managed by BHPB monitoring blast patterns to ensure compliance with air-blast and vibration criteria, and applying sequential blasting techniques limiting the maximum explosive charge size to 10kg per day.

In relation to human health and safety issues associated with any blasting, the SEIS stated that the following measures would be adopted to mitigate risks:

- Test blasts would be undertaken to ensure that charge sizes were the minimum required to fracture the rock; and
- There would be close liaison with aquaculture operators and commercial divers to ensure that divers were not in the water during blasting.

BHPB identified an unacceptable level of risk of sea-going vessels entering the blast exclusion zone. To lower the risk to an acceptable level BHPB would:

- Patrol the area two hours before blasting to ensure it was clear;
- Increase the number of vessels patrolling the exclusion zone perimeter to four at time of blasting; and
- Position additional surveillance vessels up-current from the blast to cover a wider area.

Further measures proposed by BHPB to mitigate the impacts included:

- To minimise airblast, overpressure and vibration impacts and comply with all legislative requirements;
- To conduct blasting only during daylight hours, and not on Sundays or public holidays;
- To outline specific controls in a blasting management plan including, exclusion zones and maximum charge sizes; and
- To not conduct blasting during the Australian Giant Cuttlefish breeding season, or if whales or dolphins were observed in the area.

Tunnel construction

In its existing Olympic Dam operations BHPB complies with safe working procedures and explosives legislation and undertakes geotechnical evaluation of tunnel condition before and after blasting. However, as constructing the proposed outfall pipeline would involve tunnelling under the seafloor, there were additional risks associated with the potential inrush of water and mud.

5.4.9.2 BHPB EM Program and commitments

Storing and transporting hazardous materials

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.2:

- **Objective:** No significant contamination to soils, surface water or groundwater as a result of the storage, transport or handling of hazardous materials by BHPB during expansion activities.
- **Criteria:** No lasting significant contamination arising from uncontrolled loss of chemicals to the natural environment.
- **Management plan:** To prepare emergency response, hazardous materials management and operational Health Safety Environment and Community (HSEC) plans that ensured all storage, transport or handling of hazardous materials requirements for the expansion were incorporated.
- **Commitments:** No specific commitments have been made by BHPB in relation to the desalination plant.

Blasting

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.2:

- **Objective:** No significant adverse impacts to specified marine environmental values of the USG from constructing the desalination plant at Point Lowly.
- **Criteria:** No long-term adverse impacts on the breeding success of the Australian Giant Cuttlefish as a result of construction or operation of the desalination plant.
- **Management plan:** To prepare a marine blasting management plan.
- **Commitments:** No specific commitments have been made by BHPB in relation to the desalination plant (refer to the measures proposed in the DEIS and summarised in section 5.4.9.1).

Tunnel construction

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U:

- **Objective:** No significant adverse impacts to specified marine environmental values of the Upper Spencer Gulf from constructing the desalination plant at Point Lowly.
- **Criteria:** No long-term adverse impacts on the breeding success of the Australian Giant Cuttlefish as a result of construction or operation of the desalination plant.
- **Management plan:** To prepare a marine construction management plan before any construction began (SEIS 17.15.3).
- **Commitments:** No specific commitments made on this issue.

5.4.9.3 Assessment

Storing and transporting hazardous materials

The desalination plant would be located next to the Santos Port Bonython facility which is a potential Major Hazard Facilities (MHF) site. The AR considers that BHPB would need to review the storage quantity of hazardous chemicals with regard to the threshold quantity of current MHF National Standard Schedule 1 Chemicals. In addition, the strategic location of the hazardous chemical storage facility on site would need to be reviewed with respect to the consequential risk assessment of the proposed location either affecting or being affected by the neighbouring Santos facility. A note to BHPB to this effect has been recommended for inclusion in any development approval.

The SEIS (Section 29.1.11) acknowledged that the SA Government regulates such activities and BHPB and all builders, plant operators and other contractors are required to hold government-issued licences for the transport and storage of explosives and dangerous goods, and licensees are required to comply with associated statutory regulations and conditions of licence.

Because the proposed desalination plant would be located next to another potential MHF site, subject to a regulatory assessment by SafeWork SA, an aggregate threshold quantity exceeding 10 per cent could be a trigger point for the plant as a MHF site pursuant to the current MHF National Standard Schedule 1 Chemicals. The AR considers that a flow-on action would be required from BHPB to conduct an internal and external consequential risk analysis of the desalination plant in consultation with Santos Pt Bonython and SafeWork SA.

In relation to environmental risks associated with chemical handling and storage, the AR considers that the desalination plant could be designed, constructed and operated to ensure compliance with environmental standards.

Accordingly, the AR recommends the following condition:

- The desalination plant site infrastructure must be designed to provide:
 - all loading/unloading of bulk chemicals to be carried out within an impervious bunded area designed to contain any spills;
 - lining of the sludge and evaporative lagoons in accordance with the EPA's Guidelines for Wastewater Lagoons or more recent equivalents; and
 - any chemicals used at the desalination plant to be stored within a bunded area which has a capacity of at least 120% of the volume of the greatest container to be stored within the bund and which is designed and constructed to prevent the escape of material into surface or underground water resources.

The AR also recommends the following note to BHPB:

- As the proposed desalination plant is located next to the Santos Port Bonython oil and gas facility which is a Major Hazard Facilities (MHF) site, BHPB needs to review the storage quantity of hazardous chemicals with regard to the threshold quantity of current MHF National Standard Schedule 1 Chemicals. In addition, the strategic location of the hazardous chemical storage facility on desalination plant site needs to be reviewed with respect to the consequential risk assessment of the location factor either affecting or being affected by the neighbouring Santos facility. As a consequence, the proponent should conduct an internal and external consequential risk analysis of the desalination plant in consultation with Santos and SafeWork SA.

Blasting

The shotfirer conducting any blasts must hold a Blaster's Licence under the Occupational Health, Safety & Welfare Act 1986 (SA) and must carry out an assessment of all risks and implement measures to prevent or minimise the risk of injury to persons and damage to plant. The AR recommends that blasting hazards including fly rock, vibration and noise should be addressed in such a risk assessment. Accordingly, the following note is recommended:

- The shotfirer who conducts and blasting associated with construction of the desalination plant and associated intake pipeline is legally required to hold a Blaster's Licence under the SA Occupational Health, Safety and Welfare Act 1986. They must carry out an assessment of all risks (including fly rock, vibration and noise) and implement measures to prevent or minimise the risk of injury to persons and damage to plant.

Tunnel construction

Before BHPB began tunnel construction it should conduct a geotechnical evaluation and assessment of risks associated with tunnelling, and address the risks of mud and water inrush into the tunnel. Accordingly, the following note is recommended:

- Before tunnel construction commences, an appropriate geotechnical evaluation and assessment of risks associated with tunnelling should be undertaken by the proponent. Such a risk assessment should address the risks of mud and water inrush into the tunnel.

Health and safety

BHPB should assess the downstream operational hazards and risks associated with the construction and operational management of the desalination plant and conduct a safety review during the construction, commissioning and operational phases in consultation with SafeWork SA. Accordingly, the following note is recommended:

- The operational hazards and risks associated with the construction and operational management of the desalination plant should be assessed and a safety review conducted during the construction, commissioning and operational phases in consultation with SafeWork SA.

RECOMMENDATION

Accordingly, the AR considers that management of hazards and risks can be managed appropriately subject to compliance with the above condition and compliance with legislative requirements, as advised in the recommended notes.

5.4.10 Air quality

5.4.10.1 Issues

The main air pollution issue associated with the proposed desalination plant would likely be dust generated during construction, particularly as much of the 19.5ha site would need to be cleared to make way for site developments, including lagoons, tanks and buildings, and a further 10ha would need to be cleared for the proposed lay-down area required during construction.

Operation of the plant could also give rise to the stench of decomposing organic matter from various sources, including intake screenings, pre-treatment waste cake and backwash lagoons. However, as the plant would be 500m from the nearest residential development and 1–1.5km from most of the residents at Point Lowly, this was considered adequate separation distance for odour-control purposes.

To manage air quality issues during construction and operation, BHPB has proposed the following measures:

- To rehabilitate areas disturbed during construction of off-site infrastructure and no longer required, to minimise ongoing dust impacts; and
- To periodically remove backwash solids from the lagoons and dispose of them at a licensed landfill facility, to minimise the potential for odour.

5.4.10.2 BHPB EM Program and commitments

- **EM Program:** No specific EM Program in relation to the desalination plant.
- **Commitments:** No specific commitments provided in relation to the desalination plant (refer section 5.4.10.1 for a summary of the management measures proposed by BHPB).

5.4.10.3 Assessment

Dust would be generated in the construction of the proposed desalination plant. However, the AR concludes, any dust could be kept within appropriate levels because of the relatively large distance to the nearest residents, and provided dust controls were implemented in accordance with a CEMMP, which would have to be approved by the Indenture Minister, with the concurrence of the EPA, before construction of the plant could start. Accordingly a condition has been recommended requiring the preparation of a CEMPP, that amongst other matters would require the management of dust and odour, including:

- Minimising the area and extent of earthworks required and ensuring disturbed areas are protected and revegetated in a timely manner;
- Specific measures to manage dust and limit emissions, including covered construction vehicles to prevent any loss of load; and
- Management of any odours from any organic and other sources.

RECOMMENDATION

As the operation of the plant would have to be licensed under the *Environment Protection Act 1993*, the AR considers that control of any unpleasant smells from the plant could be managed and controlled by the EPA through ongoing licensing.

5.4.11 Terrestrial impacts

5.4.11.1 Issues

Impacts on vegetation and fauna

No significant terrestrial vegetation or fauna issues were identified for the proposed desalination plant site. An assessment of potential impacts on terrestrial ecology of the proposed mine expansion is provided in this AR in Chapter 13: 'Effects on the environment'.

Topography, soil and site contamination

The Point Lowly area was assessed in the DEIS as having medium soil erosion potential (Chapter 10, Figure 10.6) which meant that standard management practices could be used to minimise soil erosion during construction. However, BHPB stated that it would develop additional erosion-control measures and a site-specific Erosion and Sediment Control Plan (ESCP) for the desalination plant before disturbance works began, to ensure that sediment generated from construction activities did not enter the ecologically sensitive marine waters.

5.4.11.2 BHPB EM Program and commitments

Refer to Chapter 13: 'Effects on the environment' of this AR for a summary of the EM Program and commitments.

5.4.11.3 Assessment

The AR considers that measures proposed by BHPB should minimise soil erosion and sediment from entering marine waters during construction. It also planned to monitor erosion and erosion-control structures until disturbed areas were stabilised, particularly after heavy rain or high winds. Measures to promote the speedy re-establishment of vegetative cover, where appropriate, should be a priority (DEIS 10.5.1 / SEIS 10.1).

RECOMMENDATION

If activities were carried out as described in the FEIS, the AR considers that there would be no adverse impacts on natural land systems or the marine environment. No conditions are considered necessary.

5.4.12 Surface water

5.4.12.1 Issues

BHPB stated in the DEIS that the construction of the proposed desalination plant would have negligible effects on local catchments and flow paths. The plant would be located in the Tent Hill land formation which is characterised by short and well-defined, drainage paths that discharge onto land adjacent to the coast. However, as the plant would be located on relatively flat land approximately 1km from the coast, such drainage features would not be intersected.

Stormwater Control Plans would be developed for the plant which would be designed so that:

- Rainfall on disturbed areas of the site would be collected, treated and channelled to an onsite detention basin sized to accommodate a 100-year Average Recurrence Interval (ARI) event (1-in-100-year downpour);
- Discharges from the detention basin would match pre-development flows; and
- Rain landing upstream of disturbed areas would be diverted around the site and discharged downstream of the detention basin.

Concept designs for the desalination plant that include the stormwater detention basin were provided in the DEIS Figures 5.27 and 5.32.

5.4.12.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.4:

- **Objective:** No significant adverse impacts to environmental receptors as a result of stormwater discharges to soil, surface water or groundwater associated with BHPB's expansion activities.
- **Criteria:** All contact stormwater maintained within designated stormwater management areas.
- **Management plan:** BHPB has proposed a Stormwater Management Plan for the desalination plant.
- **Commitments:** No specific commitment provided in relation to this issue.

5.4.12.3 Assessment

As construction of the desalination plant would involve clearing a considerable amount of vegetation from the site, rainfall and runoff would need to be carefully managed to minimise soil erosion and water pollution. The AR considers that such risks could be managed through good planning and implementation of site works by the construction contractor. It supports in principle BHPB's commitment to prepare a Stormwater Management Plan, and the management measures proposed for controlling stormwater during ongoing operation of the plant.

RECOMMENDATION

With the location and nature of the soils and topography at the site, together with the proposed stormwater management design measures, the AR concludes that the surface water impacts associated with construction and operation would be acceptable subject to the following conditions:

- The proponent must prepare a Construction Environmental Management and Monitoring Plan (CEMMP) which must be developed in consultation with the SA EPA and approved by the Indenture Minister with the concurrence of the EPA before the commencement of construction activities. The CEMMP must be implemented by the proponent and include measures that at a minimum address the management of soil erosion and drainage, including:
 - Minimising areas disturbed;
 - Rainfall landing upstream of disturbed areas to be diverted around the site;
 - Installation and maintenance of erosion control measures; and
 - Progressive rehabilitation and stabilisation of disturbed areas.

- The desalination plant site infrastructure must be designed to provide:
 - Maintenance of pre-development stormwater flows off the desalination plant site; and
 - Any off-site stormwater discharges to comply with the *Environment Protection (Water Quality) Policy 2003* or more recent equivalents.

5.4.13 Noise and vibration

5.4.13.1 Issues

Background noise levels at the closest residential properties to the proposed plant were recorded to be as low as 33-35 dB(A) L_{Aeq} during a two-day period in July 2007 (DEIS Appendix M). Industrial noise sources were limited to the Santos Port Bonython oil storage and processing plant and a kingfish processing facility. The DEIS and SEIS stated that industrial noise from both facilities was inaudible at potential noise-sensitive receivers during on-site surveys.

The construction and operation of the plant would provide an additional source of noise at Point Lowly, with electric pumps and energy recovery systems operating continuously (DEIS Section 14.5.1). The proposed plant would be located between 500m and 1.5km from the nearest housing.

BHPB undertook acoustic modelling under both neutral and adverse weather conditions, generating noise contours for the construction and operation phases of the desalination plant. Modelling took into account attenuation resulting from enclosing the desalination plant in a standard warehouse-type shed, and fully enclosing the seawater pumps associated with the intake pipe (DEIS Section 14.5.2).

To manage increased noise during construction, BHPB proposed to inform the local community before any significant noise generating activities and install temporary noise attenuation barriers, if required. Details of the barriers would be included in environmental management specifications to be developed as part of BHPB's Environmental Management Framework.

5.4.13.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 3.2:

- **Objective:** No adverse impacts to public health as a result of noise emissions from BHPB expanded operations.
- **Criteria:** Maintain noise from the expanded operations at the desalination plant to less than 30 dBLAeq (24 hour) within residential dwellings.
- **Management plan:** To prepare a noise management plan.
- **Commitments:** No specific commitments made on this issue.

5.4.13.3 Assessment

Acoustic modelling demonstrated that noise from the operation and construction of the desalination plant and associated infrastructure would comfortably meet the requirements of the *Environment Protection (Noise) Policy 2007*, taking into account the recommended noise mitigation measures. Since the modelling was undertaken, BHPB has decided to install the proposed outfall pipeline by deep underground/undersea tunnelling.

The SEIS stated that the outfall pipeline would be aligned along Port Bonython Rd very close to many residential properties but buried at a depth of between 87m and 35m below ground level. Although noise associated with operation of the outfall pipeline was likely to be negligible, the AR considers that there is potential for noise and/or vibration impacts associated with construction of the pipelines, depending on the method of construction adopted and the distance from residential properties.

The CEMMP should take into account any predicted vibration effects from construction of the outfall tunnel by maximising the separation distance between noise and vibration sources and nearby houses and other buildings. Potentially noisy construction activities should also be undertaken in such a way as to minimise noise impact on residents.

RECOMMENDATION

The AR concludes that the proposed desalination plant could comply with the required construction and operational noise criteria contained in the *Environment Protection (Noise) Policy 2003*, subject to the following conditions:

- The proponent must prepare a Construction Environmental Management and Monitoring Plan (CEMMP) which must be developed in consultation with the SA EPA and approved by the Indenture Minister with the concurrence of the EPA before the commencement of construction activities. The CEMMP must be implemented by the proponent and include measures that address the management of noise and vibration, including:
 - Identification of all construction activities with the potential to have an adverse noise or vibration impact on nearby sensitive receivers;
 - Identification and details of noise mitigation measures, preventative maintenance programs and operational protocols proposed to secure compliance with the requirements for construction noise as outlined in Part 6 of the *Environment Protection (Noise) Policy 2007* (Noise EPP);
 - Identification and details of how vibration impacts arising from construction of the proposed facility and associated pipeline infrastructure will be managed to meet the requirements of the following standards:
 - Integrity of buildings: DIN 4150
 - Human Exposure: AS 2670.2-1990;
 - Management of underwater noise to minimise adverse impact on marine fauna according to the best available information. Management must include a marine mammal exclusion zone of no less than 600m from significant underwater noise sources and notification of all nearby sea cage aquaculture operators and local dive shops; and
 - A communication plan identifying how affected residents will be contacted prior to construction and how concerns raised will be addressed and managed.
- The desalination plant site infrastructure must be designed to provide enclosure of the following plant/equipment within buildings to minimise noise:
 - The seawater pumps associated with the intake pipeline; and
 - The reverse osmosis component of the desalination plant and associated water pump station.

5.4.14 Heritage impacts

5.4.14.1 Issues

Point Lowly Lighthouse

The Point Lowly Lighthouse complex, which is entered in the South Australian Heritage Register as a State Heritage Place and on the Register of the National Estate, is 2.5km from the proposed desalination plant. The return-water outfall pipe could be routed past the Point Lowly Lighthouse complex but would be buried and avoid any heritage structures (DEIS Figure 5.30). Any visual impact would be restricted to the construction period. The most likely cause of impacts to the heritage lighthouse complex would be the possible use of land-based and underwater blasting for the intake and outfall pipe trenches. An assessment of the possible impacts of this activity provided in the DEIS concluded that blasting would comply with the recommended building damage criteria for sensitive sites, based on Australian and international standards. BHPB has proposed management measures to further reduce and monitor potential impacts on the site (DEIS Section 18.5).

The proposal for the outfall pipeline was amended in the SEIS to tunnelling instead of blasting, and concluded there would be no impacts to the heritage lighthouse. Three potential tunnelling methods were outlined in the SEIS Appendix A6.2 .

Historic shipwrecks

The remains of two historic shipwrecks south of Point Lowly, which have not been found, are protected under the *Historic Shipwrecks Act 1981*. Any proposed actions involving contact with the seabed, or operations close to the seabed, that could potentially damage, destroy or interfere with historic shipwrecks or relics, should ensure unfound historic shipwrecks are not disturbed.

BHPB stated in DEIS Section 18.5.2 that ‘no physical evidence of the two other shipwrecks has been located. The proposed construction works associated with the desalination plant intake and outfall pipelines have been categorised as having a negligible residual impact on these sites’. Although no shipwrecks were found during marine surveys, the AR recommends that BHPB conduct a pre-disturbance survey of the seabed for the presence of historic shipwreck remains in the area of the desalination plant.

An issue not recognised in either the DEIS or SEIS is the impact of changes in the marine environment on shipwrecks. Submerged shipwreck remains are subject to a combination of physical, chemical, and biological factors in the marine environment. After an initial post-wrecking period of rapid change, surfaces of the organic and inorganic components of a vessel reach equilibrium with the marine environment and often result in the vessel being covered by sediment and/or colonised by marine organisms. This colonisation is essential in forming a protective layer over exposed surfaces and preventing further deterioration. Under such conditions, underwater preservation rates can be higher than those on land. Any changes to the marine environment that alter the physical, chemical or biological factors affecting the site may accelerate the deterioration of shipwreck remains.

- BHPB has proposed the following management measures:
 - To monitor blast patterns to ensure compliance with the appropriate air blast and vibration criteria;
 - To keep accurate records describing the location of each blast and all blastholes, the design of the blast in terms of explosives and initiating system, and ground vibration and airblast measurement data; and
 - To comply with the requirements of the Historic Shipwrecks Act 1981.

5.4.14.2 BHPB EM Program and commitments

- **EM Program:** No specific EM Program in relation to the desalination plant.
- **Commitments:** No specific commitments provided in relation to the desalination plant (refer section 5.4.14.1 for a summary of the management measures proposed by BHPB).

5.4.14.3 Assessment

Point Lowly Lighthouse

BHPB has committed to installing the proposed outfall pipeline through tunnelling rather than through blasting a trench. The AR considers that this would significantly reduce the impact of vibration on structures in the State heritage-listed Point Lowly Lighthouse Complex.

RECOMMENDATION

Recommended operating protocols to prevent a breach of the *Historic Shipwrecks Act 1981* include a pre-disturbance survey of the seabed for the presence of historic shipwreck remains that could be affected. This survey could include direct diver assessments in addition to detailed sonar, magnetometer or sub-bottom profiles. Results of the survey would be provided to the Department of Environment and Natural Resources (DENR). Accordingly, the following condition has been recommended:

- The proponent must conduct a pre-disturbance survey of the seabed for the presence of historic shipwreck remains in the area of the desalination plant to be impacted by construction activities. Results of the survey must be provided to DENR.

If historic shipwreck remains are found as a result of the survey, an assessment of likely impacts from the proposed construction works would be required. If historic shipwreck remains were not found through the surveys, monitoring of the works must ensure sites encountered in the course of the works were reported to DENR and the remains managed according to the requirements of the *Historic Shipwrecks Act 1981*. Accordingly, the following condition has been recommended:

- If shipwreck remains are located by the survey or from monitoring of the construction activities, DENR must be contacted to ascertain if the in situ remains are historic and for directions on how to prevent impacts on the remains.

Projected changes to the marine environment in the northern Spencer Gulf region because of the characteristics, toxicity and dispersion of return water from the proposed desalination plant, were identified in the DEIS Section 16. Should historic shipwreck remains be found as a result of a pre-disturbance survey or monitoring of the construction works, an assessment of the potential for accelerated deterioration of the remains due to changes in the marine environment would be required. Accordingly, the following condition has been recommended:

- Should historic shipwreck remains be located as a result of a pre-disturbance survey or monitoring of the construction works, monitoring for accelerated in situ deterioration of the remains due to changes in the marine environment will be required. Any accelerated deterioration is to be reported to DENR.

5.4.15 Social impacts

5.4.15.1 Issues

BHPB stated in the DEIS that coastal home owners and visitors near the proposed desalination plant at Point Lowly would experience some disruption and disturbance over the three-year construction program. There are 55 residential properties located within 1.5–2km of the proposed plant, comprising principal residences and holiday homes. The public have access to the boat ramp, heritage lighthouse, barbecue and other facilities, and popular marine activities in the area included swimming, boating, fishing and diving.

There has been significant community interest in the proposed development of the plant and the likely impact on recreational use of the area. BHPB stated that potential adverse impacts on sensitive receivers from construction activities could be managed by adhering to relevant legislative criteria. Potential nuisance impacts on residents and visitors during construction, such as dust, vibration, noise and traffic, have been addressed in this AR in Chapter 12: 'Effects on communities'.

BHPB also stated (SEIS Section 21.2) that local business and employment opportunities associated with the proposed plant would arise for service providers, such as road earthworks, security, IT and communications support, equipment hire and repair services. An assessment of the economic impacts has been provided in Chapter 12: Effects on communities.

Construction of the proposed plant would require 400 workers; once operational it would employ 30. BHPB would establish lunch rooms and basic sanitation facilities on-site, with workers staying in existing accommodation in Whyalla. Staff would be transported by bus to and from the work site. Potential impacts on Whyalla from the construction and operation are addressed in Chapter 12: 'Effects on communities'.

5.4.15.2 BHPB EM Program and commitments

- **EM Program:** No specific EM Program in relation to the desalination plant.
- **Commitments:** To conduct ongoing community consultation with affected parties on the proposed mine expansion and associated infrastructure.

5.4.15.3 Assessment

The AR concludes that while the proposed desalination plant would create local short-term disruptions during the construction period, with minimal impacts during operation, these impacts could be appropriately managed through BHPB's relevant management plans, including the Social Management Plan. The development could also provide opportunities to local businesses during the construction and operation of the plant.

5.4.16 Visual amenity and landscape character

5.4.16.1 Issues

The DEIS identified the historic lighthouse and associated cottages, the rocky and sandy beaches and the coastal homes as important aesthetic features of Point Lowly. The presence of the Santos hydrocarbon facility gives the location a semi-industrial appearance, with its large white LPG and oil tanks, the fractionation (chemical separation) facilities and 2.4km jetty at Port Bonython clearly visible from 30-40km across the Spencer Gulf and further to the south-west at Whyalla. The lesser visual intrusion of the aquaculture rings and associated industry at nearby Fitzgerald Bay also add to the semi-industrial nature of Point Lowly. The rest of the area comprises generally undulating topography, vegetated with semi-arid low shrublands, of the southern part of the Cultana escarpment that formed a backdrop to the coastal plain.

From both close and mid-range distance visual perspectives, the proposed desalination plant would look like a collection of large industrial sheds and tanks, with associated pond areas. A photomontage of the proposed plant (DEIS Plate 20.12) showed what the plant would look like from the main road looking south-east to Point Lowly and across the Spencer Gulf. From a long distance perspective, the plant would blend with the sheds and tanks of the Santos facility. The existing views of the locality were predominantly industrial.

Siting the proposed plant adjacent to the Santos facility would provide an opportunity to minimise the potential impacts on visual amenity, and BHPB predicted it would have a 'moderate' visual impact when viewed from the Point Lowly Lighthouse and nearby holiday homes (DEIS Section 20.5.2). This was based on the qualitative visual assessment criteria (DEIS Appendix R). However, there was a photomontage showing this viewpoint.

BHPB proposed the following measures in the FEIS:

- Specific details of landscaping associated with the proposed desalination plant would be determined during the detailed design phase of the expansion project;

- BHPB or its nominated contractor would liaise with relevant authorities in ensuring appropriate landscaping was included in the building plans; and
- Only native species would be planted in this area (SEIS 23.1).

Further, impacts would be minimised by selecting colours for the desalination plant buildings that suited the surrounding landscape, and a landscape design that would screen the desalination plant and associated infrastructure (DEIS 20.5.2 / SEIS 23.1).

5.4.16.2 BHPB EM Program and commitments

- **EM Program:** No specific EM Program in relation to the desalination plant.
- **Commitments:** To conduct ongoing community consultation with affected parties on the proposed mine expansion and associated infrastructure.

5.4.16.3 Assessment

The AR considers the Santos facility to be a dominant feature in the landscape, due to its height and horizontal massing, which could screen the impact of the proposed desalination plant when viewed from the sea and across the Gulf. Locally, it would look like an extension of the Santos facility because the structures would be similar. The location and topography mean that, when viewed from recreational sites and coastal homes in the proximity, the aggregation of similar facilities would have minimal additional visual impact for tourists when viewed from the road or scenic locations. Any night lighting associated with the desalination plant would be absorbed due to the Santos facility being the predominant structure in the locality. While the desalination plant would provide a backdrop to the lighthouse and dwellings, the hinterland was only a minor viewscape. The coast, gulf and distant Flinders Ranges were the main scenic views and they would not be affected by the plant.

With BHPB proposing to tunnel the outfall pipe, earlier concerns with the construction impacts to Shingle Beach are no longer relevant.

The AR concludes that the proposed desalination plant and associated infrastructure are consistent with the semi-industrial character and zoning of the area and the residual visual impact would be moderate. The impact would be minimised by the colours chosen for the construction materials, lighting and landscaping and screening. The proposed plant would not significantly affect the visual amenity or landscape character for local residents and tourists, as viewpoints were predominantly towards the gulf.

RECOMMENDATION

Accordingly, the AR recommends the following conditions to manage impacts to visual amenity and landscape character:

- The Desalination Plant must be established in general accordance with DEIS Figure 5.27 and DEIS Appendix F2 Drawing ODP3672-DO-0002 (Desalination Plant – Site Infrastructure).
- The proponent must prepare and implement a detailed Landscaping Plan that includes a 3m vegetated buffer along the front of the development (along the boundary facing Port Bonython Road), using locally indigenous species. The plan must indicate the mature height and density of species used to screen the desalination plant along the perimeter. The Landscaping Plan must be lodged with Indenture Minister for approval prior to the operation of the plant.
- All lighting on site must use low profile lighting.

5.4.17 Waste management

5.4.17.1 Issues

BHPB committed in the SEIS to placing the desalination plant outfall pipe in a tunnel under the seabed. It would construct a launch shaft 87m below the proposed plant site and a 3.9km tunnel to the proposed discharge point off Point Lowly. The launch shaft excavation and tunnelling would produce up to 53,000 tonnes of spoil which would be reused on or close to the site, or shifted off-site. In a worst-case scenario the spoil would be transported to Olympic Dam by road. Other waste from construction activities would be taken to local licensed landfills.

Seawater entering the proposed desalination plant would be dosed with acid, coagulant and/or a polymer before being directed through mixing tanks and a sand filter. Fine particles would be captured in the filter and removed during daily backwashing to storage lagoons, while solids that accumulated in these lagoons would be periodically removed and dumped.

BHPB has proposed the following management measures:

- To discharge liquid wastes into evaporation ponds and dispose of residual solids in a licensed landfill;
- To dispose of solid wastes in a licensed landfill, and
- To line sludge ponds with a low-permeability material to prevent materials leaching into the soil and groundwater.

5.4.17.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.6:

- **Objective:** Minimise general waste generated by BHP Billiton's expansion activities, and maximise the reuse of general waste where practicable;
- **Criteria:** Increase the proportion of general waste reuse/recycling.
- **Management plan:** To update the Waste Management Plan.
- **Commitments:** No specific commitments made on this issue.

5.4.17.3 Assessment

The SEIS stated that the spoil generated from excavation of the launch shaft and tunnel should be 'competent and uncontaminated material' and therefore suitable for local reuse. However, as soil and groundwater at or near the proposed desalination plant site could be contaminated, there is potential for the spoil to be contaminated. There is also the potential for it to contain acid sulphate material.

To ensure such risks are assessed before BHPB determines to deal with the spoil, the AR considers that a qualified and experienced environmental consultant should be engaged to sample and assess the spoil to enable classification and temporary stockpiling. A sampling and analysis program should include laboratory analysis for EPA Waste Fill Criteria. The test results would determine how the spoil was managed.

The EPA does not generally support storage or stockpiling of material for recycling or reuse for longer than six months to reduce the potential for it to be abandoned or stockpiled indefinitely. These requirements are outlined in the EPA Guideline for Stockpile Management: Waste and Waste Derived Products for Recycling and Reuse.

RECOMMENDATION

Rather than prescribe exactly how the predicted large quantity of spoil should be managed at this stage, the AR considers it more appropriate to require BHPB to incorporate details about spoil stockpiling, classification, testing, remediation, reuse and/or disposal into a CEMMP. The CEMMP would address all construction-phase environmental management issues, after a construction contractor was appointed and the detailed design stage completed. Accordingly, the following condition has been recommended:

- The proponent must prepare a Construction Environmental Management and Monitoring Plan (CEMMP) which must be developed in consultation with the SA EPA and approved by the Indenture Minister with the concurrence of the EPA before the commencement of construction activities. The CEMMP must be implemented by BHPB and include measures for the minimisation and management of wastes, including:
 - Management of spoil generated from the outfall shaft/tunnel and intake pipeline trench construction, including:
 - Suitable location and design of spoil stockpiling areas to avoid pollution of surface water and/or groundwater;
 - Use of a suitably qualified and experienced environmental consultant to sample and classify spoil as it is generated to enable appropriate stockpiling, reuse and/or disposal;
 - Suitable sampling and analysis program (including laboratory analysis) to assess the extent and nature of any contaminants within the stockpiled spoil; and
 - Details of stockpile management and characterisation of spoil should be specified in accordance with the SA EPA *Standard for the production of Waste Derived Fill* and the EPA *Guideline for Stockpile Management: Waste and Waste Derived Products for Recycling*.

The following notes are also recommended:

Note 1: Spoil from construction of the outfall and intake pipelines has the potential to be contaminated or to contain acid sulphate material. Such materials will need to be contained, classified, treated and/or disposed of in accordance with relevant SA EPA standards and guidelines. In preparing the CEMMP, the proponent should consider the following:

- Mixed construction and demolition wastes should be stored in an undercover area or within skip bins with removable lids capable of preventing the infiltration and ponding of stormwater within that waste and timeframes for removal to an appropriately licensed waste depot;
- Describe the on-site waste storage facilities;
- Identify waste loading and offloading areas;
- Describe routes taken by waste disposal vehicles;
- Identify locations for off-site waste disposal; and
- Describe steps taken to minimise waste generation and maximise reuse and recycling.

Note 2: Waste oil to be stored and any other substance that may have the potential to pollute surface or groundwater must be stored in accordance with the SA EPA Guidelines for Bunding and Spill Management.

In relation to other wastes that would be generated during construction and operation, the AR concludes that disposing of such wastes at licensed landfills in the region would be acceptable and does not require specific conditions of approval.

5.4.18 Greenhouse gases and sustainability

5.4.18.1 Issues

There was legitimate government and community expectation that the design of the desalination plant and associated pumping and pipework would be carried out in a best-practice manner to achieve maximum energy efficiency and to reduce greenhouse gas emissions. There should be no ambiguity about the level of greenhouse emissions to be offset through the purchase of renewable electricity.

The extent to which voluntary action to reduce emissions would achieve additional reductions in global emissions over and above Australia's international commitments was unclear.

5.4.18.2 BHPB EM Program and commitments

- **EM Program:** Refer to Chapter 13: 'Effects on the environment' for a summary of the BHPB EM Program in relation to greenhouse gases.
- **Commitments:** BHPB made the following commitments in relation to the use of renewable energy:
 - Sourcing renewable energy (35MW capacity) via the national electricity market (NEM) for the seawater desalination plant; and
 - Sourcing renewable energy (22MW capacity) via the NEM to power the pumping stations needed to transfer the water from the Point Lowly desalination plant to Olympic Dam (SEIS Commitments Table 2.1, pages 52-53).

5.4.18.3 Assessment

Despite the Reverse Osmosis (RO) being an efficient technology for desalinating seawater, the need to use significant electricity would be unavoidable. Accordingly, the AR supports BHPB's commitments to offset the greenhouse emissions by purchasing renewable energy for the total energy requirements of the proposed plant.

This would ensure the net outcome of the proposal would reduce the impact of greenhouse gas emissions. The AR accepts and supports this approach and notes the proposed 100 per cent off-set strategy was greater than would normally and reasonably be expected from development.

Other renewable energy and greenhouse abatement opportunities, such as best-practice design of the desalination plant, would be considered by BHPB through the Greenhouse Gas & Energy Management Plan (GG&EM Plan). The AR considers this an acceptable approach.

Where material had not been provided or lacked sufficient detail, it is not considered to affect the adequacy of the DEIS/SEIS provided that the GG&EM Plan is used to incorporate the issues raised and was a successful vehicle for managing greenhouse emissions on an ongoing basis and providing public accountability for the project performance. Refer to Chapter 13: 'Effects on the environment' for a comprehensive assessment of greenhouse gases and sustainability matters in relation to the whole expansion project, including the requirement for a GG&EM Plan and publicly released annual greenhouse road map.

RECOMMENDATION

Accordingly, the AR recommends the following condition in relation to the desalination plant:

- Electricity requirements to power operation of the desalination plant and all four associated pumping stations must be drawn from renewable energy sources via the national electricity market.

Further greenhouse and sustainability conditions that relate to the whole project have been recommended in Chapter 13: 'Effects on the environment'.

5.4.19 Traffic impacts

5.4.19.1 Issue

DTEI sought additional information on the potential impacts on the Port Bonython Road during construction and operation of the proposed, including:

- Increased traffic, especially heavy loads;
- Increased noise;
- Temporary restrictions to access;
- Impact on existing road users, residents, tourists, commercial fishing and aquaculture, Santos employees and delivery services;
- Need for upgrading/modification and maintenance/repair;
- Traffic management plans and mitigation measures; and
- Impacts in relation to adjacent rail movements.

In response, BHPB proposed the following management measures in the SEIS:

- To review existing and projected traffic demands on Port Bonython Rd in conjunction with DTEI before any desalination plant construction began; and
- To determine traffic management requirements that would need to be incorporated into the Draft Off-site Traffic Management Plan. (SEIS Section 22.4 and Appendix K1).

5.4.19.2 BHPB EM Program and commitments

- **EM Program:** No specific EM Program in relation to the desalination plant.
- **Commitments:** No specific commitments provided in relation to the desalination plant (refer section 5.4.19.1 for a summary of the management measures proposed by BHPB).

5.4.19.3 Assessment

The AR considers that BHPB's response provided in the SEIS is satisfactory, subject to compliance with the management measures listed above, and the recommended conditions outlined below.

RECOMMENDATION

Accordingly, the AR recommends the following conditions:

- Access and egress to the site (including internal movements within the site) during construction must be undertaken in accordance with a Traffic Management Plan (as part of the CEMMP) approved by the Indenture Minister, with the concurrence of DTEI, prior to the commencement of construction works. The Traffic Management Plan must identify:
 - The preferred access route;
 - Outline measures to manage and mitigate traffic impacts to the local community and industry during construction; and
 - The internal access route and on-site parking arrangements for bus parking and vehicles sufficient to service the workforce.
- The proponent must comply with the relevant DTEI and Whyalla City Council standards (as appropriate) for the access arrangements to and from the desalination plant, and any upgrades required on the Port Bonython Road as a result of additional traffic associated with desalination plant, with all costs being the responsibility of the proponent.
- Signage must be installed at the Point Lowly Boat Ramp showing the exclusion zone for the desalination plant operations.

5.5 Conclusions

Assessment of the proposed desalination plant component of the Olympic Dam expansion project has required consideration of environmental, economic and social impact issues. However, due to the proposed scale of operation, sensitivity of USG waters, and the degree of concern expressed in the submissions on the DEIS by the SA Government and public, potential impacts on the marine environment have required by far the greatest and most detailed consideration in this AR.

The detailed information on which this assessment is based was contained in the May 2009 DEIS and associated appendices and the May 2011 SEIS and associated appendices. The AR has also relied on information and comments provided in public and government submissions through the consultation process and additional advice from government agencies and contracted independent scientists.

5.5.1 Site selection and consideration of alternative sites

The AR concludes that the Point Lowly site has been justified as the preferred location for the desalination plant on the basis that potential adverse impacts on the marine environment could be avoided beyond the boundary of the predicted return-water mixing area by implementing the strategies specified and the associated recommended conditions of development approval. Because of the importance of the local marine ecosystem, including the Giant Cuttlefish breeding sites at Point Lowly, and the time-span between this assessment and proposed construction, a cautious approach was needed. In particular, ongoing refinement of the hydrodynamic model and toxicity testing is recommended in order to ensure that the latest technology and monitoring data was considered before any final design and construction was undertaken. This would enable optimisation of the final diffuser design, if required.

5.5.2 Marine impacts

The AR considers that the proposed scale of desalination plant operation and diffuser location, alignment, design and operational strategy would provide the level of protection required to avoid harm to the marine environment beyond 100m of the diffuser, including avoidance of potential harm to protected and significant species. There is an opportunity to collect further data before any construction activity and the results could be used by the EPA to develop licence conditions, and by BHPB to optimise the design of the diffuser, if required.

This AR considers that the proposed method of trenching for the intake pipeline is acceptable subject to BHPB using the best available practice to minimise release of suspended solids, particularly fine particles. Additionally, extensive 'before', 'during' and 'after' turbidity and total suspended solids monitoring needed to be undertaken. , acknowledging that this would be a condition of any EPA dredging licence.

The AR concludes that if design controls aimed at minimising impingement and entrainment were fully adopted the impact of the proposed desalination plant on entrapment and entrainment would not likely be significant. The AR recommends further quantitative monitoring of marine organisms and habitats in the proposed water intake area with the aim of optimising the intake location to minimise impingement and entrainment of marine organisms, if required.

5.5.3 Greenhouse gas emissions and sustainability

The proposed desalination plant would consume a significant amount of electricity as a consequence of the RO desalination process and ongoing pumping of water to Olympic Dam. However, BHPB committed in the SEIS to sourcing renewable energy from the national electricity market to power the desalination and pumping stations. The commitment to off-set 100 per cent of greenhouse gas emissions by buying 'accredited renewable' energy from the grid is supported by the AR. The AR has recommended it be a condition of any development approval.

5.5.4 Terrestrial impacts

BHPB proposal to tunnel the outfall pipeline is supported. The AR has recommended that BHPB prepare a Construction Environmental Management and Monitoring Plan (CEMMP) including measures to manage spoil and groundwater arising from excavation of the launch shaft and outfall pipeline tunnel for the proposed desalination plant. It considers that stormwater, air quality, noise and vibration, and solid wastes could be managed during the construction phase subject to preparation and implementation of the CEMMP that would have to be approved by the Indenture Minister with the concurrence of the EPA before any construction could start. The AR also considers that these issues could be managed during ongoing operations in accordance with regulatory requirements and the Controls/Management Actions proposed by BHPB.

5.5.5 Effects on communities

No significant social impacts were anticipated in relation to the use of the proposed site for a desalination plant as it had been zoned for industrial purposes for many years and was well separated from areas of existing or potential future residential development. Impacts on residents during operation of the plant were expected to be negligible, with the nearest residential property 600m from the boundary of the proposed plant site.

No sites of European and cultural heritage significance were found on the proposed site during EIS investigations, and BHPB's decision to construct the outfall pipeline in a deep underground tunnel meant there would be no risk of the State heritage registered Point Lowly Lighthouse complex being damaged during construction activities.

5.5.6 Hazard and risk

The proposed desalination plant would be located next to the Santos Port Bonython oil and gas facility which is a potential Major Hazards Facilities (MHF) site. The AR recommends a risk assessment to be undertaken in consultation with Santos and SafeWork SA to ensure hazardous chemical storage facilities are appropriate.

Chapter 6

Landing facility and pre-assembly yard



Chapter 6: Landing facility and pre-assembly yard

6.1 General

The landing facility for offloading pre-assembled infrastructure to support the Olympic Dam expansion is proposed to be located 10km south of Port Augusta at Snapper Point on the western shore of the Upper Spencer Gulf (USG).

6.1.1 Site and locality

The site is predominantly vacant Crown land and includes one residential property owned by BHP Billiton Olympic Dam Corporation Pty Ltd (BHPB) which is shown in the Draft Environmental Impact Statement (DEIS) on Figure 9.20 and Plate 9.28. A further 12 residential properties are located within 1km south of the landing facility.

A dedicated access road would link the landing facility to the pre-assembly yard, where large equipment would be stored and assembled before being transported to Olympic Dam by road via the Stuart Highway. The pre-assembly yard is sited 3km north-west of Port Augusta on 25 hectares (ha) of Crown land.

The location of the landing facility, access road and pre-assembly yard are shown in the Supplementary Environmental Impact Statement (SEIS) Figure 22.3.



SEIS Figure 22.3 Proposed alignment of access corridor, location of Port Augusta pre-assembly yard and rail crossings

6.1.2 Existing environment

6.1.2.1 Terrestrial environment

A full description of the terrestrial ecology of the project location is contained in this Assessment Report (AR) in Chapter 13: 'Effects on the environment'.

6.1.2.2 Marine environment

Surveys of the marine habitats and communities undertaken by BHPB in the vicinity of the landing facility site found that water depths ranged from 0m (intertidal) to 10m, with a varied seafloor ranging from sandy to muddy substrate. Three distinct marine communities were identified in the DEIS, primarily influenced by the substrate type and water depth. They are:

- An intertidal/upper subtidal community with adjacent mangroves;
- A shallow, dense seagrass community; and
- A mid-depth (6m to 10m), muddy sediment community.

Details of the methods used during the marine survey were described in Appendix O1 of the DEIS.

6.2 Project description – key elements

The key individual components of the landing facility and pre-assembly yard construction project are:

6.2.1 Access road

The proposed access road linking the two facilities is detailed in the AR in Chapter 11: 'Road transport'.

6.2.2 Landing facility

BHPB has sought approval for the landing facility and associated infrastructure to enable large prefabricated modules shipped from other parts of Australia and overseas to be unloaded south of Port Augusta for transport to the mine via the Stuart Highway. The sheer bulk and dimensions of the modules - up to 15m wide by 15m high and 500 tonnes in weight – drove the decision to develop a coastal landing facility as close as possible to Olympic Dam to keep the road haulage component of the delivery process as short as possible.

A dedicated access road has been proposed to link the landing facility 10km south of Port Augusta with a pre-assembly yard 3km out of Port Augusta on its north-western outskirts. The requirements of the construction and operation of the landing facility in terms of water, electricity and workforce are indicatively outlined below:

RESOURCE REQUIREMENT	LANDING FACILITY
Water demand during construction (ML)	5–10 annually
Water demand during operation	negligible
Electricity consumption during construction (annual consumption GWh)	Negligible
Electricity consumption during operation (annual consumption GWh)	11
Peak construction workforce	100
Ongoing operational workforce	30
Total land disturbance (ha)	13 (including pre-assembly yard)

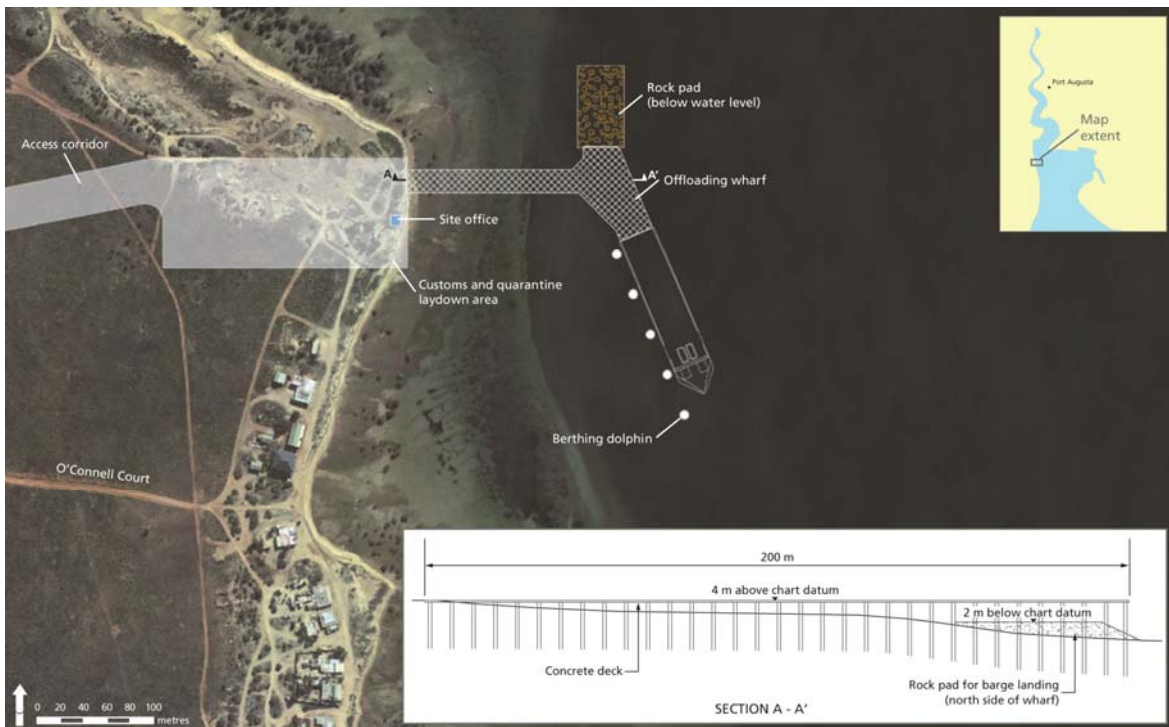
6.2.2.1 Construction

Hydrographic surveys undertaken by BHPB showed the navigational channel in the Upper Spencer Gulf (USG) was deep enough to operate the landing facility without requiring dredging and this was a consideration in the selection of the preferred site.

The proposed landing facility comprises:

- A piered jetty structure, approximately 200m long and 20m wide, constructed of precast piles and concrete decking;
- An underwater rock pad (80m x 50m) on the northern side of the jetty, rising four metres above the sea floor, to provide barges with a stable platform to rest on while unloading; and
- A hard-stand quarantine lay-down area.

The layout of the proposed landing facility is shown in the DEIS Figures 5.52 and 5.53.



DEIS Figure 5.52 Indicative configuration of the proposed land facility

As required by the Australian Customs and Border Protection Service (Customs) and the Australian Quarantine and Inspection Service (AQIS), a 2ha quarantine lay-down area would be required to store off-loaded modules before they were taken to the Port Augusta pre-assembly yard via the dedicated access road. A small office facility with worker amenities would be established at the edge of the lay-down area.

Low-quality water would be required during construction for hardstand compaction and dust suppression and would be sourced from saline aquifers. Higher quality water for in-situ concrete manufacture could be supplied from a number of sources, including the existing State water supply network. Energy needs during construction (in the order of 11,000 MWh/a) would be sourced from the National Electricity Grid. The construction workforce (approximately 100 workers) would be accommodated in short-stay accommodation in Port Augusta.

The development of the landing facility and pre-assembly yard combined would require approximately 13ha of vegetation clearance. The hardstand area and underwater rock pad would be constructed from rock fill from cut-and-fill operations at the landing facility site and construction of the access road. If there was not enough rock fill it would be supplemented by mine rock from mining operations in the Middleback Range, or a borrow pit [a pit dug to provide fill at another site] would be established near the landing facility construction site.

Precast concrete piles would be transported to the site to be driven, and the precast concrete decking would be positioned and secured to the piles. The structure would incorporate berthing dolphins [mooring structures] so ships could be secured while unloading.

A Construction Environmental Management Plan (CEMPs) would be used to manage work at the landing facility, which would be developed as part of contractual arrangements between BHPB and its subcontractors.

6.2.2.2 Operation

It is estimated that 300 ships would unload at the landing facility in the first seven years of the proposed 11-year mine expansion construction period, the traffic comprising 100 arrivals in the first two years and 200 over the following five years. This roughly equates to one visit a week for the first two years, reducing to one visit every 11 days for the following five years.

The operation would involve heavy vessels mooring for two to three days at a deep-water holding site to be identified in conjunction with the Department for Transport, Energy and Infrastructure (DTEI). Cargo would be off-loaded from large vessels onto barges which would unload at the landing facility. Vessels light enough to use the existing channel would berth at the landing facility. While the barging option was not the most efficient unloading method this assessment supports the barging option as it eliminates environment impact associated with dredging of the main channel.

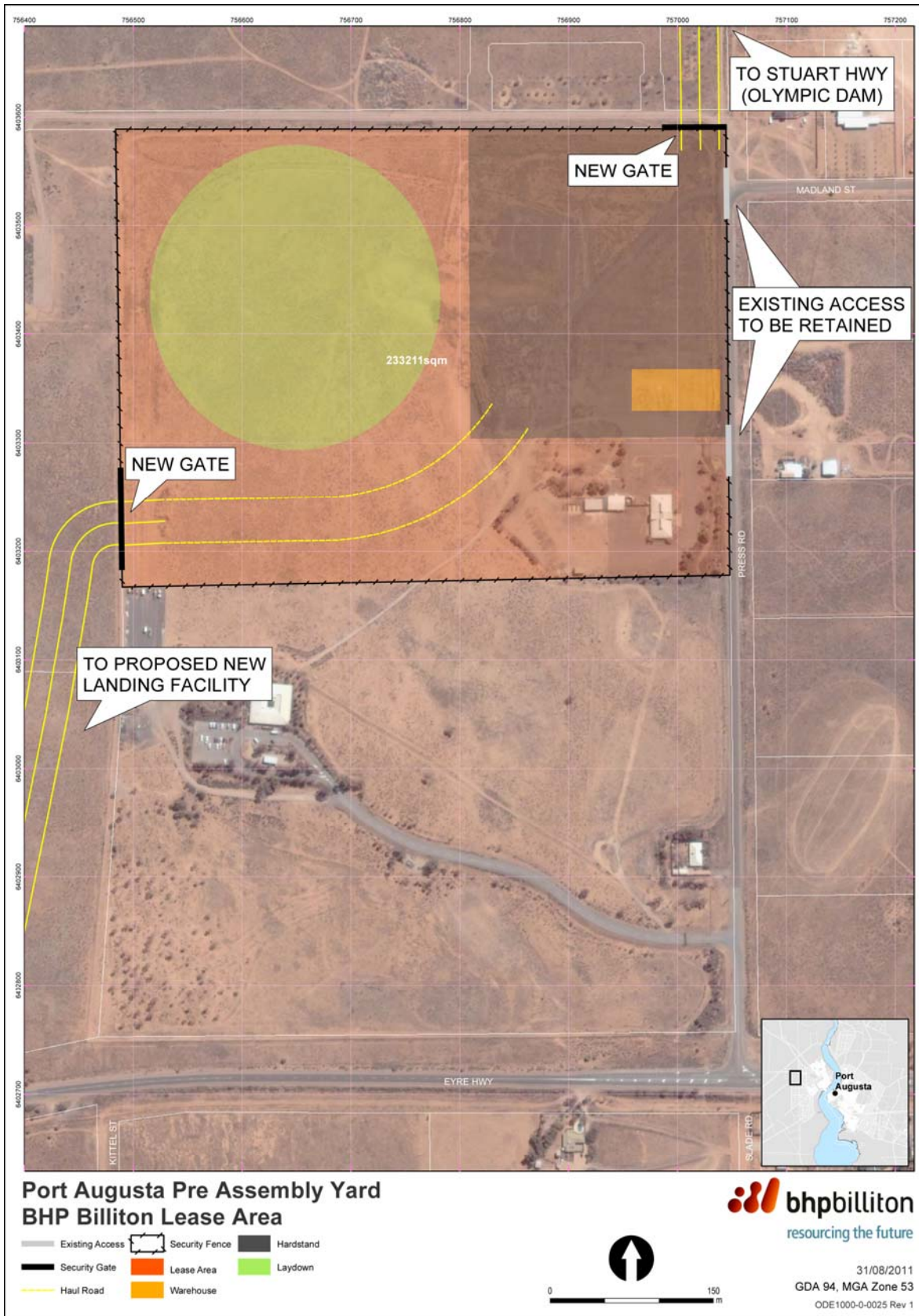
Vessels would remain at the landing facility for two to three days to unload. Unloading would occur in daylight hours only, typically between 7am and 7pm.

To meet maritime security requirements and ensure the facility's secure use by BHPB only, there would be no public access to, or third-party use of the landing facility. There would also be limitations on swimming, diving, mooring or anchoring in the immediate vicinity of the landing facility and around vessels during berthing, unloading and departure, to ensure public safety. The DEIS identified an indicative 25m safety zone around the facility and berthed vessels. There would be no restrictions on vessels travelling past the landing facility, accessing the coastline or moving into the channel outside of the safety zone.

BHPB would continue to use the landing facility infrequently in the operational phase to handle equipment associated with ongoing replacement and maintenance at Olympic Dam. BHPB has indicated that in the longer term it could continue as a landing place for future mining or other enterprises in the region or be transferred to the South Australian Government for use by the public, subject to any further approvals.

6.2.3 Pre-assembly yard

The Port Augusta pre-assembly yard would be located 3km north-west of Port Augusta on 25ha of land owned by the Commissioner of Highways. It is proposed that loads greater than eight metres wide would be transported from the landing facility to the pre-assembly area via the private access road. From the pre-assembly yard the loads would go by road to Olympic Dam via the Stuart Highway. Details of the proposed route are contained in the DEIS Appendix Q9.



Port Augusta pre-assembly yard

The pre-assembly yard site contains a number of unoccupied buildings previously used for the 1997 Olympic Dam expansion (SEIS plate 21.3). To support the activities proposed the existing hard-stand area would be re-established and expanded; additional office space would be provided, including providing for State and Commonwealth agencies, including SA Police, DTEI and Australian Rail Track Corporation, should they require it.

The activities proposed for the pre-assembly yard are similar to those undertaken for the 1997 expansion and include:

- Staging the movement of Over Dimensional (OD) modules between the landing facility and Olympic Dam;
- Storing transport related equipment;
- Fabricating and constructing modules that would involve the use of cranes, industrial pneumatic/electric tools, abrasive and related cleaning activities and painting; and
- Coordinating transport planning for moving OD loads.

There would be no night-time construction activities. However, there would be OD load movements and transport related activity at night but it would cease at 10pm in accordance with Port Augusta (City) Development Plan provisions for industrial sites within 60m of a residential zone. The exact requirements would be determined as more detailed project planning was completed. Details are contained in Section 5.7.4 of the SEIS.

6.3 Summary of submissions

6.3.1 SA Government submission

The key issues raised by the SA Government in relation to the proposed landing facility and the pre-assembly yard included:

- Assessing the maritime safety implications of the landing facility operations, including accidents in shipping lanes, interaction between boats, oil spills and coastal hazards;
- Marine operation/navigation in the channel, including details about the location and operation of the mooring facility for vessels too big to use the existing channel;
- Extent of seagrass and mangrove clearing and how this might affect the Significant Environmental Benefit (SEB);
- Assessing visual and noise impacts of the landing facility on Shack Rd residences, including operating hours and lighting;
- The management strategy for the potential risk of acid sulphate soil (ASS) as a consequence of disturbance during construction of the landing facility;
- Arrangements for quarantine inspections of vessels for marine pests;
- Safety and security requirements of the landing facility operation;
- Confirmation the facility would not be used for loading, unloading and storage of hazardous/dangerous substances; and
- Clarification of the proposed activities at the pre-assembly yard and the associated traffic impacts.

6.3.2 Public submissions

A significant number of public submissions on the proposed landing facility mirrored issues raised by the SA Government. Other concerns included:

- The location of the landing facility in terms of amenity and environmental concerns;
- The impact on the USG marine environment, including the loss of important areas of mangroves and samphires, the impact on whales, dolphins, seals and fishing, and the contamination of marine life from pollutants;
- Coastal erosion associated with the movement of tugs and barges;
- The effects of sediment disturbance on water clarity and seagrass;
- Future use of the landing facility on completion of the mine expansion; and
- Potential for marine pests to be introduced into the gulf environment.

6.4 Key environmental, social and economic issues

The key environmental impacts associated with the landing facility include:

- Risk/hazard management, including safety;
- Air quality;
- Soil erosion and acid sulphate soils;
- Introduction and/or spread of weeds;
- Marine ecology;
- Coastal processes;
- Surface water;
- Noise and vibration;
- Visual amenity;
- Social impacts;
- Waste management;
- Traffic access; and
- Rehabilitation and decommissioning.

6.4.1 Risk/hazard management

6.4.1.1 Issues

Contaminants

Specific spill-management procedures would be developed and detailed for the landing facility as part of the Environmental Management Program (EMP). These procedures would ensure that spills would be controlled at source, contained on-site and cleaned up according to the requirements of the Material Safety Data Sheet. Spill containment and clean-up equipment would be available on-site at all times and personnel would be trained in its use. Emergency response procedures for spills in the marine environment would adhere to requirements specified in Australia's National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substances (AMSA 2007).

The temporary storage of dangerous and hazardous materials at the pre-assembly yard would be handled, separated and stored in compliance with recognised industry standards for each product, such as the Australian Dangerous Goods Code, as well as BHPB's internal procedures for such products. As a minimum, this would necessitate all personnel using appropriate personal protective equipment when handling such materials, and the establishment of spill-containment measures.

A draft Emergency Response Plan (ERP) for USG facilities was provided in the SEIS Appendix N. The ERP is an overarching policy document that covers both land-based escapes of hazardous materials from containment facilities as well as marine pollution incidents. It would apply to both the landing facility and the desalination plant.

Safety

It was considered the DEIS lacked detail regarding marine operations in the Port Augusta Channel. DTEI sought a commitment from BHPB to undertake a further hydrographic survey and to improve channel delineation, including installation of new navigational aids.

In response to submissions, BHPB instigated an independent maritime safety review of the USG facilities to address the range of maritime safety-related issues, including a risk assessment (SEIS Appendix L2). The safety review concluded that the impact of BHPB-related sea traffic would be low, and that safety impacts and risks could be controlled with appropriate management measures, as well as by adherence to relevant legislation (SEIS Section 25.1.2). The review noted that the highest risk associated with the landing facility would be the potential for occupational health and safety risks from potential vessel collisions during construction. Specific management controls would be implemented to ensure this risk was controlled. To ensure appropriate measures would be put in place, BHPB has committed to preparing and implementing a Maritime Safety Plan.

BHPB would also undertake further hydrographic survey work in the USG and discuss with DTEI appropriate shipping routes and navigational aids to ensure the safe passage of vessels to and from the landing facility. It also acknowledged in the DEIS that the landing facility would be required to operate in accordance with the *Harbors and Navigation Act 1993 (SA)*.

6.4.1.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 1.2:

- **Objective:** No significant adverse impacts to specified marine environmental values of the Upper Spencer Gulf from constructing the landing facility.
- **Criteria:** Not applicable to the landing facility.
- **Commitments:** To implement specific management controls to ensure the risk of vessel collisions during construction was controlled. A Maritime Safety Plan (SEIS Table 2.1 – Commitments) would be implemented to cover:
 - Controls on vessel movements;
 - Community liaison; and
 - Safety and other shipping-related issues

6.4.1.3 Assessment

Contaminants

The AR considers that the draft Emergency Response Plan (ERP) provided in the SEIS attempted to follow the framework provided in the State Emergency Management Plan (Prevention, Preparedness, Response and Recovery). The draft ERP is considered to be partially an emergency management policy document, and partially an emergency response guide, with a greater focus on policy than response. In assessing the draft ERP, 'Prevention' is not given the primacy it should have, and 'Recovery' was confused with 'Response'. 'Recovery' is a significant post-incident policy issue that should address business continuity, reconstruction and restoration programs and priorities, and programs for community and employee support.

Despite this, the AR considers that the draft ERP (SEIS Appendix N2) contains sufficient information to accept that BHPB has developed specific spill-management procedures for the proposed landing facility and pre-assembly yard as part of the EMP. However, the draft ERP should be expanded to separate policy from function, in consultation with, and for approval by SafeWork SA. This would assist in clarifying each concept and developing an appropriate response.

RECOMMENDATION

The AR recommends that the downstream operational hazards and risks associated with the construction and operational management of the landing facility should be assessed, and a safety review conducted during the construction, commissioning and operational phases, in consultation with SafeWork SA, as part of the licensing process.

Accordingly, the AR recommends the following note to remind BHPB of its statutory obligations:

- In order to comply with clause 24 of the State Emergency Management Plan, in relation to section 9(e) of the South Australian *Emergency Management Act 2004*, an Emergency Response Plan for the landing facility should be prepared prior to construction, in consultation with the appropriate state authority that provides for the proponent's response arrangements for product recovery and site normalisation.

RECOMMENDATION

In summary, the AR considers the issue of hazard management and emergency response in relation to the construction and operation of the landing facility and pre-assembly yard, including the storage and management of hazardous and dangerous substances, could be managed effectively through compliance with commitments made by BHPB, relevant legislation (as outlined in the above note), and the following recommended condition and note:

- The landing facility and pre-assembly yard must be designed to ensure that hazardous and dangerous substances are stored in bunded and sealed compounds/areas capable of preventing the escape of material into the soil, surface waters or underground water resources.

Note: The South Australian Environment Protection Authority (EPA) Guideline - Bunding and Spill Management contains information that could help the proponent comply with this requirement.

Safety

The AR considers that sufficient information was provided in the Final Environmental Impact Statement (FEIS) to demonstrate that maritime safety issues could be managed effectively subject to commitments made in the FEIS and compliance with the requirements of the *Harbors and Navigation Act 1993*.

RECOMMENDATION

Accordingly, the AR recommends the following conditions:

- Movement of the proponent's marine traffic must be undertaken in accordance with a Maritime Safety Plan prepared in consultation with DTEI. The Maritime Safety Plan at a minimum must include a traffic management system covering the movement of the proponent's marine traffic.
- The proponent must review and upgrade the deep water markers from the deep water mooring site to the landing facility to comply with OHS&W standards.

The following notes are also recommended and outline in broad terms BHPB's obligations under the *Harbors and Navigation Act 1993*:

- Additional surveys, including hydrographic surveys required to demonstrate safe navigation and transit of material from 'bank to ship' prior to the operation of the landing facility (survey methods to be developed in consultation with DTEI).
- Should the proponent plan to moor heavy lift vessels at the holding site in deep water, a safe independent mooring location will need to be identified with an exclusion zone of 0.5 nautical miles radius around the mooring location to enable ships to off-load equipment on to the barges.
- Should 'tugs' be used by the proponent to tow barges from the mooring site to the Landing Facility then the adequacy of the tugs will need to be addressed by BHPB (to comply with relevant DTEI standards), and will have to be manned by qualified crew with pilotage exemption certificates.

6.4.2 Air quality

6.4.2.1 Issues

Both construction and operation of the proposed landing facility and pre-assembly yard have potential to generate dust. Although it did not specifically address the landing facility, BHPB stated (DEIS Section 13.3.5) that allowance had been made to use low-quality water for dust suppression for all infrastructure components. If required this would be supplemented with dust-suppressing chemicals to reduce water demand, which would be applied by water carts or mobile sprinklers.

BHPB also stated in the SEIS that dust impacts from the pre-assembly yard would be insignificant given the distance to the nearest residence, coupled with the use of dust-suppression mitigations as necessary.

6.4.2.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 3.1:

- **Objective:** No adverse impacts to public health as a result of fugitive particulate emissions from BHPB's expansion activities at Olympic Dam.
- **Criteria:** BHPB propose to achieve this by meeting assessment criteria of an annual average operational contributed PM₁₀ concentration of less than 30 µg/m³, and a 24-hour average of less than 50 µg/m³ at sensitive receptors.
- **Commitments:** No specific commitments made in relation to this issue.

6.4.2.3 Assessment

It is considered that the construction phases of the landing facility and pre-assembly yard would pose a potential dust issue as a result of vegetation clearance, reshaping of the landscape and other associated earthworks. However, this AR considers the issues of dust and air quality from construction activity could be managed effectively through the compliance of BHPB and its contractors with the *National Environment Protection Measure for Ambient Air Quality (2003)*. The AR further supports BHPB's intention to prepare a Construction Environmental Management Plan (CEMP). It is recommended the CEMP address air-quality issues that might arise during construction of both the landing facility and pre-assembly yard. A condition has been recommended to this effect.

During the operational phase, air-quality impacts would likely come from the use of the landing facility's quarantine lay-down and hard stand areas and the pre-assembly yard hard stand area. Given the volume of traffic, the landing facility and pre-assembly yard should be managed to ensure compliance with the National Environment Protection Measure for Ambient Air Quality (2003) during operation. This might necessitate sealing of the quarantine lay-down and hard-stand areas should they cause air quality issues during the operational phase.

RECOMMENDATION

The AR considers that air-quality issues associated with both the construction and operation of the landing facility and pre-assembly yard could be appropriately managed subject to compliance with the NEPM for Air Quality, and conditions requiring the preparation and implementation of a Construction Environment Management and Monitoring Plan (CEMMP) and an Operational Environment Management and Monitoring Plan (OEMMP) for the landing facility for approval by the Indenture Minister, with the concurrence of the EPA that addressed the following:

- Measures to address air quality, including management of dust issues at the quarantine lay down and hard stand areas..

Detailed and collated recommended conditions in relation to the CEMMP and OEMMP are contained in section 6.5.1 of this chapter.

6.4.3 Soil erosion and acid sulphate soils

6.4.3.1 Issues

Soil erosion

The landing facility site was classified in the DEIS as having high soil erosion potential (DEIS Figure 10.6). To manage the potential risks, BHPB stated it would prepare an Erosion and Sediment Control Plan (ESCP) in consultation with a marine ecologist before disturbance works began, which would include measures beyond standard management practices to control soil erosion during construction (SEIS Section 10.1 and DEIS Section 10.5.1). Disturbed areas would be monitored and erosion-control measures applied during construction, particularly after episodes of high rainfall and wind, and would continue after construction until the disturbed areas were stabilised. Detailed measures would be determined during the preparation of the ESCP.

The ESCP for the construction disturbance in coastal areas would:

- Be developed in consultation with a marine ecologist with knowledge of the Upper Spencer Gulf receiving environment so that potential impacts on ecologically sensitive places were avoided;
- Include annotated design drawings that showed the location, extent and type of control measures proposed; and
- Establish monitoring programs to ensure erosion and sediment control measures were inspected and maintained

The AR addresses soil-erosion issues as they relate to the pre-assembly yard in Chapter 13: 'Effects on the environment'.

Acid sulphate soils

The landing facility site was identified in the DEIS as having the potential for an acid sulphate soil (ASS) risk in the vicinity of the proposed landing facility. To manage the potential risks, BHPB has committed to undertaking more extensive ASS investigations before construction begins at the site. Should further investigations detect oxidisable sulphur levels exceeding the applicable action criteria, a site-specific ASS Management Plan would be prepared that would include appropriate soil-handling methods and lime dosing rates before construction began (DEIS Section 10.5.2).

6.4.3.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 1.1:

- **Objective:** Not applicable to soil management at the landing facility.
- **Criteria:** Not applicable to soil management at the landing facility.
- **Management plans:** Two plans would be developed, comprising:
 - Acid Sulphate Soil Management Plan for areas below 5AHD (Australian Height Datum) at the landing facility,. Further investigations would be carried out and an ASS Management Plan prepared before construction began if the sample analysis was found to exceed applicable criteria (DEIS Section 10.5.2); and
 - Erosion and Sediment Control Plan.
- **Commitments:** No specific commitments made in relation to this issue.

6.4.3.3 Assessment

The AR considers that adequate measures to control soil erosion and manage ASS risk at the proposed landing facility site have been identified in the FEIS, subject to compliance with BHPB's commitments to prepare an Erosion and Sediment Control Plan (ESCP) and, if required, an ASS Management Plan. The proposed monitoring of potential soil erosion, particularly after severe weather, is also supported by the AR.

RECOMMENDATION

Accordingly, the AR recommends a condition requiring preparation of an ESCP, as part of the Construction Environment Management and Monitoring Plan (CEMMP), which includes the following measures as a minimum:

- Minimising areas disturbed.
- Rain landing upstream of the disturbed areas to be diverted around the site.
- Installation and maintenance of erosion-control measures.
- Progressive rehabilitation and stabilisation of disturbed areas.

It is further recommended that a condition be imposed requiring the preparation of an ASS Management Plan should additional investigations find it necessary.

6.4.4 Introduction and/or spread of weeds

6.4.4.1 Issues

The potential impacts of the introduction and spread of weeds are largely the same across a number of project components. Rather than repeat this information in relevant component chapters it has been consolidated in one, Chapter 13: 'Effects on the environment'.

RECOMMENDATION

However, specifically in relation to the landing facility and pre-assembly yard, the AR recommends the following condition:

- A vehicle and plant wash down/inspection facility must be installed within 3 months of the site becoming operational to manage the introduction and spread of weeds at the landing facility and pre-assembly yard. The location and type of wash down/inspection facility must be approved by the Department of Environment and Natural Resources (DENR) before any construction.

6.4.5 Marine ecology

6.4.5.1 Issues

Construction impacts on the marine environment

The DEIS stated that direct impacts from seabed disturbance and indirect impacts from shading and increased sea turbidity (cloudiness caused by sediment disturbance) would be expected during construction of the proposed landing facility. This would require the removal of three mangroves covering about 0.2ha, samphire of less than 0.1ha, and seagrass *Posidonia australis* of 0.5ha. The construction of the pier would be expected to generate significant noise from pile-driving, which was identified as having the potential to cause impacts on sensitive marine life, particularly whales and dolphins.

The FEIS concluded that the residual impact of construction of the landing facility on the marine environment would have a minor short-term effect and a negligible long-term effect on the marine environment because the landing facility footprint would be very small, resulting in less than 0.5ha of seagrass being lost and the navigation channel not having to be dredged (DEIS Section 16.6.12).

In relation to the clearance of marine vegetation, section 15.5.1 of the DEIS discussed the Significant Environmental Benefit (SEB) to offset the vegetation losses. BHPB has proposed to make a payment to the Native Vegetation Fund to offset the seagrass loss (DEIS Appendix N9.5.3). For the full assessment of this issue see Chapter 13: 'Effects on the environment'.

Shipping Impacts on the marine environment

Potential impacts associated with increased shipping would include:

- The introduction of exotic/pest species on the hulls of ships, and/or from the discharge of ballast water;
- Potential impacts to marine mammals from collisions with ships and underwater noise; and
- Increased turbidity resulting from sediments being stirred up by ship movements in shallow water.

Marine mammals

With the low number of ship movements and whales not being common in USG, the DEIS considered the likelihood of striking a whale would be low (DEIS 16.6.6). Collisions with dolphins and seals were considered negligible as they were fast swimmers and would be able to avoid the slow-moving vessels. Noise and vibration from ships during construction of the landing facility result in disturbance to the behaviour of marine mammals, but the effect would be infrequent, brief and minor (SEIS 17.16.6)

Marine pests

All vessels contracted by BHPB would have to comply with regulatory controls established by local, national and international authorities. Under existing quarantine requirements the Australian Quarantine and Inspection Service (AQIS) is responsible for inspecting ships, crews and cargo on arriving at the first Australian port. Permission is required from AQIS in order for shipments to be unloaded.

In addition, BHPB would be required to prepare a management plan for shipping operations in the USG, describing all mandatory requirements and protocols for managing ballast water and minimising the risk of introducing marine pests and diseases to the USG. As standard practice, vessels would be required to discharge ballast water outside Australian waters. However, the operation of barges in USG would require the discharge and taking on of ballast water as part of the unloading operations at the proposed landing facility. Ballast water would be discharged into onshore tanks at the facility, rather than into USG, and the same water would be used to re-ballast vessels. BHPB has committed to the preparation of a Ballast Water Management Plan as part of the EMP for the management of barge and ship ballast water for the protection of marine environmental values. The plan would be consistent with international, Australian and local (Flinders Port Corporation) requirements (DEIS Appendix U, ID 4.1).

With regard to the potential for pests and diseases to be introduced via ships' hulls, the SEIS stated that vessels contracted to BHPB would require mandatory compliance with national and international guidelines for biofouling management. Hull maintenance would be policed by the Australian Maritime Safety Authority and border control (Customs and AQIS), which can inspect and detain vessels. With the appropriate safeguards in place and compliance with strict state and federal marine pest controls, the FEIS concluded that the risk of introducing pests or diseases into the USG would be low.

Turbidity

In response to submissions, the SEIS concluded that sediment disturbance by shipping would have no detectable effect on existing turbidity levels and the marine ecosystem. Strong currents and wind-generated waves regularly stir up sediments in the USG, resulting in periods of relatively high turbidity. Further studies, undertaken for the SEIS, found that the maximum amount of sediment stirred up by the action of boat propellers would be approximately 2mm during each vessel passage, which would generally settle out in minutes on calm days but remain in suspension for up to several days in times of strong tides and high winds. As it has been found to take 38 days of light deprivation to cause seagrass death, the FEIS concluded that periodic increases in turbidity would have a negligible impact on seagrass communities in the USG (SEIS Appendix H11).

6.4.5.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 1.2:

- **Objective:** No significant adverse impacts to specified marine environmental values of the Upper Spencer Gulf from constructing the landing facility.
- **Criteria:** Not applicable to the landing facility.
- **Management plan:** Ballast Water Management Plan (DEIS Appendix U, ID 4.1).
- **Commitments:** No specific commitments made in relation to this issue.

6.4.5.3 Assessment

Construction impacts on the marine environment

The AR acknowledges that the development and use of the proposed landing facility would not require the dredging or maintenance of shipping channels, as the existing water depths in the channels would be sufficient for barges and tugs to navigate. Large ships would be moored in deeper water south of the landing facility.

It further acknowledges measures to protect the marine environment proposed by BHPB but recommends the construction process would need to be closely managed to avoid impacts to the seagrass community from turbidity. It supports BHPB's plan to prepare a Construction Environment Management Plan (CEMP).

Six listed threatened species, including three migratory whales, turtles, the Australian Sea-lion and the Great White Shark have been identified as having the potential to occur in the vicinity of the landing facility. All of the listed species are highly mobile and have extensive habitat outside the Upper Spencer Gulf region, so construction and operation of the proposed landing facility, and an increase in ship movements in the region, was not expected to fragment or decrease the size of the listed species' populations, affect critical habitats, disrupt breeding cycles or introduce disease or pests that might adversely affect them.

RECOMMENDATION

To ensure underwater construction noise and vibration impacts were managed appropriately, the AR recommends that BHPB be required to prepare and implement, for approval by the Indenture Minister with the concurrence of the EPA, an Underwater Noise Management Plan, as part of the CEMMP.

Shipping impacts on the marine environment

Large ships travelling into Spencer Gulf are required to exchange ballast water offshore to reduce the probability of introducing marine pests into local waters. This method is considered adequate for the purpose. The management of marine pests would need to be addressed to ensure that ships or barges were free of any fouling before entering the construction area, and if ballast water was used in unloading and loading of barges that the risk of marine pests was adequately managed. AQIS has confirmed that they have adequate regulatory power to address their issues.

RECOMMENDATION

The AR considers the risk from marine pests was likely to be low in the context of the environmental safeguards already in place at a state, national and international level, coupled with the management measures proposed by BHPB, including the Ballast Water Management Plan and CEMMP.

Specifically in relation to the CEMMP, the AR recommends that the following should be addressed (amongst other matters):

- Known and potential noise and vibration impacts.
- Known and potential marine impact issues including:
 - Turbidity management;
 - Underwater noise; and
 - Management of marine pests.

It is recommended that the OEMMP should address (amongst other matters):

- Known and potential noise and vibration impacts; particularly under worst case operating and meteorological conditions.
- A Marine Pest Management Plan to address the management of marine pests at the landing facility and in neighbouring waters.

Detailed and collated recommended conditions in relation to the CEMMP and OEMMP are contained in section 6.5.1 of this chapter.

6.4.6 Coastal processes

6.4.6.1 Issues

Impacts on coastal processes, including tidal flow, wave propagation and shoreline stability, would be minimised by adopting an open pier design for the landing facility rather than a rock causeway (DEIS Section 16.6.12).

The coastal processes modelling undertaken to investigate sand-movement patterns as a result of the proposed facility found that only minor effects on the beach structure and sand-movement characteristics of the region would be expected. Specific findings included:

- Neither the jetty nor rock pad would have any significant impact on tidal flows and the nearshore wave field. The rock pad would cause slightly increased tidal velocities immediately above the pad;
- The jetty would have no significant impact on sediment movement along the coast or shore alignment because there is little background movement of sediment in the nearshore region and the structure would be permeable;
- Individual piles and the toe of the rock pad might cause turbulence, which in turn could cause localised minor scouring of the seabed; and
- The jetty would have no significant impact on shoreline alignment due to its permeable nature and the insignificant hydrodynamic and wave impacts associated with this option.

BHPB also investigated and modelled an option for a causeway structure which showed there would be localised impacts on coastal processes within 1km, including realignment of the shoreline north and south of the causeway. On the basis of these results BHPB rejected the causeway option. This AR supports this conclusion on the basis that a causeway would have a greater environmental impact.

On the evidence of the modelling BHPB concluded that the residual impact of the proposed pier and associated rock pad on coastal processes would be negligible and that recession of the regional shoreline would be more likely to occur due to an accelerating rise in sea levels associated with global warming. The shoreline is expected to recede by up to 20m over the next 100 years (DEIS Appendix O13).

6.4.6.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** No specific commitments made in relation to this issue.

6.4.6.3 Assessment

The AR supports the modelling undertaken that informed the final concept design of the landing facility. It is considered the proposed marine structures would be unlikely to result in any significant impact on coastal processes.

The customs and quarantine lay-down area would be partly built on low-lying coastal sediments. These deposits would be subject to seawater flooding during storm surges. If it was considered necessary by BHPB, land fill could be used to raise the site above storm-surge flood levels. BHPB would consider sea-level rise and storm-surge predictions in determining the siting and detailed design of the landing facility.

RECOMMENDATION

No conditions have been recommended by the AR as it is considered this issue has been adequately covered in the FEIS.

6.4.7 Surface Water

6.4.7.1 Issues

It is considered that the landing facility would have negligible effects on local catchments and flow paths because of the stormwater control measures proposed by BHPB and the natural drainage features of the Tent Hill land system (DEIS Section 11.5.1). A Stormwater Control Plan would be developed for the landing facility and, though detailed design parameters were not provided in the DEIS it stated the landing facility would be designed so that:

- Rainfall on disturbed areas of the site would be collected, treated and channelled to an on-site detention basin which would accommodate a one-in-100-year downpour (Average Recurrence Interval (ARI) rainfall event);
- Discharge from the on-site basin would match pre-development flows; and
- Stormwater from upstream would be diverted around the site and discharged downstream of the detention basin.

Erosion and Sediment Control Plans would be prepared for construction disturbance in coastal areas and would include annotated design drawings that showed the location, extent and type of erosion-control measures proposed, and monitoring programs that would ensure erosion and sediment-control measures were inspected and maintained.

Given the sensitive environment of the USG, spill-management procedures for the landing facility would be developed and detailed as part of the Environmental Management Program (DEIS Section 11.5.2). Spill-containment and clean-up equipment would be available on site at all times, with personnel trained in the use of the equipment.

Neither the DEIS nor SEIS provided details on drainage or local catchment information for the pre-assembly yard, nor has BHPB proposed the preparation of a Stormwater Control Plan for the site.

6.4.7.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.4:

- **Objective:** No significant adverse impacts to environmental receptors as a result of stormwater discharges to soil, surface water (freshwater and marine) or groundwater associated with BHPB's expansion activities.
- **Criteria:** All contact stormwater maintained within designated stormwater management areas.
- **Management plan:** BHPB has committed to developing a Stormwater Management Plan for the construction and operation of the proposed expansion, though it should be noted that the SEIS does not specifically refer to the landing facility.
- **Commitments:** No specific commitments made in relation to this issue.

6.4.7.3 Assessment

Construction of the landing facility, its associated lay-down area and the pre-assembly yard would involve clearing vegetation from the sites. Rainfall and runoff from the sites during construction would need to be carefully managed to minimise soil erosion and water pollution, particularly of the marine environment adjacent to the landing facility. The AR considers that such risks could be adequately managed through good planning and implementation of site works by the contractors engaged to construct the facilities.

The AR concludes that surface water impacts associated with the construction of the facilities would be acceptable provided an Erosion and Sediment Control Plan (ESCP) is prepared that covers both sites.

Accordingly, the AR recommends a condition requiring BHPB to prepare and implement an Erosion and Sediment Control Plan as part of the CEMMP that covers:

- Minimising areas disturbed;
- Diverting rain landing upstream of the disturbed areas around the site;
- Installation and maintenance of erosion-control measures; and
- Progressive rehabilitation and stabilisation of disturbed areas.

It is unclear whether the lay-down area and pre-assembly yard would include additional features such as vehicle refuelling and storage, vehicle wash-down or chemical storage. In this regard, the AR supports the preparation of a Stormwater Management Plan which would need to specify appropriate mitigation measures for both facilities. The plan should also include the pre-assembly yard.

Design parameters for the plan were not identified in the FEIS, and the AR recommends they form part of an Operational Environmental Management and Monitoring Plan (OEMMP) for approval by the Indenture Minister, with the concurrence of the EPA that addresses stormwater management for both the proposed landing facility and pre-assembly yard to ensure management of surface water impacts.

The AR considers that surface water from both the landing facility and pre-assembly yard should be subject to BHPB preparing and implementing a CEMMP and OEMMP for the approval of the Indenture Minister, with the concurrence of the EPA that incorporated the requirement for an Erosion and Sediment Control Plans for the landing facility. A separate condition has also been recommended regarding the application of stormwater management measures for both facilities.

RECOMMENDATION

The AR considers the impacts from surface water drainage, during construction and operation of the landing facility and pre-assembly yard could be managed subject to compliance with the following condition:

- The landing facility and pre-assembly yard must include stormwater management measures that will ensure:
 - The quality of surface water drainage complies with the general obligations and associated water quality criteria contained in the SA *Environment Protection (Water Quality) Policy 2003* or as amended;
 - Surface water drainage off the site does not exceed pre development flow rates;
 - Rain falling upstream of the landing facility is diverted around the site.

6.4.8 Noise and vibration

6.4.8.1 Issues

Landing facility

Noise modelling undertaken for the DEIS for the proposed landing facility site found that the Flinders Power Playford and Northern coal-fired power stations were the only significant continuous noise sources in the Shack Rd region (DEIS Section 14.3.4). There were no training activities being conducted at the Australian Army's Cultana Training Area at the time so day-time noise levels at Shack Rd homes were dominated by waves breaking on the shore and occasional light vehicle traffic. At night, though noise from the power station was audible, particularly during coal-bin filling or dumping activities, background noise levels were relatively low at 41–46 dB L_{Aeq} .

The DEIS acknowledged that noise from the construction and operation of the proposed landing facility and pre-assembly yard would have to meet the provisions of the *Environment Protection (Noise) Policy 2007* (Noise EPP). The noise criteria adopted in the DEIS for the landing facility assumed the land would be rezoned from 'Coastal Settlement' to 'General Industry' under the Port Augusta (City) Development Plan. On this basis the DEIS applied a derivation of the noise criteria using the average of the General Industry and Rural Living Criteria, resulting in a noise criteria of 51/43/60 max (SEIS Section 15.3).

Results of the acoustic modelling undertaken by BHPB to assess noise generated at the proposed landing facility were presented in the DEIS Table 14.16. They showed the noise criteria (51/43/60 max) would likely be exceeded at homes up to 450m away during neutral weather conditions, and 750m away when there was a wind blowing from the direction of the landing facility. It was predicted that up to 13 homes would experience noise levels above the assessment criteria during day-time unloading activities, which were predicted to occur, on average, for three days every 11 days. As this was considered to represent a periodic and short-term non-compliance with applicable limits, the DEIS categorised the residual impact as moderate, requiring additional management attention during the detailed design phase. Of the 13 homes affected, BHPB bought the one closest to the proposed landing facility.

The AR does not consider re-zoning of the site would be necessary if the development was approved. Accordingly, the EPA subsequently advised BHPB that noise assessment should be undertaken against the more stringent noise criteria under the Noise EPP best matching the current Coastal Settlement Zone. In response, BHPB proposed alternative noise criteria in the SEIS to match the EPA's noise criteria of 47/40/60 max.

BHPB was asked to remodel the noise impact using the EPA's noise criteria to determine the number of coastal homes affected above the noise criteria and the mitigation measures required to meet the criteria. The SEIS (Section 15.3) stated that, regardless of the criteria used, 12 properties would remain affected by the operations of the landing facility in adverse weather without the application of mitigation measures. Noise would be audible beyond the 12 coastal homes but would comply with the EPA's noise criteria.

The revised modelling presented in the SEIS found that the more stringent EPA noise criteria could be met at all 12 affected residences if noise could be reduced by between 6-13dB (SEIS Table 15.3 and Appendix A7). BHPB has committed to apply noise-reduction measures to all landing facility equipment and infrastructure necessary to comply with EPA criteria 47/40/60 max. Management options would continue to be discussed with affected landholders, and other engineering options for noise mitigation would be investigated during detailed design. The SEIS included a number of potential design options and operational measures to achieve the required reduction in noise, including:

- Orientating the landing facility to minimise the number of properties affected;
- Noise barriers could be used to mitigate noise from activities proposed for the lay-down area;
- Using quieter underwater exhausts and additional engine-room acoustic insulation would help reduce noise from the barge engines and generators - the most significant noise source;
- Turning off barge engines during unloading;
- Quiet muffler systems for land-based vehicles; and
- Limiting operations at the facility to between 7am and 7pm to minimise noise at night for nearby residents.

Such measures would be investigated at the detailed design stage. Noise levels at and around the proposed landing facility would be monitored when the facility was operational to confirm the accuracy of the modelling and the effectiveness of the proposed noise-mitigation measures.

The SEIS stated that traditional noise-mitigation measure like installing double-glazing in nearby homes would provide little benefit as internal noise levels in the homes would not be expected to change significantly, and would not assist in compliance with the noise criteria because it is measured from outside of homes.

Depending on the type of construction of individual homes, recommended noise levels for sleep disturbance referred to in the *WHO Guidelines for Community Noise 1999* would likely be met at night. Predicted internal night time noise levels of 42 dB(A) at the nearest residence is less than the 45dB(A) assumed to provide protection from sleep disturbance in the WHO Guidelines.

Other typical noise-mitigation measures, such as noise shields or barriers, would not be suitable for mitigating noise travelling over water from barges as they would hinder the visual amenity of residents, including their sea views.

Pre-assembly yard

The major noise-generating activities at the proposed pre-assembly yard would include moving and securing over-dimension modules, prefabricating site plant and infrastructure, the use of cranes and forklifts, abrasive blasting and high-pressure washing (SEIS Section 15.4). There would be no on-site construction activity at night but it was expected there would be over-dimension vehicle movement at night-time (up until 10.00pm) to minimise disruption to normal daily traffic. Site traffic would comprise between four and eight commercial vehicle movements each day in addition to employee vehicle arrivals and departures.

As noise criteria could be exceeded for short periods at the home nearest the pre-assembly yard, BHPB has proposed establishing a program to monitor noise levels and, if necessary, implement noise mitigation measures such as erecting noise barriers or the relocating noise-generating activities to an area of the pre-assembly yard further away from homes.

The SEIS stated that no significant increase in vibration would be expected.

6.4.8.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 3.2:

- **Objective:** No adverse impacts on public health from noise emissions at the expanded operations.
- **Criteria:** Keep noise from the expanded operations at Olympic Dam to less than 30dBLAeq within residential dwellings.
- **Management plan:** Prepare a new Noise Management Plan.
- **Commitments:** No specific commitments made in relation to this issue.

6.4.8.3 Assessment

Landing facility

Without mitigation measures the noise from barges at the proposed landing facility would exceed the day-time criteria regulated under the Noise EPP by as much as 13 dB(A) at the nearest noise-sensitive receiver and to a lessening extent at the 12 closest shacks along the coastline to the south. The AR concurs that noise mitigation options are limited because of the need to protect residents' visual amenity, including views to the sea. Potential noise strategies which would not compromise visual amenity include noise barriers for land-based activities, underwater exhausts for barge engines, and quiet muffler systems for both barges and land-based vehicles.

Acoustic modelling undertaken for the SEIS found that barge engines would be the most significant noise source by 13 dB (SEIS Section 15.3). Reducing the noise from the barge by 13 dB compared with the modelled level would be sufficient to comply with the noise criteria under existing zoning for all noise sensitive receivers, under all weather conditions. It would also be unlikely that barge engines would continue to run once barges berthed.

The AR recognises the commitment by BHPB to meet the EPA noise criteria of 47/40/60 max, and considers that compliance with this criteria could be achieved through the installation of noise-reduction controls and appropriate operating procedures.

RECOMMENDATION

Accordingly, the AR recommends the following conditions in relation to the management of noise at the landing facility:

- Operations at the landing facility must not exceed the following noise criteria at any noise sensitive receivers:
 - $L_{Aeq, 15 \text{ minutes}} = 47 \text{ dB(A)}$ (day, 7am to 10pm)#
 - $L_{Aeq, 15 \text{ minutes}} = 40 \text{ dB(A)}$ (night, 10pm to 7am)#
 - $L_{Amax 15 \text{ minutes}} = 60 \text{ dB(a)}$ (night, 10pm-7am)

When measured and adjusted in accordance with the *Environment Protection (Noise) Policy 2007*.
- All noise-generating operations at the landing facility must not be undertaken between the hours of 7pm to 7am.

Pre-assembly yard

BHPB predicted compliance under the Noise EPP would be achieved at the proposed pre-assembly yard based on the initial noise assessment presented in the SEIS. However, Section 15.4 of the SEIS also stated there was uncertainty about exactly what activities would be undertaken at the site and, as such, the noise criteria might be exceeded in localised and short-term instances at the nearest noise-sensitive receivers.

RECOMMENDATION

The AR has recommended a condition requiring that detailed design of the pre-assembly yard complies with the relevant noise criteria under the Noise EPP, specifically:

- The pre-assembly yard in Port Augusta must be designed to ensure that noise generated from ongoing operations at the facility does not exceed 51 dB(A)_{Leq} between 7am to 10pm (day) and 43 dB(A)_{Leq} during 10pm-7am (night) at the nearest noise-sensitive receiver when measured and adjusted in accordance with the *Environment Protection (Noise) Policy 2007*.

The following note is also recommended for both the pre-assembly yard and landing facility:

- The applicant is reminded of its obligation to comply with the construction noise provisions contained in Part 6 Division 1 of the *Environment Protection (Noise) Policy 2007*. These requirements include restrictions on the noise levels that can be generated at certain times of the day and certain days of the week.

6.4.9 Visual amenity

6.4.9.1 Issues

Landing facility

The site of the proposed landing facility has scenic views east across Spencer Gulf to the Flinders Ranges, and in the west to the nearby hills and escarpments within the Cultana Training Area. Sections of low mangrove woodland occur in the more sheltered areas, and rocky foreshores and occasional dunes extend to the foothills. Coastal homes line the foreshore along Shack Rd. Prominent features in the landscape include the Playford and Northern Power Stations and associated transmission lines, located across the gulf to the north-east of the site of the landing facility, with the Flinders Ranges in the background. The lights of the power stations are visible in the evening (DEIS Section 20.3.6).

The visual impact of the landing facility was assessed in the FEIS as being from 'slight' to 'moderate' depending on the proximity of homes to the site. A photomontage of the visual effect of the proposed facility was shown in the DEIS as Plate R1.19 in Appendix R. Ships and barges were not included in the visual assessment of the landing facility as they were considered too transient to significantly influence the assessment outcomes. The DEIS concluded that views from coastal homes within 240m south of the proposed facility would be the most affected and could experience some loss of amenity associated with its construction and operation. However, the DEIS considered the visual affect of the proposed pier would be lessened by the visual prominence of the Playford and Northern Power Stations across the gulf.

To lessen the impact, the landing facility and associated lay-down area would operate only during daylight hours and lighting would be for security purposes only in the form of low-intensity directional lighting (SEIS Section 23.2).

BHPB has been in contact with the 12 directly affected coastal home owners south of the facility and would continue to work with them to address concerns associated with its construction and operation. BHPB would develop a comprehensive and coordinated community communication and engagement program to provide detailed information on short, medium and long-term activities associated with the construction and operation of the landing facility and access road.

Pre-assembly yard

A visual impact assessment of the pre-assembly yard was not assessed in the DEIS. However, the SEIS stated the site was located in the Industry Zone of the Port Augusta (City) Development Plan and more specifically in the Industry Zone Policy Area 4 – Transport, meaning the zoning contemplates uses such as that proposed by BHPB.

The site currently supports:

- A large hand-stand area of approximately 2500m²;
- A vehicle inspection building of approximately 545m²;
- A disused laboratory of approximately 200m² and other smaller maintenance/storage sheds and temporary office facilities; and
- Connections to utilities such as power, telecommunications, water and sewerage.

The facility was previously used by DTEI for vehicle inspections during the 1997 Olympic Dam expansion. One residential property is adjacent to the facility, and several others are nearby. The pre-assembly yard would be expected to have a slight impact for adjoining residences (SEIS Table 21.12).

6.4.9.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** No specific commitments made in relation to this issue.

6.4.9.3 Assessment

Landing facility

Although the DEIS did not provide specific design measures to minimise the visual impact of the proposed landing facility, the AR concludes there would be opportunities to lessen the visual impact, including selecting colours that harmonise with the surrounding landscape, installing screening devices, such as integrating mounding and vegetation and/or solid fencing, and using materials that blend with the natural environment and reduce reflectivity. The location of structures in relation to the southern boundary should also be considered in the final design of the site. Night lighting should be for security purposes only and would need to be contained within the lay-down area so as not to impact on adjacent coastal homes.

Pre-assembly yard

The AR considers the proposed pre-assembly yard would be an appropriate land use due to the industrial zoning of the site, as well as the existing transport-related infrastructure still in place from the last Olympic Dam expansion project in 1997.

RECOMMENDATION

The AR considers that the landing facility and pre-assembly yard would have an acceptable level of impact in terms of visual amenity and landscape quality provided the following recommended conditions were met:

- Final designs for the landing facility must be constructed in accordance with DEIS Figures 5.52 and 5.53.
- The proponent must prepare and implement a detailed Landscaping Plan that includes a 3m vegetated buffer along the southern and northern boundaries, using locally indigenous species. The plan must indicate the mature height and density of species used to screen the facility along the perimeter of the facility. The Landscaping Plan must be lodged with Indenture Minister for approval prior to the operation of the landing facility.
- All lighting required on the landing facility site must only illuminate the minimum areas required, through the use of low profile, directional lighting.
- Final designs for the Pre-Assembly Yard must be constructed in accordance with DEIS Figure 5.48 and the plan subsequently lodged by BHPB on 1 September 2011, entitled Port Augusta Pre-Assembly Yard.
- The proponent must prepare and implement a detailed Landscaping Plan that includes a 3m vegetated buffer along the eastern boundary, using locally indigenous species. The plan must indicate the mature height and density of species used to screen the facility along the perimeter of the pre-assembly yard. The Landscaping Plan must be lodged with Indenture Minister for approval prior to the operation of the pre-assembly yard.

6.4.10 Social impacts

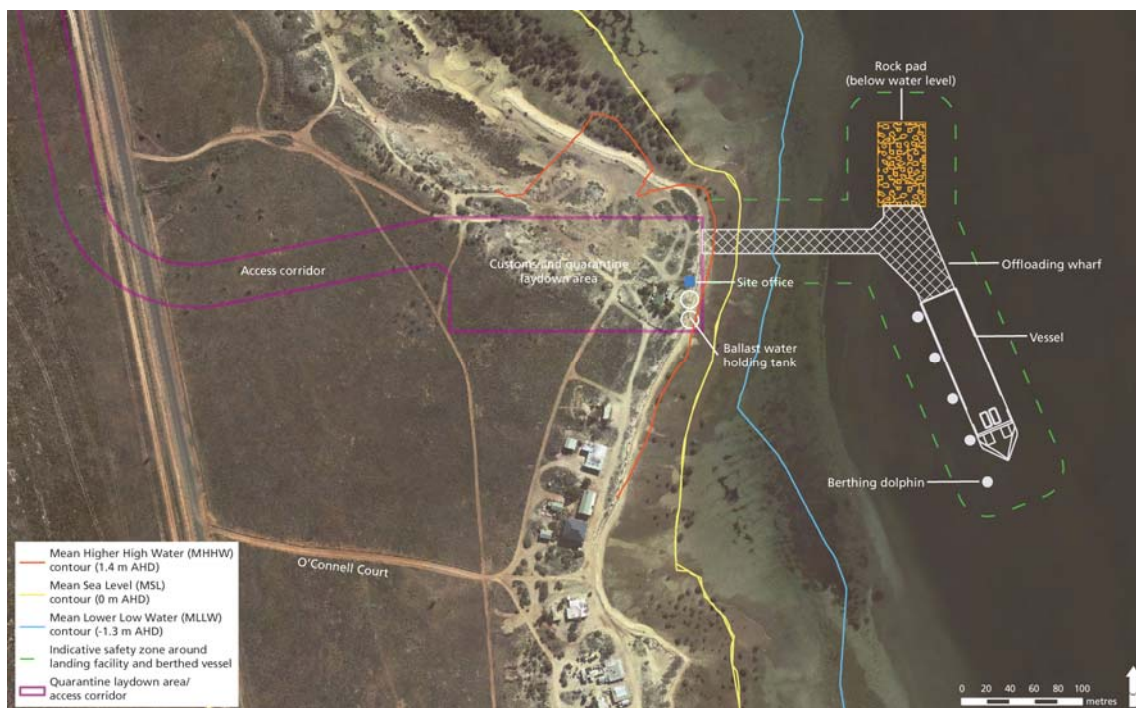
6.4.10.1 Issues

Social character and amenity

There are about 300 properties in the vicinity of the proposed landing facility, access road and pre-assembly yard. A third of these were occupied by about 250 people at the 2006 census (ABS 2007a). The DEIS stated that the potential social impacts for landholders around Port Augusta would include the loss of character and amenity, and the inconvenience and disturbance associated with the construction and operation of the facilities, including traffic delays resulting from the transporting of over-dimensional loads across public roads.

Although several site options were assessed, BHPB chose Snapper Point, north of O'Connell Court, because it had one of the lowest numbers of coastal homes nearby. Twelve properties are located within a 1km radius of the landing facility site (DEIS Plate 19.7 and Figure 19.18), and five are on or adjacent to the access road and pre-assembly yard. Residents expressed concern in submissions about the proposed landing facility's impacts on the character and ambience of the area and the local coastal environment.

BHPB has committed to ongoing consultation with coastal home owners, maritime users and other community stakeholders on the landing facility, including providing regular updates, such as advice on vessel movements, as detailed planning progresses. While there would be some minor limitations in the immediate vicinity of the landing facility to ensure public safety, there would be no restrictions on vessels travelling past the facility, accessing the coastline or moving into the channel (DEIS Section 19.5.6). SEIS Figure 5.16 identifies the indicative exclusion zone. Access to surrounding community and recreational facilities would not be affected by the landing facility or pre-assembly yard.



SEIS Figure 5.16 Layout of the proposed landing facility showing indicative exclusion zones

BHPB would develop and implement, in collaboration with government and other stakeholders, a Social Management Plan (SMP) with the aim of monitoring the impacts of the proposed expansion on Roxby Downs and communities in the northern region (including Port Augusta), and identifying areas for action.

Housing impacts

The construction workforce associated with the landing facility and pre-assembly yard would be accommodated in short-stay accommodation in Port Augusta.

6.4.10.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 5.1:

- **Objective:** Communities in which BHPB operates value our citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints addressed.
- **Management plan:** BHP would develop a Social Management Plan.
- **Commitments:**
 - BHPB would undertake a program of ongoing consultation with stakeholders would be undertaken to address community issues associated with the landing facility. The consultation would continue throughout the project construction, execution and decommissioning phases (SEIS Table 2.1 – Commitments, page 64).
 - BHPB does not propose to use the landing facility for any activities other than those described in the DEIS, nor does it propose to allow third parties to use this facility (SEIS Table 2.1 – Commitments, page 64).

6.4.10.3 Assessment

Social character and amenity

BHPB has undertaken consultation with local stakeholders well beyond the requirements of the *Development Act 1993*. The AR supports its ongoing approach to community engagement, as well as its commitment to monitor and manage social impacts through the preparation and implementation of a Social Management Plan (SMP), which would:

- Provide a mechanism for responding to social conditions;
- Measure the effectiveness of programs or initiatives in reducing adverse effects; and
- Identify new opportunities to maximise potential social benefit.

Even with these commitments, the AR concurs with the FEIS in that the community could experience some loss of character, amenity, inconvenience and disturbance, should the landing facility be approved.

RECOMMENDATION

The AR recommends that a time limit be placed on the operation of the landing facility, to coincide with the completion of the construction at the mine site - a maximum of 16 years. The AR further recommends that the use of the facility be restricted to importation of Olympic Dam expansion products and materials only, as described in the DEIS. At the end of the mine construction period the landing facility would be decommissioned and rehabilitated.

Accordingly, the following conditions have been recommended to manage impacts to residents:

- The proponent must cease operation of the landing facility at the end of the expansion construction period, or within 16 years of opening the landing facility (and associated access corridor), whichever occurs first. This condition is subject to variation on the proponent demonstrating to the government's satisfaction that the impacts to the local community can be managed in the longer term. Should this not be demonstrated, the infrastructure on land and the pier infrastructure located above low water mark must be removed and the site rehabilitated to the satisfaction of the Indenture Minister within one year of closure.
- The Landing Facility must be operated as an import only facility for the sole importation of materials and products associated with the Olympic Dam project.
- The Indenture Minister must be given 6 months notice before construction work commences at the landing facility.
- The Port Augusta City Council must be given 1 months notice, before the commencement of works, and shall be provided with the name and contact details of a person who shall be responsible for co-ordinating site works.

The recommended conditions envisage the landing facility would close at the end of the mine construction period, unless BHPB can demonstrate in the future to the Government's satisfaction that impacts to the local community can be managed in the longer term. This would require BHPB to seek approval under the *Development Act 1993* to vary the condition to operate the facility beyond 16 years.

Housing impacts

The AR considers the workforce required for both facilities would be absorbed by the existing rental market without any significant impact on the Port Augusta housing market. If additional accommodation was required, an adequate supply of residential zoned land is available under the Port Augusta (City) Development Plan to facilitate private development.

It is envisaged that BHPB would help workers get suitable accommodation. The AR considers that construction and operation of the landing facility and pre-assembly yard would have little to no impact on overall housing availability in Port Augusta, given the relatively small size of the workforce, availability of accommodation and appropriately zoned residential land. Accordingly, no conditions have been recommended.

6.4.11 Waste management

6.4.11.1 Issues

No details were provided in the FEIS on how wastewater from the landing facility site would be treated. It is assumed it would likely be managed via an on-site wastewater management system that would cater for the 100 construction workers and 30 operational staff. As the workforce would be accommodated in Port Augusta, the volume of domestic wastewater to be treated and disposed of at the landing facility site would be relatively low.

The SEIS stated that the pre-assembly yard site was already connected to the sewerage system.

6.4.11.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.6:

- **Objective:** Minimise general waste generated by BHPB's expansion activities and maximise reuse of general waste where practicable.
- **Criteria:** Increase the proportion of general waste reuse/recycling.
- **Commitments:** No specific commitments made in relation to this issue.

6.4.11.3 Assessment

Any onsite wastewater management system would need to comply with the SA on-site wastewater treatment system standards to ensure appropriate protection of public and environmental health.

RECOMMENDATION

The following note is recommended:

- Any on-site wastewater management system at the landing facility must be approved by the relevant authority in accordance with the requirements of the SA *Waste Control Regulations 2010* or equivalent regulatory requirements at the time of application.

6.4.12 Traffic and access

6.4.12.1 Issues

The FEIS said the proposed landing facility would help improve the safety and efficiency of the public road network by enabling large pre-assembled modules to be transported by sea to Port Augusta instead of them travelling long distances on over-sized vehicles by road.

Traffic and access issues associated with the proposed landing facility and pre-assembly yard have been addressed in this AR in Chapter 11: 'Road transport'. Detailed access arrangements for the two facilities, and any road upgrades, would require further approval from DTEI. The SEIS said most of the 50-100 workers at the pre-assembly yard would arrive and depart by private vehicle and a Traffic Management Plan would be developed for the site, as part of the CEMMP.

6.4.12.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** BHPB would provide for the safe and efficient movement of materials and goods (SEIS Table 2.1 – Commitments, page 62) by:
 - Installing a landing facility south of Port Augusta to handle pre-assemblies; and
 - Not transporting pre-assembled modules on the public road network between the landing facility and the pre-assembly yard in north-west Port Augusta.

6.4.12.3 Assessment

The AR supports the proposal to develop a landing facility at Port Augusta to receive large modules and equipment as a means of reducing impacts to the public road network. Moving the equipment from Port Augusta would significantly reduce the distance these large loads (over 5.5m) would have to travel if they were transported from Port Adelaide or other established ports.

The AR recommends that the material imported through the landing facility must be transported via the dedicated access road to ensure impacts to the local road network are minimised.

RECOMMENDATION

Accordingly, to ensure the least impact on the road system the AR recommends the following conditions of approval:

- Construction of the landing facility must be:
 - Substantially commenced within ten years of this approval, otherwise the approval given in this notice for the component of the Olympic Dam Expansion would lapse; or
 - In time for the movement of large pre-assembled modules required for the metallurgical plant, whichever occurred first.
- The proponent must comply with the relevant DTEI standards for the access arrangements to and from the landing facility and pre-assembly yard, with all costs being the responsibility of the proponent.
- Material imported on vessels/barges must not be transported from the landing facility to the pre-assembly yard until the dedicated access road was operational.

It is also recommended that a condition be imposed requiring the preparation and implementation of a Traffic Management Plan as part of the CEMMP.

6.4.13 Rehabilitation and decommissioning

6.4.13.1 Issues

BHPB has stated it would use the landing facility in the construction phase of the Olympic Dam mine expansion and sporadically during the operation of the mine for the movement of materials associated with maintenance and shut-downs as required.

The SEIS Section 28.2.1 stated that the future use of the landing facility following the scheduled mine closure had not been decided. Options proposed included it being used by other mining operations or enterprises, or transferring ownership to the South Australian Government or other entity for public use.

If future use of the landing facility was not considered appropriate it would be decommissioned and rehabilitated (SEIS, section 28.2.1). The concrete decking would be removed but buried structures such as the concrete piles and underwater rock pad would be retained to avoid damage to the marine environment, as is considered standard practice. Buildings associated with the quarantine lay-down area would be removed. When the site was decommissioned it would require no further management or maintenance.

6.4.13.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:**
 - BHPB would update the existing Rehabilitation and Closure Plan for Olympic Dam when it had completed the detailed design phase of the proposed expansion project.
 - BHPB would continue to consult and engage with relevant government departments and other stakeholders to further develop and refine closure criteria, including final land uses, rehabilitation, management and ongoing monitoring. The plan would be reviewed annually and updated if required (SEIS table 2.1 – Commitments, page 57).

6.4.13.3 Assessment

With the potential for ongoing social impacts for the local community, the AR recommends that approval for the landing facility be given on a temporary basis only, sufficient to support the construction phase of the mine - up to 16 years. It is recommended as a condition of approval that the landing facility would be closed and rehabilitated at the completion of the mine-expansion construction phase unless the proponent could demonstrate that the impact on neighbours could be managed.

The AR considers that the use of the pre-assembly yard beyond the mine expansion construction phase would be reasonable to manage ongoing transport requirements of the mine operation. The proposed long-term use of the site would be in keeping with its industrial zoning and is considered an appropriate permanent use. It is considered appropriate the pre-assembly be addressed in the Mine Closure and Rehabilitation Plan, to be dealt with at the completion of the mine's life.

6.5 Conclusion

This AR concludes that while the community could be expected to experience some loss of character and amenity, and some inconvenience and disturbance from the construction and operation of the proposed landing facility, the measures proposed in the FEIS and recommended conditions outlined in this AR would be sufficient to manage these concerns.

One of the recommendations is that the facility be operated for a set period of time for the construction phase of the mine (being a maximum of 16 years from the opening of the facility), unless BHPB can demonstrate in the future to the Government's satisfaction that impacts to the local community could be managed in the longer term. Further, the operation of the facility would be restricted to the import of materials to support the Olympic Dam project.

The AR supports the proposed transporting of large construction modules and equipment by sea to Port Augusta instead of by road as it would maintain the safety and efficiency of the public road network between Adelaide and Port Augusta. It recommends as a condition of approval that the landing facility must have substantially commenced within 10 years of the approval, or be operational in time for the movement of large pre-assembled modules required for the metallurgical plant, whichever occurred first.

Noise and vibration impacts, along with air-quality issues, would be managed by compliance with the Environment Protection Act 1993 and the NEPM for Air Quality, as outlined in the conditions and notes to BHPB. Specifically, the landing facility would only operate during the hours of 7.00am – 7.00pm, with no night time noise generating activity permitted.

Marine and terrestrial environment impacts would be managed by compliance with strict environmental safeguards already in place, with BHPB's commitments, and with conditions recommended in this AR, including BHPB preparing and implementing a Construction Environmental Management and Monitoring Plan (CEMMP) and an Operational Environmental Management and Monitoring Plan (OEMMP) for the landing facility, for approval by the EPA.

6.5.1 Summary of recommendations

Recommendations have been made in this chapter that require the CEMMP and OEMMP to address a number of issues. These have been collated in the following two recommended conditions:

All works and site activities must be undertaken in accordance with a Construction Environmental Management and Monitoring Plan (CEMMP) to be approved by the Indenture Minister with the concurrence of the EPA prior to the commencement of construction activities for the landing facility. The CEMMP must, as a minimum, address the following:

- Measures to address air quality, including management of dust issues at the quarantine lay down and hard stand areas, and access corridor;
- Preparation and implementation of an Erosion and Sediment Control Plan, which includes the following measures as a minimum:
 - Minimising areas disturbed;
 - Rainfall landing upstream of the disturbed areas to be diverted around the site;
 - Installation and maintenance of erosion control measures; and
 - Progressive rehabilitation and stabilisation of disturbed areas.
- Preparation and implementation of an Acid Sulphate Soils (ASS) Management Plan, should additional investigations identify it as being necessary.

- Identify and address:
 - known and potential noise and vibration impacts; and
 - known and potential marine impact issues including:
 - Turbidity management;
 - Underwater noise; and
 - Management of marine pests.
- Preparation and implementation of a Traffic Management Plan.

Operations at and in the vicinity of the landing facility must be undertaken in accordance with an Operational Environmental Management and Monitoring Plan (OEMMP) to be approved by the Indenture Minister with the concurrence of the EPA prior to commencing operation of the landing facility, lay-down yard and pre-assembly yard. The OEMMP must, as a minimum, address the following:

- Measures to address air quality, including management of dust issues at the quarantine lay down and hard stand areas, and access corridor;
- Identify and address:
 - Known and potential noise and vibration impacts, particularly under worst case operating and meteorological conditions; and
 - A Marine Pest Management Plan to address the management of marine pests at the landing facility (and in neighbouring marine waters).

In summary, the AR concludes that the potential impacts from the development of the landing facility and pre-assembly yard are manageable and acceptable, subject to compliance with State and Australian legislative requirements, commitments made in the FEIS and the recommended conditions outlined in this chapter.

Chapter 7

Hiltaba Village and airport



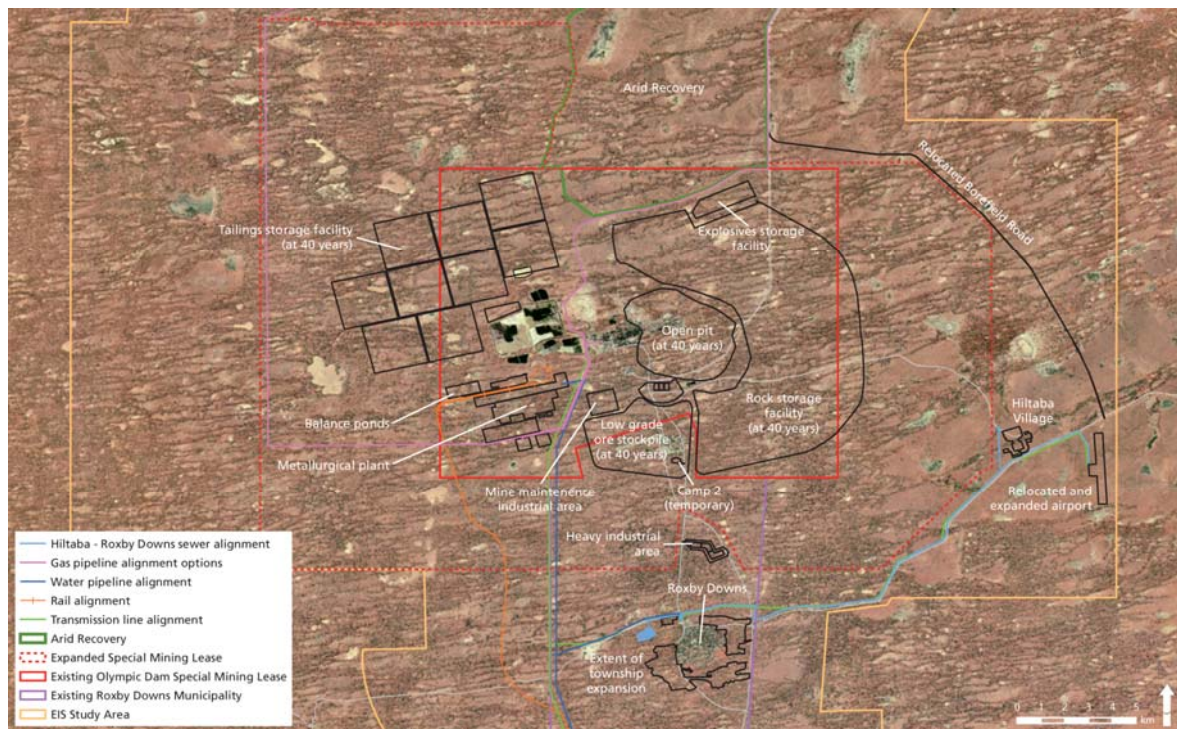
Chapter 7: Hiltaba Village and airport

7.1 General

The proposed new airport and worker accommodation village, named Hiltaba Village, would be located 17km north-east of Roxby Downs on Andamooka Rd, in the Far North region of South Australia. The airport and village sites would be 1km apart.

7.1.1 Site and locality

The facilities would be 12km from the centre of the open pit at Olympic Dam and 5km from the south-eastern edge of the Rock Storage Facility (RSF). There is no infrastructure in the area which was defined in the Draft Environmental Impact Statement (DEIS) as containing sparse, low and open shrubland, with expansive and distant views. The nearest settlements are Roxby Downs and Andamooka 17km away. The location relative to the mine and Roxby Downs is shown in DEIS Figure 5.5.



DEIS Figure 5.5 Major components of the proposed expansion around Olympic Dam

The land and its immediate surrounds are currently farmed, predominantly running cattle and harvesting kangaroos for human consumption on the Andamooka pastoral lease held by BHP Billiton Olympic Dam Corporation Pty Ltd (BHPB). The airport and Hiltaba Village would occupy about 105 hectares (ha) and 60ha respectively, about 0.06 per cent of the Andamooka pastoral lease. The facilities would be located outside the expanded Special Mining Lease (SML).

7.1.2 Existing environment

The existing environment of the area planned for development is described in this Assessment Report (AR) in Chapter 13: 'Effects on the environment'. The general environment of the proposed expansion of the Olympic Dam mining operation is common to the various project components and the descriptions are provided in Chapter 13 only to avoid repetition.

7.2 Project description – key elements

7.2.1 Hiltaba Village

BHPB considered 14 potential sites for the worker village - to the north, south and east of Roxby Downs and more than 5km from the town. The preferred location as outlined in the DEIS was chosen because it would:

- Reduce social impacts on the nearby townships of Roxby Downs and Andamooka;
- Lessen the likelihood of dust and noise impacts from the proposed open pit mine;
- Minimise impacts on heritage and native vegetation; and
- Be close to the new airport which a significant proportion of its resident workers would arrive and depart from.

The concept plan for Hiltaba Village provides for up to 8000 single bedrooms with en-suites, as well as a limited amount of accommodation for couples (DEIS Figure 5.58). The accommodation would be provided on a motel-style basis and residents would have to remove their belongings on vacating the village at the end of their shifts. Hiltaba could accommodate up to 10,000 live-in workers but it is unlikely this number would be required.



DEIS Figure 5.58 Conceptual layout of Hiltaba Village

It would accommodate the pioneer construction workforce and workers relocated from Olympic Village and Camp 2 when those facilities were decommissioned and, ultimately, covered by the Rock Storage Facility (RSF).

BHPB would develop the village in stages, adding modular precincts with amenities and facilities for about 2000 workers each year. It would also be decommissioned in stages, from years seven to 11 of the mine expansion construction phase, as the workforce declined after peak construction activity. It could be recommissioned as required, and it is expected that accommodation for around 2000 workers would be retained in the longer-term. In the event the facilities were no longer needed for accommodation they could be adapted for other uses or, if the village was decommissioned, the site could be rehabilitated and revert to pastoral land.

The concept plan for Hiltaba Village has been designed to create an urban village around a main street rather than a traditional mining camp. Facilities proposed include swimming pools, dining hall, security, first-aid facilities, taverns, gymnasiums, internet cafes, indoor and outdoor sporting areas, retail outlets, running track and passive outdoor recreation areas. A commuter bus service linking the village, airport and main work sites would operate during construction and operation of the expanded mine. The Supplementary Environmental Impact Statement (SEIS) proposed that a single facility-management contractor would be engaged to manage all aspects of the village for BHPB, including tavern and retail opportunities, buses and personal logistics. This is in line with standard industry practice and the existing Olympic Dam operations.

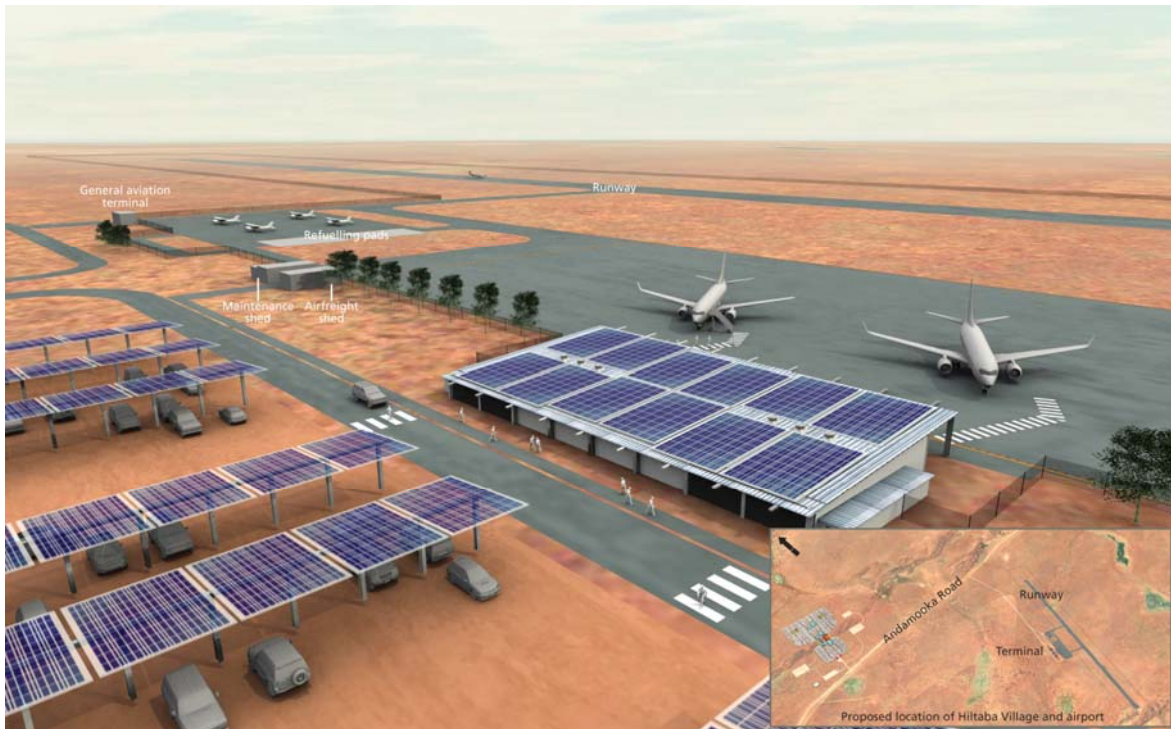
A qualified paramedic would be available 24 hours a day, seven days a week, to attend to medical incidents at Hiltaba Village, with only serious medical emergencies being referred to Roxby Downs Hospital. The facility manager would also provide a first response to all medical and fire emergencies, and the induction process for workers would include instruction in emergency response and evacuation procedures to support employee safety.

BHPB would begin construction of the village immediately the proposed Olympic Dam mine expansion was approved. It would establish a pioneer workforce camp at the village site to accommodate workers constructing the village, town infrastructure and preliminary work on the Special Mining Lease (SML). A temporary 250-bed accommodation facility, named Camp 2, has also been proposed for south of Charlton Rd, Roxby Downs, which would be used by pre-strip contractors for a two to three years until Hiltaba Village was ready for occupation (refer Chapter 8: 'Roxby Downs township').

7.2.2 Airport

BHPB has sought approval to develop a new airport on a site about 1km from the proposed Hiltaba Village site to service a larger workforce than the existing airport at Olympic Dam, including a larger proportion of 'fly-in and fly-out' workers from other centres. A new airport is essential as, ultimately, the expanded mine would absorb the existing facility. Rehabilitation of the old airport would be limited to removing major infrastructure as the site and runway would eventually be covered up by the Rock Storage Facility (RSF).

The metal-clad terminal would occupy about 2ha. It would have seating for 150 people and include check-in desks, baggage collection and security screening areas, and car rental services. A proposed 230 parking bays would be provided at the new airport (DEIS Figures 5.54) which has been designed to withstand a 100-year Average Recurrence Interval (ARI) rain event (1-in-100-year downpour).



DEIS Figure 5.54 Conceptual layout of the proposed airport

The concept design is for an all-weather runway 2.4km long and 45-105m wide, running north-south in line with prevailing winds. It would accommodate aircraft up to Code 4C class, such as the Boeing 737-800 and Airbus A320, each with a seating capacity for up to 170. The existing runway is orientated east-west and is exposed to strong cross winds that result in flights being interrupted and diverted and limiting the runway to aircraft with a maximum capacity of 56 passengers.

The proposed airport would support both day and night flights on domestic routes only. The Adelaide Airport's curfew between 11pm and 6am would constrain flight times but flights from other airports could be more flexible. Flight schedules and compliance are yet to be determined. Airport security falls within the Australian Government's jurisdiction and the airport operator would be required to comply with the *Aviation Transport Security Act 2004 (Cwlth)* and/or regulations at the time of operation.

There would be no control tower at the new airport, and the existing Olympic Dam Common Traffic Advisory Frequency (CTAF) procedures would apply within five nautical miles of the airport. The Melbourne Flight Support Service would direct flights outside of the CTAF.

A full array of runway/taxiway lighting, illuminated wind indicators, apron and obstruction lighting would be installed for night flights. The DEIS stated that the physical dimensions of the runway, aprons and the terminal building would comply with the Civil Aviation Safety Authority (CASA) Manual of Standards 139 – Aerodromes.

7.2.3 Construction and operation

In the context of the proposed mine expansion project, the infrastructure needed to service the new airport and Hiltaba Village would be comparatively insignificant.

EXPANSION RESOURCE REQUIREMENTS	AIRPORT	HILTABA
Water demand during construction (ML)	20	300
Water demand during operation (ML/d)	0.6	2
Electricity consumption during construction	Negligible	Negligible
Electricity consumption during operation (Annual consumption GWh)	4	35
Peak construction workforce	50	300
Ongoing operational workforce	10	120
Total land disturbance (ha)	160 (combined)	

The development of the airport and village combined would require 320ML of low-grade water for construction, to be sourced from local groundwater wells, and 2.6ML of potable water during operation, to be supplied via an underground pipeline from Roxby Downs. There would be sufficient capacity for fire safety needs. Depending on the timing of construction of the village and the airport, workers would be accommodated in either the first stage of Hiltaba Village or the existing Olympic Village.

Services for the airport and village, including electricity, optical-fibre cable, water and sewerage, would be supplied via a 25km long and 10m wide service corridor from Roxby Downs. All services would be installed within of the existing road corridor and, apart from the electricity transmission line, would be buried underground. The electricity towers would require about 5ha of land.

BHPB proposes to clear 160ha of vegetation to accommodate the airport and Hiltaba Village. It would seek freehold title over the sites by excising the land from its Andamooka pastoral lease in accordance with applicable laws.

The bulk of the estimated electricity demand for the airport could be met through the use of renewable energy, such as solar panels on the terminal roof, with the balance reticulated from Roxby Downs. BHPB has investigated opportunities for renewable electricity technologies at both Hiltaba Village and the airport, including installing solar hot-water systems on the 2000 permanently occupied accommodation buildings. Wastewater would be treated and used on-site for landscaping plantings in the short-term until it could be piped to an upgraded and expanded wastewater treatment plant at Roxby Downs. Solid waste would go to the Roxby Downs waste-management facility.

7.2.4 Roxby Downs and Environs Development Plan Amendment process

In a separate, but complementary process to the EIS, the Roxby Downs and Environs Development Plan Amendment (DPA) has proposed amendments to land-use policies and zoning in the Land Not Within a Council Area – Eyre, Far North, Riverland and Whyalla Development Plan to establish complementary zoning and policies for the proposed Hiltaba Village and the airport developments. Should this occur, future approvals on the sites could be managed directly by the Development Assessment Commission (DAC), as the regulatory authority for development outside of council areas (should the Major Development Declaration be revoked over the sites).

7.3 Summary of submissions

7.3.1 Public submissions

Issues raised through public submissions received on the proposed new airport and Hiltaba Village are summarised as follows:

- Residential accommodation at the village should be greenhouse-neutral. BHPB should commit to a target of renewable energy use, green dwellings and improved building efficiency exceeding the Building Code of Australia (BCA) 2008.
- BHPB should commit to providing a public bus service between Roxby Downs and the village.
- Concern about delays and safety along Andamooka Rd from the construction and operation of the airport and village.
- Roxby Downs Council said the location of the worker's village remote from Roxby Downs was not sufficiently justified. The council said many of the arguments cited that supported segregated camp sites were predominately based on studies involving mines with shorter life spans in locations where the socio-economic and educational gap between the local populations and mining staff were significant, or without established infrastructure to monitor and regulate law and order. For these reasons, it considered there was merit in BHPB exploring alternative locations closer to the southern boundaries of the township.
- Contrary views supported locating the village outside of the town.
- Insufficient consideration was given to community engagement, building a sense of community and providing community-based social and sporting facilities and activities for residents of Hiltaba Village, and the likely impact on Roxby Downs.

7.3.2 SA Government submission

The SA Government submitted that accommodation should be designed for comfort and energy efficiency to at least a 6-Star rating, exceeding the energy efficiency requirements of the BCA.

Additional information required by the State Government in its submission included:

- Noise impacts on the public health of Hiltaba Village residents;
- Air quality impacts on the public health of residents;
- Potential traffic on the public road network;
- Additional information on the timing of air movements, passenger movements and volume and frequency of flights for 737 aircraft to assist in the planning of emergency service requirements;
- Further detail on the scale of the proposed implementation of solar hot-water and solar panels.

7.4 Key environmental, social and economic issues

The key environmental impacts associated with the developments include:

- Air quality;
- Terrestrial impacts;
- Fire management;
- Surface water;
- Noise and vibration;
- Waste management;
- Traffic and access;
- Greenhouse gases and sustainability;
- Social impacts;
- Visual amenity and landscape character; and
- Rehabilitation and decommissioning.

7.4.1 Air quality

Air-quality issues for the proposed village and airport developments mainly stem from the activities proposed at the mine site. These impacts are addressed in this AR in Chapter 4: 'Mining operations and processing'.

7.4.2 Terrestrial impacts

Terrestrial impacts for the two facilities are largely the same as the impacts from the proposed mine expansion and associated expansion of Roxby Downs. Rather than this information being repeated across multiple chapters it has been consolidated in 13: Effects on the environment.

7.4.3 Fire management

7.4.3.1 Issues

While the DEIS did not include specific details on hazard management for the two facilities it stated that BHPB would complete a 'fire study' for the village under its Risk Management Design Guidelines to assess the risks, and recommend controls for prevention and mitigation. This would be undertaken in the early detailed engineering design of the village, including the provision of a monitored fire-alarm system as required under the Building Code of Australia (BCA).

BHPB proposed that the contractors responsible for managing Hiltaba Village would provide an induction program for residents on emergency procedures proposed, and provide a first response to all emergencies.

7.4.3.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided in relation to this issue.
- **Commitments:** No specific commitments made in relation to this issue.

7.4.3.3 Assessment

The AR concludes that planning for, and responding to, emergency situations at both Hiltaba Village and the airport could be appropriately managed providing Emergency Services were involved in planning and risk management, including the preparation and implementation of the proposed fire study. The facilities would also have to comply with the relevant standards/legislation regarding emergency response and equipment/systems.

RECOMMENDATION

The AR considers the potential fire hazard at the two facilities could be managed through compliance with legislation and standards, including the *Development Act 1993* and the BCA, as well as the undertaking by BHPB to prepare a fire study. Accordingly the following condition is recommended:

- The BHPB must prepare and implement a Fire Study for Hiltaba Village and the airport that must address (as a minimum) the following matters:
 - The ability of Hiltaba Village management to provide adequate first response to emergency incidents (Fire, Rescue, Hazmat);
 - The structure and resources that BHPB (or its contractors) would have, including suitable appliances to deal with the size of the aircraft, as well as details of staff training and numbers;
 - The appropriate rescue capacity in case of an aircraft crash;
 - Supply of fire fighting foam, foam delivery systems and appliances;
 - Adequate water supplies; and
 - Details of compliance with the Building Code of Australia in relation to installing fire alarm systems and residential sprinklers throughout Hiltaba Village.

The Fire Study must be lodged with the Indenture Minister for approval prior to the operation of the airport and Hiltaba Village.

7.4.4 Surface water

7.4.4.1 Issues

Given that built infrastructure associated with the new airport would take up just 2ha, it is not expected the proposal would have any significant effect on catchments and stormwater flows. The development of Hiltaba Village, however, would result in changes to stormwater flows from the significant increase in impervious surfaces that would occur, particularly in an area currently devoid of infrastructure.

The village site would be graded to define five drainage catchments and rainfall would be directed by drainage pipes to shallow swales that would line the internal roads and pathways (DEIS Section 11.5.1). The swales would be big enough to manage a five-year (ARI) downpour of rain and designed to spill over onto the internal road network to carry stormwater in the event of larger downpours up to a 100-year (ARI) event. Stormwater runoff would be directed to two storage basins located immediately north and south of the village. If the northern basin overflowed, stormwater would flow to an existing stock dam further to the north. The layout of the village and associated stormwater catchments, drainage lines and stormwater storage basin was shown in the DEIS Figure 11.6. Stormwater from the village would be reused wherever practicable (DEIS Section 11.5.1).

7.4.4.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.4:

- **Objective:** No significant adverse impacts to environmental receptors as a result of stormwater discharges to soil, surface water or groundwater associated with BHPB's expansion activities.
- **Criteria:** All stormwater maintained within designated stormwater management areas.
- **Management plan:** BHPB would develop a Stormwater Management Plan (SMP) for the construction and operation of the proposed expansion.
- **Commitments:** No specific commitments provided in relation to this issue.

7.4.4.3 Assessment

The AR considers that stormwater can be managed at both the proposed airport and village sites provided the design measures outlined in the DEIS Section 11.5.1 are adopted. However, rather than allowing stormwater captured in the stormwater basins to dissipate by infiltration and evaporation, it is recommended that BHPB should establish a reuse system for irrigating stormwater onto gardens and other green areas around the village. This would not only make the village more attractive for residents but could also reduce dust levels in the settlement. It is recommended that further consideration of options to maximise stormwater reuse in the village be addressed in the detailed-design stage.

RECOMMENDATION

The AR considers that appropriate measures have been proposed to manage stormwater at Hiltaba Village subject to compliance with the following condition:

- Apart from storm events that cause local flooding, runoff into the proposed northern and southern stormwater storage basins at Hiltaba Village (as shown on DEIS Figure 11.6) must be reused, and in particular must be reused to reduce dust levels and to irrigate landscaped areas around the village.

7.4.5 Noise and vibration

7.4.5.1 Issues

Airport noise impacts on Hiltaba Village and Roxby Downs

Low background noise, varying between 31dB(A)_{Leq} and 42dB(A)_{Leq} is experienced at the proposed airport and village sites, with occasional noise from passing traffic on Andamooka Rd and noise from the Olympic Dam operation.

The DEIS stated that the new airport would likely schedule both day and night flights, in compliance with curfew times as they applied at the airports involved. As the site boundaries of Hiltaba Village and the airport would only be approximately 1km apart, noise levels would increase substantially above current background levels.

Design considerations that would help reduce noise included orientating the airport runway north-south in alignment with prevailing winds, and avoiding flight paths over Hiltaba Village and Roxby Downs.

Though there is no legislative criteria for aircraft noise in South Australia, the requirements of Australian Standard AS 2021:2000 (Acoustics – Aircraft Noise Intrusion – Building, Siting and Construction) should apply. This standard specifies that maximum indoor noise levels caused by aircraft should not exceed 50dB(A), on the basis a building structure reduces noise by 15dB.

Accordingly, this figure converts to a maximum allowable external noise level of 65dB(A). The 65dB(A)_{L_{Amax}} noise contour around the airport (being how far away noise at 65dB(A)_{L_{Amax}} would be heard) was shown in DEIS Figure 14.6.

This figure indicated the Hiltaba Village accommodation units would be located approximately 2km beyond the predicted noise contour. The modelling indicated that noise levels at Hiltaba Village and Roxby Downs would comply with the agreed noise criteria (Australian Standard AS 2021:2000) if the facility was sited appropriately and the accommodation units were constructed of materials that reduced internal noise levels (SEIS Section 15.1). The DEIS concluded that noise impacts at Roxby Downs would be less than existing conditions as the airport would be further away flight paths would be realigned to avoid the town.

Mining noise impacts on Hiltaba Village

Potential noise impacts on Hiltaba Village from mining activities, including processing, have been assessed in this AR in Chapter 4: 'Mining operations and processing'.

7.4.5.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 3.2:

- **Objective:** No adverse impacts to public health as a result of noise emissions from BHPB's expanded operations.
- **Criteria:** Not applicable to Hiltaba Village and the airport.
- **Commitments:** BHPB would maintain levels generated from the expanded mining and processing operations to below 45dB at the exterior of residential dwellings in Hiltaba Village (SEIS Table 2.1 – Commitments).

7.4.5.3 Assessment

In the absence of any legislative criteria for aircraft noise in South Australia, the AR supports the use of 65dB(A)_{L_{Amax}} as an appropriate external noise limit for sensitive receivers near the proposed airport.

The AR concludes that aircraft noise from the proposed new airport would not cause excessive noise levels for workers at Hiltaba Village as:

- The village would be located about 3km west of the proposed airport – 2km beyond the predicted 65dB(A)_{L_{Amax}} noise contour – and outside the flight path; and
- BHPB develop accommodation units that would reduce external noise levels by between 24 and 30dB with windows closed (SEIS Section 15.1), which would further reduce internal noise from aircraft.

In addition, the AR acknowledges that the new airport would reduce aircraft noise in Roxby Downs from the levels generated by the existing airport operation. This is supported by the AR.

RECOMMENDATION

The AR considers that appropriate measures have been proposed to manage noise impacts from the airport on Hiltaba Village and Roxby Downs, subject to the following recommended condition:

- Accommodation units at Hiltaba Village must be designed and constructed so that external noise sources do not exceed 30dB(A) when measured within sleeping areas at all times of the day when windows are closed.

7.4.6 Waste management

7.4.6.1 Issues

Solid waste from Hiltaba Village and the new airport would go to the Roxby Downs waste-management facility, and a new pipeline would take wastewater to the Roxby Downs wastewater treatment plant which would be upgraded and expanded to manage the increased volume of waste. Any wastewater generated at the village and airport before the completion of the pipeline would be treated and disposed of on-site (DEIS).

Roxby Downs Council already has approval for the proposed expansion of the wastewater treatment facility.

7.4.6.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.6:

- **Objective:** Minimise general waste generated by BHPB's expansion activities and maximise reuse of general waste, where practicable.
- **Criteria:** Increase the proportion of general waste reuse/recycling.
- **Commitments:** No specific commitments made in relation to this issue.

7.4.6.3 Assessment

Solid waste

The AR considers that the proposed disposal of solid waste, including building waste, from Hiltaba Village at the Roxby Downs waste-management facility is an acceptable strategy. However, BHPB should engage early with Roxby Downs Council on this to ensure landfill space was available and cell design and construction were suitable. BHPB should also seek to apply the waste management hierarchy by promoting waste avoidance, reduction, recycling, and recovery at Hiltaba Village ahead of waste treatment /disposal at the facility. Such an approach would be in line with the waste management objective contained in the *South Australian Environment Protection (Waste to Resources) Policy 2010*.

Wastewater

As the proposed Hiltaba Village could be used to accommodate up to 10,000 people during the peak construction phase, it would generate a large volume of wastewater - up to 1.4ML/d that would require managing to avoid adverse health and/or environmental impacts. The AR concludes that the proposed pumping of wastewater from the village to the Roxby Downs wastewater treatment plant is acceptable, particularly as:

- A separate development application by Roxby Downs Council for expansion of the township wastewater treatment facility has already been approved; and
- Treated effluent from the expanded treatment plant would be reclaimed for reuse to reduce the demand on the potable water supply.

Any interim arrangement to manage wastewater on-site while the pipeline to the Roxby Downs wastewater treatment facility was being built would need to comply with State on-site wastewater treatment system standards to ensure public and environmental health were protected.

RECOMMENDATION

The AR considers the methods proposed in the DEIS for the storage and disposal of solid wastes and wastewater are acceptable, subject to compliance with the recommendation that any temporary or longer-term treatment and disposal of wastewater from Hiltaba Village for landscaping purposes would require the provision of further information and a separate approval from the SA Department of Health and SA Environment Protection Authority (EPA). The following notes are recommended:

- If treatment and disposal of wastewater is proposed to take place at Hiltaba Village, approval would need to be given by the Department of Health and EPA and the following details would need to be contained in any application:
 - Maximum design capacity of the treatment plant;
 - Type of wastewater treatment plant to be used;
 - Standard of treatment to be achieved;
 - Where and how treated wastewater would occur; and
 - Schematic plans showing location and design of the proposed treatment plant and reuse areas including pipe work layout.
- The proponent should engage early with the Municipal Council of Roxby Downs about the disposal of solid waste to the council's waste management facility to ensure the availability of landfill space and the suitability of cell design and construction.
- In order to achieve the waste management objective contained in the SA *Environment Protection (Waste to Resources) Policy 2010* solid wastes generated at the Hiltaba Village and the airport should be managed according to the waste management hierarchy by promoting waste avoidance, reduction, recycling, recovery ahead of waste treatment and/or disposal to the Roxby Downs landfill facility.

7.4.7 Traffic and access

7.4.7.1 Issues

BHPB would establish a commuter bus service between Hiltaba Village, the new airport and main work sites during both construction and operation of the proposed Olympic Dam mine expansion project (DEIS). It would also build a new dedicated eastern access road from the village to the mine (SEIS). It is expected these measures would minimise the traffic associated with shift change-over at the worksites. A bus park and three car-parking areas have been planned for outside the perimeter of Hiltaba Village (DEIS Figure 5.58). However, BHPB does not intend to provide a bus service between the village and Roxby Downs or Andamooka. Its aim would be to encourage workers to remain at Hiltaba Village for social and recreational activities by providing high-quality facilities on-site.

A detailed assessment of traffic impacts for the proposed expansion is contained in this AR in Chapter 11: 'Road transport'.

7.4.7.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** To provide for the safe movement of traffic between, and within, Roxby Downs, Hiltaba Village and Olympic Dam, BHPB would provide a fleet of buses for travel between the construction site and accommodation areas (SEIS Table 2.1 – Commitments, page 63).

7.4.7.3 Assessment

The AR considers adequate measures have been proposed in the Final Environmental Impact Statement (FEIS) to effectively manage the transport and access issues associated with Hiltaba Village and the airport.

RECOMMENDATION

BHPB would need to provide further detailed information such as construction and operational traffic estimates as outlined in the recommended condition and note below:

- The proponent must comply with the relevant DTEI standards for the access arrangements to and from Hiltaba Village and the airport, and any upgrades required on the Andamooka Rd as a result of additional traffic associated with the expansion project, with all costs being the responsibility of BHPB.

7.4.8 Greenhouse gases and sustainability

7.4.8.1 Issues

The discussion, assessment and recommendations relating to greenhouse gases for the entire Olympic Dam mine expansion project proposed by BHPB are presented in this AR in Chapter 13: 'Effects on the environment'.

BHPB would seek to incorporate renewable energy options in the project, including installing solar panels at the airport, Hiltaba Village and Roxby Downs, and solar hot-water systems on the 2000 permanently occupied accommodation units in the village, and new housing in Roxby Downs (DEIS Sections 5.8.8. and 5.9.6).

7.4.8.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 3.6:

- **Objective:** Contribute to stabilising global atmospheric greenhouse gas concentrations to minimise environmental impacts associated with climate change.
- **Criteria:** Apply a management goal of reducing greenhouse gas emissions, reportable under the National Greenhouse and Energy Reporting (Measurement) Determination 2008, to an amount to at least 60% reduction (to an amount equal to or less than 40%) of 1990 emissions, by 2050.
- **Management plan:** BHPB has committed to developing a Greenhouse Gas and Energy Management Plan that would cover the entire expansion project.
- **Commitment:** Installing solar panels at the airport to supplement the electricity supplied from the National Electricity Market (NEM) (SEIS Table 2.1 – Commitments, pages 52-53).

7.4.8.3 Assessment

The AR strongly supports sustainability commitments made by BHPB to install solar hot water systems at Hiltaba Village, Roxby Downs and the airport, and the use of renewable energy (such as solar panels) at the airport.

RECOMMENDATION

The AR recommends the following conditions be imposed:

- The proponent, or its contractor, must install solar hot water systems or an equivalent renewable technology, for the permanent accommodation units at Hiltaba Village and the airport.
- The proponent must install photo voltaic panels or an equivalent renewable technology, and associated power systems during construction of the airport.

7.4.9 Social impacts

7.4.9.1 Issues

Crime and anti-social behaviour

Following research and consultation with the Roxby Downs community and literature reviews, BHPB has proposed to develop Hiltaba Village, a separate village 17km from Roxby Downs, for the short-term construction workforce. This decision was based on the expressed view of residents in Roxby Downs and Andamooka to accommodate the construction workforce at a distance from the townships and to reduce the potential for negative interactions between the construction workforce and residents. Other reasons were to reduce dust and noise impacts; maximise the proximity to the new airport; and avoid known heritage sites.

BHPB proposed a range of measures in the DEIS to address crime and anti-social behaviour through the appropriate design of a separate, self-contained village and new airport adjacent, proactive polices, and collaboration with local and state government and the community. However, based on experience at other mining projects, it is anticipated there would be an increase in demand for police and associated justice services at both Roxby Downs and Andamooka despite these proposed measures, largely due to the significant increase of contract workers during the construction phase of the Olympic Dam mine expansion.

In response to specific issues raised by the community about increased anti-social behaviour, BHPB conducted a further study of potential social impacts on Andamooka (SEIS Appendix J2). It proposed a number of strategies to prevent people visiting Hiltaba Village for illegal purposes, including providing a single entry point at the main entrance that would be controlled by a security gate, and providing a security service to monitor and control personnel entering the village. The security service would also monitor behaviour within the village and, where necessary, advise authorities of disturbances or offences. There would be a closed-circuit television system, and electronic recognition cards to manage access to facilities, including rooms (SEIS Section 21.5.3).

BHPB also said it would consult with SA Police (SAPOL) during the detailed design phase to ensure the appropriate security measures were put in place.

Accommodation choice/types

Hiltaba Village would be built in stages of precincts accommodating 2000 to 3000 people in accommodation units that would be supported by a range of facilities on-site (refer SEIS Figure 21.11 for the proposed staging plan). The facilities would cater for the needs of unaccompanied employees living in the village short term in the construction phase of the mine expansion. The design (DEIS figure 5.58) provides for up to 10,000 single rooms with en suites, with some limited accommodation options for couples. It is not expected that families would live in the village.

Social character and wellbeing

The proposed village would likely accommodate a diverse labour force, which could result in issues arising around cultural differences. This would be addressed by the preparation and implementation of a Social Management Plan (SMP) that would address potential adverse impacts for workers and the broader community. Workers living in the village would undergo an induction process and be required to sign an agreement to comply with village rules covering behaviour, conduct, discrimination and intimidation or harassment. Depending on the makeup of the workforce, accommodation facilities would take into account different cultural backgrounds in areas such as food preparation and choices, recreation, leisure and social activities, communication and religious practices.

Roxby Downs Council raised concerns during the consultation period that regardless of Hiltaba Village having its own licensed facility, people would be attracted to Andamooka or Roxby Downs for entertainment. BHPB said it did not intend to provide a bus service between Hiltaba Village and Roxby Downs or Andamooka. The intention would be to encourage the short-term workforce to remain at the village for social and recreational activities by providing quality on-site facilities, including internet cafes and associated retail and bottle shop facilities, a small public plaza, gym, swimming pool, and recreation and sports areas (DEIS Section 19.5.2).

The council's view was that integrating both short-term and long-term workers into Roxby Downs would benefit workers and the local community alike. This view, however, was not shared by the majority of submissions received from community members, with support for the development of a separate village. In most cases, this support was based on experience from the last expansion of Olympic Dam in 1997, and the strong preference to keep the existing township family-orientated.

7.4.9.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 5.1:

- **Objectives:** Communities in which BHPB operates value our citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints are addressed.
- **Management plan:** BHPB has committed to developing a Social Management Plan (SMP).
- **Commitments:**
 - To reduce the likelihood of adverse impacts associated with the construction workforce, BHPB plans to construct separate, high-quality accommodation (Hiltaba Village) with on-site entertainment, recreation and sports facilities (SEIS Table 2.1 – Commitments, page 64); and
 - To implement a range of measures, in conjunction with local service providers, to address concerns relating to crime and anti-social behaviour resulting from the expansion (SEIS Table 2.1 – Commitments, page 65). Proposed measures include:
 - Developing a code of behaviour for Hiltaba Village residents;
 - Developing, in collaboration with police, a proactive community policing-style security and surveillance presence in Hiltaba Village to prevent and respond to incidents;
 - Continuing to implement the fitness-for-work program, including routine drug and alcohol monitoring of workers;
 - Participating in the development of a plan by the SA Government to address social services and infrastructure; and
 - Establishing complaints procedures to enable reported incidents of unacceptable behaviour to be investigated.

7.4.9.3 Assessment

Crime and anti-social behaviour

The AR considers that many of the community concerns in respect to prostitution and crime displacement reflect a misunderstanding of the SAPOL policing model. SAPOL would continue to deploy additional staff from outside the Roxby Downs Police Station, for extra-ordinary and specialised policing needs. SAPOL and its external resources would be capable of addressing any increased crime and anti-social behaviour at Roxby Downs and Andamooka, such as:

- Misuse of alcohol and drugs;
- Increased crime, prostitution, assault, sexual assault and domestic violence;
- Unauthorised access to station properties and irresponsible behaviour causing damage to property and roads and tracks, vandalism, theft of equipment and stock issues; and
- Off-road driving around Roxby Downs and on surrounding pastoral stations and Arid Recovery areas.

The Far North Local Service Area also provides a crime prevention 'outreach' for remote communities.

In response to submissions, BHPB proposed in the SEIS to establish a complaints procedure to investigate any reported incidents of unacceptable behaviour, but that criminal activities would be reported to the police. SAPOL, and accordingly this AR, supports this approach. SAPOL would continue to monitor policing requirements in Roxby Downs and Andamooka as a matter of core business. A newly constructed police station at Roxby Downs could accommodate staff requirements during the expansion.

SAPOL is not committed to any study into prostitution issues, as suggested by BHPB, but would apply its existing problem-solving and intelligence-led policing strategies to prevent and detect prostitution.

SAPOL and BHPB management at Olympic Dam enjoy a positive and co-operative relationship which they expect would continue, particularly in respect of the undertakings provided in the DEIS that related to crime and anti-social behaviour. BHPB's consultation and community engagement proposals would help all stakeholders respond to issues that could arise. The AR considers that the proposed Social Management Plan (SMP) would add strategic value to the integrated response required to address crime and anti-social behaviours.

RECOMMENDATION

While this AR considers the measures proposed by BHPB are appropriate to manage an expected increase in crime and anti-social behaviour, it recommends the following be included in the Social Management Plan (SMP):

- BHPB must consult and cooperate with SAPOL in respect to:
 - The percentage reduction in victim recorded crime; and
 - The questions to be asked in the 'perceptions of crime' survey of Roxby Downs and Andamooka.

Accommodation choice/types

With the proposed village being designed to accommodate a largely single/unaccompanied short-term construction workforce, the AR considers the proposal for self-contained accommodation and facilities are appropriate, provided appropriate recreation and leisure facilities are available on-site for the first 2000 residents.

It could be expected that if the construction workforce were to reside in town, that increased rental costs and insufficient supply of short-term accommodation could result. Accordingly, BHPB's intention to accommodate the construction workforce in a dedicated village at the location proposed is supported by the AR, as it would assist in mitigating housing availability and affordability issues in Roxby Downs.

Social character and wellbeing

The AR supports the separate location of Hiltaba Village as proposed for the reasons outlined in the DEIS and SEIS and reflected in public submissions. While the Roxby Downs Council would rather the village be integrated into the existing township, the AR considers the location as presented by BHPB is most suitable. The village has been designed for a short-term single/unaccompanied workforce. Whereas long-term workers wishing to remain in the region or have their family relocate would find accommodation in Roxby Downs.

The AR concludes that the location and facilities proposed in the DEIS are appropriate, subject to BHPB preparing and implementing a Social Management Plan (SMP) to be prepared in collaboration with government and the community. The SMP would apply to Hiltaba Village, Roxby Downs, Andamooka and other regional communities and be used to monitor the impacts and identify areas for action. A condition has been recommended requiring the collaborative preparation of the SMP and establishment of the 'social management partnership' to oversee its preparation and implementation.

In relation to the layout of the proposed Hiltaba Village, the AR supports the concept plan and landscaping arrangements provided in the FEIS. Accordingly, no condition is recommended regarding the detailed layout of the village.

7.4.10 Visual amenity and landscape character impacts

7.4.10.1 Issues

The proposed airport and village would be built in a remote location halfway between Roxby Downs and Andamooka, in a landscape of low open shrub land on vast almost flat, stony plains (refer DEIS Plate 20.3). There is no existing infrastructure. The DEIS considered the viewpoint from Andamooka Rd in assessing visual amenity and considered the new airport and village would have a moderate visual impact as they would be clearly visible on the open plains to drivers on Andamooka Rd. Their impact could be managed by using materials and colours in construction that blended with the natural environment. Landscaping in keeping with the arid environment would minimise the visual impact from Andamooka Rd.

7.4.10.1 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** No specific commitments made in relation to this issue.

7.4.10.2 Assessment

Any infrastructure at the location of the proposed airport and village would be clearly visible from Andamooka Rd and result in permanent changes to the landscape. But, as the massing and scale of the village would not be dissimilar to a small outback town, the use of compatible materials, colours and landscaping in the construction of the facilities would enable them to blend comfortably with the environment and provide a point of visual interest for travellers.

A Ministerial Development Plan Amendment (DPA) being prepared concurrently with the EIS would provide an assessment framework for the future development of Hiltaba Village and the airport (should it be required). The DPA would introduce a Mining Settlement Policy Area and an Airfield Policy Area within the Remote Areas Zone of the Land Not within a Council Area Eyre, Far North and Riverland, and the Whyalla Development Plan, to facilitate the development of a settlement for Olympic Dam mine workers. The DPA proposes that typical land uses found in mining settlements be listed as complying developments within a defined Mining Settlement Policy Area.

In addition to more specific policies in the Mining Settlement Policy Area, new policies have been proposed in the Airfield Policy Area, including the listing of key airport facilities as complying uses and listing envisaged uses as Category 1 forms of development. Infrastructure provision from Roxby Downs to the Mining Settlement Policy and the Airfield Policy Areas would also comply as long as it was contained within a defined corridor that followed Andamooka Rd.

RECOMMENDATION

The AR considers the measures proposed by BHPB are appropriate to manage the visual effect of the airport and Hiltaba Village, subject to the following condition:

- Final design of the Airport must be constructed in accordance with DEIS Drawing ODP 3152-D0-0001 (Andamooka Road Airport Site Layout) and DEIS Drawing ODP 3152-D5-0001 (Andamooka Road Airport Terminal Building).¹⁶

7.4.11 Rehabilitation and decommissioning

7.4.11.1 Issues

It is expected that infrastructure associated with Hiltaba Village, in the order of 2000 rooms, and the airport would still be in place at year 40, when it is currently proposed that Olympic Dam would close. There could be potential for the village to be used for accommodation, research laboratories and education/training facilities post-closure of the mining operation (DEIS Section 23.8.6).

However, BHPB has said that if the site was decommissioned it would revert to pastoral use. When the mine closed, as much as possible of the Hiltaba Village infrastructure would be sold and reused or recycled in and around Roxby Downs, Andamooka and regional centres. All redundant material would either be removed or buried at Olympic Dam. Surfaces would be re-contoured and deep-rippled to allow and encourage natural revegetation.

If the airport was no longer viable it would be decommissioned and the land returned to its original state, to be used as pastoral land or left as vacant crown land.

¹⁶ Refer DEIS Appendix F2

7.4.11.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:**
 - The Rehabilitation and Closure Plan for the existing Olympic Dam operation would be updated to include the expanded components of the proposed expansion after the detailed design phase of the project had been completed; and
 - BHPB would continue to consult and engage with government departments and other stakeholders to further develop and refine closure criteria, including final land uses, rehabilitation, management and ongoing monitoring. The plan would be reviewed annually and updated if required (SEIS table 2.1 – Commitments, page 57).

7.4.11.3 Assessment

The AR considers that the proposed rehabilitation and decommissioning procedures are appropriate and details would form part of the Olympic Dam Mine Rehabilitation and Closure Plan, to be prepared in consultation with, and for the approval of the Indenture Minister.

7.5 Conclusion

The AR considers that the issues outlined in the FEIS and submissions are manageable, and the proposed Social Management Plan and subsequent measures proposed by BHPB are appropriate for this purpose.

The existing landscape is free from built form, meaning the proposed Hiltaba Village and airport would be clearly visible for a considerable distance. Despite this, the AR assessed the visual impact as having minimal impact because the village and airport would add visual interest in an environment otherwise devoid of infrastructure, with the exception of the expanded mine that, visually, would be significantly more prominent in the landscape.

Noise and vibration impacts, along with air-quality issues, would be managed through compliance with the *Environment Protection Act 1993* as outlined in the recommended conditions and notes for BHPB.

In summary, the AR concludes that the potential impacts from the development of Hiltaba Village and the airport are manageable and acceptable, subject to compliance with commitments made in the FEIS, legislative requirements and the recommended conditions outlined in this chapter.

Chapter 8

Roxby Downs township



Chapter 8: Roxby Downs township

8.1 General

Roxby Downs was established in 1988 to service the Olympic Dam mining operation. The township was extended in the 1990s, largely to the south, to cater for the 1997 expansion of Olympic Dam. The settlement is 14km south of Olympic Dam mine and about 560km north-west of Adelaide in the Far North region of South Australia (Draft Environmental Impact Statement (DEIS) Figure 5.4).

Roxby Downs, population 4500, accommodates the permanent workforce of Olympic Dam, service providers, and long-term contractors and their families, and is the largest regional town in South Australia north of Port Augusta.

8.1.1 Site and locality

Roxby Downs covers 260ha of land in the Roxby Downs Municipality, an area of some 11,000ha of mostly vacant land on Crown land occupied by BHP Billiton Olympic Dam Corporation Pty Ltd (BHPB) under the terms of its occupational licences, granted by the South Australian Parliament under the *Crown Lands Act 1929* and pursuant to the Roxby Downs Indenture, as well as various freehold and leased land holdings.

An administrator appointed by the South Australian (SA) Government exercises the powers and functions of the Roxby Downs Council. The council is responsible for providing a range of local government services and also manages electricity, water and sewerage services as commercial operations. The council levies rates on properties based on general valuations, with BHPB and the SA Government equally funding shortfalls in its annual budget.

Roxby Downs has 1400 residential properties, two caravan parks, a commercial centre, light and heavy industrial areas, a variety of community and recreational facilities, and an airport. The township also provides services for neighbouring communities and pastoralists. The demographic profile of Roxby Downs includes a young age profile, a high proportion of families with children, high income and population mobility.

8.1.2 Existing environment

8.1.2.1 Terrestrial environment

As most of the environment descriptions are common across the various components of the proposed expansion project, the description of the Roxby Downs terrestrial environment is provided in Chapter 13: 'Effects on the environment' of this Assessment Report (AR) with all other existing-environment descriptions, to avoid repetition.

8.1.2.2 Social environment

Roxby Downs was described in the DEIS as a safe and friendly place, with a strong community spirit and good lifestyle. Community consultation identified positive aspects of life in Roxby Downs such as it was considered a good place to raise a family and had good facilities, open space and parks. Based on the Quality of Life index (BankWest in 2008) Roxby Downs ranked 16th out of 63 Local Government Areas (LGAs) in South Australia.

Concerns expressed during community consultation included the cost of living; limited competition and variety of shopping; lack of specialised services, support agencies and secondary school options; poor streetscape and maintenance; isolation and heat; and alcohol and drug misuse.

Sixty per cent or 2500 of the total BHPB workforce of 4150 lives in Roxby Downs, Andamooka or Woomera; the balance, 1650 workers, are long-distance commuters (LDCs). LDCs stay in BHPB accommodation at either Roxby Village (capacity 500) or Olympic Village (capacity 1365).

Roxby Downs town is unusual in terms of its size and longevity when compared with other mining settlements in Australia. With the expected life of Olympic Dam mine put at 70 years or more, Roxby Downs would have to expand and plan for a long life. Most workers living at Roxby Downs are BHPB employees or family members of employees.

Roxby Downs is one of the wealthiest towns in South Australia based on the average annual income of \$67,000. It is also one of the most mobile, with families and single workers tending to spend a few years in the town and then moving on. Families with young or primary school-age children tend to stay until their children reach high school-age when schooling choices are limited. BHPB provides assistance for high school-age students to attend boarding schools in Port Augusta or Adelaide.

8.2 Project description – key elements

BHPB has proposed expanding Roxby Downs to provide for a population of up to 10,000 to accommodate the increased permanent labour force required to service the proposed expanded Olympic Dam mining operation. An expanded Roxby Downs would require another 465ha of vacant land within the Roxby Downs Municipality.

The growth of the town is proposed to occur gradually over the 11-year construction period of the mine expansion. It would start with the surveying of housing allotments, roadways and other infrastructure, and the progressive clearing of vegetation and levelling of land. Underground telecommunications, electricity, gas, water and wastewater services would be installed before building construction began. An estimated 100 to 300 new dwellings would be built each year over the 11 years.

The draft Roxby Downs Master Plan presented in the DEIS provided a framework for managing growth, specifically the additional facilities required for a town to double in size, including housing subdivisions, civic facilities, and expanded business, recreational and industrial areas (DEIS Appendix F4). The concept design for the township expansion is shown in the DEIS Figure 5.47.



DEIS Figure 5.47 Conceptual features of the expanded Roxby Downs including new road infrastructure

Increases in social services, health services and infrastructure would be required for Roxby Downs to accommodate the increase in population. Population-increase estimates, including the LDC population, are contained in the DEIS Table 19.15 of the DEIS. Additional services and facilities expected to be required by an expanded town (DEIS Section 19.5.4) include:

- Education, pre-school and other family support services;
- Medical services, such as accident and emergency, general surgery, obstetrics and paediatrics, paramedic ambulance;
- Community health services, including mental health and counselling;
- Accommodation for short-term, emergency and office purposes;
- Increased policing and other justice-related services and programs, including juvenile justice;
- Culturally appropriate services and programs depending on workforce recruitment strategies;
- Services to assist people with alcohol and drug problems, smoking and gambling addictions;
- Youth programs, services and facilities, including support for Aboriginal youth and young people from culturally and linguistically diverse backgrounds;
- Family support and crisis services, including domestic violence and child protection services;
- Support services and facilities for people with special needs, including disabilities;
- Emergency services;
- Expanded municipal services; and
- Public and community transport services, including expanded transport options between Roxby Downs, Port Augusta and Adelaide.

An updated description of social services and facilities available in Roxby Downs (as at April 2010) is shown in the Supplementary Environmental Impact Statement (SEIS) Table 21.7.

Any approval of the mine expansion project would not include approval for the Roxby Downs township expansion as part of the EIS process. The detailed planning framework and further development approvals would occur under the normal *Development Act 1993* process, and largely be determined by the Roxby Downs Council. Should the mine expansion proposal be approved, the draft Roxby Downs and Environs Development Plan Amendment (DPA) has proposed amendments to land-use policies and zoning within the town to enable its expansion, generally in accordance with the draft Roxby Downs Master Plan.

Both the draft master plan (prepared as part of the DEIS) and the Ministerial DPA went on public display together. The Ministerial DPA would only be progressed and finalised by the Minister for Urban Development, Planning and the City of Adelaide if the mine expansion project was approved. Changes to the DPA might be required as a result of the investigations undertaken in the assessment of the DEIS. The AR has made recommendations where this applies.

8.2.1 Infrastructure and services

The construction and operation of an expanded Roxby Downs would create an additional demand for water and electricity:

ROXBY DOWNS EXPANSION RESOURCE REQUIREMENTS	
Water demand during construction (ML)	200
Water demand during operation (GL/a)	1.8
Electricity consumption during operation (Annual consumption GWh)	184

Low-quality water for construction activities such as earthworks and dust suppression would be sourced from local groundwater wells. Higher-quality water required for concrete manufacture and workforce amenities would be sourced from the on-site mine desalination plant.

Potable water would continue to be supplied to Roxby Downs from the mine desalination plant until the proposed coastal desalination plant was commissioned. Depending on quality, the water from the coastal plant would either be pumped directly to the Roxby Downs potable water storage tanks for distribution, or pumped to the mine site where an amount for town use would be put through the desalination plant and piped to Roxby Downs as potable water.

BHPB has sought approval for an additional 275 kV electricity transmission line from Port Augusta to meet, wholly or partly, the electricity demand of the expanded operation. It has stated it would investigate renewable energy sources for Roxby Downs, focusing on domestic photovoltaic cells and/or buying renewable energy from the national grid, but made no commitments were made in the DEIS. All new housing in the town would be required to have solar hot-water systems.

The draft master plan proposed new distributor roads to service residential expansion to the west and east of the existing town as well as traffic-control measures to cater for increased in traffic.

New landfill cells (where waste is deposited and compacted to optimise space) would be required at the Opal Rd waste facility to cater for increased municipal waste of at least 2-million m³ over a 40-year life. The landfill expansion would be constructed, operated and closed in compliance with the SA Environment Protection Authority (EPA) guidelines Environmental Management of Landfill Facilities. The transfer station would be used to segregate recyclable material, which would be sent by rail to Adelaide for recycling to maximise the recovery of resources and the life of the Opal Rd landfill site.

The EPA has already approved the upgrade and expansion of the wastewater treatment system which would be developed in stages to service Roxby Downs, the proposed Hiltaba Village and the new airport. The expanded wastewater treatment facility would be at least 400m from the nearest new home in the proposed town expansion, exceeding EPA requirements (DEIS Figure 5.47). Treated wastewater from the storage lagoons would be reticulated to public and government open-space areas to irrigate landscaping plantings and sports facilities, including the golf course, community and school ovals, civic gardens, hospital grounds and streetscapes.

8.2.2 Telecommunications

The National Broadband Network (NBN) will provide telecommunications and broadband infrastructure and services to the region, and both Roxby Downs and Woomera houses and premises are scheduled to be connected to the optical-fibre cable network. Andamooka has been identified for satellite broadband services only. BHPB has committed to providing broadband access to Hiltaba Village (SEIS Section 21.5.3).

In response to submissions, BHPB stated that the supply of essential services was the role of government but BHPB would consider proposals for access to its infrastructure to deliver broadband services if they had merit and in line with BHPB policies.

Under the NBN plan, households and small businesses in a yet-to-be-defined footprint in Roxby Downs will receive broadband services by optical-fibre cable. Any access to BHPB infrastructure to facilitate the NBN deployment would be a matter for negotiation by NBN Co and BHPB. Other locations outside the NBN optical-fibre footprint will be connected by wireless technology.

NBN Co has previously indicated it was more likely to advance the NBN rollout in places where access to infrastructure would assist the process.

8.2.3 Accommodation

The proposed expansion of Roxby Downs would need to provide a range of accommodation types to meet the needs of a diverse workforce.

8.2.3.1 Permanent workers living in Roxby Downs

In the long term it is expected that 50 per cent of the permanent workforce would live in an expanded Roxby Downs. To cater for this growth BHPB prepared a draft Roxby Downs Master Plan that provided a blueprint for the orderly development of the town, based on the following design principles:

- Establishing a single retail/civic/commercial/education sector within a 2km radius of the current town core of Richardson Place;
- Establishing small local centres as needed, no closer than 1.5km from the town core;
- Developing groups of medium-density housing units for singles and couples no further than 1.5km from the town core;
- Introducing residential development to the west of Olympic Way; and
- Locating housing in a concentric pattern around the town core.

The draft master plan also provided for additional recreational and community facilities, including:

- Two new regional parks, to the north-west and south-east of the town;
- A new park and skate park in the town to the rear of the swimming pool;
- Two new ovals and associated facilities including a sports and community centre and lighting;
- Relocating the social club and bowling club;
- New tennis courts and additional netball courts;
- A new cycleway, race course and pony club;
- Provision to expand the hospital and health services; and
- Provision for a new primary school and early childhood centre.

The draft master plan envisaged more than 2500 new residential allotments in a range of sizes, with most more than 600 m², and a new caravan park for about 300 caravans on the eastern edge of town. The DEIS stated that additional land to provide for a vacancy rate of 5 per cent would be released as required for private housing, commercial development and light industrial development.

Also proposed was new transitional housing village, called Axehead Village, of self-contained houses to accommodate new permanent residential employees and their families while they looked for permanent accommodation at Roxby Downs.

8.2.3.2 Permanent workers as long-distance commuters (LDCs)

It is expected the remaining 50 per cent of the permanent workforce would live outside the Roxby Downs region as LDCs. Commuting on a drive-in/drive-out or fly-in/fly-out basis, it is expected they would live in the following areas when not at work:

- 60 per cent in the Upper Spencer Gulf (USG) region;
- 30 per cent elsewhere in South Australia; and
- 10 per cent interstate.

When at work the permanent LDC workforce would live in one of two accommodation facilities, either the Roxby Village or the proposed 'Village 6' (DEIS Figure 5.47).

Roxby Village, a BHPB-managed camp for residential employees and some long-term non-residential employees, would not be expanded beyond its existing 800 single ensuite rooms. Village 6 would be established to the west of Roxby Village and consist of two types of accommodation:

- 1300 camp-style rooms similar to those at Roxby Village – each 16 m² in floor area with a single bed and ensuite; and
- 500 self-contained cabins of 30 m² including a separate bedroom, living room and kitchen.

Village 6 would provide a range of facilities similar to Roxby Village, including a gym, mess facilities, a tavern and other entertainment infrastructure.

8.2.3.3 Construction and short-term workers

The short-term workforce required in the construction phase of the proposed expansion, and for routine plant maintenance shutdowns, would be accommodated at Olympic Village, a redeveloped Camp 2, and the proposed Hiltaba Village (DEIS Figure 5.5).

The 73ha Olympic Village is 10km north of Roxby Downs adjacent to the airport and heavy industry area. Its 1365 rooms house long and short-term non-residential employees and contractors. BHPB planned to expand Olympic Village to 2865 rooms and upgrade facilities to meet the needs of the underground mining operation. There would be no further increase for the proposed mine expansion. To minimise potential exposure to dust and noise impacts during the development of the new open-pit mine and the associated Rock Storage Facility (RSF), Olympic Village residents would be relocated to Hiltaba Village in years two or three of the expanded operation. Olympic Village's rooms and facilities would be decommissioned and either relocated to Hiltaba Village or sold off. The area would not be rehabilitated as it would eventually be covered by the RSF.

Camp 2, located 200m south of Olympic Village, would be redeveloped to accommodate 250 pre-mine contractors. It would be self-contained and require the construction of a mess, tavern, laundry and office facilities. The camp would be decommissioned at the same time as Olympic Village because it, too, would be absorbed by the RSF.

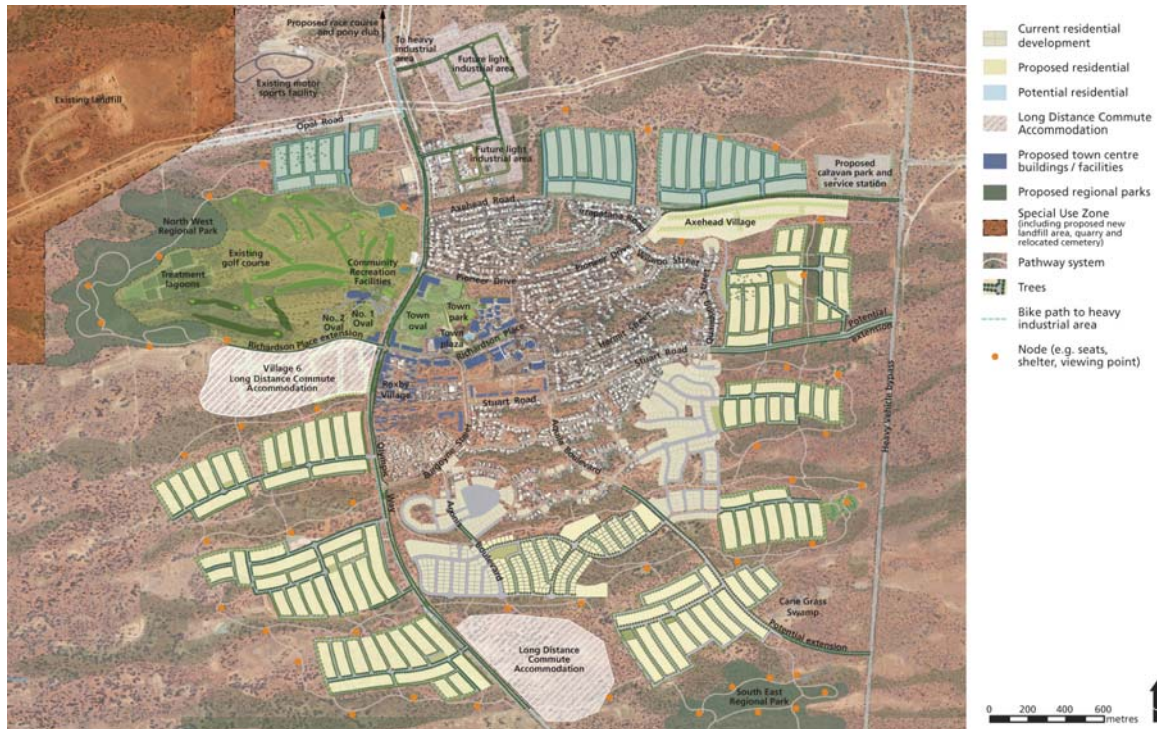
The bulk of the construction workforce would be accommodated in the proposed Hiltaba Village, 17km east of Roxby Downs and adjacent to the proposed new airport. Hiltaba Village would house up to 10,000 workers during peak construction, and have an average population of 6000. The detailed assessment of the proposed village and airport in this AR is provided in Chapter 7: 'Hiltaba Village and airport'.

With the exception of Hiltaba Village, worker accommodation in the Roxby Downs Municipality was excluded from the Major Development Declarations. The development proposals for Camp 2 and Village 6 would need the approval of the Roxby Downs Council under the normal *Development Act 1993* process.

8.2.4 Industrial areas

The heavy industry area at Olympic Village, comprising approximately 20 leases, would be relocated as the proposed open-pit mine and RSF expanded. The new location would be 3km south of the Charlton Rd estate on 73ha of vacant land. It would comprise 150 serviced allotments and provide for a workforce of 500 (DEIS Figure 5.59).

Provision has also been made in the draft Roxby Downs Master Plan for the expansion of the existing light industrial area on the northern boundary of Roxby Downs to provide 90 serviced allotments (DEIS Figure 19.14).



DEIS Figure 19.14 Key feature of the Roxby Downs Draft Master Plan

Both the proposed heavy and light industrial areas were excluded from the Major Development Declarations. Accordingly, these two proposals would need approval of the Roxby Downs Council under the normal *Development Act 1993* process.

8.3 Summary of submissions

8.3.1 SA Government submission

SA Government agencies raised a range of issues requiring the attention of BHPB in relation to the expansion of Roxby Downs. The issues, summarised here, were:

- Provision of community and health services, including increased hospital capacity and specialist services;
- Impact on the town centre in terms of location and space for improved education and recreation facilities;
- Noise and vibration impacts from the mine;
- Air quality, including dust impacts on areas flagged for expanded residential development, and impacts from heavy metals and sulphur dioxide;
- Greenhouse gases and sustainability;
- Visual amenity and landscape character impacts from the mine site and Roxby Downs surrounds;
- Terrestrial impacts, including vegetation clearance;
- Waste management, including the need for an upgraded sewage treatment plant;
- Traffic and access , and the impact of upgrades on Highway and Olympic Way;
- Further details required on social impacts, and in particular the proposed Social Management Plan; and
- Strategies for the management and supply of affordable housing.

8.3.2 Public submissions

Few submissions were received directly from the public, either from Roxby Downs residents (less than 10) or surrounding areas, in relation to the proposed expansion of the town. The Roxby Downs Council and the Roxby Downs Community Board lodged substantial submissions, along with the Tennis, Football and Sporting Car clubs.

8.3.2.1 Roxby Downs Council and Community Board

The Roxby Downs Council and the Roxby Downs Community Board submissions raised issues concerning the following:

- Renewable energy and sustainability;
- Waste management;
- Greenhouse gas and air quality;
- Noise and vibration;
- Governance;
- Religious observance;
- Leisure centre and recreation;
- Provision of community and health services, including mental health;
- Business development;
- Crime;
- Commuting;
- Education;
- Traffic; and
- Support services, including courts and justice, ambulance and emergency.

8.4 Key environmental, social and economic issues

The key environmental, social and economic impacts associated with the proposed Roxby Downs expansion are:

- Air quality;
- Noise and vibration;
- Terrestrial impacts;
- Radiation;
- Surface water;
- Traffic and access;
- Social impacts;
- Visual amenity and landscape character;
- Waste management;
- Greenhouse gases and sustainability;
- Traffic and access; and
- Rehabilitation and decommissioning.

8.4.1 Air quality

8.4.1.1 Issues

Air-quality issues for Roxby Downs stem from the activities proposed at the Olympic Dam mine site and are addressed in this AR in Chapter 4: 'Mining operations and processing'. However, in light of potential dust impacts from the proposed mine expansion and concerns raised by the South Australian Environment Protection Authority (EPA), the AR makes the following recommendation:

RECOMMENDATION

Should the mine expansion project be approved the Ministerial Development Plan Amendment (DPA) should avoid growth to the north of the existing Roxby Downs town boundary. This would minimise the potential for adverse air-quality impacts on residents. The exact point at which residential growth should be limited to the north would be a policy decision to be determined through the DPA process, based on advice from the EPA.

8.4.2 Noise and vibration

8.4.2.1 Issues

Noise and vibration issues for Roxby Downs stem from the activities proposed at the Olympic Dam mine site and are addressed in this AR in Chapter 4: 'Mining operations and processing'.

8.4.3 Terrestrial impacts

8.4.3.1 Issues

Terrestrial impacts issues are largely the same across a number of the proposed Olympic Dam mini expansion project components. Rather than repeat the information in each component it has been consolidated in the AR in Chapter 13: 'Effects on the environment'.

8.4.4 Radiation

8.4.4.1 Issues

Radiation issues for Roxby Downs stem from the activities proposed at the Olympic Dam mine site and are addressed in the AR in Chapter 4: 'Mining operations and processing'.

8.4.5 Surface water

8.4.5.1 Issues

Roxby Downs has a low average rainfall of 150mm/yr. However, rain periods can be sporadic and brief but of high intensity. The land system in the Roxby Downs area is characterised by many small, enclosed catchments bound by a mainly east-west system of dunes up to six metres high. Each catchment typically contains a boundary formed by the crest of a dune, an interdunal swale and a lower depression which is often a clay pan. In significant rainfall, water drains through the sand dunes into the swales and clay pans where it can remain for several days to weeks depending on rainfall intensity and duration.

The natural profile of the land in the areas proposed for the expansion of Roxby Downs suggests that rainfall runoff will flow predominantly east-west utilising the natural low points in the dune-swale system. The stormwater drainage system in Roxby Downs consists of a combination of pipes and open channels that drain, ultimately, into four lined stormwater ponds and one unlined basin. Water draining into the stormwater ponds is harvested for re-use by directing it to the sewage treatment lagoons, while water in the basin pond is lost through evaporation and seepage to groundwater.

The proposed expansion of Roxby Downs would increase the area of impervious surfaces and generate higher runoff towards the existing infrastructure. New drainage networks and stormwater retention basins would be required to accommodate the increased flows. The DEIS stated that stormwater and wastewater, including grey water, would be treated and reused where practicable, conserving potable water. The following design principles for the management of stormwater were provided in the Draft Roxby Downs Master Plan (DEIS Appendix F4):

- Establishing detention basins, in the form of parklands, near new housing precincts to harvest and reclaim not-potable surface water;
- Using conventional surface-water networks to convey water collected from new hard surfaces to detention basins for storage and reuse;
- Introducing Water Sensitive Urban Design elements to manage surface water runoff and remove pollutants through measures such as swale drains; and
- Designating flood plain zones and overland flow paths from residential areas that would cater for peak storm events.

8.4.5.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.4:

- **Objective:** No significant adverse impacts to environmental receptors as a result of stormwater discharges to soil, surface water or groundwater associated with BHPB's expansion activities.
- **Criteria:** All contact stormwater maintained within designated stormwater management areas.
- **Management plan:** BHPB would develop a Stormwater Management Plan for the construction and operation of the proposed expansion.
- **Commitments:** Stormwater and wastewater would be collected, treated and reused where practicable, which in turn would conserve potable water (SEIS Table 2.1 – Commitments, page 67).

8.4.5.3 Assessment

The AR endorses the design principles contained in the draft Roxby Downs Master Plan as an appropriate policy framework for the proposed expansion of the town.

RECOMMENDATION

The AR recommends the design principles be adopted in the detailed planning and design of the proposed expansion of Roxby Downs. Should the Olympic Dam mine expansion be approved, it is recommended these principles be adopted by the Ministerial Development Plan Amendment (DPA).

8.4.6 Traffic and access

8.4.6.1 Issues

Road noise

Noise impacts from general road transport would arise mostly from increased traffic on the Roxby Downs road network. Traffic on major roads around Roxby Downs, such as between Roxby Downs and Olympic Dam could increase by up to four times (DEIS Section 14.5.2). Such an increase would likely correspond to an increase in noise (L_{Aeq}) of 6dB(A), which would decrease following construction activities. Traffic was expected to double on larger feeder roads in Roxby Downs, corresponding to an increase in noise (L_{Aeq}) of 3dB(A).

Several project configuration changes were made after the DEIS was released, including the addition of a second dedicated access road into Olympic Dam from the proposed Hiltaba Village (SEIS Section 1.4.2). The implications for traffic noise levels were discussed in the SEIS Section 15.1 which concluded that traffic volumes on Olympic Way and, consequently, traffic-related noise would be less than initially predicted in the DEIS.

Public transport

The proposed Olympic Dam expansion could result in the population of Roxby Downs increasing from 4200 to 10,000 through the influx of additional workers, long and short-term contractors, families and service providers. To meet the increased demand for accommodation and services, the construction of up to 2500 new homes, community centres, primary school, retail facilities and recreation centres would be expected. The DEIS did not include any provision for new public transport services to provide regular access to any new and expanded services and facilities in the town. However, BHPB would establish a private bus service to move the workers from their accommodation to the mine site.

Transport infrastructure

The issue of transport infrastructure to support the growth of Roxby Downs is addressed in this AR in Chapter 11: 'Road transport'.

8.4.6.2 BHPB EM Program and commitments

No specific commitments have been made by BHPB in relation to 'Traffic and access'. Commitments made in relation to transport infrastructure are covered in Chapter 11: 'Road transport'.

8.4.6.3 Assessment

Road noise

Although the DEIS stated that traffic could increase by up to four times on some major roads in Roxby Downs, the AR considers the predicted associated increase in traffic noise levels would be acceptable because they would be expected to comply with Department of Transport, Energy and Infrastructure (DTEI) Road Traffic Noise Guideline criteria. Accordingly, additional noise mitigation measures are not considered necessary.

Public transport

The AR supports BHPB's commitment to provide a private bus service to move employees and contractors from major accommodation nodes to Olympic Dam and other key project components of the proposed mine expansion project.

The AR also supports the design principles proposed for the town expansion that provide for a retail and civic core and a number of local centres to ensure the community is close to services, thereby encouraging walking and cycling. In terms of providing a public transport service, BHPB and the SA Government could investigate a number of delivery models if a service was warranted in the future, including:

- An intra-town service that would provide access to the proposed new services and facilities. The experience of town services of this type suggests a fixed-route service was unlikely to be effective. A 'dial-a ride' or on-demand service would likely be the most appropriate and cost efficient;
- A weekly service between Roxby Downs and Port Augusta for people wanting to travel into a major regional centre for services not available in Roxby Downs. To minimise costs this could be incorporated into the intra-town service, with the intra-town service operating four days a week and the service to Port Augusta once a week, enabling the operator to use the same vehicle. Greyhound Australia provides three services a week between Roxby Downs and Port Augusta, but they are part of the Adelaide to Alice Springs overnight service that departs Roxby Downs at 10.25pm and arrives at Port Augusta at 1.15am; and
- A fixed-route service for people to access employment and schools on daily morning and afternoon services. Currently there is one kindergarten, one R-12 public school and one R-7 Catholic School that would require such a service.

The AR considers that the issue of public transport services in Roxby Downs should be the subject of separate discussions outside the EIS process between the SA Government and BHPB.

Transport infrastructure

The AR considers sufficient information has been provided to assess Roxby Downs transport infrastructure requirements should the proposed expansion go ahead. However, there should be further consultation with DTEI about traffic upgrades that would be required on State roads if the mine expansion project was approved. Local road upgrades would need to be considered by the Roxby Downs Council in consultation with BHPB.

Further assessment of this issue is contained in Chapter 11: 'Road transport'.

8.4.7 Social impacts

8.4.7.1 Issues

A review of large mine developments in other developed countries on the scale proposed by BHPB has not discovered any communities/mining towns similar to Roxby Downs. Ore body resources of the size found at Olympic Dam are generally located in countries with limited environmental legislation or benchmarks for social impact assessment. There are no benchmarks for an expansion project of the size proposed for Roxby Downs.

There are mines in Australia for which social-impact assessment has played a role, particularly in the Bowen and Surat basins in Queensland. Social Impact Assessment (SIA) and associated Social Impact Management Plans (SIMPs) are now a feature of the approvals process in Queensland and represent current best practice. BHPB has proposed to prepare a Social Management Plan (SMP) in collaboration with the SA Government and other key stakeholders for the expansion project, which was referred to in the Final Environmental Impact Statement (FEIS) as both an SMP and a Social Management Framework. BHPB provided a draft SMP with the SEIS which is covered in greater detail further on in this section.

BHPB has been proactive in keeping its workforce and the community informed about the impacts and planning for the mine expansion project. It could be considered that the extensive consultation undertaken with the local community (DEIS Section 7) contributed to the low number of submissions received from the community on the DEIS.

Housing supply and affordability

At the time that BHPB was preparing the DEIS it was stated that the housing market in Roxby Downs was constrained by supply, evidenced by waiting lists of approximately 200 people for BHPB-owned houses and private rental properties. This resulted in inflated house prices and rents (DEIS Section 19.5.3). The situation has eased and is no longer an immediate concern. Re-zoning under the Ministerial DPA would also accommodate the population growth associated with the proposed mine expansion.

Despite land being made available for residential development, a report on housing affordability for key workers such as nurses, teachers, police, fire-fighters and ambulance officers showed Roxby Downs was the least affordable town or rural area in South Australia (Bank West 2008a). Housing costs in Roxby Downs were also relatively high compared to similar Australian mining communities (DEIS Appendix Q6).

The community consultation process revealed housing as a priority issue, with key concerns including:

- Ensuring an adequate supply of land and housing to meet the needs of an increased residential population and attract workers to the town, including non-mine personnel, particularly during the initial growth period;
- Housing affordability for low and moderate-income households which would largely affect non-mine personnel;
- The potential for speculative land and house purchasing in Roxby Downs, Andamooka, Woomera and the USG;
- The potential for skills shortfalls in the building industry; and
- Flow-on effects on housing construction, supply and affordability, locally and regionally, if these factors were not adequately addressed.

The management and release of serviced land to meet demand, including for non-mine requirements, is considered critical to reduce pressure on housing availability and affordability. As 'developer' BHPB must provide at Roxby Downs the housing and accommodation necessary for the needs of its employees and their dependants, subject to the Indenture, in particular clauses 22 and 23. BHPB is also required as best it can to assist in meeting the housing needs of ancillary-service workers and their dependants.

BHPB said in the DEIS it would ensure land was released and housing provided in a timely and orderly manner to maintain vacancy rates in the town at five per cent. Provision had been made for an extra 2500 housing allotments under the draft Roxby Downs Master Plan. On approval of the mine expansion BHPB would seek to enter into development agreements with building companies as soon as practicable to secure competitive resourcing and timely delivery of the required housing.

The SA Government has set a target of 15 per cent affordable housing in all new residential developments, including five per cent high-needs housing. An analysis of 2006 Census data identified that some seven per cent of households in Roxby Downs on low-to-moderate incomes could find housing unaffordable, costing more than 30 per cent of their income. BHPB has committed to working with the Government to develop and implement a housing strategy aimed at providing a mix of accommodation to meet the socio-economic requirements of the community, and meet the housing needs of the non-mining sector as well as those of BHPB workers and families.

Strategies identified by the Government to deliver affordable housing include the design and construction of smaller houses and groups of dwellings, and innovative home financing and partnering opportunities. Advice from Housing SA indicates that the development industry has responded to the challenge to deliver affordable housing in a wide range of metropolitan and regional locations. This has resulted in the innovative design of different house forms and a range of smaller homes which have met with a positive market response.

BHPB's proposed collaborative SMP would also provide a mechanism to monitor housing supply and affordability issues and identify areas for action.

Social character and well-being

The DEIS found that the combination of a large construction workforce, increased long distance commuter (LDC) populations, and more overseas workers could have an adverse impact on the community character of Roxby Downs, especially in the early stages of the proposed mine expansion. In the medium term, however, there would more likely be a positive effect from the increased population achieving a critical mass to support different lifestyles, cultures, services and leisure opportunities, including a more diverse built form, upgraded streetscapes and public spaces, improved infrastructure, and an expanded range of services and facilities.

Community consultation and research on other mining towns identified critical population groups that would be susceptible to adverse impacts from the proposed mine expansion, including women, children, young adults, aboriginal people and people on low incomes. The vulnerability of these groups would be a consequence of:

- The geographic remoteness of the town and isolation from extended family;
- Long working hours and shift work and its impact on families;
- The male-dominated culture;
- High alcohol consumption;
- An increasing threat, or potential for, crimes against people, including assault, sexual assault, and rape;
- Barriers to reporting offences associated with reduced anonymity in rural and regional communities;
- Limited parental supervision;
- Potential growth in gambling and related social effects;
- Limited access to a full range of services; and
- Potential marginalisation of people employed outside the mining sector or in low income jobs as a result of high living costs.

BHPB's response to managing the likely social impacts on the Roxby Downs community from the proposed mine expansion was to propose building a separate and self-contained village 17km away. Hiltaba Village would include on-site entertainment, recreation and sports facilities. Its separation from Roxby Downs was proposed to encourage the construction workforce to remain at the village for social and leisure activities, which would reduce both the demand on Roxby Downs facilities and the potential for negative interactions between permanent residents and construction workers. The full assessment of the village proposal is contained in this AR in Chapter 7: 'Hiltaba Village and airport'.

A further mechanism to manage social impacts on the community was the incorporation of Crime Prevention Through Environmental Design (CPTED) principles in the draft Roxby Downs Master Plan. Such principles include maximising the visibility of pedestrians and property, while encouraging passive surveillance to enhance safety and security.

Social Management Plan/Framework

As referred to earlier, BHPB would prepare a SMP, to be implemented in collaboration with Government and other stakeholders, if the proposed mine expansion gained approval. Its purpose would be to monitor, respond, and report on changes in social conditions at Roxby Downs, Andamooka, Woomera and other communities, and identify areas for action. The collaborative SMP would also identify and establish the roles and responsibilities of BHPB, the Government, stakeholders like the Roxby Downs Council/Administrator, and communities throughout the life of the project. The SMP would be a 'live' document, updated and refined as necessary following discussions and commitments by both BHPB and the Government.

The collaborative SMP would:

- Ensure the effective, timely and consistent delivery of social commitments and management actions/controls by BHPB and the SA Government during the construction, operation and closure of the expanded mine;
- Identify a broad set of social indicators to measure and monitor the social effects of the expansion, including performance against social goals and outcomes, and trend indicators to help identify and assess emerging social issues and areas for action;
- Ensure social-management arrangements adapt to changes in social dynamics over time; and
- Provide for reporting on the implementation and performance of social management actions and the social effects of the expansion.

The draft SMP is detailed in the SEIS Appendix J1. Figure 1 shows the proposed relationship between the SMP and partnership, monitoring and reporting arrangements.

BHPB proposed that a 'Social Management Partnership' be established to provide a forum for BHPB, the SA Government and other key stakeholders to discuss and respond to the social effects of the Olympic Dam expansion, particularly those outside the sole authority and control of BHPB, or for which it had joint responsibility. It has been proposed that the 'Social Management Partnership' would meet quarterly during the initial construction phase and six-monthly thereafter, and would include representatives from BHPB, the SA Government, the Roxby Downs Community Board and Roxby Downs Council. Further details are provided in the draft SEIS Appendix J1 Appendix 2.

8.4.7.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 5.1:

- **Objective:** Communities in which BHPB operates value its citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints addressed.
- **Management plan:** BHPB would develop a Social Management Plan.
- **Commitments:**
 - BHPB would construct separate, high-quality accommodation - Hiltaba Village - with on-site entertainment, recreation and sports facilities to reduce the likelihood of adverse impacts on Roxby Downs associated with the mine expansion construction workforce (SEIS Table 2.1 – Commitments, pg 64).
 - BHPB would implement a range of measures in conjunction with local service providers to address concerns relating to crime and anti-social behaviour resulting from the expansion (SEIS Table 2.1 – Commitment, pg 65). Examples of initiatives BHPB would implement include:
 - Developing a code of behaviour for Hiltaba Village residents;
 - Developing in collaboration with the police, a proactive community policing-style security and surveillance presence in Hiltaba Village to prevent and respond to incidents;

- Continuing to implement the fitness-for-work program, including routine drug and alcohol monitoring of workers;
- Participation in the development of a plan by the SA Government to address social services and infrastructure; and
- Establishing complaints procedures by which reported incidents of unacceptable behaviour would be investigated.
- BHPB would implement the following additional measures (SEIS Table 2.1 – Commitment, pg 65):
 - Working with local authorities in Roxby Downs to achieve practical outcomes relating to a safe house and/or emergency accommodation;
 - Working with SA Government and appropriate organisations to develop code of practice for alcohol management in Roxby Downs and Andamooka for BHPB workers;
 - Working with the Premier’s Council for Women to develop ways of ensuring women’s safety during the expansion construction period;
 - Participating in a workshop or study on the local impacts of prostitution, if this was organised by the South Australian Police or other key stakeholders; and
 - Working with the Roxby Downs Family and Youth Forum, Roxby Downs Council and the SA Government to develop a youth strategy, with the possibility of extending the programs to Andamooka.
- BHPB would work collaboratively with the SA Government to develop and implement a strategy to provide an appropriate diversity of accommodation to meet the socio-economic requirements of the demographic mix of the Roxby Downs community as it expanded (SEIS Table 2.1 - Commitments, pg 66).
- In collaboration with the urban land and housing development industry, BHPB would meet its obligation pursuant to Clause 21(1) of the *Roxby Downs Indenture (Ratification) Act 1982* with the SA Government “use (its) best endeavours to assist in the provision of the housing needs of such other persons and their dependents who provide services in the town that are ancillary and necessary to the needs of (mining sector) employees and their dependents”. BHPB would develop and maintain a schedule to deliver housing to meet the expected increase in demand from the mine and non-mine workforce. It would also continue to work with the urban land and housing development industry to ensure adequate industry resources were available to meet accommodation requirements, and to influence the cost of land, housing and ongoing operational costs in Roxby Downs (SEIS Table 2.1 - Commitments, pg 66).

8.4.7.3 Assessment

Housing supply and affordability

The Department of Transport, Energy and Infrastructure (DTEI) is responsible for the supply of housing for government employees providing essential services to the Roxby Downs community. DTEI is funded to procure additional housing in the 2011/12 financial year to meet increasing demand. The provision of government employee housing will continue to be monitored and supply adjusted to meet demand throughout the proposed expansion of the Olympic Dam mine.

The AR strongly supports BHPB’s commitment to provide housing vacancy rate of 5 per cent in Roxby Downs to be monitored under the SMP, and recommends a condition in this regard on any approval.

The SA Government requires affordable housing to be provided in all new, large-scale residential developments, which would apply to Roxby Downs. Government would require, at the minimum, a staged approach to providing affordable housing in the town. This approach to housing affordability should be monitored and adjusted through the collaborative SMP.

RECOMMENDATION

The AR supports the measures proposed to manage housing supply and affordability, subject to compliance with the housing provisions prescribed in the Indenture. Further, a condition is recommended that requires the collaborative preparation of an SMP, that amongst other matters, achieves the following housing targets:

- Maintain a minimum rental housing vacancy rate in Roxby Downs of 5 per cent.
- Provide for a minimum of seven per cent affordable rental and home purchase opportunities within all new developments, adjusted in accordance with affordability thresholds provided in the SMP.

It is further recommended that provisions in relation to affordable housing policy for Roxby Downs be reflected in the Ministerial DPA, where possible.

Social character and well-being

Well-being is a broad concept and can have many meanings in terms of social progress. The draft SMP Appendix 3.1 has started the task of developing social well-being indicators for Roxby Downs (SEIS Appendix J1), that include:

- Reducing the rate of victim recorded offences per 1000 people in Roxby Downs;
- Increasing the housing vacancy rate in Roxby Downs to five per; and
- Increasing the number of women employed at Olympic Dam in relation to workforce size.

It is considered that work undertaken by the Australian Bureau of Statistics (ABS) would assist in the development of the well-being indicators for inclusion in the SMP. However, these indicators would be expected to evolve as the expansion project progressed, and as such should be reviewed annually and amended as required.

The AR supports the inclusion of social well-being indicators in the SMP to manage social well-being in Roxby Downs and other affected communities, provided the indicators are reviewed and updated on an annual basis.

Social Management Plan (SMP)

Based on moves in Queensland to regulate SMPs, the approach proposed by BHPB to manage the ongoing social development of the region is considered best practice. The collaboratively prepared and implemented SMP would have to be aligned with existing community development plans and government policies, strategies, programs and services for it to be effective.

The key issues addressed in the FEIS as outlined below should be included in the SMP:

- Housing and accommodation;
- Community health safety and well-being;
- Social infrastructure;
- Workforce matters;
- Employment and economic development;
- Indigenous engagement; and
- Stakeholder engagement.

The AR supports the collaborative implementation approach proposed through the establishment of the 'Social Management Partnership'. The AR also recognises the ongoing role of the Roxby Downs Community Board as the peak community body in Roxby Downs that works towards achieving the community's vision by overseeing the implementation of the Roxby Downs Community Plan. The AR supports BHPB's proposal to include a member from each of the Community Board and Roxby Downs Council on the 'Social Management Partnership' group.

RECOMMENDATION

The AR strongly supports the collaborative preparation and implementation of a Social Management Plan (SMP), as well as BHPB's commitment to participate in the 'Social Management Partnership' to ensure the SMP was implemented appropriately and applied to all project components. The following conditions are recommended to manage social impacts:

- BHPB must collaboratively prepare and implement a Social Management Plan within 12 months from the date of the approval (in consultation with the State Government and key stakeholders) for approval by the Indenture Minister that included measures to achieve the following:
 - Maintain a minimum rental housing vacancy rate in Roxby Downs of 5%;
 - Provide for a minimum of 7% affordable rental and home purchase opportunities within all new developments, adjusted in accordance with affordability thresholds provided in the SMP;
 - Monitor rental rates, rental availability and housing stress in Whyalla, Port Augusta, Andamooka and Woomera;
 - Inclusion of community health and social well-being indicators to manage social well being within Roxby Downs and other affected communities;
 - Thresholds for the delivery and monitoring of social infrastructure provision;
 - Set performance indicators/targets in relation to employment and training;
 - Consultation procedures to facilitate cooperation and consultation with SAPOL in respect to:
 - the percentage reduction in victim recorded crime; and
 - the questions to be asked in the 'perceptions of crime' survey of Roxby Downs and Andamooka;
 - A dispute resolution mechanism that supported an active response to community and stakeholder concerns about social impact issues; and
 - A Stakeholder Engagement Strategy (SES) which contained a list of key stakeholders and describes their interest in the project, actions and outcomes.

The SMP must establish the roles and responsibilities of the proponent, government, stakeholders and communities throughout the life of the project.

- A 'Social Management Partnership' must be established to provide a forum for key stakeholders to discuss and respond to the social effects of the Olympic Dam expansion. At a minimum the 'Social Management Partnership' must include representatives from BHPB, the SA Government, the Roxby Downs Community Board and Roxby Downs Council.

8.4.8 Visual amenity and landscape character

8.4.8.1 Issues

The landscape character of Roxby Downs is arid, bordered by east-west oriented dunes that support White Cypress-pine (*Callitris glaucophylla*) woodland. Native trees surrounding the town and landscaping within screen the distant views of the mine infrastructure to a significant degree. The taller mine infrastructure, such as the stack, is visible from the road just north of the town and elevated sites in town. Aspects of the town's design that enhance its visual amenity are the curved streets; large-scale planting of native shrubs and trees along the streets, in parks and around dwellings; a number of civic parks and public amenities; the golf course; and a well-landscaped commercial centre.

8.4.8.2 BHPB EM Program and commitments

Although no specific commitments have been made by BHPB, the draft Roxby Downs Master Plan outlines detailed strategies to enhance the visual amenity of the town as it expanded, involving built form and landscape and open-space strategies, including preserving sand dunes and natural vegetation.

8.4.8.3 Assessment

The AR considers the proposed expansion of Roxby Downs would be in keeping with the landscape amenity values of the town, and would be further improved by the preservation of dunes and natural vegetation and additional landscaping, as shown in the draft master plan. The proposed layout of growth areas for residential, commercial, recreation and civic purposes outlined in the DEIS would provide continuity between the urban form and surrounding desert landscape.

Should the expansion project be approved the growth of Roxby Downs would be regulated under the requirements of the Roxby Downs Development Plan, including measures to manage building heights, landscaping and design, and would form part of the future assessment process. No conditions are considered necessary as the Development Plan and current Ministerial DPA provided adequate policy provisions to manage the visual amenity and landscape character of the town as it grew.

8.4.9 Waste management

8.4.9.1 Issues

Solid wastes

Disposal to landfill would play a principal role in managing additional solid wastes generated from an expanded Roxby Downs (plus the proposed Hiltaba Village and airport). The expansion project would be expected to increase municipal wastes to about 50,000m³, along with construction waste of about 42,000m³, during the initial phase of the project. The DEIS identified the need for new waste landfill cells at the Opal Rd facility 1.5km north-west of Roxby Downs, with a capacity of at least 2 million m³ required over the proposed 40-year life of the Olympic Dam mine operation. The expanded landfill facility would have three new sections:

- A new landfill cell covering 5.6ha;
- A waste and recycling transfer station of 1.5ha; and
- A non-putrescible landfill cell (containing no decaying organic waste and associated smells) of 3.8ha.

The proposed waste transfer station would be used to segregate recyclable material which would be sent by rail to Adelaide for recycling, maximising both the recovery of resources and the life of the landfill facility.

Town wastewater

The wastewater treatment system would be upgraded and expanded in stages to service an expanded Roxby Downs, the new Hiltaba Village and airport. The system would be designed to cater for the proposed combined peak population of Roxby Downs and Hiltaba Village and then reduced as the construction workforce declined. The daily flow rates at the expanded plant would average 2.9ML/d with a peak of 5.9ML/d. Wastewater treatment would include large aeration and settling/sludge lagoons; tertiary treatment by disinfection and filtration; and irrigation of the golf course, community and sports ovals, and parks and gardens.

8.4.9.2 BHPB EM Program and commitments

BHPB did not make specific commitments on waste management in the FEIS because any expansion of the Roxby Downs infrastructure for solid wastes and wastewater would be a function of the Roxby Downs Council, as owner of the facilities, in accordance with legislative requirements at the time.

8.4.9.3 Assessment

Solid wastes

The Opal Rd landfill is licensed under the *Environment Protection Act 1993*. It opened in the 1980s and was designed to comply with the landfill standards of the time. The construction, filling and eventual closure of new cells would need to comply with the current standard in the EPA guidelines: *Environmental Management of Landfill Facilities* (municipal solid waste and commercial and industrial general waste).

Expansion of the Roxby Downs landfill does not form part of BHPB's Olympic Dam proposed expansion project so this AR can not recommend conditions on any development approval for the expanded facility. Roxby Downs landfill is operated by Roxby Downs Council and the construction, filling and closure of any new cells at the site would need to be done in accordance with EPA licensing requirements, including meeting EPA standards of the day.

The AR considers the proposed solid-waste management proposals are appropriate given the location and nature of the proposed development that would generate the waste. Roxby Downs Council will be responsible for seeking the necessary approvals.

Town wastewater

As with the landfill facility, the proposed Roxby Downs wastewater treatment system expansion and upgrade is not part of BHPB's proposed Olympic Dam expansion project. Following the DEIS the Roxby Downs Council sought and received approval under the *Development Act 1993* to expand the treatment plant to cater for 17,000 people. The EPA set conditions of development approval.

The wastewater treatment plant would be at least 400m from the nearest residence in the proposed town expansion which complies with EPA recommended minimum separation criteria. The proposed irrigation of treated wastewater on recreational and garden facilities in the town would reduce the use of mains water for these purposes. The EPA would continue to licence the Roxby Downs wastewater treatment plant under the *Environment Protection Act 1993* which includes monitoring and reporting requirements.

The AR considers the Roxby Downs wastewater management strategies and facilities outlined in the FEIS comply with EPA environmental standards and are appropriate for this type of location and the predicted maximum volume of wastewater inflow.

8.4.10 Greenhouse gases and sustainability

8.4.10.1 Issues

The draft Roxby Downs Master Plan included the following sustainability principles that should be applied to the growth of the town:

- Making the installation of water-saving appliances and fittings mandatory in all new homes;
- Establishing retention basins in parklands to enable harvesting and reclaiming of stormwater for non-potable applications;

- Applying the principles of water-sensitive urban design;
- Reusing treated effluent from the wastewater treatment plant to reduce the demand on the potable water supply;
- Investigating renewable energy sources in conjunction with State and local government, focusing on domestic photovoltaic cells and/or purchasing renewable energy from electricity generators connected to the National Electricity Market (NEM);
- Making solar water heating mandatory for all new residential buildings, and making it mandatory for all new buildings to comply with Building Code of Australia energy limits;
- Incorporating Department of Planning and Local Government's (DPLG) energy conservation measures into land and building layouts; and
- Incorporating principles of shading and solar orientation into building design to minimise energy use, including wide eaves on new buildings.

8.4.10.2 BHPB EM Program and commitments

BHPB has not made specific commitments in the FEIS in relation to sustainability at Roxby Downs outside of the measures proposed in the draft Roxby Downs Master Plan.

8.4.10.3 Assessment

The AR considers that reasonable design measures and principles have been proposed in the draft Roxby Downs Master Plan to promote sustainability within an expanded Roxby Downs (DEIS Appendix F4 and Figure 5.47). It is recommended that, where achievable, they are reflected the Ministerial DPA.

8.5 Conclusion

The major development declarations for the proposed Olympic Dam expansion specifically excluded the growth of Roxby Downs, including subdivisions, houses, workers accommodation, industrial and commercial uses. The regulation of such development is more appropriately managed at the local level by the council under the provisions of the Roxby Downs Development Plan. The AR supports, in principle, the growth of Roxby Downs and provides a number of policy recommendations outlined below that should be incorporated into the Ministerial DPA to ensure the orderly growth of the town, should the Olympic Dam expansion project be approved:

- Limiting town growth to the north of the existing boundary to minimise potential air-quality impacts;
- Adopting stormwater management principles;
- Providing affordable housing targets;
- Providing design controls to protect the visual amenity and landscape character of Roxby Downs; and
- Including sustainability measures where relevant to future planning decisions.

The AR strongly supports the commitment made by BHPB to collaboratively prepare and implement a Social Management Plan (SMP). To ensure this happened, the AR has recommended a condition of development approval that would require BHPB to collaboratively prepare and implement an SMP that would apply to all components of the proposed expansion project. It has also recommended mechanisms to support the development and ongoing implementation of the SMP, including the creation of the 'Social Management Partnership' group to oversee the preparation/implementation of the SMP that would include representatives from BHPB, SA Government, Roxby Downs Council and the community.

Chapter 9

Pimba Intermodal facility



Chapter 9: Pimba Intermodal facility

9.1 General

9.1.1 Site and locality

The proposed Pimba Intermodal facility would be located 1.1km north of Pimba, partly on the Arcoona pastoral lease (20ha) and partly on vacant Commonwealth land (30ha) held by the Australian Rail Track Corporation Ltd (ARTC). The 50ha required for the Intermodal facility would result in a permanent change in land use. BHP Billiton Olympic Dam Corporation Pty Ltd (BHPB) proposes to lease the land from ARTC and, for the remainder, seek consent from the pastoral leaseholder to use the land or obtain it freehold.

Pimba is a small, remote settlement 7km south-west of Woomera and 95km south of Olympic Dam, adjacent to the Stuart Highway and the Trans Australian Railway. The township of 53 permanent residents, 26 houses and a roadhouse (2006 Census) supports a mix of pastoral and rail transport activities. All other services, including accommodation, are mostly provided from Woomera.

9.1.2 Existing environment

The Intermodal facility would be located in the southern infrastructure corridor of the Environmental Impact Statement (EIS) study area. As a number of project components are proposed for this corridor and the existing environment is largely the same as that described for other key infrastructure items, the description of the environment is provided in this Assessment Report (AR) with all other existing-environment descriptions in Chapter 13: 'Effects on the environment', to avoid repetition.

9.2 Project description - key elements

The location of the Pimba Intermodal facility and rail line were chosen to maximise the use of existing facilities, including the rail network and the Pimba-Woomera rail embankment. The Intermodal facility would allow for most non-oversized construction materials to be moved from Adelaide or interstate to Pimba on the existing rail network before being offloaded and transferred to trucks for delivery to Olympic Dam. The facility could also be used to back-load cathode copper for transport to Adelaide. Short-term storage would be provided for materials such as water pipes, construction materials and chemicals.

The Draft Environmental Impact Statement (DEIS) stated that the transport of construction and mining equipment to Olympic Dam would be primarily by road from the commencement of the construction program until the completion of both the Pimba Intermodal facility and the rail spur line from Pimba to Olympic Dam. Rail would then become the primary mode of transport for equipment and commodities to and from the mine site.

The major components of the proposed Intermodal facility include:

- A hardstand area of crushed rock and/or gravel for loading, unloading and temporary storage;
- A small portable office and amenities building;
- A maintenance shed incorporating a bunded fuel storage area; and
- An additional 400m of rail to allow train access from the main Pt Augusta to Tarcoola line.

The crushed rock for the hardstand area would be sourced from an on-site crusher or from the Axehead quarry in Roxby Downs. A conceptual layout of the proposed Intermodal facility is shown in the DEIS as Figures 5.44 and 5.45.



DEIS Figure 5.44 Indicative configuration of the proposed Pimba intermodal road/rail facility

To build and operate the facility would require the following in terms of water, electricity and workforce:

PIMBA INTERMODAL FACILITY RESOURCE REQUIREMENTS	
Water demand during construction	20ML
Water demand during operation	negligible
Electricity consumption during construction	negligible
Electricity consumption during operation (annual consumption GWh)	16
Peak construction workforce	120 (including rail spur)
Ongoing operational workforce	5 - 10 (80 was quoted in the DEIS but revised in the SEIS)
Total land disturbance	46.8ha

Services required by the facility would include:

- A septic system for the treatment of on-site waste;
- Connections to the potable water network;
- Telephone and internet connections, either to the existing regional network or by satellite;
- Connection to the National Electricity Grid; and
- Temporary storage bins for inert waste before it could be taken to a licensed waste-management facility.

It is expected that the construction workforce for the Intermodal facility and rail line would be housed at Woomera, as would the operational workforce post-construction. The DEIS acknowledged that this option could be limited by the availability of housing for rent or purchase in Woomera, as most housing was owned and managed by the Department of Defence. The DEIS did not discuss options for expanding the housing supply at Pimba.

9.3 Summary of submissions

9.3.1 Public submissions

There were no public submissions on the proposed Pimba Intermodal facility.

9.3.2 SA Government submission

The SA Government submission requested additional information to adequately assess the proposed facility, concerning:

- Dust-management measures proposed;
- Landscaping and buffering measures proposed to protect visual amenity;
- Light spill from the facility and security measures proposed;
- Justification for the location being within 1km of Pimba township;
- Clarification about the proposed wastewater treatment system;
- Impacts on the public road network, including construction and operational traffic;
- Transport and storage of ammonium nitrate; and
- Acoustic modelling to include all possible noise sources from the new activities, including identifying hours of operation.

9.4 Key environmental, social and economic issues

The key environmental impacts associated with the proposed Pimba Intermodal facility include:

- Hazard and risk;
- Noise and air quality;
- Radiation;
- Surface water;
- Waste management;
- Traffic and access;
- Social impacts;
- Visual amenity and landscape character; and
- Rehabilitation and closure.

9.4.1 Hazard and risk

The assessment of the hazards and risks associated with the transport of materials in relation to:

- the movement and handling of ammonium nitrate;
- the transporting of hazardous substances; and
- work, health and safety

is covered in Chapter 11: 'Road transport' in this AR.

The sole 'Hazard and risk' assessment provided here in relation to the proposed Pimba Intermodal facility concerns the transport and temporary storage of sulphur and diesel.

9.4.1.1 Issues

Transport and temporary storage of sulphur and diesel

In the proposed expansion of Olympic Dam, diesel would be transported by rail from Outer Harbour, Port Adelaide, to Pimba where it would be off-loaded at the Intermodal facility for transport to Olympic Dam by road. The DEIS indicated that the transport of sulphur as per the method proposed for diesel could also occur, however, the bulk storage of sulphur at Outer Harbour does not form part of this AR, and should BHPB seek to pursue this option it would have to seek further approvals under the *South Australian Development Act 1993*.

9.4.1.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** No specific commitments have been made by BHPB in either the DEIS or Supplementary Environmental Impact Statement (SEIS) about this issue.

9.4.1.3 Assessment

Sulphur and diesel are combustible materials and would need to be isolated from oxidising agents during transit storage in the lay-down area of the Pimba intermodal terminal.

RECOMMENDATION

The AR considers the short-term storage of sulphur, diesel and other chemicals at the Pimba Intermodal facility before they're moved to Olympic Dam is appropriate subject to BHPB complying with the following recommended condition and note:

- The Pimba Intermodal facility must be designed to ensure that hazardous and dangerous substances are stored in bunded and sealed compound/areas designed to prevent the escape of material into the soil, surface water or underground water resources.
- Note: The SA Environment Protection Agency (EPA) Guideline – Bunding and Spill Management contains information that could help BHPB comply with this requirement.

9.4.2 Noise and air quality

9.4.2.1 Issues

Noise

The DEIS assumed that ambient noise levels measured at Woomera would be relevant to all rural residences affected by the proposed expansion, including Pimba (DEIS Section 14.3.5). Monitoring at Woomera found no significant source of continuous industrial noise and assumed this situation for other rural residences. Minor traffic noise was audible at night but generally background noise levels were very low (33 to 35 dB(A)_{Leq}).

The legislative criteria governing industrial noise in South Australia is the *Environment Protection (Noise) Policy 2007* (Noise EPP), which establishes industrial noise limits for sensitive receivers likely to be affected. Based on the Noise EPP, BHPB determined that the following noise criteria would apply to homes in Pimba:

- 51 dB(A)_{Leq} (day from 7am to 10pm); and
- 43 dB(A)_{Leq} (night from 10pm to 7am).

The Noise EPP requires noise levels to be measured outside a residence, not inside. The SA Environmental Protection Authority considers it appropriate to apply these noise levels in Pimba.

No consideration was given in either the DEIS or SEIS to noise impacts associated with construction and preparation work at the proposed Intermodal facility site. However, it is likely that the distance between the site and homes in the township would be sufficient to minimise off-site impacts from construction activity. Regardless, the Noise EPP (Part 6 Division 1) would apply to such activity which, if it had an 'adverse impact on amenity' would not be permitted on Sundays, public holidays, or outside of the hours of 7am to 7pm on any other day. If noise from construction activity was likely to have an adverse impact on amenity, all reasonable and practicable measures would have to be taken to reduce the impact of the noise.

Operations at the proposed Intermodal facility would result in increased noise levels from rail shunting and materials handling, including from loading and unloading containers and the use of reversing alarms (DEIS Section 14.5.1). Noise modelling undertaken considered the operation of an idling freight locomotive operating 1.1km north of homes, as well as freight impact noise (DEIS Appendix M section 6.4). Based on findings, the DEIS concluded that the applicable noise criteria would be met at Pimba and it was unlikely that noise from the Intermodal facility would have a significant impact on residents (DEIS Section 14.5.2). However, if additional noise generating activities and equipment use were proposed while trains were shunting, the night-time criteria could be exceeded under certain weather conditions (DEIS Appendix M section 6.4).

The state government's submission on the proposed Intermodal facility identified that the proposed site boundary would be only 580m from the nearest home, not 1.1km as modelled. Whilst it is correct that the site boundary would be 580m from the nearest home, the activity would be 1.1km. In response the SEIS stated that the night-time noise criteria could be exceeded in a worst-case scenario, but only if all activities occurred at the site boundary. As this situation would not occur in practice, the modelling was considered appropriate (SEIS Section 15.6).

Air quality

Dust generated from construction activities such as vegetation clearing and site grading, as well as from unsealed areas during operations, would likely be the main causes of air-quality issues (DEIS Section 13.3.5). To manage this BHPB would use low-quality water for dust suppression that could be supplemented with dust-suppressing chemicals applied by water carts or mobile sprinklers to reduce demand for water. Disturbed areas no longer required would be rehabilitated to minimise dust and water use.

9.4.2.2 BHPB EM Program and commitments

Noise

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 3.2:

- **Objective:** No adverse impacts to public health as a result of noise emissions from BHPB's expanded operations.
- **Criteria:** Not applicable to Pimba, as the assessment criteria is specific to Olympic Dam, the desalination plant and the landing facility.
- **Commitments:** BHPB would monitor noise when the Intermodal facility was operational and implement mitigation measures as necessary to meet the noise criteria at Pimba homes (SEIS Table 2.1 - commitments, pg 64).

Air quality

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 3.1:

- **Objective:** No adverse impacts to public health as a result of fugitive particulate emissions from BHPB's expansion activities at Olympic Dam.
- **Criteria:** Meet the average operational contributed PM₁₀ concentration of less than 30 µg/m³ and a 24-hour average of less than 50 µg/m³ at sensitive receptors.
- **Commitments:** No specific commitments provided in relation to air quality at the intermodal facility.

9.4.2.3 Assessment

Noise

Based on the distance between the site and the Pimba residences the AR considered it unlikely there would be adverse noise impacts from construction of the Intermodal facility. No specific noise conditions relating to construction and site preparation are considered necessary as such works would have to comply with the mandatory provisions of the Noise EPP Part 6 Division 1. A note to this effect is recommended for inclusion in any development approval.

The AR considers the Intermodal facility could be designed, sited and operated in compliance with the Noise EPP. It strongly supports BHPB commitments to ongoing monitoring of operational noise to ensure compliance. Acoustic treatments such as double-glazing or insulating dwellings would not aid compliance with outdoor noise criteria specified but are supported as a means of improving the amenity for residents (SEIS Section 15.6).

Air quality

The AR concludes that dust-suppression methods proposed during construction of the Intermodal facility would be suitable given the site boundary would be 580m from the nearest home in Pimba. Rather than specify the need for such methods as a condition of development approval it is considered sufficient to include a note to BHPB (as outlined below) in any decision that highlighted the need to comply with the general environmental duty under the SA *Environment Protection Act 1993* during the construction phase, and that dust suppression by watering or chemical methods were possible ways of achieving this.

RECOMMENDATION

The AR considers the issue of noise and dust during construction and operation of the Intermodal facility proposed for Pimba could be managed effectively subject to compliance with legislative requirements and the following recommended conditions:

- The Pimba intermodal facility must be designed to ensure that it does not generate noise levels at the façades of noise sensitive receivers in Pimba that exceed 51 dB(A)_{Leq} between 7am to 10pm (day) and 43 dB(A)_{Leq} between 10pm to 7am (night) when measured and adjusted in accordance with the *Environment Protection (Noise) Policy 2007*.
- A report, prepared by an acoustic engineer, detailing the methods and results of noise monitoring undertaken post construction, as well as any recommended noise mitigation measures to ensure compliance with the noise criteria contained in condition above must be submitted to the EPA within three months, or within such a time as otherwise approved by the Indenture Minister, of the commencement of operations at the Pimba Intermodal facility. The noise monitoring must be of sufficient duration to encompass all operational situations, including night time operations, the full range of operational equipment noise sources and adverse weather conditions.

The following notes are also recommended:

- The applicant is reminded of its obligation to comply with the construction noise provisions contained in Part 6 Division 1 of the *Environment Protection (Noise) Policy 2007*. These requirements include restrictions on the noise levels that can be generated at certain times of the day and certain days of the week.
- The applicant is reminded of its general environmental duty, as required by section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities associated with the construction and operation of the Pimba intermodal facility do not pollute the environment in a way that causes or may cause environmental harm.

9.4.3 Radiation

9.4.3.1 Issues

The Intermodal facility would be used for the transfer of uranium oxide from road to rail transport before the rail spur to Olympic Dam was completed. As such, workers at the facility could potentially be exposed to radiation above background levels from the sealed containers. It is estimated that radiation levels within 1m from a container of uranium oxide would be 10 μ Sv/hr (DEIS Appendix S2, section 2.4.1). Assuming limited time spent in such close proximity to the containers, the annual dose to workers and members of the public at the Pimba facility would be considered well below the relevant limits of 20mSv/y.

The movement of uranium products has been assessed in greater detail in Chapter 11: 'Road transport' of this AR.

9.4.3.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 3.5):

- **Objective:** No adverse impacts to health of employees or members of the public from exposure to radiation from BHPB's expansion activities.
- **Criteria:** Radiation doses to members of the public less than 1 mSv/y above natural background and 20 mSv/y above natural background for designated workers.
- **Management plan:** BHPB has committed to developing an Incident Response Plan.
- **Commitments:** BHPB would comply with internationally accepted radiation limits for workers and the public and would set a goal of maintaining doses at less than 50 per cent of the internationally acceptable limits for workers (SEIS Table 2.1 - Commitments, pg 54).

9.4.3.3 Assessment

Preliminary soil sampling and gamma dose rate measurements have been conducted at the Pimba intermodal site to establish background radiation levels. The concentrate containment and handling methods proposed by BHPB are considered achievable and would manage the risk of spills or radionuclide contamination to workers. Radiation dose-rate estimates for workers and members of the public are considered reasonable for normal exposure situations.

The AR considers the copper concentrate and uranium oxide handling and containment methods proposed by BHPB are appropriate and, combined with appropriate emergency response and clean-up processes, would prevent contamination at the Pimba Intermodal facility. No conditions of development approval have been recommended in relation to this issue.

RECOMMENDATION

The AR recommends, however, a note to BHPB that highlights the need to incorporate radiation monitoring at the Intermodal facility into the Radioactive Waste Management Plan, which would likely become a licence requirement under the *Radiation Protection and Control Act 1982*, as outlined below:

- It is expected that BHPB would incorporate the following requirements within the Radiation Waste Management Plan that must be approved by the SA Environmental Protection Authority (EPA) as conditions of the licence under the *Radiation Protection and Control Act (1982)* to conduct expanded mining or milling of radioactive ore at Olympic Dam:
 - Conduct background gamma dose rate measurements and soil sampling at representative locations along the rail corridor before operations commence to clearly establish background radionuclide concentrations; and
 - Include routine monitoring of the transport corridors as part of the Radioactive Waste Management Plan.

9.4.4 Surface water

9.4.4.1 Issues

There was no description in the DEIS of any stormwater or surface water management that would occur in the construction and operational phases at the proposed Pimba Intermodal facility. It was stated (DEIS Section 5.9.3) that the site would consist of a compacted rock hard-stand area with a small maintenance shed and bunded fuel storage area for on-site equipment. It was also stated that most non-oversize construction materials and some chemical supplies for the proposed mine expansion project would be transported by rail to the Intermodal facility for subsequent transfer by road to Olympic Dam.

Potential impacts identified in the DEIS during both construction and operation of the proposed Intermodal facility included:

- The risk to surface water quality during construction from soil erosion; and
- The risk to off-site surface water and watercourses during operation from chemical spillage, suspended solids and erosion.

9.4.4.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.4:

- **Objective:** No significant adverse impacts to environmental receptors as a result of stormwater discharges to soil, surface water or groundwater associated with BHPB's expansion activities.
- **Criteria:** All contact stormwater maintained within designated stormwater management areas.
- **Management plan:** BHPB has proposed a Stormwater Management Plan for the Olympic Dam expansion project that does not appear to cover the Intermodal facility.
- **Commitments:** No specific commitment made in relation to this issue.

9.4.4.3 Assessment

Despite there being no reference in the DEIS to stormwater management measures or surface water impacts associated with the proposed Pimba Intermodal facility, the AR considers that water-quality impacts could be managed subject to compliance with the general obligations and associated water-quality criteria contained in the *SA Environment Protection (Water Quality) Policy 2003* (Water Quality EPP). This could require the construction of stormwater detention basins and/or other drainage-control devices. Erosion-control devices would need to be constructed on drainage outlets from the site to ensure that concentrated stormwater runoff would not cause scouring and erosion of downstream drainage lines and watercourses.

Areas planned to store chemicals would need to be sealed and bunded to ensure that any chemical spillages did not penetrate the underlying soil or drain off-site into local surface and/or groundwater resources. Section 9.4.1.3 of this chapter has recommended a condition in this regard.

RECOMMENDATION

The AR considers that stormwater and surface water impacts associated with the proposed Pimba Intermodal facility could be managed subject to compliance with the Water Quality EPP and the following recommended conditions:

- The Pimba Intermodal facility must be designed to ensure erosion-control devices are constructed on drainage outlets from the site to ensure concentrated stormwater runoff does not cause scouring and erosion of downstream drainage lines and watercourses.
- The Pimba Intermodal facility must be designed to ensure the quality of surface water draining from the Pimba Intermodal facility complies with the general obligations and associated water-quality criteria contained in the SA *Environment Protection (Water Quality) Policy 2003 (Water Quality EPP)*.

9.4.5 Waste management

9.4.5.1 Issues

Temporary waste-management facilities would be established on-site during construction of the proposed Pimba facility. When the facility was operational, its solid waste would be collected and taken to licensed waste-disposal facilities, while wastewater would likely be treated on-site in a package treatment plant (modular factory-made system transported to remote sites) and the treated effluent dispersed by irrigation (DEIS Section 5.9.3).

There would likely be building and domestic wastes but no excess soil or rock would be created during construction. With construction workers expected to be accommodated in existing facilities at Woomera, the volume of domestic wastewater for treatment and dispersal at the Intermodal facility would be low during both construction and operation.

9.4.5.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 4.6:

- **Objective:** Minimise general waste generated by BHPB's expansion activities and maximise reuse of general waste, where practicable.
- **Criteria:** Increase the proportion of general waste reuse/recycling.
- **Commitments:** No specific commitments made in relation to this issue.

9.4.5.3 Assessment

The AR considers that the waste management strategies outlined in DEIS are appropriate for the location and the type and scale of the proposed Intermodal facility development at Pimba. The wastewater package treatment plant and treated-effluent irrigation system would need to comply with South Australian on-site wastewater treatment system standards to ensure public and environmental health was protected.

RECOMMENDATION

The AR recommends the following note to BHPB:

- The proposed on-site wastewater management system at the Pimba Intermodal facility must be approved by the relevant authority in accordance with the requirements of the SA *Waste Control Regulations 2010* or equivalent regulatory requirements at the time of application.

9.4.6 Traffic and access

9.4.6.1 Issues

The movement of materials from the proposed Intermodal facility would significantly increase commercial traffic volumes on the Pimba-Olympic Dam road until the proposed rail spur to Olympic Dam was built. However, the Intermodal facility operation would significantly decrease traffic on the road network between Adelaide and Pimba as a considerable portion of loads would be moved by rail instead of road.

BHPB recognised that the design and construction of the Intermodal facility access point to the Pimba-Olympic Dam road had to address the risks associated with introducing additional traffic and new potential conflict points to the existing road system. The DEIS predicted traffic movements on major public roads in South Australia to 2020, where traffic volumes took into account the use of the Pimba Intermodal facility and rail spur (DEIS Figure 19.20). The SEIS provided additional information to satisfy the SA Department of Transport, Energy and Infrastructure (DTEI) that the direct impacts of the Intermodal facility on the public road network could be managed effectively (SEIS Section 22.4).

9.4.6.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** BHPB would provide for the safe and efficient movement of materials and goods in and out of Olympic Dam through the installation of a rail/road Intermodal facility at Pimba (SEIS Table 2.1 – Commitments, page 62).

9.4.6.3 Assessment

The AR supports the purpose of the Intermodal facility being to reduce the volume of traffic on the Princes and Stuart highways, thereby improving traffic movement and enhancing road safety.

RECOMMENDATION

The AR considers that reasonable measures have been demonstrated in the FEIS to manage traffic impacts on the Pimba-Olympic Dam road from the proposed mine expansion, subject to compliance with the following recommended conditions:

- The proponent must comply with the relevant DTEI standards for the access arrangements to and from the Pimba Intermodal facility, with all costs being the responsibility of the proponent.
- The proponent must complete construction, and commence operation of the Pimba Intermodal facility within 2 years from the date of this decision.

It is further recommended that BHPB engage with DTEI early on to determine the extent of road development work required to cater for the additional traffic, before developing final designs for access points and upgrades.

9.4.7 Social impacts

9.4.7.1 Issues

It was originally proposed that construction and operation of the Pimba Intermodal facility would require about 120 workers and 80 workers respectively (DEIS Section 5.9.3). Workers would be housed in existing facilities in Woomera, which would increase the population by 40 per cent, resulting in potential short-term impacts on services and facilities. As at the 2006 Census almost 60 per cent of private dwellings were empty (DEIS Section 19.3.5).

Following the release of the DEIS, the size of the operational workforce for the facility was revised down from 80 to about 5 to 10 staff. BHPB said this workforce would be required only until the proposed rail line was extended from Pimba to Olympic Dam (SEIS Section 21.6). It was likely that operational staff would be long-distance commuters who would be accommodated in short-stay accommodation in Woomera during their rostered work periods. The SEIS also outlined the option of the operational workers and their families choosing to live in Woomera or Roxby Downs rather than Pimba because of the range of accommodation, facilities and services at those locations.

9.4.7.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in the DEIS Appendix U, ID 5.1:

- **Objective:** Communities in which BHPB operates value its citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints are addressed.
- **Management plan:** BHPB would develop a Social Management Plan.
- **Commitments:** BHPB would develop and implement, in collaboration with government and other stakeholders, a Social Management Plan by which to monitor the impacts of the proposed expansion on Roxby Downs and communities in the northern region and identify areas for action (SEIS table 2.1 – Commitments, page 68).

9.4.7.3 Assessment

BHPB would need to consult with the Department of Defence (DoD), the owner and manager of housing in Woomera, ahead of construction of the proposed Intermodal facility to determine both the availability and suitability of housing for workers. The DoD has indicated it would support accommodating mining personnel in the Woomera village given it had done so in the past. It considers that additional residents would have the potential to offset village operating costs, improving the social fabric and increase patronage of services. The supply of leased accommodation to workers would be at the discretion of the DoD and subject to its own operational requirements. The conduct of construction/operation-worker residents would be managed through a code of behaviour which would be part of the accommodation lease.

If it was forecast that available housing would be either insufficient or inappropriate for housing construction workers, BHPB should explore options in the Social Management Plan to house employees locally and discuss the situation with government ahead of proposed construction.

9.4.8 Visual amenity and landscape character

9.4.8.1 Issues

The proposed Intermodal facility would be expected to have a moderate effect on the visual amenity of the landscape, as the structure would be visible for several kilometres because of the open nature of the surrounding plains (DEIS Appendix R1.5.8). The site would also have considerable perimeter fencing in open cyclone mesh that would increase the visual impact of the facility, its equipment and container storage area.

9.4.8.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:** No specific commitments made on this issue.

9.4.8.3 Assessment

While Pimba is not considered a scenic location, its landscape values arise from it being an isolated, quiet township in a vast open plain. Likely impacts on the tourism value of Pimba are difficult to quantify as it is a unique outback destination. However, it is considered the proposed Intermodal facility would be in keeping with the existing railway/transport nature of Pimba and not significantly change its character.

RECOMMENDATION

The AR considers the proposed facility would have an acceptable level of impact on both visual amenity and landscape quality subject to compliance with the following recommended conditions:

- Final designs for the Pimba Intermodal facility must be constructed in accordance with DEIS Drawing G1500 (Pimba Transit Terminal).
- All lighting required on site must be low-profile, directional lighting that illuminates only those areas required to be illuminated.

9.4.9 Rehabilitation and decommissioning

9.4.9.1 Issues

While there was no statement in either the DEIS or SEIS about the long-term use of the intermodal site, it is considered reasonable that it would be used beyond the construction phase of the proposed Olympic Dam mine expansion for short-term storage, such as for fuel, even after the new rail spur from Pimba to Olympic Dam came into use. However, it was expected that BHPB would decommission and rehabilitate the site when it was no longer required for the Olympic Dam mining operation.

9.4.9.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided for this issue.
- **Commitments:**
 - BHPB would update the Rehabilitation and Closure Plan for the existing Olympic Dam operation on completion of the detailed design of the proposed expansion to cover the new project components; and
 - BHPB would continue to consult and engage with government departments and other stakeholders to develop and refine closure criteria, including final land uses, rehabilitation, management and ongoing monitoring. The plan would be reviewed annually and updated if required (SEIS table 2.1 – Commitments, page 57).

9.4.9.2 Assessment

The AR concludes that the decommissioning and rehabilitation of the Pimba Intermodal facility could be adequately managed, and should be detailed in the Olympic Dam Closure and Rehabilitation Plan, to be prepared in consultation with, and for the approval of the Indenture Minister.

9.5 Conclusion

The AR concludes that the proposed Pimba Intermodal facility is an acceptable use of the site, and the facility would not have any significant impact on the community and environs of Pimba. To ensure the appropriate mitigation and management of potential issues covered in this chapter, the AR has recommended conditions on any approval that address:

- The appropriate storage of hazardous and dangerous substances;
- Compliance with noise criteria as set out under the *Environment Protection (Noise) Policy 2007*, including specifying the hours of operation;
- Management of stormwater in accordance with the *Environment Protection (Water Quality) Policy 2003*, including use of erosion-control devices;
- Operation of the Intermodal facility must commence within 2 years from the date of approval;
- Access and transport arrangements; and
- Night lighting to be contained within the site.

A condition has also been recommended requiring the Intermodal facility to be developed in accordance with DEIS Drawing G1500 (Pimba Transit Terminal). Should the final design differ from this drawing it would require a variation from the Minister under the *Development Act 1993*.

Should the Intermodal facility project be approved, further approvals and licensing would be required, including approval of the wastewater treatment system, as identified in notes to BHPB.

Chapter 10

Infrastructure corridors



Chapter 10: Infrastructure corridors

10.1 General

This chapter assesses the key infrastructure needed to facilitate and support the proposed expansion of Olympic Dam, which would comprise:

- Water supply pipelines;
- Electricity transmissions lines;
- Rail spur; and
- Gas supply pipeline.

10.1.1 Site and locality

Wherever practicable the proposed water and gas supply pipelines, electricity transmission lines and the rail spur alignments would be located within or adjacent to existing infrastructure corridors to maximise the use of existing access tracks, reduce habitat fragmentation and minimise impacts on communities.

The proposed southern service corridor alignments for water, electricity and rail, and their proximity to Port Augusta, Woomera and Roxby Downs are shown in the Draft Environmental Impact Statement (DEIS) Figure 5.35.



DEIS Figure 5.35 Insets of major towns related to infrastructure within the southern corridor

The proposed gas pipeline corridor options are shown in DEIS Figure 5.3. Most of the proposed gas pipeline corridor would be located in land defined as unincorporated (out of council), which falls under the management of the Outback Areas Authority. The nearest settlements would be at Marree and the Moomba oil and gas plant. Depending on the preferred alignment, the gas pipeline would affect up to 12 pastoral stations (Option 3).



DEIS Figure 5.3 Major infrastructure elements of the proposed expansion within the gas pipeline corridor options

Should the expansion be approved, BHP Billiton Olympic Dam Corporation Pty Ltd (BHPB) has stated it would investigate potential tenure arrangements, including excising the infrastructure corridors from pastoral leases into a freehold easement, obtaining licenses from the relevant lessees, or other applicable tenure.

10.1.2 Existing environment

10.1.2.1 Terrestrial

The terrestrial environment of the EIS Study Area is described in this Assessment Report (AR) in Chapter 13: 'Effects on the environment', because the descriptions are common across the various components of the proposed expansion of Olympic Dam. The descriptions are not repeated in the individual project component chapters, except for the following description of cultural heritage which is specific to the proposed infrastructure corridors.

Non-indigenous cultural heritage

The DEIS concluded there were no World Heritage properties or Commonwealth Heritage Places within the proposed infrastructure corridors for water, rail and electricity, based on a search of national and State databases and review of heritage information. However, three sites of local significance were identified in the southern service corridor investigation area between Roxby Downs and Pimba, including:

- Purple Downs Homestead ruins;
- Phillips Ponds ruin; and
- Phillips Ponds grave site.

The sites have had no formal heritage assessment and are not protected under the South Australian *Heritage Places Act 1993* (State) or the South Australian *Development Act 1993* (Local).

In the proposed gas corridor investigation area, Blanchewater Homestead ruin was identified as being on the South Australian Heritage Register as a State Heritage Place. It was also listed in the Register of the National Estate. It is an offence to excavate in the vicinity of a listed place without a permit from the South Australian Heritage Council.

The gas corridor investigation area also includes sites listed on the Register of the National Estate for their natural values. They are:

- **Lake Eyre and Environs, Oodnadatta Track, Finnis Springs via Marree (5949):** Listed for its importance as one of the world's largest inland drainage basins, with hydrological, geological and palaeogeographic biodiversity and wilderness significance. Option 2 of the proposed pipeline route travels for some distance through the listed area. This route does not appear to follow existing tracks (DEIS Figures 5.3 and N1.6h in Appendix N);
- **Finniss Springs Mission and Pastoral Station, Oodnadatta Track, Finnis via Marree:** This place is listed for its Indigenous and natural RNE values, which relate to the significant mound springs in the region, including their important flora and fauna;
- ***Eriocaulon carsonii* Sites, Oodnadatta Track, Marree (100955):** *Eriocaulon carsonii* is a nationally endangered plant associated with mound springs in Queensland, South Australia and New South Wales. The species is being monitored in terms of its association with the Great Artesian Basin mound springs. *E. carsonii* is entirely restricted to flowing mound springs (further discussion is provided Chapter 13: 'Effects on the environment' in this AR); and
- **Lake Callabonna Reserve, Mount Hopeless via Lyndhurst:** Lake Callabonna Reserve is an important fossil location for Australia's extinct giant mammals known as 'megafauna' and, particularly, Australia's largest fossil marsupial *Diprotodon australis*. The RNE listing covers Lake Callabonna itself.

Indigenous cultural heritage

The following sites in the gas pipeline investigation area are listed on the Register of the National Estate (RNE) for indigenous heritage values:

- **Finniss Springs Mission and Pastoral Station:** The mission and station, which are listed as separate places in the RNE, are located outside the proposed gas pipeline corridor by about 5km and 3km respectively. BHPB would need to consult with the traditional owners if the proposed gas pipeline corridor was going to affect significant values associated with the site;
- **Lake Eyre and Environs and Cooper Creek Floodplain:** The RNE listings note that the places have indigenous values of national estate significance, but provide no detail. Neither the presence of these RNE-listed places nor their indigenous heritage values are identified in the DEIS;
- **Blanchewater homestead complex:** The RNE listing and DEIS show that the area has strong Aboriginal associations and BHPB would need to ensure that the Aboriginal cultural heritage of the site was considered when it came to submitting final easement plans;
- **Lake Callabonna Reserve, Mount Hopeless via Lyndhurst;** and
- ***Eriocaulon carsonii* Sites (Hermit Hill Mound Springs).**

The following 11 places of local significance were identified in the gas corridor investigation area:

Clara St Dora Mine ruins*	Hayes Hill trig marker
Alberrie Creek Siding	Junction Well and hut*
Muloorina Homestead	Mount Hopeless Homestead
Dulkaninna trig marker*	Montecollina Homestead ruins
Lake Boocaltaninna Mission ruins	Carraweena Homestead Ruins
Clayton Homestead	

* Denotes places that have been assessed in either *the Oodnadatta Track Heritage Survey (2001)* or the *Birdsville & Strzelecki Tracks Heritage Survey (2002)* as potentially fulfilling the criteria for listing as local heritage places. The remaining places have not been subject to a formal heritage assessment.

None of the 11 places are protected under South Australian *Development Act 1993*. However, the DEIS stated the proposed routes for the infrastructure corridors were chosen for being far enough away from the sites that they would not be disturbed.

This AR outlines the legislative framework for managing indigenous issues, including cultural heritage matters, in Chapter 12: 'Effects on communities'.

10.2 Project description – key elements

10.2.1 Water supply pipeline

BHPB has sought approval to develop a 320km water supply pipeline from the proposed Point Lowly desalination plant to Olympic Dam. Existing and new feeder pipelines would distribute water to the various project components, including to supply Hiltaba Village and the new airport. Construction of the pipeline would require a short-term change in use of 1485ha of land. As all but 1.5km of the 320km pipeline would be underground any long-term change in land use would be limited to small sections where the pipeline would be on the surface, at water crossings (6 ha) and pump stations (4 ha). Post-construction land-use would return to its previous state.

In the area between Point Lowly and Port Augusta, the pipeline would pass through a mix of pastoral, Crown and freehold land. It is proposed the pipeline would be aligned in Crown land adjacent to the southern boundary of the existing Cultana Training Area (CTA) for 9km and cross the proposed CTA expansion area for 33km (DEIS Figure 9.17).

Between Port Augusta and Olympic Dam it would be aligned where practicable with the existing electricity transmission line. It would also cross the Woomera Prohibited Area (WPA) for 15km, for the most part in the electrical transmission corridor which BHPB holds freehold. While high-impact weapons testing could not occur in areas carrying the proposed pipeline, the movement of defence vehicles, including tanks, could continue.

The proposed specifications of the water supply pipeline are provided in the table below:

WATER PIPELINE SPECIFICATIONS	
Diameter of pipeline (m)	1.4
Average width of corridor/easement (m)	40
Typical width of disturbance within the easement (m)	20–35
Approximate total length of sections above ground (km)	1.5
Depth of excavated trench (m)	2.0–3.0
Average width of excavated trench (m)	2.0
Total length of the trench open at any given time during construction (km)	up to 5
Maximum operating pressure (kPa)	4000
Number of pumping stations	3
Number of pipe stacking sites	50

10.2.1.1 Construction and operation

To build and operate the water supply pipeline would require the following in terms of water, electricity and workforce:

WATER PIPELINE RESOURCE REQUIREMENTS	
Water demand during construction (ML)	485–590
Water demand during operation (GL/a)	Negligible
Electricity consumption during operation (Annual consumption GWh)	154
Peak construction workforce	100
Ongoing operational workforce	2
Total land disturbance (ha)	993

Water would be used during construction for hydrostatic testing of the pipeline (85-90ML), first-flush testing (400-500ML), plus small volumes for dust suppression and concrete manufacture. Supply options for testing and concrete manufacture would include:

- Water generated during commissioning of the Point Lowly desalination plant;
- Water from the Olympic Dam desalination plant;
- Water from the State potable water network; or
- A combination of the above.

Water for each new section of pipeline would be drawn from the tested adjacent section, with 'make-up' water added to replace the small amount lost through leakage. Following hydrostatic testing, the pipe would be filled completely for first-flush testing. This would require 400ML to 500ML of water sourced from either the State potable water network or from the proposed new desalination plant commissioning. The first-flush water would be screened for debris before being sent to the process water storage dams at Olympic Dam. Water used for dust suppression would be sourced from saline aquifers.

Temporary facilities, including lunch rooms and sanitary facilities would be constructed at each pumping station site, and mobile facilities would be provided at the pipeline construction sites. The workforce would be accommodated at Whyalla, Port Augusta, Woomera and Roxby Downs. No on-site accommodation camps would be necessary.

Three pumping stations are proposed at intervals of 50-100km along the pipeline route in addition to the main pumping station at the desalination plant (DEIS Figure 5.33). Each station would be located next to the pipeline easement, within a fenced 1.2ha compound. Concrete-slab foundations and a 35m by 20m structure would be built to house pumps and related equipment. Electrical substations would be built next to each pumping station, in the fenced compound.

An estimated four surge tanks, covering an area of up to 90m by 70m, would be needed to release water into the pipeline during emergency shutdowns. The tanks would likely be covered with a lightweight steel roof to reduce evaporation and exclude vermin and native fauna. Permanent fencing and gates would be erected around the tank site boundary.

BHPB has proposed delivering the 12-13.5m long steel pipe sections directly to the pipeline easement. In some situations, however, pipe would need to be stacked temporarily in lay-down areas. These sites could be every 5-10km along the pipeline corridor and occupy an area of 200m x 200m. Each site would be cleared and prepared with a 200mm layer of compacted quarry rubble or similar base to ensure flat, all-weather access.

The proposed pipeline would be buried about 0.5m underground for most of its length in a 2m-wide trench. The excavated material would be stockpiled next to the trench to be used as backfill. Excess material would be spread and contoured where required, with topsoil and cleared vegetation used to retain the seed bank and promote regeneration, and any excess spread over the easement.

At any one time there would be about 1km of open trench at each work site, depending on the soil type and amount of rock encountered. Four to five work sites could operate concurrently and a variety of excavation methods could be used for areas crossing watercourses, roads and major infrastructure corridors. This would be determined by the construction contractor and could include open trenching, boring or directional drilling.

Small sections of the pipeline, totalling 1.5km, would remain above ground, particularly those intersecting with watercourses such as the inlets to Lake Windabout and Pernatty Lagoon. They would be supported on pre-cast concrete plinths or culverts to keep them above flood levels.

Post-closure of Olympic Dam the proposed water supply pipeline from the Point Lowly desalination plant to Olympic Dam could continue to be used to supply water to regional centres in northern South Australia. It is unlikely, though, there would be continued use of the pipelines from the Great Artesian Basin wellfields to Olympic Dam, and decommissioned pipeline easements would revert to pastoral use in accordance with BHPB's Rehabilitation and Closure Plan.

10.2.2 Electricity transmission lines

The construction and operation of the proposed open-pit mine, metallurgical plant and associated infrastructure at Olympic Dam would require an increase in the electricity supply from the current 125MW to 650MW, resulting in annual electricity consumption increasing from 870GWh to 4400GWh. While the existing 275kV transmission line has spare capacity to meet the additional demand in the first few years, it would not have enough capacity to deliver the total increase in electricity required to power the expanded mine operation.

BHPB has sought SA Government approval for three supply options:

- **Option 1:** Construction and operation of a new 275kv electricity transmission line from Port Augusta to Olympic Dam, with the maximum capacity of 600MW sourced from the national electricity market;
- **Option 2:** Construction and operation of a 600MW on-site combined cycle gas turbine (CCGT) power plant using gas from the Moomba gas hub via a dedicated pipeline to be constructed on one of three proposed routes (DEIS Figure 5.3); and
- **Option 3:** A hybrid of Options 1 and 2, providing maximum operational flexibility.

It has also sought approval to construct a new 132kV transmission line from the Cultana substation to service the proposed desalination plant.

In addition, BHPB has proposed installing a co-generation plant to recover waste heat from the acid-plant gas converters and other sources of steam. This could reliably generate between 100MW and 250MW, reducing the required base load supply. The proposed plant is detailed in Chapter 4: 'Mining operations and processing' of this AR.

10.2.2.1 Construction and operation

To build and operate the proposed transmission lines from Port Augusta and Cultana would require the following in terms of water, electricity and workforce:

ELECTRICITY TRANSMISSION LINES RESOURCE REQUIREMENTS	
Port Augusta to Olympic Dam line	
Water demand during construction (ML)	50
Water demand during operation	Negligible
Electricity consumption during operation (line losses) (annual consumption GWh)	61
Peak construction workforce (combined for both lines)	90
Ongoing operational workforce	2
Total land disturbance (ha)	337
Cultana to Point Lowly line	
Water demand during construction	Negligible
Water demand during operation	Negligible
Electricity consumption during operation (line losses) (MWh)	2000
Ongoing operational workforce	Nil
Total land disturbance (ha)	13

A 5m cleared easement would be needed for the transmission towers, requiring a total 166ha of vegetation to be cleared to allow for the installation of the towers and associated substations. Low-quality water used for the construction of foundations and dust suppression would likely be sourced from existing and new saline groundwater wells along the alignment. Potable water for domestic use and concrete manufacture would be sourced from the Olympic Dam desalination plant and/or the State water network. The workforce would be accommodated at Whyalla, Port Augusta, Woomera and Roxby Downs, so on-site camps would not be necessary.

Following construction of the transmission line, the site would be rehabilitated by removing extraneous material, contouring, and respreading topsoil and cleared vegetation. Vegetation would be allowed to regenerate under the transmission line. While there could be disruption to pastoral land-use during construction, pastoral activities would continue in the long term.

The transmission line would need minimal maintenance. Access tracks would be retained for tower inspection and maintenance activities and the towers would be inspected annually through a helicopter-based thermal imaging program.

Port Augusta to Olympic Dam line

The construction of the proposed 275kV transmission line from Port Augusta to Olympic Dam would be similar to the existing 275kV line, with the two separated by a distance of 30-170m (DEIS Figure 5.34). The 700 free-standing steel lattice towers, each 40m tall, would be fabricated and galvanised off-site and delivered to each tower site for assembly and erection.

A 30m x 40m area would be cleared for the footings and pre-assembly and to erection of each tower. Outside of the towers the cleared area along the transmission line easement would be reduced to a central strip averaging 5m in width. Another 5m strip would be cleared for a construction and maintenance access track. Ten temporary 1ha storage depots would be built along the corridor to house temporary site offices, moveable concrete batching plants and concrete trucks.

Cultana to Point Lowly line

The 25km transmission line from Cultana to the desalination plant at Port Lowly would be carried on 60 towers 20-30m tall and service the plant's 35MW power. Construction requirements of the 132kV transmission line would be the same as for the 275kV line without the need for temporary storage depots.

10.2.3 Pimba to Olympic Dam rail spur

The proposed new 105km rail spur between Pimba and Olympic Dam, to connect Olympic Dam to the national rail network, is intended to carry sulphur and diesel to the mine site and processed product from the mine site. A new rail terminal at Olympic Dam would include large lay-down and bulk loading facilities for copper concentrate, and unloading facilities for sulphur and diesel. The rail spur would not be able to carry large or Over Dimensional (OD) loads. Specifications include:

RAIL SPUR SPECIFICATIONS	
Maximum width of corridor (m)	150
Average width of disturbance in the easement (m)	30
Length of trains (km)	1.4-1.8
Number of wagons	65-80
Maximum speed (km/h)	110

10.2.3.1 Construction and operation

To build and operate the proposed rail spur would require the following in terms of water, electricity, fuel and workforce:

RAIL SPUR RESOURCE REQUIREMENTS	
Water demand during construction (ML)	500
Water demand during operation	Negligible
Electricity consumption during operation	Negligible
Diesel consumption during operation (ML/a)	36.5
Peak construction workforce(including Pimba intermodal)	120
Ongoing operational workforce (including Pimba intermodal)	5-10
Total land disturbance (ha)	444

The proposed rail alignment would be surveyed and the total 270ha of easement cleared of vegetation and, post-construction, revegetated using cleared topsoil and vegetation. Access to the rail corridor would be primarily by stub roads from the Pimba to Roxby Downs Road. The rail corridor would be built on average 1m above natural ground level, using fill primarily sourced and crushed on-site, to withstand a 100-year (ARI) rainfall event (1-in-100-year downpour).

Pre-cast concrete railway sleepers and steel rail manufactured off-site would be delivered to a temporary lay-down facility at Olympic Dam or the Pimba Intermodal facility before being delivered by road or rail to the laying site, where track would be welded.

Water would be sourced primarily from groundwater wells along the alignment. Potable water for workers and concrete manufacture would be sourced from either the existing desalination plant at Olympic Dam or the State water supply network at Woomera and transported to sites in water carts. Construction workers would be accommodated at either Woomera or Hiltaba Village. Temporary facilities would be established at work sites. Solid wastes would be consigned to licensed waste disposal facilities, with wastewater likely to be treated at an on-site package treatment plant and the treated effluent dispersed by irrigation or evaporation.

Following the commissioning of the proposed rail spur, BHPB road traffic would be expected to reduce to lower than pre-expansion levels. The new railway would allow greater volumes of sulphur to be transported from Adelaide and processed product (including copper concentrate) to be transported to the Port of Darwin for export. Weekly train movements to Adelaide's Outer Harbor and the Port of Darwin during and following the expansion are projected at 28 and 14 respectively for trains of between 1.4km and 1.8km in length. Maintenance works during operation would be minimal.

10.2.4 Gas supply pipeline

The natural gas required to operate the proposed gas turbine power station (Option 2) would be sourced from the Moomba gas hub through a new pipeline. The gas would come to Moomba from one or more of the major gas production wells connected to the hub, or from Queensland through Epic Energy's Queensland/South Australia/ New South Wales Link Pipeline.

The proposed new pipeline would be underground for most of its length except for small sections at valves, which would allow sections of pipeline to be isolated in emergencies, and scraper stations that would allow for devices to be inserted to clean sections of pipe or detect damage.

BHPB has sought approval for three alternative gas supply alignments from Moomba to Olympic Dam (DEIS Figure 5.3), comprising:

- **Option 1:** 440km directly from Olympic Dam to Moomba;
- **Option 2:** 400km from Olympic Dam linked to the existing Moomba-Adelaide pipeline at an existing compressor station (CS2); or
- **Option 3:** 560km from Olympic Dam to Moomba via CS2 and a pipeline to Moomba from that point parallel with the Moomba-Adelaide pipeline.

BHPB is yet to make a decision on whether to proceed with the power station. If it went ahead, construction would start in approximately year four and take two years to complete. Specifications include:

GAS SUPPLY PIPELINE SPECIFICATIONS	
Above or below ground	Predominantly below ground
Pipeline material	Steel
Length (km)	400–500
Average width of corridor/easement (m)	30
Average width of disturbance within easement (m)	20–30
Length of sections above ground (m)	100
Volume of transported gas (PJ/a)	45
Diameter of pipeline (mm)	350–400
Depth of excavated trench (m)	1.2–1.7
Average width of excavated trench (m)	0.9
Total length of open trench at any time during construction (km)	Up to 30
Depth to top of buried pipeline (m)	0.7–1.2
Depth to top of pipeline at road crossings (m)	1.2
Number of compressor stations	1
Distance between pipe stacking sites (km)	5

10.2.4.1 Construction and operation

To build and operate the proposed gas supply pipeline would require the following in terms of water, electricity, and workforce:

GAS SUPPLY PIPELINE RESOURCE REQUIREMENTS	
Water demand during construction (ML)	200
Water demand during operation (ML)	Negligible
Electricity consumption during operation(MWh/a)	Negligible
Peak construction/shutdown workforce	100
Ongoing operational workforce	2

An estimated 1342-1686ha of land would be disturbed in the construction of the gas pipeline from Moomba to Olympic Dam, depending on the route chosen. Vegetation along the pipeline easement would be cleared and tracks built to provide access for pipeline installation equipment. Deep-rooted vegetation would be removed within a distance of 3m either side of the mid-line of buried pipeline sections to prevent possible damage to the pipe. Grass and other shallow-rooted vegetation would be allowed to regenerate post-construction. Marker posts would be installed next to the pipeline at distances in accordance with Australian Standard 2885 Pipelines - Gas and Liquid Petroleum.

Pre-coated 18m-long steel pipe sections would be delivered to the pipeline easement for stringing (placing sections end to end in preparation for welding) to avoid storage and double-handling. Some temporary storage sites could be required every 5km along the pipeline easement, each occupying an area of 100m x 50m. A wheel trencher, rock saw or large excavator would be used to dig the trench, and trenching, boring or directional drilling could be used for areas crossing watercourses, roads and major infrastructure corridors. Around five work sites could be operational at any one time.

Construction workers on the proposed pipeline would be accommodated in up to four mobile camps, the locations of which would be determined at the detailed design stage. Typically the camps would comprise transportable buildings with communal mess facilities. Site selection would be undertaken in consultation with landowners and would avoid homesteads and environmentally and culturally sensitive areas (DEIS Section 9.5.3). Solid waste from the camp sites would be collected and taken to licensed waste disposal facilities. Wastewater would be treated by an on-site package treatment plant and the treated effluent dispersed by irrigation or evaporation. Accommodation would generally accord with the objectives and principles of development control for short-term worker accommodation in the Land Not Within a Council Area – Eyre, Far North, Riverland and Whyalla Development Plan (DEIS Section 19.5.3).

Hydrostatic testing of the pipeline would be undertaken at the completion of construction to assess strength and potential leaks in accordance with the requirements of AS 2885. Testing would use 20ML of water (DEIS Section 5.8.6). On completion of testing the pipeline would be emptied and dried. The first flush of water through the pipeline would be screened before being discharged and the testing water would be collected in on-site water storage tanks to be reused at the existing metallurgical plant.

Most of the 20ML of water required for hydrostatic testing and dust suppression during construction would be sourced from wastewater recovered at the Moomba gas refinery (BHPB's preferred option) or from Olympic Dam. Additional water for dust suppression would be obtained from local saline wells.

Should BHPB get approval and decide to proceed with the power station and gas pipeline, it would need to apply for a Pipeline Licence under the *Petroleum and Geothermal Energy Act 2000*. The application would have to provide detailed information on the final pipeline route, typically in the form of an Environmental Impact Report (EIR). On the basis of the information contained in the EIR, BHPB would need to develop a draft Statement of Environmental Objectives (SEO) and submit it to the Department of Primary Industries and Resources of South Australia (PIRSA). PIRSA would consult with stakeholders on the EIR and draft SEO before the SEO could be approved by the Minister and the Pipeline Licence granted.

10.2.5 Infrastructure Corridor from Roxby Downs to Hiltaba Village and the airport

Essential infrastructure to service Hiltaba Village and the airport including water, sewer, electricity (and optical fibre cable) is proposed to be provided via connection to services in Roxby Downs. The services would be supplied via a 25km long and 10m wide service corridor from Roxby Downs. All services would be installed within the existing road corridor and, apart from the electricity transmission line, would be buried underground. The electricity towers would require about 5ha of land.

The proposed infrastructure corridor alignments are shown on DEIS Figure 5.5 and SEIS Figure 5.13.

10.3 Summary of submissions

Very few public and government submissions were received on the proposed infrastructure corridors. Those received from the public reflected the SA Government's submission that raised the following issues:

- Insufficient information was provided regarding management measures to enable assessment in accordance with Section 98 of the *Petroleum and Geothermal Energy Act 2000*. Additional detailed information would be required in support of a Pipeline Licence application;
- Confirmation required to support that the selection of the pipeline route alignments were chosen to minimise vegetation clearance;
- Additional information was required on management strategies to control wind erosion;
- Clarification was required on the level of consultation undertaken with affected pastoralists regarding the gas pipeline; and
- The potential impact on South Australia's electricity baseload supply, as well as the network stability and system security.

10.4 Key environmental, social and economic issues

The key environmental impacts associated with the proposed infrastructure corridors for water, gas and electricity supply include:

- Hazard and risk;
- Air quality;
- Transport of radioactive product;
- Terrestrial impacts;
- Surface water;
- Noise and vibration;
- Visual amenity and landscape character;
- Waste management;
- Impacts on pastoral uses;
- Impacts on Department of Defence land; and
- Rehabilitation and closure.

10.4.1 Hazard and risk

10.4.1.1 Issues

Electricity supply and network stability and security

BHPB is South Australia's largest single power consumer, with a power demand of 120MW. The electricity required to power the underground mine and proposed expansion at full production would be 690MW. The size of the proposed expansion and associated increased energy demand are issues which need to be addressed in terms of ongoing network system stability in South Australia. This would require active assessment and management to minimise potential impact on the system and must be a key consideration in the final design of BHPB's proposed power solution.

BHPB would need to ensure network system stability issues were addressed in its discussions with the Technical Regulator and Australian Energy Market Operator regarding the National Electricity Rules (NER), the technical standards in the Rules applicable to it either as a customer or as a generator, and the interface with the South Australian Electricity Transmission Code. To manage this requirement, there would likely be a need for BHPB to make additional investments as part of the initial design of the expansion project to ensure that credible contingencies associated with its infrastructure would not impact on other customers connected to the national electricity network.

The issue of the overall stability of the grid should be a key consideration in the design stage of the proposed project, as it would help manage BHPB's operational impacts as well as broader system issues. These options are most easily incorporated at the least cost in the early stages of design.

BHPB has stated it would construct its power-supply needs in a manner that does not significantly impact other users (SEIS Section 32.2.3). This could require it constructing new connections to the ElectraNet transmission network or modifying existing connections. BHPB would ensure the connections were designed for compliance in relation to its operations and the requirements of the NER in relation to network stability, and would work with the relevant Technical Regulator and the Australian Energy Market Operator to achieve this.

Managing risks

Managing the risks associated with the expansion project would involve BHPB developing contingencies for events affecting the power system that would likely involve removing a generating unit or transmission element from service. Contingencies in the National Electricity Market (NEM) are categorised into two areas:

- Credible contingencies, which are events likely to occur and must be managed without affecting other customers; and
- Non-credible, or multiple contingency events which are less likely but still possible.

For the proposed Olympic Dam expansion project it is considered that an appropriate starting point would be an examination of the largest single credible contingency. This would involve looking at the detailed design at a transmission, sub-station and local network level and the related protection arrangements to identify the largest load at risk of imposing an over-frequency/over-voltage type risk on the rest of the power system. It would also involve examining any on-site generation and reactive support arrangements, such as the ability to keep the system energised with appropriate power quality at anytime, and the risk of under-voltage/under-frequency type events when this capacity was lost. The convention under the NER is that credible contingencies should not lead to involuntary load shedding.

As these events can not be managed through involuntary load shedding, appropriate investment and contingency measures should be factored in to the initial design of the proposed mine expansion to ensure credible contingencies did not impact on other network customers. An unplanned outage of a significant piece of infrastructure, for example, such as an on-site generator or a crushing mill, should not result in the loss of the entire Olympic Dam load and, thereby, affect the rest of the network.

Non-credible or multiple contingencies related to the mine expansion would also have to be examined. A multiple-contingency event, such as the trip of both circuits of the double-circuit line or a bus fault in a substation, could lead to the sudden loss of the entire load. The NER and operating practice require the need for automatic load and/or generator shedding to protect the system in these circumstances. These actions seek to protect the system from catastrophic failure.

10.4.1.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided in relation to this issue.
- **Commitments:** No specific commitments made in relation to this issue.

10.4.1.3 Assessment

The existing regulatory framework accommodates and defines system security and reliability requirements for significant electricity demand or generation expansions. The NER and South Australian Electricity Transmission Code place performance obligations on transmission service providers such as ElectraNet to ensure that power quality and system security are ensured at all points in the network. Additionally, Registered Participants in the National Electricity Market (NEM) are obliged to operate their equipment in a manner that helps prevent or control instability in the power system. The SEIS addressed this issue briefly in response to submissions from the SA Government.

RECOMMENDATION

The AR considers the matter of electricity stability and security should be managed through BHPB complying with technical standards in the NER to the satisfaction of the relevant Technical Regulator. Accordingly the following condition has been recommended:

- To ensure electricity stability and network security, the proponent must comply with the technical standards in the National Electricity Rules (NER) to the satisfaction of the Technical Regulator (as the Jurisdictional System Security Coordinator).

10.4.2 Air quality

10.4.2.1 Issues

Construction impacts

The construction of the proposed infrastructure corridors for water and gas supply and, to a lesser extent, the electricity transmission line and rail spur would likely lead to increased dust. The DEIS said these impacts were not considered significant because of the considerable distance between dust-generating activities and the nearest sensitive receivers, combined with the use of dust-suppression measures such as watering construction areas and rehabilitating disturbed areas. Post-construction, no dust above ambient levels was expected because the trenches would be filled and revegetated to their original condition.

Rail Transport

Both the DEIS (Section 5.9.5) and the SEIS (Section 26.1.1) stated that BHPB propose the use of a closed system for the transportation, handling and loading of copper concentrate, due to the low concentrations of uranium, which triggers the requirement for the material to be handled and transported as a radioactive substance. As a consequence, rail wagons would be fitted with dust covers and watertight lids and loaded/unloaded in sheds designed to avoid dust release (i.e. fitted with dust extraction equipment). Section 5.9.5 of the DEIS also stated that all wagon rolling stock used to transport elemental sulphur from Outer Harbour to Olympic Dam would also be sealed to avoid sulphur escape under routine transport conditions.

10.4.2.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 2.3:

- **Objective:** No adverse impacts to health of employees or the public from exposure to radiation as a result of BHPB's expansion activities.
- **Criteria:** Radiation doses to the public less than 1 mSv/y above natural background and 20 mSv/y above natural background for designated workers.
- **Commitments:** A closed system would be used to transport, store and convey concentrate from Olympic Dam to the holds of ships at the Port of Darwin (SEIS table 2.1 – Commitments, page 61) including:
 - Rail wagons would be sealed with fitted covers so concentrate would not escape during routine transport; and
 - Water used to wash the outside of the rail wagons would be collected and reused. Solids from the water would be placed on the concentrate stockpile and, when required, water would be returned to Olympic Dam for disposal.

10.4.2.3 Assessment

Construction impacts

The AR considers the proposed alignments and construction methods for the gas and water supply pipelines, rail spur and electricity transmission lines are acceptable based on the information contained in the FEIS, contingent on:

- Dust mitigation and minimisation strategies being implemented;
- Pesticides being applied in accordance with best-practice guidelines; and
- Disturbed areas being rehabilitated.

The AR concludes that reasonable measures have been demonstrated in the DEIS to manage potential impacts from dust during construction of the infrastructure corridors, and no conditions of development approval are required.

RECOMMENDATION

The AR recommends the following note to BHPB highlighting the need to comply with the general environmental duty under the SA *Environment Protection Act 1993*, particularly in relation to dust management:

- BHPB is reminded of its general environmental duty, as required by section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure activities associated with the proposed construction and operation of infrastructure corridors would not pollute the environment in a way that caused or could cause environmental harm. Particular care should be given to dust management and soil erosion controls, including rehabilitation of disturbed areas, during the construction process.

Rail Transport

The AR considers that BHPB's proposed closed transportation system for transporting and handling copper concentrate and sulphur is an appropriate way of ensuring that there is no dust release and deposition along train lines and near handling areas. In order to ensure that such a system is implemented, the AR has recommended a condition of development approval that requires the use of rail wagons that achieve containment with no release, for the transportation of copper concentrate and sulphur to and from Olympic Dam. A note to BHPB has also been recommended regarding the need to comply with the general environmental duty under the SA *Environment Protection Act 1993*, as referred to in the note above (which includes the need for suitable dust management) during construction and operation of such roads.

RECOMMENDATION

Accordingly, the AR considers that the issue of dust (air quality) from the movement of material via rail can be managed effectively subject to the measures proposed in the DEIS and SEIS (as listed above) and the following condition:

- Rail wagons used for transporting sulphur and copper concentrate to and from Olympic Dam must achieve no release containment.

10.4.3 Transport of radioactive product

10.4.3.1 Issues

In relation to the movement of copper concentrate from Olympic Dam for export out of Darwin, BHPB determined that the most cost efficient and environmentally suitable manner would be through the use of bulk rail wagons with purpose designed lids and seals. Each wagon would be emptied at the end of the journey at the Port of Darwin by removing the lid as the wagon moved into the tipping mechanism. Notably the rail movement through the Northern Territory and the export of the copper concentrate out of the Port of Darwin do not form part of this AR, and readers should refer to the Northern Territory AR for the assessment of the 'Northern Territory Transport Option'.

In this regard, one of the key issues raised in government and public submissions was the potential for the build-up of contamination, or spillage of copper concentrate along transport corridors as the material contains low levels of radionuclides (uranium, radium, etc).

Specifically in relation to the spillage of copper concentrate on transport routes, the SEIS stated that it would be treated similarly to any incident involving a metal concentrate. To minimise the spread of material any exposed concentrate would be covered with tarpaulins and the area would be secured. A team from BHPB would assist local emergency response crews with the clean-up. The SEIS further stated that as radiation exposures to workers during clean-up would be well below the dose limit for members of the public that standard precautions and clean-up methods could be used. BHPB indicated in the SEIS that they would provide the necessary additional training for emergency response personnel along the route.

The FEIS included the following assessment of radiation exposure resulting from transport of radioactive material:

- The DEIS (Appendix S2) identified external gamma as the main exposure pathway to workers in the transport of uranium oxide estimating a conservative dose of 1 $\mu\text{Sv/h}$ within the truck cabin. For a driver who makes 100 eight-hour trips with uranium oxide a year, the total dose is estimated to be about 0.8 mSv. For the public, doses are expected to be significantly lower (fractions of microsieverts) as uranium oxide containers pass by.
- The DEIS (Appendix E4) identified external gamma and inhalation of radon decay products and radioactive dusts as the main exposure pathways for workers and the public from the transport and storage of copper concentrate (i.e. ore without the uranium removed) for the NT transport option.
- The DEIS (Appendix S2) identified the main exposure pathway in the non-human environment as stemming from the long-term deposition of radioactive dusts.
- The DEIS (Chapter 22) discussed accidents in relation to the transport of uranium oxide, with an overview of the management process provided.
- The DEIS (Chapter 22) and Appendix E4 described the transport by rail of copper concentrate (i.e. ore without uranium removed) and provides an overview of the management process in the event of a transport accident.
- The SIES (Chapter 25) provided additional detail on the response to a transport incident involving copper concentrate and radioactive material, including estimates of doses received under accident conditions. It identifies external exposure and inhalation of dust as the major exposure pathways, concluding that doses to emergency workers would be well below the public dose limit.
- The SIES (Appendix I1 and I2) provided an Emergency Response Plan for accidents in the transport of Class 7 radioactive material and a Radioactive material Transport Management Plan, respectively.

10.4.3.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 2.3:

- **Objective:** No adverse impacts to health of employees or the public from exposure to radiation as a result of BHPB's expansion activities.
- **Criteria:** Radiation doses to the public less than 1 mSv/y above natural background and 20 mSv/y above natural background for designated workers.
- **Management plan:** The Transport Plan for Uranium Oxide from Olympic Dam to Shipping Ports would be updated to ensure requirements for safely storing and transporting uranium oxide, including the emergency response to incidents occurring along transport routes. The plan would also describe the roles and responsibilities of the agencies involved. A new Transport Plan for Copper Concentrate would be developed in consultation with appropriate authorities and include transport precautions and emergency procedures.
- **Commitments:** A closed system would be used to transport, store and convey concentrate from Olympic Dam to the holds of ships at the Port of Darwin (SEIS table 2.1 – Commitments, page 61) including:
 - Rail wagons would be sealed with fitted covers so concentrate would not escape during routine transport; and
 - Water used to wash the outside of the rail wagons would be collected and reused. Solids from the water would be placed on the concentrate stockpile and, when required, water would be returned to Olympic Dam for disposal.

10.4.3.3 Assessment

It is noted that preliminary soil sampling and gamma dose rate measurements have been conducted at the Pimba Intermodal site. The AR considers that the uranium oxide concentrate and copper concentrate containment and handling methods proposed by BHPB are achievable. The 'interim draft Operational Radiation Management Plan' contained in Appendix N of the SEIS proposed radiometric testing of rail wagons prior to their leaving Olympic Dam or Darwin.

In relation to doses to workers, members of the public and non-human biota from transporting radioactive uranium oxide by road to Port Adelaide, including accident scenarios, the AR concludes that the most significant likelihood of increased exposure is to drivers transporting uranium oxide by road.

The key pathway of exposure to a driver is external gamma radiation from uranium oxide contained in the transport container. The dose rate in the cabin and the time exposed has been adequately approximated by BHPB and therefore the total dose of 0.8 mSv is a reasonable estimate. As a comparison, a UK study estimated doses ranging from 0.2 to 0.3 mSv/y that also included transport of uranium oxide concentrate.

The AR recommends that the rail spur should be operational in time for the first movement of copper concentrate.

RECOMMENDATION

The AR considers that the currently approved uranium oxide concentrate transport procedures are appropriate. Further, the copper concentrate handling and containment methods proposed by BHPB are appropriate, and combined with routine monitoring would prevent contamination. In order that this is clearly demonstrated, BHPB should conduct soil and gamma dose rate surveys along the corridor to establish background conditions.

Accordingly the following condition and note have been recommended:

- The rail spur from Pimba to Olympic Dam must be operational prior to the first movement of copper concentrate, derived from the open pit¹⁷.

Note: As a condition of licence under the *Radiation Protection and Control Act 1982* to conduct expanded mining or milling of radioactive ore at Olympic Dam, the following requirements should be included in the Radiation Waste Management Plan for approval by the EPA:

- Conduct background gamma dose rate measurements and soil sampling at representative locations along the rail corridors prior to the commencement of operations, to clearly establish background radionuclide concentrations; and
- Include routine monitoring of the transport corridors as part of the Radioactive Waste Management Plan.

Further, the AR has recommended in Chapter 4: 'Mining operations and processing' that a condition be imposed requiring the rail spur from Pimba to Olympic Dam be operational before the first movement of copper concentrate derived from the open-pit.

10.4.4 Terrestrial impacts

A comprehensive assessment of potential impacts on the terrestrial environment - including flora, fauna and soils - for the proposed expansion project area is covered in the AR in Chapter 13: 'Effects on the environment'. However, some impacts are specific to the proposed gas and water pipelines, rail spur and electricity transmission lines and are discussed in this chapter, including:

- Impact of open trenches on fauna;
- Impacts of transmission lines on birds;
- Impacts to significant species; and
- Impacts on reserves and sensitive receivers.

10.4.4.1 Issues

Impact of open trenches on fauna

The DEIS stated that the construction of the water and gas pipelines would create sections of open trench that would be pitfall traps for small mammals and reptiles. Pipeline projects in similar environments have resulted in an average of 10 to 40 animals per km falling into open trenches; mortality of fauna, however, was reported to be as low as 3 to 5 per cent. BHPB would develop a Trench Management Plan to minimise the impact on fauna of the open trenches, including:

- Using skilled and resourced personnel to collect, identify and release fauna that fell into the trench;
- Assigning sufficient personnel to ensure all sections of open trench were checked for fauna before 10am each day in summer and midday in winter;
- Leaving trench plugs (filled-in sections) or bridges/planks at intervals of 250m in summer and 500m in winter to allow fauna to cross; and
- Placing a water-soaked, sawdust-filled hessian bag in the trench every 250m in summer and 500m in winter to provide shelter for trapped fauna before capture and release (DEIS Section 15.5.11).

¹⁷ This condition would be attached to the mine approval.

The DEIS concluded that with implementation of the Trench Management Plan and other measures outlined in this section the residual impact of open pipeline trenches on fauna would be low. Additional trench management measures for specific medium to high risk species would also be implemented.

The proposed 320km water supply pipeline and 400-560km gas supply pipeline trenches would provide a significant ecological research opportunity for the time they were open. The identification of fauna captured in the pipeline trenches would provide valuable data for the SA Department of Environment and Natural Resources (DENR) Biological Survey Database of South Australia. It is unclear from the DEIS whether BHPB would be collecting data of this nature.

Impacts of transmission lines on birds

There was a risk identified that birds would be injured or killed through striking transmission lines. The greatest mortalities associated with existing transmission lines in the southern service corridor are said to occur around the Aroona Lake System. The DEIS concluded that the proposed transmission lines would be expected to marginally increase the risk to bird species in the area. While the cumulative risk was assessed as relatively low, BHPB has committed to attaching highly visible reflective markers to conductors at regular intervals on sections of the transmission line within 1-2km of ephemeral lakes.

Impacts on significant species

Pernatty Knob-tailed Gecko

The habitat of the Pernatty Knob-tailed Gecko (*Nephrurus deleani*) occurs in the dunes along a 50km section of the southern service corridor between Island Lagoon and Dutton Lake. The gecko is considered vulnerable to impacts from development activities as it is known to be territorial, not highly mobile and difficult to detect during the day. The DEIS considered habitat loss and potential impacts on the gecko from proposed mine expansion activities would be significant as it is one of the rarest reptiles in South Australia and its range is limited.

Construction of the proposed infrastructure within the known range of the Gecko (DEIS Figure 15.7) would have only short-term low residual impact during construction, based on BHPB's commitment to the following management measures:

- Including the Pernatty Knob-tailed Gecko as a Category 1 species under BHPB's monitoring program because of the species being critically reliant on its habitat;
- Developing a management plan prior to construction to ensure appropriate management and mitigation measures were implemented; and
- Undertaking pre-construction surveys to determine if final positions or alignments of infrastructure should be moved to minimise potential impacts on gecko habitat.

Plains Rat

The Plains Rat (*Pseudomys australis*) is described as inhabiting environments with cracking clay soils over a wide area of the arid zone, possibly due to the lower predator numbers in this habitat type. Its most important habitat is the chenopod low shrubland on gibber plains and tablelands. BHPB has identified habitat for this species in the northern section of the southern service corridor and Special Mining Lease (SML) (DEIS Appendix N Figures N1.3 and N1.4a-b).

BHPB assessed that proposed activities associated with the infrastructure corridors could have a localised, short-term disturbance of Plains Rat habitats but were unlikely to significantly affect local populations. Mitigation measures proposed included the expansion to Arid Recovery to offset impacts within the SML.

This AR provides further details regarding impacts to significant species from the expansion project as a whole in Chapter 13: 'Effects on the environment'.

Impacts on reserves and sensitive receivers

The proposed gas pipeline has the potential to impact on two reserves proclaimed under the South Australian *National Parks and Wildlife Act 1972* - the Strzelecki Regional Reserve and Lake Eyre National Park. BHPB committed in the DEIS to avoiding Lake Eyre National Park.

The gas pipeline route Options 1 and 3 ((DEIS Figure 5.3) cross 120km and 20km respectively of the Strzelecki Regional Reserve. Impacts on the reserve would include clearing a 30m-wide construction corridor. Long-term disturbance would result from the construction of surface facilities and access track maintenance in the construction corridor. However, the existing land use would be resumed on all but the permanently disturbed areas of the pipeline easement.

Gas pipeline route Option 2 is proposed to pass approximately 1km to the west of the Lake Callabonna Reserve, through a drainage zone between Lake Callabonna and Lake Blanche (DEIS Figure 5.3). Lake Callabonna is listed on the Register of the National Estate (RNE), and is an important fossil location for Australia's extinct giant mammals known as 'megafauna'. Although the drainage zone is not within the RNE listing, it is possible that these remains are related to those within the RNE site.

10.4.4.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.1:

- **Objective:** No significant adverse impacts to listed threatened species in the proposed expansion project area as a result of construction activities.
- **Criteria:** No significant adverse impact on the Ampurta (small marsupial) and an important population of the Pernatty Knob-tailed Gecko, Dusky Hopping-mouse or Plains Rat.
- **Management plan:** A Trench Management Plan for the construction and operation of the proposed expansion.
- **Commitments:** To develop a Trench Management Plan to address the collection and safe removal of animals that could fall into the temporary open trenches that would be required for the installation of the water and gas supply pipelines (SEIS Table 2.1 - Commitments, pg 60).

10.4.4.3 Assessment

Impact of open trenches on fauna

The AR supports the assessment provided in the DEIS that native fauna mortalities would be low as a result of entrapment in the open trenches, subject to enforcement of measures proposed in the Trench Management Plan. Accordingly, a condition has been recommended requiring BHPB to prepare and implement its proposed Trench Management Plan, as outlined below:

- The proponent must prepare and implement a Trench Management Plan for the gas pipeline and water supply pipeline that includes measures to respond to a significant increase in fauna mortalities. A 'significant increase' must be defined in the Trench Management Plan, and submitted to the Indenture Minister for approval, prior to construction commencing on the water supply and gas pipeline corridors.

Further, the AR recognises the significant ecological research opportunity available for the time that the trenches are open, as such the following condition is recommended:

- Within 6 months of completing the water and gas pipeline construction activities, or within such time as otherwise approved by the Indenture Minister, the proponent must provide records of species recovered and removed from the easements, including their GPS location in a form suitable to the Department of Environment Natural Resources (DENR) for inclusion in the Biological Databases of South Australia (BDBSA) database.

Impact of transmission lines on birds

The AR considers as acceptable the assessment provided in the DEIS that residual impacts on birds from flying into transmission lines would be low with the mitigation measures proposed by BHPB. The following condition has been recommended:

- BHPB must attach highly visible reflective markers to conductors at 30m intervals on sections of the transmission line within 2km of ephemeral lakes and coastal areas, in a manner suitable to ElectraNet.

Impacts on significant species

The AR supports the assessment provided in the DEIS that the impacts to significant species from construction activities would be short-term and low to residual. Accordingly, the following conditions have been recommended requiring BHPB to undertake further surveys, prior to finalising the detailed alignment of the infrastructure corridors:

- Prior to finalising the detailed route alignment for the linear infrastructure components (including the parking bays) the proponent must undertake surveys of listed fauna populations, including targeted surveys for the Pernatty Knob-tailed Gecko and Plains Rat. The final alignment must avoid populations of listed fauna, where practicable.
- Prior to finalising the detailed route alignment for the linear infrastructure components BHPB must conduct floristic surveys, ideally following adequate rainfall, to confirm the presence/absence of listed threatened species. The surveys must target vegetation types that are likely to support threatened species, in particular:
 - *Atriplex Kochiana* (Koch's Saltbush)
 - *Ophioglossum polyphyllum* (Large Adder's Tongue)
 - *Atriplex eichleri*
 - *Gratwickia monochaeta*
 - *Bulbostylis turbinata*
 - *Calandrinia sphaerophylla* Bead Purslane
 - *Eleocharis plana* Flat Spike-rush
 - *Frankenia cupularis*

Whilst every effort should be made by BHPB to avoid listed flora and fauna species, the AR recognises that this may not always be possible. The following conditions are recommended:

- If clearance of listed flora species is unavoidable, BHPB must relocate these species to adjacent work areas, or as otherwise agreed by DENR.
- Except in areas of permanent clearance, revegetation of impacted areas for the construction of the linear infrastructure components must commence within 6 months of construction activities concluding, or within such time as otherwise approved by the Indenture Minister, environmental conditions permitting.
- Within 6 months of completing the construction activities for the linear infrastructure components, or within such time as otherwise approved by the Indenture Minister, BHPB must commence rehabilitation of the cleared areas of Mulga *Acacia aneura* low woodlands on the sand plain, except in areas of permanent clearance, weather conditions permitting.

Where clearance of listed plants can be avoided, BHPB must provide for an appropriate buffer. The following condition is recommended:

- All identified listed plants will require a buffer zone of at least 50m from construction and operational activities for the linear infrastructure components. If it is impractical to provide a 50m buffer zone for the listed species and it will be impacted directly, the species must be reinstated or relocated to adjacent work areas; or as otherwise agreed by DENR.

Further, to assist in determining the final alignment of the infrastructure corridors, the following condition is also recommended:

- The proponent must prepare guidelines, in consultation with DENR, to determine the methodology of final corridor realignment to avoid listed species, including definition of practical construction limitations, prior to construction of the water and gas supply pipelines, rail spur and electricity transmission lines.

Impacts on reserves and sensitive receivers

Water supply pipeline

The proposed route for the water supply pipeline was chosen to avoid sensitive receivers including homesteads, vegetation types, listed species habitat, water bodies and heritage features (DEIS Appendix N, Figures N1.4a – f). The AR has recommended a condition that BHPB establish the proposed pipeline in accordance with the route provided in the DEIS to ensure it avoided sensitive receivers, as outlined below:

- Final alignment of the water supply pipeline must be constructed in accordance with DEIS Figures N1.4 (a) – (f) (refer DEIS Appendix N).

Should the detailed survey work proposed by BHPB find additional sensitive receivers, requiring it to modify the route shown in the DEIS, it would be required to lodge the revised plans with the Minister and seek a variation to the conditions in accordance with the Development Act 1993.

The AR supports this approach as a means of ensuring protection of sensitive receivers.

Electricity transmission lines

The AR considers that further approval of the detailed alignment of the proposed 275kV electricity line from Port Augusta to Olympic Dam would not be necessary as the line would run parallel to the existing high voltage line. It has recommended conditions requiring the electricity transmission lines be established in accordance with the following routes as provided in the DEIS:

- The final alignment of the 275kV electricity line from Port Augusta to Olympic Dam must be constructed in accordance with DEIS Figures N1.4 (a) – (f) (refer DEIS Appendix N).
- The final alignment of the 132kV electricity transmission line from Cultana to Point Lowly must be constructed in accordance with Figure N1.4(f) (refer DEIS Appendix N).

Rail spur

BHPB stated that the proposed route of the rail spur from Pimba to Olympic Dam was chosen to avoid sensitive receivers, including homesteads, vegetation types, listed species habitat, water bodies and heritage features (DEIS Appendix N, figures N1.4a – b). As such, a condition as outlined below has been recommended requiring establishment of the rail infrastructure in accordance with the route provided in the above mentioned figures, to ensure that it avoids sensitive receivers.

- Final alignment of the rail spur from Pimba to Olympic Dam must be constructed in accordance with DEIS Figures N1.4 (a) – (b) (refer DEIS Appendix N).

As for the other infrastructure corridors, should the detailed survey work proposed by BHPB find areas to be avoided (i.e. sensitive receivers), requiring it to modify the route shown in the FEIS, it would be required to lodge the revised plans with the Minister and seek a variation to the conditions in accordance with the Development Act 1993.

Gas supply pipeline

The Department of Environment and Natural Resources (DENR) has stated a preference for Option 2 (DEIS Figure 5.3) for the proposed gas pipeline route because it avoids the Strzelecki Regional Reserve. The AR notes, however, that Regional Reserves do allow for mining, petroleum, geothermal and pipeline activities to occur under certain conditions. Petroleum exploration and production licences are currently held over a large percentage of the northern area of the Strzelecki Regional Reserve. The proposed gas pipeline would require licensing under the *Petroleum and Geothermal Energy Act 2000*. A licence cannot be issued over a regional reserve without the approval of the Minister administering the *National Parks and Wildlife Act 1972*. Should BHPB seek to pursue Options 1 or 3, approval would be required from the Minister as part of the pipeline licensing process. The AR has recommended a note to this effect, as outlined below:

- A pipeline licence will need to be applied for under the *Petroleum and Geothermal Energy Act 2000*. With the Pipeline Licence and approved SEO in force, an activity notification must be submitted to PIRSA in accordance with Regulations 18 and 20 of the *Petroleum and Geothermal Energy Regulations 2000*. This notification must be accompanied by detailed information relating to the design, construction, operation and maintenance of the gas pipeline. The Minister's written approval would be required before pipeline construction can commence. A further approval is then required following completion of the hydrotest and prior to the introduction of gas into the pipeline. Further, a pipeline licence cannot be issued over a regional reserve without the approval of the minister administering the *National Parks and Wildlife Act 1972*. Accordingly, should the proponent seek to pursue option 1 or 3, approval would be required from the Minister administering the *National Parks and Wildlife Act 1972*.

BHPB would undertake further field surveys before the linear infrastructure easements were finalised, and areas of particular importance to listed flora species would be marked as 'no-go' areas on construction design drawings and fenced off (DEIS Section 15.5.4). It would also develop a procedure for identifying and treating fossils should they be found during ground works.

Infrastructure corridor from Roxby Downs to Hiltaba Village and airport

The AR supports BHPB's proposal to install the essential services (water, sewer and optical fibre cable) for Hiltaba Village and the airport via underground supply within the road corridor from Roxby Downs. The AR acknowledges that the electricity transmission line would also be located within the road corridor. Accordingly the following condition is recommended:

- Final alignment of the water supply pipeline, sewerage pipeline and electricity transmission line from Roxby Downs to Hiltaba Village and the airport must be constructed in general accordance with DEIS Figure 5.5 and SEIS Figure 5.13.

RECOMMENDATION

The AR concludes that reasonable measures have been demonstrated in the DEIS to manage potential impacts the terrestrial environment from the proposed infrastructure corridors subject to BHPB complying with its stated commitments and the suite of conditions recommended in this section.

10.4.5 Surface water

10.4.5.1 Issues

It is considered that construction and operation of the infrastructure corridors would have negligible effects on catchments and flow paths of surface water (DEIS Section 11.5). Any changes from the buried water supply pipeline and gas supply pipeline would be short-term and re-dressed following construction. Small sections of the water supply pipeline, particularly those sections intersecting watercourses, would remain above ground supported on pre-cast concrete plinths or culverts to keep the pipeline above flood levels (DEIS Section 5.10.5). The infrastructure components for water and gas supply would have negligible impact on flooding or flood storage capacity because of the relatively small area of structures compared to the catchments in which they would be located (DEIS Section 11.5).

The northern section of the proposed Pimba to Olympic Dam rail spur, in the Roxby land system, would cross a number of small, localised interdunal catchments. However, the southern section, in the Arcoona land system, would cross well-defined drainage paths and catchments and require the construction of up to 140 cross-drainage structures. It would involve culverts or similar cross-drainage structures that were designed to avoid the potential for increasing flood levels in low-lying areas caused by stormwater backed-up against the rail embankment.

The final alignment of linear infrastructure on the gas pipeline corridor options would be selected to avoid surface water features of particular significance, such as Reedy Springs and Saint Mary Pool. BHPB has proposed implementing soil erosion and water pollution control measures in areas of high or very high soil erosion potential when installing infrastructure in infrastructure corridors, including the use of silt fencing, catch banks/drains and rock armoring (DEIS Section 10.5).

10.4.5.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.4:

- **Objective:** No significant adverse impacts to environmental receptors as a result of stormwater discharges to soil, surface water or groundwater associated with BHPB's proposed expansion activities.
- **Criteria:** All contact stormwater maintained within designated stormwater management areas.
- **Management plan:** To develop a Stormwater Management Plan for the construction and operation of the proposed expansion.
- **Commitments:** No specific commitments made in relation to this issue.

10.4.5.2 Assessment

The AR considers that construction and operation of the proposed gas, electricity, water supply and rail infrastructure will have negligible adverse impacts on surface water quality and catchment flows, contingent upon:

- Proposed soil erosion and water pollution control measures being implemented;
- Cross-drainage structures undergoing detailed engineering design;
- Disturbed areas being rehabilitated shortly after the pipeline being installed;
- Raised sections of the water supply pipeline being built over major watercourses and water features; and
- The final alignment of service corridors being selected to avoid significant surface water features, such as Reedy Springs and Saint Mary Pool.

RECOMMENDATION

The AR concludes that reasonable measures have been demonstrated in the DEIS to manage potential impacts on surface water from the proposed infrastructure corridors subject to BHPB complying with its stated commitments and the following recommended condition:

- Final route alignment for the gas pipeline must identify St Mary's Pool and Reedy Springs as 'no go' zones to be avoided by construction activities.

In terms of impacts to groundwater, the AR recommends the following condition:

- No new groundwater wells are to be located within 20km of GAB springs for water extraction during gas pipeline construction.

10.4.6 Noise and vibration

10.4.6.1 Issues

Construction Noise

Noise associated with the construction of the water and gas pipelines, rail spur and electricity infrastructure would be expected to meet the requirements of the SA *Environment Protection (Noise) Policy 2007* (Noise EPP). Although some noise would be audible during the construction phase, operational noise would be confined to that generated by the three pumping stations located along the water pipeline corridor. The distance between the pump stations and the nearest rural residence would be 2.4km (DEIS Section 14.5.2).

The DEIS concluded that noise and vibration criteria would be met in relation to the water supply pipeline and that impacts would be negligible. Temporary and localised noise would also be expected with the construction of the gas supply pipeline, where the nearest sensitive receiver would be 1.3km away.

The closest noise sensitive receiver to the proposed electricity transmission line would be Purple Downs Homestead, 1km away. While it is expected that some temporary and localised noise would be generated during construction, the DEIS stated that the Noise EPP criteria would be met.

Operational Noise

During the operation of the gas and water supply pipelines there would be potential for noise to be generated from the compressor stations on gas pipeline options 2 and 3, as well as noise from the three pumping stations on the water supply pipeline.

During operation of the electricity line there would be potential for aeolian tones (the sound power lines make when wind whistles through them). This noise has been predicted to meet the necessary noise criteria at the nearest noise sensitive receiver for wind speeds up to 10 m/s, assuming up to 4 cables (DEIS Appendix M). The noise from higher winds would usually mask any aeolian tones. If wind speeds were greater than 10 m/s in the vicinity of the electricity line any aeolian tones would not likely be audible over the ambient noise.

Rail noise is excluded from the SA *Environment Protection (Noise) Policy 2007* (Noise EPP). However, in relation to the operation of the rail spur, compliance with the following noise criteria has been considered a suitable alternative:

- Rail noise not to exceed 60dB(A) $L_{Aeq,24h}$ /85dB(A) L_{Amax}

Noise impacts from the proposed Pimba-Roxby Downs rail line were assessed for the nearest noise sensitive receivers, including Purple Downs homestead 1.2km from the proposed alignment, as well as Roxby Downs and Woomera. The assessment considered the maximum predicted train movements a day for the expanded operation. Modelling found the proposed rail line would generate noise levels well below the applicable limits (as referred above) and have a negligible residual impact (DEIS Section 14.5.2). Ground-borne vibration from rail line was also assessed and found to be undetectable beyond a few hundred metres of the rail line (DEIS Section 14.5.2).

10.4.6.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 3.2:

- **Objective:** No adverse impacts to public health as a result of noise emissions from BHPB's expanded operations.
- **Criteria:** Maintain noise from the expanded operations at Olympic Dam to less than 30dBLAeq (24 hour) within residential dwellings.
- **Commitments:** No specific commitments made in relation to this issue.

10.4.6.3 Assessment

The AR considers the potential issues associated with the proposed infrastructure corridors in relation to noise and vibration were appropriately identified in the DEIS.

The AR further considers the distance between the proposed alignments and nearby noise sensitive receivers would ensure that short-term construction noise impacts, as well as operational impacts, would be negligible and unlikely to disturb residents or fauna. Conditions have been recommended that would require BHPB to avoid noise sensitive receivers, such as homesteads, by constructing the infrastructure corridors in accordance with the detailed alignments it provided in DEIS Appendix N. No further noise mitigation measures are considered necessary in relation to this issue.

RECOMMENDATION

The AR recommends the following note to BHPB highlighting its need to comply with construction noise requirements contained in the *Environment Protection (Noise) Policy 2007* Part 6 Division 1:

- The applicant is reminded of their obligation to ensure that construction noise complies with the requirements of Division 1 of Part 6 of the *Environment Protection (Noise) Policy 2007* at all times. Supplementary information on construction noise management can be found in the Guidelines for the Use of the *Environment Protection (Noise) Policy 2007* and Construction Noise Information Sheets (available at: www.epa.sa.gov.au).

10.4.7 Visual amenity and landscape character

10.4.7.1 Issues

The transmission line, water and gas supply pipelines and rail spur are proposed to be located in or adjacent to existing infrastructure corridors, minor exceptions aside. The DEIS considered the water and gas supply pipelines would have very little impact on visual amenity because they would be buried for most of their length and, in the case of the gas pipeline, located in extremely remote country seldom visited by the public. BHPB has committed to progressively revegetating sections as construction activity moved on.

The longest above-ground section of the water pipeline would be 500m at Lake Windabout, adjacent to an existing elevated water pipeline. BHPB acknowledged that in the short term, the clearing of vegetation for pipeline construction would create a visual impact, but following revegetation the visual impact would be negligible to slight. The most visible component of the infrastructure would be the three pumping stations located several hundred metres from main roads.

The visual impact of the proposed electricity line and towers was considered to be negligible to slight as BHPB proposes to build the structures parallel to the two existing electricity lines and towers already obvious on the landscape (DEIS Plates 20.4 and 20.5).

The visual impact of the proposed rail spur from Pimba, to be located adjacent to the main road to Olympic Dam, was considered to be negligible to slight because it would have a low profile and be screened for much of its length by dune vegetation and the Wirrawirralu Creek valley to the east of the road to Olympic Dam.

10.4.7.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No EMP provided for this issue.
- **Commitments:** No specific commitments made in relation to this issue.

10.4.7.3 Assessment

The AR concurs with the DEIS assessment that visual impacts from the proposed infrastructure corridors would be negligible to slight. It concludes that the largely short-term impacts during construction would be acceptable, subject to compliance with commitments made by BHPB to bury the water and gas supply pipeline for the majority of their lengths and progressive rehabilitation of the corridors as construction was completed. Accordingly no conditions are recommended.

10.4.8 Waste management

10.4.8.1 Issues

BHPB stated in the DEIS that it would establish the necessary facilities at construction sites and camps to manage waste. Waste water would be treated by an on-site plants and the treated effluent dispersed by irrigation for evaporation. Solid wastes would be collected and taken to licensed waste disposal facilities that would require approval from the EPA. Construction waste would also be taken to licensed waste disposal facilities.

10.4.8.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.6:

- **Objective:** Minimise general waste generated by BHPB's expansion activities and maximise reuse of general waste where practicable.
- **Criteria:** Increase the proportion of general waste reuse/recycling.
- **Commitments:** No specific commitments provided in relation to this issue.

10.4.8.3 Assessment

The AR considers the proposed wastewater and solid waste management strategies are acceptable given the temporary nature, location and scale of construction operations.

The on-site wastewater management systems associated with the proposed service corridor construction camps would need to comply with SA on-site wastewater treatment system standards to ensure protection of public and environmental health.

RECOMMENDATION

The AR recommends the following notes to BHPB:

- On-site wastewater management systems associated with proposed service corridor construction camps must be approved by the relevant authority in accordance with the requirements of the *SA Waste Control Regulations 2010* (or current equivalent regulatory requirements at the time of application).
- In order to achieve the waste management objective contained in the *SA Environment Protection (Waste to Resources) Policy 2010* domestic and building wastes generated at temporary construction camps and/or from service corridor construction activities should be managed according to the waste management hierarchy by promoting waste avoidance, reduction, recycling, recovery ahead of waste treatment and/or disposal to licensed landfill facilities.

10.4.9 Impacts on pastoral uses

10.4.9.1 Issues

The proposed infrastructure corridors could cross up to 12 pastoral stations with potential impacts including:

- Pastoral land being divided and lost, access issues, including access to stock watering points, and inconvenience caused by infrastructure construction and maintenance;
- Livestock being injured from falling into excavated water supply pipeline trenches;
- Weeds being introduced during the construction and maintenance of infrastructure;
- Vandalism, property damage and stock loss caused by unauthorised access to properties;
- Off-road driving and irresponsible behaviour, particularly during the construction phase;
- Unauthorised use of the private roads and infrastructure access tracks by the public, and associated property damage and stock losses during the operation phase;
- Increased competition for labour; and
- Access to groundwater supplies.

Measures proposed by BHPB in the DEIS to reduce impacts on pastoralists included:

- Burying infrastructure wherever practicable;
- Developing workforce codes of practice and behaviour;
- Consultation in selecting sites for mobile work camps for the gas pipeline construction; and
- Educational programs and information to promote socially and environmentally responsible behaviour.

There would also be continued discussions with directly affected landholders in relation to infrastructure easements, including land access, fencing along access tracks, crossing points for pastoral activities and strategies for dealing with potential incidents during the construction and operation phases (DEIS Section 19.5.6).

10.4.9.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 5.1:

- **Objective:** Communities in which BHPB operates value our citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints are addressed.
- **Management plan:** To develop a Social Management Plan.
- **Commitments:** No specific commitments made in relation to this issue.

10.4.9.3 Assessment

The AR considers the potential issues associated with the proposed infrastructure in relation to interaction with pastoral properties were appropriately identified in the DEIS. Depending on the nature and final design of the infrastructure, stock movement could be restricted which could impact on grazing systems in the longer term. The AR recommends that any workforce codes of practice should include standard operating procedures for ensuring biosecurity integrity was maintained. Whilst BHPB's proposed management measures are broad and encompass the issues, significant attention should be placed on ongoing and consistent communication with the landholders affected.

The AR considers that appropriate measures have been proposed by BHPB to manage impacts to pastoral uses. Accordingly, no conditions have been recommended.

10.4.10 Impacts on Department of Defence land

10.4.10.1 Issues

Cultana Training Area

The Cultana Training Area (CTA) is located north-east of Whyalla, 10km west of Port Augusta (DEIS Figure 9.7 and Plate 9.5). It covers 48,000ha, although the Department of Defence (DoD) is planning to double this area by buying adjoining pastoral properties to the west.

The Australian Army uses the CTA for training and manoeuvres with wheeled and tracked vehicles. With the additional land the CTA could also be used for major armoured and mechanised exercises previously undertaken only in Northern Australia.

The proposed service corridor to Olympic Dam would intersect an expanded CTA, and BHPB would be obliged to enter into an agreement with DoD to establish easements and ongoing access to the corridor.

Woomera Prohibited Area

The proposed water supply pipeline would be located within the electricity transmission corridor for most of the distance through the Woomera Prohibited Area (WPA). The rail corridor is proposed to pass through approximately 25km of the WPA.

DoD would be prepared to enter into an access licence arrangement to enable the infrastructure corridors to cross the WPA. This arrangement would ensure DoD's capability requirements were protected while enabling BHPB to access the corridor (for water and electricity) in accordance with DoD's operational requirements. While BHPB would own the land freehold, DoD would have authority over the activities on the land.

In relation to rail, BHPB would need to agree arrangements with DoD for constructing and operating the rail corridor through the WPA. This would be sufficient to ensure that DoD interests were protected.

10.4.10.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided in relation to this issue.
- **Commitments:** No specific commitments made in relation to this issue.

10.4.10.3 Assessment

Cultana Training Area

The water pipeline would be laid in an easement directly adjacent to the Santos liquid fuels pipeline and would have only minimal impact on DoD's future use of an expanded CTA. Defence would use the expanded area for training activities, though no live-fire would occur near the pipeline. The proposed corridor would not significantly affect DoD's proposed future use because there is already pipeline infrastructure adjacent to the proposed water supply pipeline. An easement would be created by either the State or Commonwealth for the water pipeline. DoD would expect to be consulted over the creation of the easement and its terms. DoD's interests would also be protected under the Defence Force Regulations when the CTA expansion area was declared a Defence Practice Area.

Woomera Prohibited Area

The proposed electricity transmission would cross part of the WPA that is used for electronic warfare testing, Unmanned Aerial Vehicle flights and provides a safety buffer for stand-off weapon trials.

The AR considers that the proposed infrastructure corridors should not affect Department of Defence's (DoD) activities on the site, provided DoD retains the right to use the land for testing military materials when necessary. DoD agrees in principle that the proposed infrastructure corridors would be acceptable. A Deed of Access similar to a mining deed as currently used for other companies would be employed to manage the infrastructure corridors.

It is recommended that BHPB should continue to liaise with DoD in finalising the alignment of the water supply pipeline, electricity transmission line and rail line. No conditions are recommended.

10.4.11 Rehabilitation and decommissioning

10.4.11.1 Issues

The Pimba-Olympic Dam rail spur could continue to be used for goods/tourist transport to Roxby Downs and Woomera following the closure of the mine. If it was to be decommissioned, it would be one of the last infrastructure components removed as it would be used to transport benign and redundant materials from the closed Olympic Dam operation. Then the rail easement would ultimately revert to pastoral land use.

10.4.11.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided in relation to this issue.
- **Commitments:**
 - BHPB would update the existing Rehabilitation and Closure Plan for Olympic Dam operation following completion of the detailed design phase to include the components of the proposed expansion; and
 - BHPB would continue to consult and engage with SA Government agencies and other stakeholders to further develop and refine closure criteria, including final land uses, rehabilitation, management and ongoing monitoring. The plan would be reviewed annually and updated if required (SEIS table 2.1 – Commitments, page 57).

10.4.11.3 Assessment

The AR considers the proposed rehabilitation and decommissioning procedures to be appropriate and they would form part of the Olympic Dam Rehabilitation and Closure Plan, to be prepared by BHPB in consultation with, and to the satisfaction of, the Indenture Minister.

10.5 Conclusion

With the commitment from BHPB to avoid sensitive environmental receivers for the proposed gas pipeline and southern service corridor for the water pipeline, electricity line and the rail spur, the AR considers there would be minimal environmental impact from their construction and operation. Potential impacts on fauna, in particular the threat posed by open trenches during construction of the corridors, could be managed through constant monitoring and the rehabilitation of the sites following construction in accordance with measures proposed in the Trench Management Plan. It is recognised that a significant ecological research opportunity would be available for the time that the trenches are open.

Social impacts have been assessed as negligible because the infrastructure corridors would occupy generally uninhabited locations. Temporary noise and vibration impacts from construction and operational noise have also been assessed as negligible.

In summary, the AR concludes that the potential impacts from infrastructure corridors during construction and operation would be manageable, subject to BHPB complying with commitments made in the FEIS and the recommended conditions outlined in this chapter. Secondary approvals, under other legislation, would be required for a number of the activities/services proposed, most notably a gas pipeline license and compliance with the National Electricity Rules among other approval/permits/easements outlined in the recommended notes to BHPB.

Chapter 11

Road transport



Chapter 11: Road transport

11.1 General

11.1.1 Site and locality

BHPB has sought approval to use and upgrade the state's arterial and local road network; as well as approval to construct new road (and rail) infrastructure. Accordingly, the site area for the expansion project covers the road network from Port Adelaide and Port Augusta (proposed landing facility) to Olympic Dam.

The proposed rail infrastructure is addressed in Chapter 10 – 'Infrastructure corridors' of this AR.

11.1.2 Existing environment

As BHPB propose to largely use the existing arterial and local road network, the existing environment is largely the same as that described for the southern infrastructure corridor which is provided in this Assessment Report(AR) in Chapter 13: 'Effects on the environment', and not repeated in this chapter.

11.2 Project description – key elements

11.2.1 General

The proposed expansion of Olympic Dam would significantly increase road and rail transport to allow for the movement of bulk commodities, mining equipment, plant and construction materials. This would require a significant increase in heavy and Over Dimensional (OD) vehicles, principally on the Princes Highway between Adelaide and Port Augusta, and the Stuart Highway between Port Augusta and Olympic Dam. This would be coupled with significant increases in associated ancillary road traffic to service supporting townships and from private and leisure trips.

Construction and operation of the proposed expansion would change the volume and type of traffic currently using the road network. It was estimated in the Draft Environmental Impact Statement (DEIS) that 11,400 OD loads would be expected during the proposed 11-year construction period, peaking at 45 a week, followed by a lower, steady rate of traffic during the operational phase of the mine expansion.

The following is the estimated over-dimensional/over-mass (OD/OM) vehicle volumes at peak construction (Year 5), with the maximum yearly volume by vehicle type proposed for the construction period shown in brackets as provided in the DEIS:

- 132 (135) vehicles that would require a police-controlled road closure;
- 165 (165) vehicles that would require police escorts and all opposing traffic to park on the adjacent road shoulder;
- 844 (1296) vehicles that would encroach into the opposite lane and require opposing traffic to make allowances. This would include a significant proportion of vehicles encroaching onto the road shoulder, with pilot vehicles and police escorts potentially being required depending on vehicle type and load dimensions. Specific escort requirements could be determined from the *Policy for the Transport for Oversize and Overmass Vehicles*, in Tables 2.4, 2.5 and 2.6 in Section 2.6 'Escort Charts for Oversize Vehicles and Loads'; and
- 34 (974) vehicles that would be wider than a general vehicle but not encroach into the opposing lane, meaning no escorting requirements would be anticipated.

An additional 90 heavy vehicle (B-double and double road train) movements a day would be expected north of Port Augusta during the construction phase plus significant increases in ancillary traffic volumes to service supporting townships.

Before the Intermodal facility and rail spur are built, freight trips to Olympic Dam would be by road. Should the intermodal facility and rail spur be approved and built, almost all freight trips would convert to rail, with the exception of over-dimensional (OD) loads that would come largely through the Upper Spencer Gulf landing facility.

To facilitate the proposed expansion project, BHPB has sought approval to construct the following road and rail infrastructure to accommodate the movement of materials and equipment to Olympic Dam:

- A road/rail Intermodal facility at Pimba (refer Chapter 9 of this AR);
- A rail spur from Pimba to Olympic Dam (refer Chapter 10);
- A road overpass associated with the rail spur;
- The relocation of Borefield Rd;
- The installation of up to 15 new parking bays along the Stuart Highway and Olympic Way to enable traffic to pass safely;
- New road infrastructure in and around Roxby Downs;
- A private access corridor from the proposed Upper Spencer Gulf (USG) landing facility to the pre-assembly yard in Port Augusta to cater for the movement of oversized equipment and material; and
- A new private access road from Hiltaba Village to Olympic Dam, and a second access gate.

Each of these components are described below.

11.2.2 Rail spur from Pimba to Olympic Dam

A description and assessment of the proposed rail spur from Pimba to Olympic Dam is provided in Chapter 10: 'Infrastructure corridors'.

11.2.3 Road overpass

BHPB has sought approval to construct a road overpass where the proposed rail spur would cross the Olympic Dam to Pimba Road, 15km north of Woomera (DEIS Figure 5.43). The overpass would cover 5ha and be built of pre-cast concrete elements transported to the site for assembly. Rock for bridge abutment would be sourced from borrow pits or the pre-mining operations.

11.2.4 Relocation of Borefield Rd

BHPB has sought approval for portions of Borefield Road to be relocated where it crosses the sites proposed for the open-pit mine and Rock Storage Facility locations in an expanded Special Mining Lease. Borefield Rd provides a key strategic link between the Woomera and Roxby Downs areas and the Far North region of South Australia, and is categorised by the SA Department of Transport, Energy and Infrastructure (DTEI) as a 'Primary Link' road, the highest of four categories in the Outback roads classification structure.

The proposed alignment would be located to the east of the existing road through BHPB's Andamooka pastoral lease and outside of the proposed expanded SML boundary (DEIS Figure 5.5). The turn-off to Borefield Rd would be from the Olympic Dam to Andamooka road, adjacent to the proposed new airport, 17km north-east of Roxby Downs. Impacts on land use would be reduced by aligning the road to avoid disturbing heritage sites and large areas of vegetation, and allowing for surface water drainage by including floodways in road design.

The relocation would increase travel time by an estimated 10-15 minutes when heading north to locations such as the entrance to the Arid Recovery, groundwater wellfields, Marree and William Creek. The relocated road would remain unsealed. BHPB has stated it would start immediately on the realignment of the road, should the expansion project be approved. It is expected that the new alignment would be opened at the same time as the existing alignment was closed to avoid disruption to traffic.

11.2.5 New parking bays

BHPB has proposed building parking bays to accommodate traffic delayed by road closures along the Stuart Highway and on the Olympic Dam to Pimba Road when large OD loads were transported from the Port Augusta pre-assembly yard to Olympic Dam. For loads wider than 8m, sections of road between the parking bays would be closed temporarily. When a load reached the next parking bay, it would be held there whilst the road was reopened to allow traffic to pass before the next section of road was closed. BHPB has committed to ensuring disruption to road users would be a maximum of 45 minutes, though the SA Government requires a maximum of 30 minutes. Amenity and snack facilities would be provided during OD load movements.

Parking bay locations would be determined during detailed design of the proposed expansion project, though it was stated in the DEIS that bays would be spaced approximately 17km apart, resulting in nine bays between the Pt Augusta pre-assembly yard and Pimba, and six bays between Pimba and Olympic Dam (DEIS Figure 5.33). The parking bays would be 30m wide and 250m long, and require a total 12ha of land.

11.2.6 Transport infrastructure in Roxby Downs

BHPB has proposed upgrading roads in and around Roxby Downs to manage the expected increase in traffic from residential growth associated with the proposed expansion of Olympic Dam, including the following:

- Stuart Rd and Aquila Boulevard would be extended to meet the heavy vehicle bypass;
- Four new distributor roads would be constructed to service new residential precincts west of Olympic Way;
- Two new distributor roads would connect Olympic Way to new residential precincts east of Olympic Way;
- A new 'T' intersection would be constructed between Burgoyne St and Richardson Place; and
- New traffic management measures would be implemented, including traffic controls at the junction of the extended Richardson Place and Olympic Way, and further north of Roxby Downs at the junction of Olympic Way and the heavy vehicle bypass.

This AR provides a detailed description of the proposed expansion of Roxby Downs in Chapter 8: 'Roxby Downs township'. Road works in Roxby Downs would require the approval of the Roxby Downs Council.

11.2.7 Private access corridor

A private-access corridor 15m wide and 10km long would be constructed between the Upper Spencer Gulf landing facility and the pre-assembly yard on the north-western outskirts of Port Augusta. The corridor would be constructed of compacted crushed rock to establish an all-weather surface.

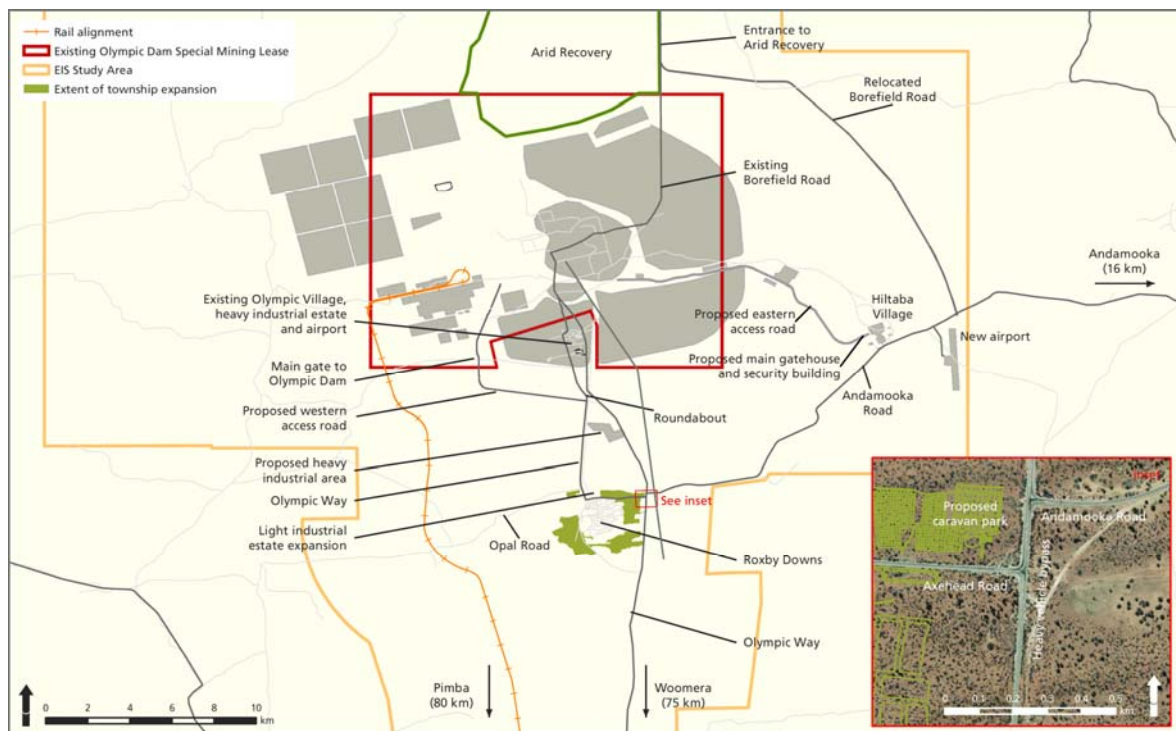
The proposed alignment of the corridor was amended in response to submissions from the SA Government and Port Augusta City Council and the final alignment shown in the Supplementary Environmental Impact Statement (SEIS) Figure 22.3.



SEIS Figure 22.3 Proposed alignment of access corridor, location of Port Augusta pre-assembly yard and rail crossings

11.2.8 New mine access road

BHPB has proposed building a second entry gate and eastern access road to provide a direct link between the proposed Hiltaba Village and Olympic Dam mine site (SEIS Figure 22.2). The idea was to split the transportation of workers to the mine, where mining-related workers would be bussed to Olympic Dam on the eastern access road, and processing-related and administration workers would be bussed along Andamooka Rd, the heavy vehicle bypass, Olympic Way and the new western access road.



SEIS Figure 22.2 Key components of the proposed expansion at Olympic Dam for the traffic assessment

11.2.9 Road construction

Borrow pits would be required to provide crushed rock and granular material for road construction. While the exact number and locations would be determined during detailed design of the proposed mine expansion project, it is estimated that 13 borrow pits, each 50m x 50m, would be required for road works south of Pimba, and 10 pits, each 130m x 130m, would be required for road and rail construction north of Pimba.

Once the proposed numbers and locations are finalised, BHPB or its contractor would need to seek further approvals outside the EIS process to establish the borrow pits.

It is estimated that earthworks and dust suppression during road construction would require 200ML of low-quality water sourced primarily from local groundwater wells. The estimated 50 workers required for road works would be accommodated at either Hiltaba Village or Roxby Village during road construction in and around Roxby Downs, and Woomera and Port Augusta during construction of the access corridor, rail overpass and parking bays on the Stuart Highway.

11.3 Summary of submissions

11.3.1 SA Government submission

The SA Government submission required BHPB to address a number of concerns and provide more information so the issues associated with the proposed road transport infrastructure could be adequately assessed, involving:

- Clarification of BHPB's management and mitigation strategies to minimise impacts of moving over-dimensional (OD) loads on the State road network;
- Road delays to the travelling public should be reduced from 45 minutes (as stated in the DEIS) to 30 minutes;
- Clarification of the impact of expansion-related traffic and the impact on Princes Highway traffic south of Port Augusta;
- BHPB should consider either duplicating the Stuart Highway or, as a minimum, upgrading the road shoulders;
- BHPB should bear the full cost of upgrading the road/rail level crossings at Hesso and Pimba;
- BHPB was to remove statements from the DEIS about funding commitments made by the SA Government associated with proposed upgrades to the State's roads;
- Clarification of traffic volumes, upgrades and maintenance of roads north of Olympic Dam;
- Clarification of proposed activities at the pre-assembly yard and the associated traffic impacts of OD load movements on the surrounding local road network; and
- Clarification of how BHPB would minimise the effects on road users of expansion traffic associated with the proposed Pimba Intermodal facility.

11.3.2 Public submissions

Public submissions reflected those raised by the SA Government, and, in addition, the following concerns/requests for information were raised:

- Impacts to local traffic and access arrangements resulting from the proposed landing facility for residents who travelled along Shack and Caroon roads;
- Clarification of the impact and location of the access corridor and pre-assembly facility in relation to the Eureka Estate;
- Clarification of the position of BHPB on its use of Yorkey's Crossing for project-related traffic required to pass through Port Augusta, and predicted traffic volumes over the Port Augusta Bridge; and
- Clarification of the impact of the proposed rail activities on the Spencer Junction rail yards.

11.4 Key environmental, social and economic issues

The key issues associated with the road and rail transport corridors include:

- Transport safety and emergency response;
- Moving over-dimensional (OD) loads;
- Safety at rail crossings;
- Traffic management and impacts south of Port Augusta;
- New road transport infrastructure;
- Increased Outback traffic;
- Road safety;
- Air quality;
- Transporting radioactive products;

- Surface water;
- Noise and vibration;
- Terrestrial impacts;
- Impacts to Department of Defence land; and
- Rehabilitation and decommissioning.

11.4.1 Transport safety and emergency response

11.4.1.1 Issues

Transporting hazardous materials

BHPB stated in the DEIS that it did not expect to introduce new hazardous substances in the proposed mine expansion, but quantities of hazardous materials used would increase. Significantly larger quantities of dangerous substances, including 350 million litres of diesel annually for the mining fleet, would be transported to Olympic Dam by road and rail. Sulphur and diesel would be transported by rail to Pimba then by road to Olympic Dam (SEIS Section 4.15.1). Other chemicals for the metallurgical plant would be transported as per the existing situation (on road) and would move to rail when available.

As hazardous substances are already used in the mining operation, BHPB emergency service officers have been trained in responding to incidents involving hazardous materials. BHPB works with the SA Country Fire Service (CFS) which has multiple Hazardous Materials Response (Hazmat) Units capable of responding to a significant spillage on the road or rail network in Roxby Downs, Woomera, Coober Pedy, Port Augusta and other strategic locations throughout the State. The SA Metropolitan Fire Service (MFS) also has significant Hazmat resources to support CFS operations. It is proposed that this approach would continue for the expansion.

Ammonium nitrate storage and movement

Significant quantities of ammonium nitrate (AN) in the order of 110,000 tonnes per annum (tpa) would be required for blasting at Olympic Dam (DEIS Table 5.5). The DEIS provided an assessment of the impacts based on the material being transported by rail. Following extensive consultation with the SA Government, BHPB subsequently proposed a road-based transport solution in the SEIS that would involve sourcing AN preferentially from Australian suppliers and transporting it as bulk material in 6m-long containers using double road trains. This would be a temporary solution and BHPB would continue to work with the Government to identify an acceptable long-term rail transport solution.

11.4.1.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 2.1:

- **Objective:** No significant contamination to soils, surface water or groundwater as a result of the storage, transport or handling of hazardous materials by BHPB during expansion activities.
- **Criteria:** No lasting significant contamination arising from uncontrolled loss of chemicals to the natural environment (area to be defined).
- **Management plan:** To update the Emergency Response Plan to ensure additional requirements of the proposed expansion were incorporated, particularly for accident spills associated with possible derailment, truck accident or vandalism. The Management of Hazardous Materials Document would also be updated.
- **Commitments:** No specific commitments made in relation to this issue.

11.4.1.3 Assessment

The *Dangerous Substances (Dangerous Goods Transport) Regulations 2008* under the *Dangerous Substances Act 1979* regulates the transport of hazardous substances in South Australia. In addition, specific requirements for the transport of various substances are covered under the *Australian Dangerous Goods Code 2007*. Should the proposed Olympic Dam expansion project be approved, BHPB would have to apply for licenses to transport prescribed dangerous substances, where required.

Transporting hazardous materials

The AR supports the proposal that, as for the existing operation, the local emergency response services along the transport route would provide an immediate response and seek to stabilise, contain and neutralise any spill. Advice from SA Police (SAPOL) is that local emergency plans exist and that the Far North Local Service Area is able to coordinate with Far North Highway Patrol, and Woomera and Roxby Downs police to manage emergency responses and traffic. To support this existing arrangement, the AR considers that BHPB should maintain adequate supplies of the specialist chemicals required to contain and normalise spills and transport incidents, which would significantly reduce the time required to load and transport them to any incident.

Accordingly, in updating their transport safety and emergency response plans, BHPB should develop a risk mitigation strategy to ensure enough neutralisers and associated chemicals are available in the event of an incident during transportation or handling. These plans should be developed in conjunction with SafeWork SA, SAPOL and the emergency services sector through SAFECOM to ensure that sufficient vehicles and resources exist along the transport corridors to meet the increased risk of Hazmat and Heavy Rescue incidents.

Joint exercises with the CFS, MFS, State Emergency Service (SES), SAPOL, DTEI and BHPB should be undertaken to test systems and responses to keep them contemporary. Consideration has already been given to this idea and should be further actioned by the Far North Zoned Emergency Management Committee (FNZEMC).

RECOMMENDATION

In summary, the AR considers that the issue of safety and emergency response on the transport network in relation to the movement of hazardous materials can be managed effectively through BHPB complying with legislative and licensing requirements and commitments it has already made. Accordingly, the AR recommends the following notes to BHPB:

- In order to comply with the South Australian *Dangerous Substances (Dangerous Goods Transport) Regulations 2008*, a Transport Emergency Response Plan (TERP) should be prepared, in consultation with SafeWork SA and other relevant authorities. The TERP should include the proponent's response arrangements for product recovery and site normalisation for Concentrate and Uranium Oxide that would include requirements for safely storing and transporting uranium oxide, including, amongst other matters, the emergency response to potential incidents along routes.
- In order to achieve compliance with clause 24 of the State Emergency Management Plan, pursuant to Section 9(e) of the South Australian *Emergency Management Act 2004*, the development of an Emergency Response Plan (ERP) for the Olympic Dam site should be undertaken prior to construction, in consultation with the South Australian Hazard Leader Agency for Escape of Hazardous Materials, SafeWork SA. The MHF-related operational hazards and risks should be reviewed during the pre-commissioning, commissioning and operational phases, in consultation with SafeWork SA.

The AR also recommends BHPB engages early with SafeWork SA, the emergency services sector through SAFECOM, and SAPOL in the development of the ERP and TERP.

Ammonium nitrate (AN) storage and transport

BHPB presented a road-transport solution in the SEIS which removed the need to store AN at Pimba. However, BHPB has proposed working with the SA Government to achieve a rail solution for the bulk movement of AN in the future. The AR supports further discussions being held in this regard.

The AR considers the road transport of AN to Olympic Dam from an Australian supply site is an appropriate solution, subject to compliance with any licensing conditions imposed under the Explosives Act 1936.

RECOMMENDATION

The AR recommends the following note to BHPB:

- Detailed planning for the storage and transport of bulk ammonium nitrate will be required to be undertaken prior to construction occurring at the mine site, and in consultation with the South Australian explosives regulatory authority, SafeWork SA to satisfy licensing requirements under the South Australian *Explosives Act 1936*.

11.4.2 Moving over-dimensional (OD) loads

11.4.2.1 Issues

There would be a significant increase in the number of OD loads on the road network should the proposed mine expansion be approved. The AR has assessed the following issues:

- OD-load impacts on the trafficability (the extent to which traffic can flow) and safety of the State road network;
- Impacts of OD-load vehicle convoy movements; and
- Delays to road users from OD-load movements.

Trafficability and safety

OD loads from Adelaide would be less than 8m wide and required either to be accompanied by a pilot or escort vehicle, or have a permit exempting them from travelling with a pilot or escort. A small number of loads could be required to have both pilot and escort vehicles in attendance. The OD loads would comply with the existing arrangements for SA roads and expected to have minimal impacts on traffic flows (DEIS 19.5.6).

Loads wider than 8m would be moved from the proposed landing facility to the pre-assembly yard in Port Augusta and then to Olympic Dam. The Traffic Impact Assessment (TIA) undertaken to inform the EIS determined that over an eleven year construction period that loads up to 8m wide would move on average every 4-5 days, and loads greater than 8m would move on average every 3-4 days during peak construction periods (DEIS Appendix Q9). After the construction period, the number of OD loads travelling to Olympic Dam would be very low, with none expected to require temporary road closures.

In assessing the likely impacts from predicted increases in OD-load movements during the construction period, the SA Government sought more information regarding the proposed infrastructure augmentation to the public road network between Port Augusta and Olympic Dam, necessary to accommodate BHPB's OD and over-mass (OM) vehicles. The Government requested BHPB consider reconstructing and sealing the road shoulders between Port Augusta and Olympic Dam to ensure they could support traffic loads and be trafficable and safe.

OD vehicle convoy movements

The DTEI policy document, *Transport of Oversize and Indivisible Loads and Vehicles (June 2006)* specifies that only one convoy is allowed in any 24 hour period, with no more than two vehicles in a convoy. BHPB was advised that should it seek to increase the number of convoys in any 24-hour period and/or an increase in the overall length of each convoy/number of vehicles, it would be required to provide the following information for DTEI's consideration:

- Risk mitigation regarding vehicle breakdowns;
- Scheduling of operations;
- Proposed convoy configurations; and,
- Evidence that the proposal would be strongly supported from a road-user perspective.

Delays to road users

BHPB has proposed a network of parking bays which would aim to limit the maximum delay for road users from the movement of OD vehicles to 45 minutes. All OD loads over 8m wide would use the parking bays to allow vehicles to overtake safely and minimise delays to road users. The parking bays would be 17km apart (DEIS Section 19.5.6). BHPB also committed to the preparation of a Traffic Management Plan to manage and monitor the movement of OD loads.

DTEI considered the delay to road users should not exceed 30 minutes. BHPB were advised in the consultation period that if it was considering a delay greater than 30 minutes it should provide justification in the SEIS, including details of road-user support strategies associated with the extended delay. For the 1997 expansion of Olympic Dam, which generated a lot less traffic over a much shorter construction timeframe, a maximum delay of 30 minutes was prescribed.

11.4.2.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 5.1:

- **Objective:** Communities in which BHPB operate value its citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints are addressed.
- **Management plan:** To prepare a Traffic Management Plan for the safe and efficient transport of large loads and OD loads between Port Augusta and Olympic Dam. And, in response to submissions, BHPB agreed to determine a baseline road condition for the Stuart Highway between Port Augusta and Olympic Dam.
- **Commitments:**
 - To provide for the safe and efficient movement of materials and goods in and out of Olympic Dam by developing up to 15 parking bays along the Stuart Highway and Olympic Way that would enable traffic to pass safely (SEIS table 2.1 – Commitment, page 62).
 - To manage inconvenience to the public and the safe and efficient transport of OD loads and pre-assemblies between Port Augusta and Olympic Dam by (SEIS table 2.1 – Commitment, page 63):
 - Giving notice of road usage and interruptions through regular community announcements;
 - Aiming to move OD loads outside of peak periods;
 - Having a goal of ensuring the maximum time the public would be disrupted by individual road closures was 45 minutes;
 - Developing a Traffic Management Plan in consultation with DTEI to ensure traffic-related impacts on residents from the movement of OD loads during construction and operation of off-site infrastructure were minimised, and that people were not unduly inconvenienced;
 - Assisting interested parties in a study aimed at determining the feasibility of a bus service between Andamooka and Olympic Dam; and
 - Supporting any study that might be initiated by the SA Government into the feasibility of a public transport system in Roxby Downs.

11.4.2.3 Assessment

SA legislative framework

The transport of OD and OM loads on the state's road network must comply with the limits on the dimensions and mass of vehicles as specified in the *Road Traffic Act 1961*. The Act, however, provides for vehicles exceeding these limits to operate on all or part of the road system, and allows for exemptions or permits to be granted where justified. This process is administered through the DTEI Permits System which operates under the delegated authority of the Minister for Transport. For further information, refer to DTEI's *Policy for the Transport of Oversize and Overmass Indivisible Loads and Vehicles (June 2006)*.

The purpose of a permit is to ensure safe travel of the vehicle, the safety of other road users and preservation of the road. The conditions and restrictions specified in the permit document are intended to ensure the following does not occur:

- Damage to roads, bridges or culverts;
- Damage to road-side fixtures, such as street lights, traffic lights, power cables, signs;
- Danger for other motorists; and
- Danger for the vehicle, driver and load.

BHPB has committed to working with DTEI to investigate other options to reduce impacts on road users, including:

- Increasing the number of convoys allowed each day;
- Transporting loads outside peak times, such as at night; and/or
- Increasing the number of vehicles/loads per convoy to reduce the number of road closures.

Should the mine expansion be approved, BHPB would need to seek to the relevant permits from DTEI to transport OD/OM loads, which would include discussions with the SA Government about the options outlined above. A note to this effect has been recommended, as outlined below:

- The proponent would be required to obtain approvals/permits from DTEI for the movement of OD/OM loads under the *Road Traffic Act 1961*.

Trafficability and safety of roads

The State and national arterial road networks are a highly visible community asset, fundamental to its economic, social and environmental well-being. Road users and the community demand a safe, reliable and accessible road network. Increases in road use, particularly by heavy vehicles, have a significant impact on the rate of deterioration and road maintenance activities required to meet the demands of road users and the community.

Neither AusLink nor the SA Government have a short term intention or need to seal the shoulders of the Stuart Highway between Port Augusta and Pimba, or the Olympic Dam to Pimba road. The route has been gazetted for use by OD vehicles.

The need for shoulder sealing has only arisen as a result of BHPB's proposal to use the existing public road network for the movement of a large volume of piloted OD vehicles, in the order of 8700 over an 11-year construction period for the proposed mine expansion project.

The AR considers that the projected total of up to 45 escorted 6-8m wide loads each week would cause a rapid deterioration of the unsealed road shoulder, which has typically been constructed to cater for the occasional errant or stopping vehicle. The expected damage would be a safety concern because it would increase the risk of accidents, especially vehicle roll-overs. It would also increase maintenance costs for the SA Government.

The AR supports the use of large volumes of OD vehicles for the expansion project using the existing road network between Port Augusta and Olympic Dam provided the road shoulders are sealed over the entire length of the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba road. Accordingly the following condition has been recommended:

- The road shoulders over the entire length of the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road must be sealed, at the proponent's cost, within twelve months of this development authorisation.

Further, where OD/OM loads enter or exit the sealed arterial road network, BHPB would be required to design, construct and maintain sealed junctions to the approval of DTEI to minimise deterioration to the edge of the sealed carriageway and prevent debris being carried onto it, including:

- To/from the Pimba Intermodal facility;
- All entry/exit points to parking bays for use by road users; and
- All access points used by OD/OM vehicles associated with the Olympic Dam expansion project.

Accordingly the following condition has been recommended:

- Where Over-Dimensional (OD) and Over Mass (OM) loads enter or exit BHPB facilities onto the sealed arterial road network, BHPB must design, construct and maintain sealed junctions in accordance with DTEI standards to minimise deterioration to the edge of the sealed carriageway and prevent debris being carried onto it, including (but not limited to):
 - To/from the Pimba Intermodal;
 - All entry/exit points to rest areas (parking bays) for use by existing road users; and
 - All access points used by OD/OM vehicles.

The AR considers that the sealing of the road shoulders and road junctions would be a necessary up-front infrastructure improvement to allow safe transport of large volumes of OD loads. With this infrastructure in place, the AR supports the proposal that BHPB and DTEI determine an agreed baseline road condition for the section of the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba road (SEIS Section 22.1). Accordingly the following condition has been recommended:

- The proponent must determine baseline road conditions for the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road to the satisfaction of DTEI, prior to the movement of OD/OM loads for the expansion project.

The purpose of determining a baseline would allow for both BHPB and the state government to determine and attribute deterioration of the road pavement and shoulders. In this regard, the AR notes that subsequent permits issued for the movement of OD and OM vehicles would include the standard condition that applies to all permits issued for the movement of OD and OM loads with respect to the obligation to pay the road authority (council and/or DTEI) *for the reasonable costs of making good damage caused as a result of the passage of a vehicle or combination travelling under a permit.*

Support for this approach is provided on the basis that an agreement on baseline road condition be reached before BHPB start moving OD loads between Port Augusta and Olympic Dam for the proposed mine expansion. Accordingly, the following note has also been recommended:

- BHPB is advised that permits issued for the movement of OD and OM vehicles will include the standard condition that applies to all permits issued for the movement of OD and OM loads with respect to the obligation to pay the road authority (council and/or DTEI) *for the reasonable costs of making good damage caused as a result of the passage of a vehicle or combination travelling under a permit.*

This approach is supported by the Australian Government which has indicated that implications for future upgrading and maintenance of the Stuart Highway would need to be considered and agreed by the respective parties.

RECOMMENDATION

The AR considers that the movement of OD loads and their potential impact on road safety and trafficability could be managed effectively through the permitting process, and compliance with the conditions listed above that require the following:

- Shoulder sealing on the Stuart Highway between Port Augusta and Olympic Dam.
- The upgrading of sealed junctions.
- Establishing a baseline road condition of the Stuart Highway.

OD convoy movements

The AR considers that BHPB has not provided sufficient evidence to address the four convoy-movement issues listed in Section 11.4.2.1 to enable DTEI to consider any changes to the standard provisions for convoy movements in its policy document *Transport of Oversize and Indivisible Loads and Vehicles*. SAPOL is in agreement with this assessment and has specifically advised that at this time it does not support an increase in the number of convoys in any 24-hour period and/or an increase in the overall length of each convoy because of the potential long delays with road blockages caused by breakdowns, and risks associated with other vehicles attempting to overtake convoys.

However, the AR considers sufficient information has been provided for the purpose of the EIS assessment, as the detail of the OD convoy movements would be addressed through subsequent permitting processes for the movement of OD loads required under the *Road Traffic Act 1961* (as referred to above - SA legislative framework). The AR supports BHPB's commitment to meet with DTEI and SAPOL to discuss such measures should they wish to operate beyond the constraints of the DTEI policy document (*Policy for the Transport of Oversize and Overmass Indivisible Loads and Vehicles (June 2006)*).

RECOMMENDATION

Accordingly, the AR recommends the following note to BHPB:

- The proponent has not provided sufficient evidence of any of the requested four (4) matters to allow any change in the standard conditions as set out in the DTEI policy document, '*Transport of Oversize and Indivisible Loads and Vehicles*'. Further consultation on this matter between BHPB, DTEI and SAPOL is required to discuss contingencies for breakdowns and moving traffic past the loads, including the following four (4) matters:
 1. Risk mitigation regarding vehicle breakdowns;
 2. Scheduling of operations;
 3. Proposed convoy configurations; and
 4. Evidence that the proposal would be strongly supported from a road user perspective.

Delays to road users

BHPB stated in the SEIS that "of the 4197 submissions received on the DEIS, no submission from a member of the public raised the 45-minute delay as an issue of concern". While the AR accepts this to be the case, a lack of submissions should not be taken to be representative of public acceptance.

Drivers of regulated heavy vehicles must comply with legislated working and rest hours. Long-haul truck drivers are quite often on tight schedules or carrying time-sensitive freight with little scope for delays. Extended delays potentially expose these drivers to travel time violations if the delays have interfered with their planned long rest breaks, and increase the risk of unsafe driving to 'make up' time. An increase in all motorists' planned journey times has the potential to expose them to night travel on unfenced roads, increasing their risk of colliding with animals.

Daytime temperatures in the region can regularly exceed 40C. The time spent waiting in such heat should be minimised, particularly when involving families with young children, elderly tourists, and overseas tourists unaccustomed to Australia's climate.

Vehicle slow-down time, and subsequent acceleration time, as a result of the delay process also need to be considered, as this has the potential to surreptitiously 'extend' the 45-minute maximum, particularly when the traffic mix is likely to contain a combination of slow and faster-moving vehicles.

During the previous Olympic Dam expansion in 1997, SAPOL identified that it was not always possible to clear closed or controlled sections of road in the allotted time. SAPOL advice is that more parking bays and shorter travel distances between them for a 30 minute maximum delay would significantly assist in this task.

In response, BHPB stated in the SEIS that to shorten the delay the following increase in the number of parking bays would be required:

- Stuart Highway: Fourteen (14) bays for a 30-minute delay, as opposed to nine (9) bays for a 45-minute delay; and
- Olympic Way: Eight (8) bays for a 30-minute delay, as opposed to six (6) bays for a 45-minute delay.

The cost of the additional parking bays would be approximately \$1 million.

BHPB has acknowledged that by providing more parking bays, each bay itself would be shorter. However, it notes that it would still result in a 25 per cent increase in the "area of land disturbance". The AR considers that such land disturbance is of minimal concern when weighing up the safety benefits gained from additional parking bays, and in the context of the total clearance proposed for the mine expansion project.

BHPB also stated that the additional bays would result in additional construction sites on the Stuart Highway and Olympic Dam to Pimba road. The AR does not consider this to be a significant issue, given that construction would be undertaken largely off-road, with the only need for on-road works being in the connection of the parking bays to the existing road. Provided that all work was undertaken in accordance with DTEI guidelines for road construction, DTEI anticipated minimal disruption for road users. DTEI considered that any minor delays during the construction of additional bays would be far less of an inconvenience to the public than delays of up to 45 minutes caused by having fewer bays.

BHPB said travel times for OD loads would be extended as a result of more stops, but it did not provide quantitative evidence in the SEIS of the extent of any such increase.

The AR acknowledges that BHPB intends to discuss with DTEI such issues as:

- Transporting loads outside of peak traffic periods, including at night; and
- In certain circumstances, using increased convoy sizes as opposed to individual truck loads outlined in the Traffic Impact Assessment.

The AR also acknowledges and supports BHPB's commitment to undertake specific community consultation regarding the delays, and the intention to provide amenities and refreshments. The AR nevertheless considers that a delay of up to 45 minutes for the travelling public has not been justified and accordingly has recommended a condition for sufficient parking bays to be constructed by BHPB to reduce delays to a maximum of 30 minutes.

RECOMMENDATION

Accordingly, the AR considers the issue of traffic delays from OD-load movements could be managed effectively subject to the following condition:

- The proponent must construct sufficient parking bays on the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road, to ensure a maximum delay of 30 minutes for the travelling public, to the satisfaction of DTEI.

A further condition has been recommended in accordance with BHPB's proposed EM Program that requires the preparation and implementation of a Traffic Management Plan, as outlined below:

- BHPB must prepare and implement a Traffic Management Plan for approval of the Indenture Minister, with the concurrence of DTEI, prior to the movement of escorted OD/OM loads associated with the major development approved herein. The Traffic Management Plan must include the following:
 - Details about traffic volumes, proposed transport routes, required road infrastructure maintenance and/or upgrades, transport scheduling and road safety;
 - Measures to restrict OD/OM movements in extreme hot weather, with a temperature limit being identified to avoid road closures during these events;
 - Measures to restrict OD movements during peak times (as informed by Culway data¹⁸);
 - An education and media information strategy regarding road closures be implemented in the lead up to and during the expansion project;
 - The plan must incorporate a provision that, 12 months prior to commencing any program to move escorted OD loads associated with the project, the proponent will advise and consult with DTEI and SAPOL;
 - Road Safety Management Plans to be prepared in consultation with SAPOL and DTEI; and
 - Consideration of vehicle mix in the parking bays (i.e. vehicles carrying dangerous goods should be corralled separately from general vehicles due to increased risks and compliance with the Dangerous Goods Code).

The AR also recommends the following notes to BHPB:

- The Traffic Management Plan should include details for Restricted Access Vehicle (RAV) routes. As RAV's (i.e. B-doubles, over-dimensional vehicles) will be using the state road network to access the Olympic Dam site it will be necessary for the routes to be assessed and appropriate upgrades made prior to DTEI issuing approval for these vehicles to utilise the surrounding road network.
- The South Australian Police (SAPOL) will require at least six (6) months notice of OD scheduling from BHPB to manage its Police Escort Group capacity.

¹⁸ *Culway Data is used to optimise traffic movement information gathered by other systems such as Counters and Classifiers.*

11.4.3 Safety at rail crossings

11.4.3.1 Issues

The DEIS omitted to include a specific commitment by BHPB to improve safety at the Hesso and Pimba road/rail crossings in relation to the forecast increase traffic as a result of the proposed mine expansion project. DTEI advised BHPB it would have to install boom barriers at Hesso and active advance warning equipment at Pimba.

11.4.3.2 BHPB EM Program and commitments

No commitments required as the matter has been resolved.

11.4.3.3 Assessment

In response to issues raised by DTEI, BHPB stated in the SEIS that improvements had been made to the Hesso road/rail crossing as part of the Nation Building Rail Crossing Program. Following the improvements, DTEI advised BHPB that it had reassessed its position and the safety infrastructure it requested for the Hesso and Pimba road/rail crossings was no longer required. Accordingly, this has been resolved.

11.4.4 Traffic management/impacts south of Port Augusta

11.4.4.1 Issues

BHPB stated that the proposed use of rail, along with the movement of OD materials by barge to the Upper Spencer Gulf landing facility would reduce heavy vehicle movements south of Port Augusta on the Princes Highway. In this regard, DTEI requested additional information regarding traffic management and the likely transport impact south of Port Augusta, specifically that further analysis be undertaken by BHPB to ensure that it could identify and manage any adverse impacts to the public road network and existing road users. BHPB was requested to provide in the SEIS:

- A total traffic management plan and an estimate of the likely mining-equipment movements south of Port Augusta; and
- To reassess the Port Augusta to Port Wakefield road over a minimum six separate sections to provide more accurate Level of Service (LOS) calculations.

BHPB undertook an additional study to assess the effect of increased traffic from the proposed mine expansion project on the LoS for six sections of the Princes Highway. The study showed that the existing LoS at these locations on the Princes Highway varied between LoS A and LoS B, with B defined as stable flow but with a little less comfort/convenience than A (SEIS Appendix K3). The study also found that LoS would not be expected to change as a result of traffic generated by the proposed expansion (SEIS Table 22.1), and concluded that there was spare capacity to maintain the respective LoS at each location, taking into account background traffic growth and expansion-related traffic.

BHPB acknowledged the potential inconvenience and safety implications and committed to work with the SA Government to prepare a Traffic Management Plan (as referred to above in section 11.4.2.3).

11.4.4.2 BHPB EM Program and commitments

Refer to the information provided in Section 11.4.2.2 of this chapter under 'Moving OD loads'.

11.4.4.3 Assessment

The AR considers that sufficient information was presented in the Final Environmental Impact Statement (FEIS) to satisfy DTEI that the issue of traffic management south of Port Augusta could be managed effectively.

SAPOL has advised, however, that heavy-vehicle permit compliance would be expected and would be strictly enforced should the proposed mine expansion project be approved. Drivers would have to comply with requirements of time and distance between loads and pulling off the road at regular intervals to allow other traffic to overtake. Failure to do so could cause other drivers to become frustrated and make poor decisions, including taking unsafe overtaking options. Police would monitor permit compliance along the routes.

RECOMMENDATION

The AR considers that the level of service (LoS) would be maintained on the Princes Highway, and that traffic management and the impacts to road users could be managed through compliance with permit requirements and the proposed Traffic Management Plan. Accordingly no conditions have been recommended.

11.4.5 New road transport infrastructure

In addition to the road upgrading projects referred to above, BHPB has proposed building new road infrastructure should the mine expansion be approved, including:

- Private access corridor from the sea landing facility to the pre-assembly yard in Port Augusta;
- Private access road from Hiltaba Village to Olympic Dam;
- Relocation of Borefield Rd; and
- A rail spur road overpass.

Each new road proposal is addressed separately below.

11.4.5.1 Issues

Port Augusta private access corridor

DTEI considered that BHPB provided insufficient detail in the DEIS regarding the traffic impacts from the proposed private access corridor between the landing facility and pre-assembly yard, and its interface with existing infrastructure in Port Augusta. DTEI sought further information regarding forecast traffic volumes and assessment of the corridor interfaces with State and local roads and rail networks, including traffic management and infrastructure augmentation. Primary interfaces of concern to DTEI included:

- The intersection of Stuart Highway and Old Tarcoola Road;
- The intersection of the access corridor and the Eyre Highway;
- The intersection of the access corridor and Carroona Rd; and
- The intersection of the access corridor and the Port Augusta to Whyalla rail line.

The alignment of the proposed access corridor shown in the DEIS was not the preferred solution of the SA Government or Port Augusta City Council, particularly in relation to the crossing point on the Eyre Highway. DTEI's preference was for the crossing point to be on a straight stretch of road to provide a greater line of sight, and located on the northern side of the Eyre Highway instead of the southern side as proposed by BHPB.

Safety concerns were raised about the proposed crossing point on the southern side because of the high-speed environment of the national freight corridor. The SA and Australian governments have an obligation to preserve and maintain the functionality of the national freight corridor, as well as the safety of road users.

BHPB subsequently revised the alignment in accordance with the SA Government and Port Augusta City Council's preferred alignment (SEIS Figure 22.3).

Private access road from Hiltaba Village to Olympic Dam

BHPB was required to assess the impact on the public road network, including access arrangements, for a new private access road from Hiltaba Village to Olympic Dam.

Relocation of Borefield Rd

Details were sought on design considerations for the re-alignment of Borefield Rd, such as traffic volumes, upgrading required and maintenance.

Rail spur road overpass

BHPB has sought approval to build a road overpass 15km north of Woomera where the proposed new rail spur would cross the Olympic Dam to Pimba road (DEIS Figure 5.43). The overpass would require 5ha of land and would be built immediately adjacent to the existing road. Its construction would require the approval of DTEI.

Government road funding

The DEIS made assumptions about State and Australian government funding for road upgrades. It is not the role of the AR or BHPB's EIS to commit current or future governments to funding commitments for upgrades to the road network. DTEI requested the SEIS include a statement withdrawing BHPB's previous assumptions regarding future national and State funding.

11.4.5.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 5.1:

- **Objective:** Communities in which BHPB operates value its citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints addressed.
- **Commitments:** To provide for the safe and efficient movement of materials and goods in and out of Olympic Dam by:
 - Relocating the proposed landing facility-pre-assembly yard access corridor nearer to the Port Augusta airport, and on a revised route around the Eureka Estate, to minimise impacts in line with government and community requests; and
 - Upgrading the access corridor crossing points at Shack and Caroon roads and Eyre Highway (SEIS table 2.1 – Commitment, page 62).

11.4.5.3 Assessment

Port Augusta private access corridor

The amended alignment of the proposed access corridor presented in the SEIS (Figure 22.3) matched the requirements and preferred alignment of the SA Government and Port Augusta City Council that was outlined in correspondence dated 31 March 2010.

RECOMMENDATION

Accordingly, the AR considers this issue has been resolved and recommends the following conditions of approval:

- The access road from the landing facility to the pre-assembly yard in Port Augusta must be constructed in accordance with the alignment shown on SEIS Figure 22.3.
- The proponent must consult with and seek approval from DTEI, for the private access corridor from the landing facility to the pre-assembly yard, with all costs being the responsibility of BHPB.

Private access road from Hiltaba Village to Olympic Dam

The AR supports both the location of the proposed private access road and the intent, being to remove traffic from Andamooka Rd.

RECOMMENDATION

Accordingly, the AR supports the construction of a private access road from Hiltaba Village to the mine site, subject to compliance with the following recommended conditions:

- The eastern access road from Hiltaba Village to the mine site must be established in accordance with the alignment shown on SEIS Figure A6.2 (refer SEIS Appendix A6).
- The proponent must comply with the relevant DTEI standards for the eastern access road from Hiltaba Village to the mine site, with all costs being the responsibility of BHPB.

Relocation of Borefield Rd

The AR supports the proposed realignment of Borefield Rd and considers the additional travel time involved is acceptable. The AR recommends that the re-alignment would need to be completed before the 'pre-strip' phase of BHPB's operations.

RECOMMENDATION

Accordingly, the AR considers the proposed re-alignment of Borefield Road could be managed effectively subject to compliance with the following recommended conditions:

- The re-alignment of the Borefield Road must be constructed in accordance with DEIS Figure 5.5.
- Construction of the re-aligned Borefield Road must be complete before the exiting Borefield Road is closed due to 'pre-strip' construction activities.
- The proponent must comply with the relevant DTEI standards for the realignment of Borefield Road, with all costs being the responsibility of the proponent.

Rail spur road overpass

The AR recognises and supports the need for the road overpass to facilitate construction of the rail spur from Pimba to Olympic Dam.

RECOMMENDATION

Accordingly, the AR considers the road overpass proposed for where the road and rail spur would intersect could be built and managed effectively subject to compliance with the following recommended condition:

- The proponent must comply with the relevant DTEI standards for the road overpass (associated with rail spur operation), with all costs being the responsibility of the proponent.

Government road funding

BHPB acknowledged in the SEIS that neither the SA nor Australian governments had made funding commitments to upgrade road infrastructure in the project area, and that government retained overall responsibility for the management and funding of the state and national road network. The AR considers BHPB's response provided sufficient information to satisfy the SA Government that the issue had been dealt with appropriately. Accordingly, this matter has been resolved.

11.4.6 Increased Outback traffic

11.4.6.1 Issues

Freight movement on the Olympic Dam to Andamooka road

It is considered the DEIS did not sufficiently address the impact of freight movement on the Olympic Dam to Andamooka road. Under BHPB's proposal to relocate Borefield Rd, the initial 17km of the Olympic Dam to Andamooka road would become a freight route. The DEIS did not consider the necessary augmentation required to the road and its junction with the Olympic Dam to Pimba Road.

DTEI asked BHPB to identify any required works and commit in the SEIS to carrying them out to DTEI's satisfaction. In response, BHPB proposed constructing a second new entry gate and eastern access road to provide a direct link between Hiltaba Village and Olympic Dam. This would result in two new entry gates and traffic being split between the western and eastern access roads. BHPB stated in the SEIS that this would reduce traffic on Olympic Way and the western access road, and slightly increase traffic on Axehead and Andamooka roads (SEIS Appendix A6, section 6.3 and Attachment D, Figure 1.12). The main implication of the increase would be a minor reduction in the LoS and operating capacity of the staggered 'T' intersection of Axehead Rd, the heavy vehicle bypass and Andamooka Rd. Despite this, the proposed traffic volumes would operate well within the capacity of the intersection.

The SEIS recognised that neither the intersection nor Andamooka Rd are an approved route for the safe movement of Restricted Access Vehicles (RAVs) such as B-double, double and triple road trains. BHPB would require approval from DTEI under the *Road Traffic Act 1961* to allow for the movement of RAVs to the proposed eastern access gate.

The FEIS stated that at the detailed planning stage BHPB would design intersections to minimise the impact on traffic heading to and from the Andamooka Rd from the proposed airport, the relocated Borefield Road and Hiltaba Village. This could include:

- Establishing turning lanes and passing lanes to retain flow of through-traffic;
- Incorporating slip lanes for breaking or merging traffic entering or departing; and
- Accommodating queue lengths for turning vehicles in the intersection layouts.

11.4.6.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 5.1:

- **Objective:** Communities in which BHPB operates value its citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints addressed.
- **Commitments:** To provide for the safe movement of traffic between, and within, Roxby Downs, Hiltaba Village and Olympic Dam, BHPB would (SEIS table 2.1 – Commitments, page 63):
 - Provide a fleet of buses for travel between the construction site and accommodation areas;
 - Construct an additional road on the SML and between Hiltaba Village and the mine site to isolate this traffic from the public road network; and
 - Work in partnership with the SA Government and Roxby Downs Council to coordinate and align road safety initiatives that could be applied to all road users.

11.4.6.3 Assessment

BHPB stated in the SEIS that the Traffic Impact Assessment and additional studies adequately assessed the effects of increased traffic on the Andamooka Rd and concluded that it would continue to flow freely at LoS A.

RECOMMENDATION

The AR considers that the movement of increased traffic on Andamooka Rd could be managed subject to compliance with the following recommended condition:

- The proponent must comply with the relevant DTEI standards for any upgrades required on the Andamooka Rd as a result of additional traffic associated with the mine expansion project.

11.4.7 Road safety

11.4.7.1 Issues

DTEI raised concerns that road transport casualty crashes would increase as a result of increases in the Million Vehicle Kilometres Travelled (MVKT) rate and Annual Average Daily Traffic (AADT) rate, despite information to the contrary published in the DEIS. Concern was also raised that the DEIS only addressed fatalities. BHPB was asked to undertake an assessment of the impacts of casualty crashes, particularly on serious injuries, for the SEIS. It was to reassess casualty crashes using DTEI's standardised casualty costs, and consider mitigation measures. BHPB was also asked for details of bus casualties, as well as greater detail on risk-mitigation measures for railway crossings. These issues were clarified in the SEIS (Section 25.1.1).

11.4.7.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 5.1:

- **Objective:** Communities in which BHPB operates value its citizenship.
- **Criteria:** Community concerns are tracked and all reasonable complaints addressed.
- **Commitments:**
 - To provide for the safe and efficient movement of materials and goods in and out of Olympic Dam by (SEIS table 2.1 – Commitments, page 62):
 - Installing a rail/road Intermodal facility at Pimba and building a rail line between Pimba and Olympic Dam;
 - Installing a landing facility south of Port Augusta to handle pre-assembly construction modules;

- Building a road-over-rail overpass on Olympic Way; and
- Installing up to 15 parking bays along Stuart Highway and Olympic Way that would enable traffic to pass safely.
- To provide for the safe movement of traffic between, and within, Roxby Downs, Hiltaba Village and Olympic Dam by (SEIS table 2.1 – Commitments, page 63):
 - Installing a new four-lane, median-separated carriageway from the northern intersection of the heavy vehicle bypass and Olympic Way to a new main gate at Olympic Dam;
 - Installing new roads, intersections and engineered traffic controls, such as roundabouts, in Roxby Downs; and
 - Providing a fleet of buses for travel between the construction site and accommodation areas.

11.4.7.3 Assessment

To address the interaction between mine expansion-related traffic movements and public road users, BHPB has committed to preparing and implementing traffic safety plans and procedures in partnership with DTEI, SAPOL and Roxby Downs Council. The safety plans would form part of the Traffic Management Plan (TMP), and would aim to coordinate safety initiatives (SEIS Appendix K1).

SAPOL advised that BHPB would require a nominated compliance officer to monitor all road activities. Driver fatigue could become an issue due to the projected high number of vehicle movements. BHPB may have responsibilities under Chain of Responsibility legislation and would need to have robust systems in place to manage this issue.

The AR considers road safety could be managed effectively should the mine expansion be approved, subject to commitments made by BHPB in relation to the preparation and implementation of a Traffic Management Plan (TMP), provided the plan includes the following:

- Road Safety Management Plans developed in consultation with SAPOL and DTEI; and
- Measures to restrict OD movements during peak times (as informed by Culway data¹⁹).

RECOMMENDATION

Accordingly, the AR recommends that road safety issues can be managed appropriately subject to compliance with commitments made by BHPB and the following condition requiring a Traffic Management Plan:

- The proponent must prepare and implement a Traffic Management Plan for approval of the Indenture Minister, with the concurrence of DTEI, prior to the movement of escorted OD/OM loads associated with the major development approved herein. The Traffic Management Plan must include the following:
 - Details about traffic volumes, proposed transport routes, required road infrastructure maintenance and/or upgrades, transport scheduling and road safety;
 - Measures to restrict OD/OM movements in extreme hot weather, with a temperature limit being identified to avoid road closures during these events;
 - Measures to restrict OD movements during peak times (as informed by Culway data²⁰);
 - An education and media information strategy regarding road closures be implemented in the lead up to and during the expansion project;

¹⁹ *Culway Data is used to optimise traffic movement information gathered by other systems such as Counters and Classifiers.*

²⁰ *Culway Data is used to optimise traffic movement information gathered by other systems such as Counters and Classifiers.*

- The plan must incorporate a provision that, 12 months prior to commencing any program to move escorted OD loads associated with the project, BHPB will advise and consult with DTEI and SAPOL;
- Road Safety Management Plans to be prepared in consultation with SAPOL and DTEI; and
- Consideration of vehicle mix in the parking bays (i.e. vehicles carrying dangerous goods should be corralled separately from general vehicles due to increased risks and compliance with the Dangerous Goods Code).

11.4.8 Air quality

11.4.8.1 Issues

Construction of the new and upgraded roads associated with the proposed mine expansion has the potential to generate dust that would be controlled using water and/or dust suppressants applied by water carts or mobile sprinklers (DEIS Section 13.3.5). The operation of new roads, including the access corridor from the landing facility to the pre-assembly area in Port Augusta, would be constructed of compacted crushed rock and gravel to establish an all-weather surface to reduce dust impacts.

11.4.8.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No EMP provided for this issue.
- **Commitments:** No specific commitments made in relation to this issue.

11.4.8.3 Assessment

The AR considers that dust from construction of the proposed access corridor from the landing facility to the pre-assembly yard on the north-west outskirts of Port Augusta posed the greatest potential risk to air quality of all the road works that would be undertaken in the proposed expansion of Olympic Dam. However, BHPB's revised road alignment presented in the SEIS satisfies concerns raised by the SA Government regarding impacts to nearby residents. The revised alignment abuts the airport and sets the corridor approximately 60m from the nearest housing. This separation distance, coupled with the proposed dust management/suppression measures outlined in the DEIS would minimise the risk of dust being a nuisance.

RECOMMENDATION

Accordingly, the AR considers that dust from road construction could be managed effectively subject to the measures proposed in the DEIS and SEIS and the following recommended condition to ensure an adequate separation distance is maintained:

- The access road from the landing facility to the pre-assembly yard in Port Augusta must be constructed in accordance with the alignment shown on SEIS Figure 22.3.

The AR also recommends the following note:

- BHPB is reminded of its general environmental duty, as required by Section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities associated with the construction and operation of new private roads did not pollute the environment in a way that caused or could cause environmental harm. Dust suppression through watering or application of chemicals would be possible methods of achieving this.

11.4.9 Transporting radioactive products

Transporting radioactive products on the rail network has been addressed in this AR in Chapter 10: 'Infrastructure corridors'.

11.4.10 Surface water

11.4.10.1 Issues

The proposed 10km access corridor from the landing facility to the pre-assembly area in Port Augusta would be constructed of compacted crushed rock and gravel and would include culverts over drainage lines to prevent changes to existing drainage patterns (DEIS Section 5.9.4).

11.4.10.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 4.4:

- **Objective:** No significant adverse impacts to environmental receptors as a result of stormwater discharges to soil, surface water or groundwater associated with BHPB's expansion activities.
- **Criteria:** All contact stormwater maintained within designated stormwater management areas.
- **Management plan:** To develop a Stormwater Management Plan for the construction and operation of the proposed expansion of Olympic Dam.
- **Commitments:** No specific commitments made in relation to this issue.

11.4.10.3 Assessment

The AR considers the proposed surface water management design measures for the proposed Port Augusta access road from the landing facility would provide an appropriate means of minimising adverse impacts on catchment flow regimes and water quality, subject to BHPB implementing:

- Detailed engineering design of cross-drainage structures; and
- Risk-based soil erosion protection measures/works.

RECOMMENDATION

No conditions have been recommended in relation to this issue. However, the AR recommends a note to BHPB highlighting the need to comply with the general environmental duty under the SA *Environment Protection Act 1993*, particularly in relation to soil erosion and water pollution control.

11.4.11 Noise and vibration

11.4.11.1 Issues

Road traffic and rail noise are excluded from the SA *Environment Protection (Noise) Policy 2007* (Noise EPP). However, in relation to new road and rail development proposals, compliance with the following noise criteria is considered a suitable alternative:

- Road traffic noise not to exceed noise levels in the DTEI Road Traffic Noise Guidelines; and
- Rail noise not to exceed 60dB(A) $L_{Aeq,24h}$ /85dB(A) L_{Amax}

Noise impacts from the proposed access corridor connecting the landing facility and pre-assembly area in Port Augusta have been assessed as road traffic noise, with the DTEI Road Traffic Noise Guidelines used as the best available criteria for transient noise from road traffic.

The southern portion of the 10km corridor would run adjacent to Shack Rd and the Cultana Training Area (CTA), while the northern portion would run adjacent to Kittel St. An amendment to the proposed route resulted in the northern portion of the corridor being set further away from housing and hence would reduce potential noise impacts (SEIS Section 5.7.3).

The proposed access road is predicted to carry 5-10 heavy-vehicle movements a week, and 10 light-vehicle movements a day when a barge was unloading (SEIS Section 5.7.3). Neither the DEIS nor SEIS contained details whether the vehicular activity would be day-time only, or day-time and night-time.

Closer investigation by the EPA of the properties most likely to be affected revealed that the minimum separation distance afforded by the proposed alignment to housing would be 60m. This was consistent with information provided in Section 15.4 of the SEIS. Based on the separation afforded by the proposed alignment, and the predicted volume of traffic, the DEIS considered that noise from the proposed access corridor would likely meet the relevant criteria in the DTEI Road Traffic Noise Guidelines, and further consideration of noise impacts was not required.

11.4.11.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 3.2):

- **Objective:** No adverse impacts to public health as a result of noise emissions from BHPB's expanded operations.
- **Criteria:** Maintain noise from the expanded operations at Olympic Dam to less than 30dBLAeq (24 hour) within residential dwellings.
- **Commitments:** No specific commitments made in relation to this issue.

11.4.11.3 Assessment

On the basis of both the low number of heavy vehicle movements predicted to occur weekly, and the degree of separation to the nearest noise-sensitive receivers, the AR considers that noise from the proposed access corridor at Port Augusta would meet the most stringent criteria under the DTEI Road Traffic Noise Guidelines, and therefore no further consideration is necessary. Accordingly a condition has been recommended requiring construction of the proposed access corridor in accordance with the alignment provided in the SEIS (Figure 22.3).

In terms of other roads proposed to facilitate the project, the AR considers the predicted small increase in road traffic noise levels along some major roads, including Olympic Way, in Roxby Downs would be within DTEI Road Traffic Noise Guideline criteria and there would be no need for the implementation of noise mitigation measures. A detailed assessment of predicted traffic impacts in Roxby Downs is provided in Chapter 8: 'Roxby Downs township'.

In relation to the construction of all new and upgraded roads, the AR recommends the following note to BHPB:

- The applicant is reminded of its obligation to ensure that construction noise at all times complied with the requirements of *Environment Protection (Noise) Policy 2007* Division 1 of Part 6. Supplementary information on construction noise management can be found in the Guidelines for the Use of the *Environment Protection (Noise) Policy 2007* and Construction Noise Information Sheets at www.epa.sa.gov.au.

11.4.12 Terrestrial impacts

A comprehensive assessment of potential impacts on the terrestrial environment, including flora and fauna and soils, for the proposed mine expansion project area is provided in this AR in Chapter 13: 'Effects on the environment'.

The following section covers the potential impacts to vegetation from clearance for the construction of the parking bays on the Stuart Highway.

11.4.12.1 Issues

BHPB has yet to determine the locations of the proposed parking bays. Up to 15 bays on the Stuart Highway and Olympic Dam to Pimba Road were proposed in the DEIS. However the AR has recommended the construction of additional parking bays to reduce the delays to road users from 45 minutes (as proposed by BHPB) to 30 minutes.

11.4.12.2 Assessment

The AR supports the installation of parking bays on the Stuart Highway as a way to improve safety and efficiency should the proposed expansion of Olympic Dam be approved. However, the DEIS did not specify locations for the parking bays. Accordingly, the AR recommends the following condition:

- Prior to finalising the location of the parking bays on the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road, the proponent must conduct floristic surveys, following adequate rainfall if possible, to confirm the presence/absence of listed threatened species. In determining the final location of the passing bays, the proponent must avoid listed species, however if clearance is unavoidable, revegetation of these species must be reinstated or relocated to adjacent work areas, or as otherwise agreed by DENR.

The AR notes that the alignments presented in the FEIS for the other road infrastructure have been chosen to achieve the least impact, or to avoid sensitive receivers. If during the detailed survey work, BHPB find additional sensitive receivers that required it to modify infrastructure locations presented in the FEIS, the company would be required to lodge the revised plans with the Minister and seek a variation to the conditions in accordance with the *Development Act 1993*.

11.4.13 Impacts to Department of Defence land

11.4.13.1 Issues

The proposed access corridor from the landing facility to the pre-assembly yard would pass through the Cultana Training Area (CTA) along the western side of Shack Rd and through vacant freehold and Crown land north of the CTA and east of the Port Augusta airport. The corridor would join the Sturt Highway 3km north-west of Port Augusta. The DEIS stated that BHPB would seek to obtain a lease from the Department of Defence over the portion of the corridor that crossed the CTA and freehold title over the rest of the route.

11.4.13.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No EMP provided for this issue.
- **Commitments:** No specific commitments made in relation to this issue.

11.4.13.3 Assessment

BHPB would be obliged to enter into a 'Deed of Access' for the access corridor with the Department of Defence. This would be sufficient to ensure that Defence interests were protected. Full details are provided in Chapter 10: 'Infrastructure corridors'.

11.4.14 Rehabilitation and decommissioning

11.4.14.1 Issues

Port Augusta private access corridor

The FEIS did not provide specific details regarding the long-term future and decommissioning arrangements for the proposed private access corridor between the landing facility and pre-assembly yard.

11.4.14.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No EMP provided for this issue.
- **Commitments:**
 - To update the Rehabilitation and Closure Plan for Olympic Dam to include the expanded components of the proposed mine expansion following completion of detailed design.
 - To consult and engage with relevant government departments and other stakeholders to further develop and refine closure criteria, including final land uses, rehabilitation, management and ongoing monitoring. The plan would be reviewed annually and updated if required (SEIS table 2.1 – Commitments, page 57).

11.4.14.3 Assessment

Port Augusta private access road

Because of the potential for ongoing social impacts to the local community, the AR recommended in Chapter 6: 'Landing facility and pre-assembly yard', that approval for the landing facility should be given on a temporary basis only, sufficient to support the scheduled 16-year construction phase of the proposed mine expansion project. The long-term use of the site as a port facility is not considered appropriate given the close proximity of coastal homes. The AR recommended a condition requiring the decommissioning and rehabilitation of the landing facility at the completion of construction.

Should this recommendation be supported, it would follow that the proposed access corridor should also be temporary in nature, as it would not be required without the landing facility.

RECOMMENDATION

Accordingly, the AR recommends the following condition:

- The proponent must cease operation of the Port Augusta access corridor at the end of the mine construction period, or within 16 years of the opening of the Port Augusta access corridor (whichever occurs first). The infrastructure on land must be removed and the site rehabilitated to the satisfaction of the Indenture Minister within one year of closure of the Port Augusta access corridor.

11.5 Conclusion

The AR recognises that new and upgraded transport infrastructure would be essential for the proposed Olympic Dam expansion project. It supports BHPB's approach to keeping loads off the road network where possible by using the established rail system, as well as facilitating the movement of large equipment and material via the landing facility.

With the implementation of measures recommended in the AR, including the provision of additional parking bays and the sealing of the road shoulders on the Stuart Highway between Port Augusta and Olympic Dam, the AR considers that large loads could be moved in a manner that protects both the safety and efficiency of the established road network.

Detailed planning for the proposed road infrastructure should be at the cost of BHPB and undertaken in accordance with DTEI standards and legislative requirements.

Chapter 12

Effects on communities



Chapter 12: Effect on communities

12.1 General

The potential social and economic impacts of the proposed expansion of the Olympic Dam mining operation are largely applicable to all components of the project. The overall assessment of its likely effect on communities is provided in this chapter of the Assessment Report (AR) rather than repeated through the various project component chapters. It addresses the following issues:

- 12.2 - Economic issues;
- 12.3 - Employment, skills and training;
- 12.4 - Regional community impacts; and
- 12.5 - Indigenous issues.

Where the social and economic impacts are specific to only one project component these issues have been addressed under the relevant project component chapter. As with the component chapters, the structure of this chapter for each issue except 'indigenous issues' is:

- Description of the existing environment;
- Project description;
- Summary of submissions;
- Assessment of the impacts; and
- Conclusions

The structure of the Indigenous issues section of this chapter is:

- Legislative environment;
- Aboriginal cultural heritage;
- Aboriginal services;
- BHPB commitments; and
- Conclusion.

12.2 Economic Issues

12.2.1 Existing economic environment

The Olympic Dam mine is located in Roxby Downs in the Northern Statistical Division (SD) in South Australia. The Northern SD has a significant industrial base, including mining, oil and gas, iron and steel, lead smelting, mineral processing and power generation. Tourism and transport are two other major industries in the region. The Northern SD is also well suited to defence training and military testing operations, and while the traditional pastoral and farming industries are in decline they are being offset by emerging industries such as alternative energy, food production and the arts.

The Draft Environmental Impact Statement (DEIS) stated that the Olympic Dam operation contributed \$1.7-billion per annum (2.4 per cent) to South Australia's Gross State Product (GSP), and \$2.0-billion to the State's annual overseas exports (13 per cent).

12.2.2 Project description

12.2.2.1 Economic impacts

The proposed Olympic Dam expansion project would have a significant impact on the South Australian economy. The DEIS stated that when the expanded mine was at full production South Australia's GSP would be an estimated \$6.9 billion - 8.7 per cent per annum higher in annual average terms compared to the business-as-usual (BAU) case projection. Other predicted economic impacts reported and updated in the Supplementary Environmental Impact Study (SEIS) in 2010 dollars over the 30-year modelled period included:

- South Australia Gross State Product (GSP) to increase by \$48.4-billion in Net Present Value (NPV) compared with the BAU case projection;
- Northern Statistical Division (SD) Gross Regional Product (GRP) to increase by \$22-billion;
- Adelaide SD Gross Regional Profit (GRP) to increase by \$27.6-billion;
- Investment in South Australia to increase by \$33 billion;
- Private consumption in South Australia to increase by \$22.3 billion; and
- Household consumption spending in South Australia to increase by \$3.1-billion (6.1 per cent) each year by the full operation phase – years 12 to 30 - of the project.

The Final Environmental Impact Study (FEIS) compared the economic impacts of the proposed expansion to those of a BAU case. The BAU case was defined as the current levels of operation at Olympic Dam, being 235,000 tonnes per annum (tpa) of refined copper plus associated products uranium oxide, gold and silver. The modelling took into consideration direct and indirect impacts, as well as the effects of 'crowding out' other economic activities, both in South Australia and interstate, arising from the proposed expansion.

The economic impacts were based on the proposed 11-year construction period as presented in the DEIS while the SEIS also contained alternative estimates of economic impacts based on an 'extended construction' scenario beyond 11 years (to 16 years). Such a scenario might eventuate if demand were slower than anticipated or delayed by significant events such as the recent Global Financial Crisis.

The extended construction scenario assumed that processing at 20-million tpa would be delayed by three years and processing at full capacity of 72-million tpa would be delayed by five years. The impact of a delayed expansion would be to reduce the Net Present Value (NPV) of the economic benefits because future years' impacts would be discounted more heavily. The results of the 'extended construction' modelling suggested that the NPV of the Gross State Product (GSP) gain compared with the BAU would be 30 per cent lower than previously modelled, namely \$34.2-billion compared to \$48.4-billion. Nonetheless, these would still be considered very large impacts in the context of the overall size of the South Australian economy.

12.2.2.2 Industry impacts

Aside from the mining and associated processing industries, the economic modelling showed the rail transport, electricity supply, water transport services, chemical production and road transport industries would benefit the most significantly from the proposed mine expansion over the 30-year period of the study. Key industry sector growth trends and timeframes identified were:

Initial construction phase: Strong growth expected in construction services, equipment suppliers, road transport services, cement manufacturers and rail transport services in South Australia.

Second construction phase: Strong growth expected in road and rail transport services, electricity suppliers, construction services and equipment suppliers in South Australia.

Operational phase: Export-oriented industries projected to grow at a slightly slower rate than BAU projections as a result of the appreciation in the Australian dollar.

12.2.2.3 Government revenues and expenditure

South Australian Government revenues are projected to increase by \$3.4-billion over the 30-year modelling period. Average royalty revenues from the mine to the State are projected to be \$190-million a year higher compared to the BAU-case projections in real terms, assuming no change from the current royalty rate of 3.5 per cent.

However, the increased royalty revenues would have implications for South Australia's share of GST Revenue Grants. The FEIS did not quantify the extent of the redirection in GST Revenue Grants to South Australia as a result of the increase in the State's revenue raising capacity. The royalty increase impacts overstate the revenue gain to the SA Government.

The modelled 'extended construction' scenario suggested the increase in SA Government revenues would reduce to \$2.5-billion over 30 years. The actual impact would be less than this figure as a result of the reduction in South Australia's share of GST revenue grants.

No estimate is provided in the DEIS of the costs to Government associated with the proposed mine expansion. However, the economic model assumed the SA Government would make a \$100-million contribution to the common-user economic and social infrastructure in Roxby Downs for items such as schools, hospitals and police stations. The actual cost would depend on policy decisions at the time and will not be determined as part of the EIS assessment process.

12.2.3 Summary of submissions

12.2.3.1 SA Government Submission

Issues raised in the SA Government submission relating to the economic impacts of the proposed mine expansion project included:

- While the DEIS acknowledged the impact of fiscal equalisation, the estimated revenues gains to South Australia due to the project do not take fiscal equalisation into account. As a result, the quantified revenues are larger than would be expected;
- Greater clarity was required about State revenue impacts. GST revenues collected from South Australia should not be used as a way of assessing benefits to South Australian residents as it would be collected by the Commonwealth Government and then distributed to all State and Territory Governments;
- Greater explanation was required about the assumptions of the economic modelling, particularly on labour-supply elasticity and commodity prices;
- Greater explanation was required about the economic modelling data, as well as the discussion around some of the model inputs and outputs, such as the narrow focus on employment impacts in areas that would benefit, with little or no attention on the results for other regions. BHPB was requested to provide expanded tables of modelling results;
- The carbon pricing assumed for the analysis was not disclosed;
- The sourcing of inputs from multiple sources would assist in providing supply opportunities for South Australian businesses and BHPB should confirm how much it was prepared to multi-source inputs;
- The assessment of industry impacts, which covered the top five expanding industries in South Australia and the Northern Territory, should be expanded to include all industries. Additional information should be provided for all industries in the Northern SD;
- The direct and indirect impacts should be reported separately, rather than aggregated;
- An assessment of the degree of 'crowding out' of existing economic activity should be made and information provided on industries expected to decline as a result;
- Additional details were required for the occupation breakdown of construction and new operation workforces;

- The potential impact of earthquakes and the financial impact they could have on BHPB and the South Australian economy should be assessed as part of the risk assessment; and
- No assessment was provided on the potential economic impacts on commercial and recreational fisheries in the Upper Spencer Gulf region from the proposed desalination plant.

12.2.3.2 Public submissions

Issues raised in public submissions in relation to economic impacts included:

- The DEIS considered only one configuration of the Olympic Dam expansion and did not consider:
 - a no-uranium-export option;
 - a no-open-pit option; and
 - processing the uranium-enriched copper concentrate in South Australia/Australia;
- The current royalty rate of 3.5 per cent should be increased;
- BHPB should not receive diesel fuel rebates;
- Compensation should be paid to residents and business owners near Roxby Downs, Port Augusta and Port Lowly due to impacts such as decreased property prices and environmental damage;
- The environmental-impact costs of the project were not included in the DEIS;
- The project would account for a large percentage of South Australia's carbon emissions, which would create an economic cost to the State's businesses and residents by driving up the price of carbon permits;
- The DEIS only addressed economic and environmental impacts from an expansion to 750,000 tonnes per annum (tpa) of copper product, despite the EIS Guidelines referring to a production rate of up to 1-million tpa;
- The ongoing costs of remediating the mine site on completion of the mining operation might outweigh the overall benefits received by the SA Government;
- Business-as-usual scenarios presented in the DEIS were not adjusted for the impact of the global financial crisis and lower commodity prices;
- Economic risk management for the transport of the uranium to the Northern Territory and China was costed;
- Costs to the SA Government and the potential impacts of money having to be diverted from other Government projects; and
- The economic costs of the project were not as well detailed as the economic benefits. For example, the 'crowding out' effect and its cost to South Australia and other states with regards to skilled labourers was not detailed beyond a basic level.

12.2.4 Assessment of economic impacts

12.2.4.1 Issues

In response to submissions BHPB provided additional data to the Department of Treasury and Finance (DTF), to enable the SA Government to quantify the effect of fiscal equalisation. However, the GST redistribution among the States was not estimated because it would be separately determined by the Commonwealth Grants Commission through a complex process.

Further information was also sought from BHPB on potential impacts on the economy and jobs market, in particular longer-term job security and whether offshore processing of copper concentrate would reduce economic benefits to the State. BHPB stated that it could not guarantee the behaviour of global financial markets but was committed to the long-term operation of Olympic Dam and would endeavour to ensure job security was maintained. It also advised that the processing of all copper concentrate at Olympic Dam would not provide the optimal return on investments because it would require the construction of an additional smelter.

Further information on the capacity of local business to supply products to BHPB and the procurement policies of BHPB were requested. BHPB advised it would endeavour, as far as reasonably, economically and commercially practicable, to use local labour, business supplies and services in its operations.

12.2.4.2 BHPB EM Program and commitments

Environmental Management Program (EMP): To work through regional economic boards and the Industry Capability Network of South Australia to maximise opportunities for South Australian and Aboriginal businesses by (DEIS Appendix U ID 5.1 – Community Interactions):

- Establishing a database of SA businesses with an interest in the project;
- Facilitating the pre-qualification of SA businesses;
- Providing information about current and future opportunities and tendering processes;
- Supporting business training, development and diversification; and
- Linking existing or potential suppliers to improve local competitiveness.

Commitments: To undertake activities to enhance local business opportunities, including (SEIS Table 2.1 – Commitments, page 68):

- Continuing to convene the Contractor Framework Implementation Team. While the focus of this group is on BHPB's Health, Safety, Environment and Community (HSEC) Standards at Olympic Dam, it also provides a forum for communication and engagement with contract companies;
- Conducting supply forums locally and elsewhere in SA to provide information on current and future business opportunities, tendering processes and pre-qualification of businesses;
- Reinstating a web address for potential suppliers to register and express interest in tenders;
- Re-establishing an online project supplier database in conjunction with the Industry Capability Network South Australia to enable potential suppliers to register their interest in the project;
- Continuing to fund the Olympic Dam Indigenous Participation Program to develop the capacity of Indigenous companies and contractors to supply goods and services to Olympic Dam;
- Working with the SA Government, regional economic development boards, and education and training providers to support capacity building, meet skills requirements, and link existing or potential suppliers to improve local competition;
- Participating in the Roxby Downs Business Forum if it was reformed by local businesses; and
- Giving consideration to the SA Government's Industry Participation Policy to give local businesses a full, fair and reasonable opportunity to be considered for work in the expansion of Olympic Dam.

12.2.4.3 Assessment

Economic modelling of the proposed expansion of Olympic Dam shows large impacts on the South Australian economy. Given that the mine accounts for 2.4 per cent of South Australian Gross State Product (GSP) and the proposed expansion would increase average production more than three-fold, it is clear there would be significant impacts on the region and the broader South Australian economy. It would include flow-on benefits to industries supplying inputs and increased competition for labour resources. The inclusion of the 'extended construction' scenario in the SEIS, however, demonstrates the significant variability in impacts depending on timeframes involved in the various stages of the expansion.

The FEIS contained estimates of significant impacts on SA Government taxes and revenues. The expansion of the mine and flow-on effect would significantly increase the Government's capacity to raise taxation revenue. This would result in adjustments to South Australia's share of GST revenue grants.

Significant economic benefits are expected to be realised in the region and the broader South Australian economy. The AR considers that gains to the Government's budget would be less than the figures provided by BHPB due to the impact of fiscal equalisation, and the increased demands for community services and infrastructure in Roxby Downs and other communities that would be affected by the expansion. The extended construction scenario, if it materialised, would also diminish the short to medium-term revenue gains.

RECOMMENDATION

In order to achieve the economic gains in timely manner, the AR recommends the following conditions requiring the substantial commencement of the open pit:

- For the purposes of section 48(11)(b) of the *Development Act, 1993*, the proponent must commence the development by substantial work on the site of the development within 5 years of the date of this authorisation, failing which the authorisation may be cancelled.
- The proponent must have substantially commenced construction of the open pit within 5 years of the date of this authorisation.

12.2.5 Conclusion

The AR considers the economic benefits to the regional and State economy would be significant. It strongly supports BHPB's general commitment to use, where economically and commercially practicable, local labour, business supplies and services in its operations. Its proposed mechanisms to facilitate this are also supported.

12.3 Employment, skills and training

12.3.1 Existing Environment

12.3.1.1 Employment

For the Olympic Dam mining operation (DEIS - 2008 figures) BHPB employed:

- 1700 staff, including 96 apprentices and 56 graduates;
- 2450 contractors - 1400 long-term and 1050 short-term – 60 per cent of whom lived locally;
- Workers of 34 nationalities; and
- Females totalling 14 per cent of the workforce, 57 per cent of whom were in professional occupations.

12.3.1.2 Workforce planning

The DEIS stated that unemployment was very low in Roxby Downs with the highest rate of unemployment among young people. The Commonwealth Department of Employment and Workplace Relations (DEWR) statistics for March 2008 showed the town had 0.4 per cent unemployment, equating to 10 people.

Current workforce participation initiatives being undertaken by BHPB include:

- Expanding the traineeship/apprenticeship and new graduate intake;
- Supporting TAFE SA programs in Roxby Downs, including the Job Readiness and Mechanical Engineering Prevocational programs;
- Working closely with education and training providers to develop relevant curricula; and
- Developing career promotion and recruitment strategies.

12.3.1.3 Skills and training

Roxby Downs had a high proportion of residents with post-secondary qualifications, most commonly a certificate in engineering or a related field, or who were attending school or undertaking technical and further education through TAFE SA (DEIS Section 19.3.7). The Roxby Downs Community Plan 2005 identified education and training as the highest priority. BHPB involvement with training initiatives specifically relating to Olympic Dam is shown in the DEIS Appendix Q, Table Q7.3.

Roxby Downs and other Upper Spencer Gulf campuses of TAFE SA provide post-secondary courses to advanced diploma stage, plus pre-vocational training and continuing education. However, there is still a need for higher education and expanded TAFE SA options (DEIS Section 19.3.7).

The training profile of TAFE SA Roxby Downs campus from 2006-2009 had increased steadily from 440 to 1007 students and from 29,000 to 49,000 training hours. Though there was a drop of 150 students in 2009, the number of student hours increased by almost 6000 hours. In terms of hours over the four years, training in the Business Services Program had increased while remaining constant in Mechanical Engineering and Transport.

12.3.1.4 Aboriginal employment and training

The Northern Statistical Division (SD) of South Australia had a much larger proportion of Aboriginal people (8.6 per cent) than SA as a whole (1.7 per cent). The proportion of Aboriginal people in Roxby Downs was also 1.7 per cent, though labour force participation for Aboriginal people in the Northern SD was lower than for SA as a whole (DEIS Table 19.1).

Measures by BHPB to increase initiatives targeting employment and skills for Aboriginal people included:

- Providing an Indigenous Master of Business Administration Scholarship to increase opportunities for Aboriginal people in business and management;
- Assisting Aboriginal people to commence and complete traineeships;
- Supporting the Young Indigenous Entrepreneur program to encourage young Aboriginal people to pursue business skills and higher education;
- Developing the Pathways to Success program to provide study assistance for Aboriginal high school students in Port Augusta; and
- Developing the Olympic Dam Indigenous Participation Program aimed at increasing Aboriginal participation in the Olympic Dam workforce.

12.3.2 Project description

12.3.2.1 Employment

In full-time equivalent (FTE) terms, it is projected that the proposed expansion of Olympic Dam would increase employment in South Australia 13,100 (5.2 per cent) over the 30-year period modelled. The increase would be 7000 (19 per cent) in the Northern SD and 6600 (1.2 per cent) in the Adelaide SD.

The FEIS provided the following employment figures, based on an 11-year construction period:

- 5400 in the initial construction phase (start to year 6);
- 15,700 in the second construction phase (years 7 to 11); and
- 15,200 during full operation (years 12 to 30) comprising jobs at Olympic Dam and indirect employment elsewhere stimulated by the expansion.

The increase in employment was predicted to be predominantly in the Northern SD during the initial construction phase but would likely be split relatively evenly between the Northern and Adelaide SDs from the second construction phase onwards.

The workforce profile of an expanded mining operation was expected to be similar to the existing operation (DEIS Section 19.3.4) in comprising:

- 40 per cent labourers;
- 33 per cent professional and related workers;
- 16 per cent tradespeople and related workers; and
- 11 per cent in other occupations.

12.3.2.2 Skills and training

There will be a community need for higher education and expanded TAFE SA opportunities in the region in addition to the training needs identified by BHPB, with the most significant workforce pressures likely to be for qualified and experienced electricians, instrumentation technicians, metal tradespersons and maintenance personnel (DEIS Section 19.5.1). BHPB would also require professionals and para-professionals of whom there was a global shortage, as confirmed by the National Institute of Labour Studies.

It is considered that the Roxby Downs campus of TAFE SA would not have sufficient capacity to support the projected demand for training from either BHPB or the local community if the mine expansion was approved. The resulting expansion of the local community would result in demand for training beyond that required by BHPB, including health and community services, retail, tourism and business management. Though commitments can not be made in this AR regarding future TAFE SA facilities, land for expanded training facilities has been provided in the draft Roxby Downs Master Plan (DEIS Appendix F4).

12.3.2.3 Workforce planning

Workforce planning by BHPB would continue to respond to labour market conditions, national and international project demands, and refinements to the project configuration and associated infrastructure of the proposed mine expansion (DEIS Section 19.5.1). The increased workforce would present challenges such as recruitment and retention, attracting workers from existing local, regional and State-wide ventures, capacity constraints on the South Australian business sector and the need for additional social services and facilities, including culturally appropriate services.

Though BHPB has yet to determine its recruitment strategies it has considered attraction strategies that target employees from other occupations, industries and interstate, with a focus on:

- Workplace culture and conditions;
- Job design;
- Career opportunities;
- Education and training;
- Housing opportunities; and
- Positive perceptions of lifestyle and community.

While BHPB intends to recruit locally and nationally, skills shortages in Australia could force it to recruit from overseas as well. It has said it would collaborate with government and non-government agencies to provide a range of services to support workers from overseas.

BHPB would undertake more detailed workforce planning, including occupation categorisation and skill-set requirements, and provide its requirements to government and training organisations (SEIS Section 21.2.1). Employment targets would be discussed and determined as part of BHPB's proposed collaborative Social Management Plan (SMP).

12.3.2.4 Aboriginal employment and training

The Olympic Dam Agreement between BHPB and Aboriginal groups Barngarla, Kokatha and Kuyani includes specific targets for indigenous employment with a focus on the northern region of SA, the geographic area of interest of the three groups.

In addition to existing initiatives for indigenous employment and training, BHPB has committed to the development of an Aboriginal Engagement Plan, as part of the Olympic Dam Agreement, to address issues such as:

- Employing staff who have responsibility for Aboriginal engagement and delivery of commitments;
- Cross-cultural training for all employees and contractors;
- Plans for employment and training of local Aboriginal people and identification of potential training and employment opportunities, including apprenticeships;
- Identifying contracting/subcontracting opportunities that could be made available to local Aboriginal businesses;
- Considering wider business and joint-venture opportunities for local Aboriginal businesses; and
- Supporting local Aboriginal business development.

BHPB is also developing an Olympic Dam Indigenous Participation Program aimed at increasing Aboriginal employment at Olympic Dam and enabling Aboriginal enterprises to secure contracts at the site.

The DEIS recognised that employment opportunities for Aboriginal groups would need targeted programs, which focused on job readiness as well as training. This initiative would need to coordinate with mainstream workforce development and provide a point of contact to encourage Aboriginal participation.

12.3.3 Summary of submissions

12.3.3.1 SA government submission

Issues raised concerning employment, skills and training in the SA Government submission on the proposed mine expansion included:

- Clarification of the inconsistent employment data provided in the DEIS Table 1.2 and Section 2.9.1;
- More detail was needed on the breakdown of occupations required for the construction and operations workforces because the DEIS Table 19.14 provided only an assessment of the minerals industry as a whole, not the impact of the proposed expansion;
- More information was needed on how the required skills and workforce would be acquired;
- Regarding the assumption in the DEIS of an employment elasticity of 0.3 - with 0.7 the extra hours worked by existing workers – it would be appropriate to consider alternative elasticities to provide a sensitivity analysis or range of likely outcomes; and
- The extent to which a larger operation reduced the extent of workforce turnover as a percentage of overall township workforce needed to be explained further.

12.3.3.2 Public submissions

Issues raised concerning employment, skills and training in public submissions on the proposed mine expansion included:

- Insufficient commitment to local employment opportunities;
- The location of an expanded TAFE SA campus, the possibility of which was raised by Roxby Downs Council in its draft master plan, should be subject to a more detailed review/separate master plan for the area. The corner of Richardson Place and Arcoona St was suggested as a possible location;
- The issue of capital and recurrent funding of education in Roxby Downs should be addressed;
- Concern for Aboriginal people, their economic advancement and connection with their lands, the protection and economic and social advancement of young workers and the economic advancement of women;
- The consultation process not involving the trade union movement and individual unions as key stakeholders, meaning there was not input from worker representatives on key issues such as labour, employment, training and industrial arrangements. A formal process of consultations should occur with the union movement, including both State and national officials;
- Impact on other SA businesses of the expansion project's demand for workers;
- Impact of job losses at the end of construction period, and on the SA labour market.
- Employment targets should be set for BHPB to create economic opportunities for South Australians, such as 20 per cent of the workforce to be female;
- Requiring BHPB to make a significant investment in training to meet workforce requirements;
- Requiring BHPB and its sub-contactors to invest in the training of apprentices to the extent they comprise up to 10 per cent of the workforce, in line with the Australian Government infrastructure stimulus funding requirement; and
- BHPB should commit to work with the Outback Communities Authority (OCA), Northern Regional Development Board and local communities to identify and maximise employment opportunities in the Outback, particularly in small-scale service activities and potential tourism services.

12.3.4 Assessment of employment, skills and training impacts

12.3.4.1 Issues

Employment

The proposed expansion of Olympic Dam would have an impact on local, regional and State-wide enterprises, particularly during the construction phase, and would draw on labour from surrounding areas and industries. Workers with the required qualifications and skills, and businesses associated with the expansion, would likely benefit while other businesses could be left with skills shortages and recruitment challenges (DEIS Section 19.5.1).

The demand for workers would likely occur as other major resource projects interstate were getting under way, such as Liquefied Natural Gas (LNG) projects in Queensland and Western Australia, and post-flood recovery projects continued in south-eastern Australia. Competition for workers would be high.

While BHPB intends to recruit locally and nationally it expects it would also have to recruit between 200 to 500 contractors from overseas for construction and commissioning work, and 200 operational staff for a range of professional and senior roles. BHPB has stated it would collaborate with government and non-government agencies to provide services for workers from overseas.

Skills and training

Future training at Roxby Downs and surrounding regions would need to consider training at higher levels of qualification and in the occupations identified by BHPB as being most in demand. Initial and immediate training needs of new workers would include induction, licensing and accreditation, and safety.

While the SA Government and BHPB have discussed potential contributions to providing training infrastructure and delivery, BHPB would not be obliged to use TAFE SA as a provider, nor would it be obliged to source training locally. There would be a risk to Government of over-investing in expanded education and training facilities before BHPB clarified its training intentions.

BHPB has committed to continue support for various employment and training initiatives and would continue to participate in Government and industry groups to address skills shortages and reduce potential adverse impacts of labour demands. It has stated it would prepare detailed recruitment strategies when the final configuration of the expansion project was known, and its proposed Social Management Plan (SMP) would provide a mechanism to establish targets and performance indicators in relation to employment and training.

Workforce planning

Though BHPB did not provide detailed recruitment strategies in the DEIS it said it would implement programs to attract, train and retain workers to meet skill requirements in collaboration with government, providers and regional development boards.

A comprehensive analysis of the potential impact on the national skilled workforce, and range of strategies required to mitigate against negative impacts of skills shortages, is contained in the June 2010 report of the National Resources Sector Employment Taskforce (Resourcing the Future, www.deewa.gov.au/nrest).

Aboriginal employment and training

The AR does not address impacts or assessment of Aboriginal employment and training because it considers an appropriate framework is already in place, as outlined earlier in this section. Strategies and initiatives are being implemented and supported, including the Community Development Employment Program (CDED).

12.3.4.2 BHPB EM Program and commitments

Environmental Management Program (EMP): To address the skills shortage by supporting Australian and South Australian government employment and training initiatives. To also undertake specific measures (DEIS Appendix U, ID 5.1 – Community Interactions) including:

- Initiatives targeting employment and skills formation for Aboriginal people;
- Expanding its traineeship, apprenticeships and new graduate intakes;
- Providing bursaries for two students a year to study mining engineering at Adelaide University for four years;
- Supporting TAFE SA programs at Roxby Downs;
- Supporting a Careers Expo at Roxby Downs;
- Working with governments, universities, TAFE colleges and high schools to encourage the development of curricula relevant to the mining industry;
- Targeting high schools and universities to attract new employees; and
- Working with government, regional development boards, TAFE SA and other training and education providers to build the capacity of South Australian businesses to meet skill requirements.

Commitments: No specific commitment provided in relation to this issue.

12.3.4.3 Assessment

Employment and workforce planning

The expansion project would have a significant impact on the labour market in South Australia and beyond. The AR strongly supports the preparation and implementation of a Social Management Plan (SMP) to manage issues related to employment and training that would set targets for employment, including Aboriginal employment, apprentices, trainees and graduates, as well as opportunities for employing South Australians as a percentage of total employees. While performance indicators for employment and training are still to be finalised, BHPB's commitment to developing a SMP demonstrates an intention to maximise social benefit to the region. More detailed and formal workforce planning in collaboration with the SA Government is strongly supported by this AR. Accordingly, a condition has been recommended requiring the SMP to be collaboratively prepared with Government, and to include (amongst other matters) performance indicators/targets for employment and training.

Skills and training

The expansion and associated population growth at Roxby Downs would place greater demand on education and training infrastructure. However, the size and timing of the increase in demand is unknown at this stage and any decision to expand local facilities would require a careful cost-benefit analysis to avoid the risk of over-investment of public funds. It is not the role of this AR to commit the SA Government to providing public infrastructure, and while the issue can not be resolved as part of the EIS process it should be addressed in the ongoing discussions between BHPB and the Government regarding service delivery. The AR recommends that discussions include options for a shared education and training precinct for schools, Vocational Education and Training (VET) and higher education, together with on-line learning solutions such as video conferencing, because of the higher cost of establishing training infrastructure in remote locations.

As referred to above, the AR considers that the SMP would provide an effective mechanism to establish targets and performance indicators in relation to employment and training, and the AR has recommended a condition requiring BHPB to prepare and implement a SMP that includes this provision.

Aboriginal employment and training

The AR supports existing initiatives and the strategies proposed by BHPB to encourage Aboriginal employment and training.

12.3.5 Conclusion

Most issues raised in the SA Government and public submissions are matters of detail that would depend on BHPB decisions on the final configuration and delivery of the proposed mine expansion. However, the AR supports BHPB's initiatives and commitments to this point. It considers the SMP to be an appropriate mechanism to identify benchmarks and targets in relation to the ongoing recruitment and training needs for BHPB and the broader community. And it strongly encourages ongoing discussions between BHPB and the SA Government over workforce planning, training infrastructure and training delivery.

12.4 Regional community impacts

12.4.1 General

This section deals with the expected impact of the proposed expansion project on regional towns beyond Roxby Downs. Managing growth and delivering government services in these towns is discussed in the AR but is not being assessed as part of the EIS process. These issues would be managed as part of the core business of government in monitoring and managing growth, through the provision of well located and serviced land to meet population demand.

12.4.2 Site and locality

The Olympic Dam expansion would have direct impacts on Roxby Downs and Pimba/Woomera. To a lesser extent, other regional towns would also be expected to be affected, including Whyalla, Port Augusta and Andamooka.

12.4.3 Existing Environment

'Existing environment' descriptions for Andamooka, Woomera, Port Augusta and Whyalla are provided in the DEIS Chapter 19 and Appendix Q. Key points include:

Andamooka

- Located 33km east of Roxby Downs;
- 526 residents and 80 visitors counted in the 2006 Census, a 14 per cent increase on the 2001 Census;
- The Andamooka Progress and Opal Miners Association (APOMA) estimate the population increases to 1000 in cooler months;
- The town accommodated 220 Olympic Dam employees and contractors in 2009;
- Very limited services provided and residents often use services and facilities in Roxby Downs;
- APOMA manages and promotes improvements in public services and facilities, and articulates the views, interests and aspirations of the community; and
- The management and governance authority for Andamooka is the Outback Communities Authority. It covers 65 per cent of the State, taking in areas not serviced by local councils, with Andamooka its largest community.

Woomera

- Located 78km south of Roxby Downs;
- Established to accommodate the joint Australian and British project to test weapons and rockets at the Woomera Rocket Range;
- 300 residents and 180 visitors counted in the 2006 Census - half the number recorded in the 2001 Census and a fraction of its historic high of 6000 when the testing program was at its peak;
- The support and investment of the Department of Defence (DoD) is ongoing;
- The town accommodated 40 Olympic Dam employees and contractors in 2009; and
- Community services and facilities have been maintained despite the declining population.

Port Augusta

- Located 250km south of Roxby Downs;
- 13,875 people counted at the 2006 Census; and
- 90 Olympic Dam employees live in the town.

Whyalla

- Located 325km south Roxby Downs.
- 21,420 people counted at the 2006 Census.

12.4.4 Project description

In terms of impacts to regional communities from proposed project components located outside the SML, the DEIS indicated the following peak workforce and accommodation requirements:

- Over 700 workers would be required for construction of the proposed transmission line, water supply and transport projects (including the landing facility, intermodal facility, pre-assembly yard and rail spur). Workers would live in short-stay accommodation in local centres, including Whyalla, Port Augusta and Woomera, and commute daily.
- Up to 400 workers would be required for the construction of the proposed Point Lowly desalination plant. The workforce would stay at existing accommodation facilities within Whyalla, and would be transported by bus to and from the work site, with lunch rooms and basic sanitation facilities established on-site for the expected 33 month construction period.

12.4.5 Summary of submissions

12.4.5.1 SA Government submission

There was no government submissions on the impact of the proposed mine expansion on regional towns and government services.

12.4.5.2 Public submissions

Issues raised by public submissions included:

- Opportunities for new infrastructure in northern South Australia, including Roxby Downs and regional communities;
- Improvements to sporting and leisure facilities;
- Strengthening/improving educational institutions, with a focus on TAFE SA;
- Township expansion in Andamooka problematic because of a lack of infrastructure;
- The risk of unplanned development in Pimba;
- The need for adequate public services in Andamooka;
- Population impacts on Port Augusta and Whyalla;
- Impact of Hiltaba Village residents on Andamooka, Woomera and Roxby Downs; and
- Lack of health services, including obstetrics/gynaecology.

12.4.6 Assessment of regional community impacts

12.4.6.1 Issues

Impacts on regional towns

The Olympic Dam expansion would have direct impacts on Roxby Downs and Pimba/Woomera, and other regional towns would also be expected to be affected. Likely impacts relating to population growth and the associated demand for services and facilities would include:

- Andamooka and Woomera would attract workers and families wanting to live outside Roxby Downs and Hiltaba Village;

- Port Augusta would also attract workers and families as it is only a three- hour drive from Olympic Dam. While on shift at the mine, these workers would reside in long distance commuter (LDC) accommodation in Roxby Downs;
- Construction workers on the proposed landing facility, access road and pre-assembly yard projects would also be accommodated at Port Augusta; and
- Whyalla would be affected during the construction of the proposed desalination plant at Point Lowly 35km away.

The expected impact on Roxby Downs is addressed in Chapter 8: 'Roxby Downs township' of this AR.

An assessment of the potential impacts to Andamooka, Woomera, Whyalla and Port Augusta is outlined below.

Andamooka

Workers and their families could choose to live in Andamooka should the mine expansion be approved, particularly during peak construction periods. A small percentage of the Olympic Dam workforce already lives in the town.

Andamooka has experienced growing housing demand and rising costs, with average weekly rental doubling between 2005 and 2007 and the Development Assessment Commission (DAC) receiving more than 90 development applications for accommodation units over a six-month period in 2007. However, no development applications for non-complying group dwellings have been lodged in the past year as typically such applications have either been refused or placed on hold by proponents expecting more favourable policies to emerge as part of the Olympic Dam expansion assessment. Further intensive development of Andamooka is unlikely unless essential infrastructure is upgraded.

Locating the proposed airport between Roxby Downs and Andamooka, lower living costs and the unique character of Andamooka could enhance its attraction as a place to live, leading to further population increases and compounding pressures on housing, infrastructure and services. However, development at Andamooka is constrained by the requirement for a single dwelling to have a minimum site area of 1200m² and the lack of infrastructure, keeping residential development to a minimum. Workers would have to consider buying or renting existing housing rather than building. Further, the development of group or multiple dwellings is significantly constrained by Andamooka not having a sewage treatment and effluent disposal scheme. BHPB does not intend to build accommodation in the town.

In response to a submission from the Andamooka Progress and Opal Miner's Association (APOMA), BHPB undertook a study of the social effects of the proposed Olympic Dam expansion on Andamooka (SEIS Appendix J2). The study predicted a possible doubling of the 200 or so Olympic Dam workers living in Andamooka, which would create increased demand for housing and push up prices and rents. It would also likely lead to business opportunities in the town and a larger source of revenue to provide and maintain infrastructure. The study noted that Roxby Downs would be the key service centre for the region and that planning for social services and facilities there would have to take into account population increases in Andamooka.

The SEIS stated that while BHPB did not have a direct role in land and housing development at Andamooka it could manage housing outcomes in Roxby Downs and Hiltaba Village. In this regard, BHPB has committed to providing sufficient accommodation in an expanded Roxby Downs and Hiltaba Village. It has also committed to the development of a Social Management Plan (SMP) that would provide a mechanism to monitor housing issues in Roxby Downs and Andamooka and identify areas for action.

Woomera

The construction workforce for the proposed Pimba Intermodal Facility and rail spur would likely be accommodated in short-term accommodation at Woomera because there were limited services and accommodation in Pimba.

Olympic Dam workers might also choose to live at Woomera and commute to the mine. The SEIS stated that the estimated construction workforce required for each of the intermodal facility and rail spur projects would increase the short term population of Woomera by 40 per cent. The corollary was that almost 60 per cent of private dwellings were vacant (2006 Census). The town is maintained by the Department of Defence (DoD) and considered well-serviced for a town of its size.

Further details are provided in Chapter 9: 'Pimba intermodal facility'.

Whyalla

Whyalla could be affected by the proposed construction of a desalination plant at Point Lowly in terms of labour demand and housing availability. While 400 workers would be required for the construction of the plant, only 30 would be needed for its operation. The most recent figures (2011) showed 100 rental properties as vacant in Whyalla. It is expected BHPB and the government would monitor the availability and affordability of accommodation required for its construction workforce and respond accordingly.

Whyalla is currently well serviced in terms of infrastructure and community services, as the city was planned for a much larger population than exists today. Government and community services could be enhanced as required if the population increased significantly as a result of an expanded Olympic Dam and/or other major projects.

Port Augusta

Port Augusta is a major service centre for the northern region and provides a regional base for many government services. About 90 Olympic Dam workers currently live there, constituting a very small percentage of the total population of 15,000. Construction worker numbers would likely increase to approximately 400 if the mine expansion went ahead, with further business and employment opportunities arising from construction of the proposed landing facility, access corridor and pre-assembly yard, plus associated infrastructure, likely to increase that number.

BHPB stated that any increase in the population of Port Augusta as a result of the proposed mine expansion would be modest, but it would continue to have regular dialogue with the Port Augusta Council with the aim of managing any social impacts and contributing to sustainable community development (SEIS Section 21.7.5).

12.4.6.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** To develop and implement, in collaboration with the SA Government and other stakeholders, a Social Management Plan (SMP) with the aim of monitoring the impacts of the proposed mine expansion on Roxby Downs and communities in the northern region and identify areas for action (Appendix U, ID 5.1).
- **Commitments:** To work with the SA Government to manage potential negative risks and social impacts on Andamooka as an important neighbouring community, and to contribute to sustainable community development. To continue to consult and have regular dialogue with the Andamooka Progress and Opal Miners Association, local residents and other stakeholders as planning for the proposed expansion progressed (SEIS Table 2.1 – Commitments, page 69).

12.4.6.3 Assessment

Impacts on regional towns

Communities closest to the mine expansion project, such as Andamooka and Woomera, would likely be the most affected in terms of population growth and demand for services, compared to Port Augusta and Whyalla which are already major regional centres and generally well serviced for their size.

Family, community and health services and facilities available in Andamooka and Woomera are summarised in the DEIS Section 19.3.6. It is not expected BHPB would invest in services and facilities in these towns but, through the Social Management Plan (SMP), it would be involved in dialogue regarding the future development and directions of these towns. Goals relating to building and maintaining stakeholder relations in Woomera and Andamooka (SEIS, Appendix J, appendix 3) are supported by the AR as they would provide an opportunity for ongoing engagement between the company, community and government on community development matters.

In general, the AR considers that managing the growth of regional towns outside of Roxby Downs as a result of any expansion of Olympic Dam, and other projects in the State's north, rests primarily with State and local government. Planning will need to consider likely future growth and ensure an adequate supply of well located and serviced land is available for residential, industrial, commercial and civic purposes. Affordable housing within any new land divisions in regional towns (outside Roxby Downs) would be dealt with under existing protocols for affordable housing.

The AR recommends BHPB assist workers find accommodation in the affected regional towns, in consultation with local government, if the mine expansion goes ahead. Through the SMP, BHPB and the government should monitor housing demand Andamooka, Woomera, Port Augusta and Whyalla during the construction period and monitor rental rates, rental availability and housing stress. Should issues arise BHPB should implement strategies to address them in conjunction with the SA Government.

RECOMMENDATION

Accordingly, the AR has recommended a condition requiring the proponent to collaboratively prepare and implement the SMP with government, that amongst other matters, requires:

- Thresholds for the delivery and monitoring of social infrastructure provision.
- Monitoring of rental rates, rental availability and housing stress in Whyalla, Port Augusta, Andamooka and Woomera.

12.4.7 Conclusion

The AR concludes that managing the growth of regional communities is primarily the responsibility of State and local government through the provision of well located and serviced land. Under the guidance of the collaboratively prepared and implemented SMP, BHPB and government would benchmark essential services and respond according to need based on community growth. The AR considers this to be part of the core business of government in monitoring and managing growth. Accordingly, no commitments have been made in the AR regarding the delivery of services.

12.5 Indigenous issues

12.5.1 General

This section applies to the proposed Olympic Dam expansion project as a whole and considers the issues the project raises in relation to indigenous people, Aboriginal cultural heritage and native title. Indigenous employment and training were addressed in section 12.3 of this chapter.

This section provides a summary of the legislative environment and mechanisms for managing indigenous issues.

12.5.2 Legislative environment

12.5.2.1 SA Legislation

The *Roxby Downs (Indenture Ratification) Act 1982* requires that Aboriginal heritage issues on the Stuart Shelf and Olympic Dam area (SML) be dealt with under the *Aboriginal Heritage Act 1979* (the '1979 Act'). For activities located outside the Stuart Shelf and the SML, the *Aboriginal Heritage Act 1988* (the '1998 Act') applies.

Aboriginal Heritage Act 1979

The *Aboriginal Heritage Act 1979* covers Aboriginal heritage within the Indenture area. Specifically, BHPB activities in the Indenture area are governed by the Roxby Downs and Stuart Shelf Indenture, as ratified by the *Roxby Downs (Indenture Ratification) Act 1982*. The *Roxby Downs (Indenture Ratification) Act 1982* requires that Aboriginal heritage issues be dealt with under the *Aboriginal Heritage Act 1979*.

Any applications from BHPB to 'damage, disturb or interfere with' Aboriginal sites in the Indenture area must be considered by the Minister for Mineral Resource Development, in consultation with the Minister for Aboriginal Affairs and Reconciliation.

Aboriginal Heritage Act 1988

The *Aboriginal Heritage Act 1988* covers all areas outside the Indenture area. Therefore, if BHPB needs to 'damage, disturb or interfere with' any Aboriginal sites or objects or remove or disturb remains outside the Indenture area, the company must seek authorisation from the Minister of Aboriginal Affairs and Reconciliation, pursuant to section 23 of the *Aboriginal Heritage Act 1988*. BHPB is also obliged to make reports under section 20 of the *Aboriginal Heritage Act 1988* if any sites, objects or remains are discovered.

12.5.2.2 Commonwealth Legislation

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* enables the Australian Government to respond to requests to protect traditionally important areas and objects that are under threat, if it appears that state or territory laws have not provided effective protection.

12.5.2.3 Native title legislation

Native Title Act 1993 (Cth)

The *Native Title Act 1993 (Cth)* has a number of functions, including setting up processes through which native title can be recognised and providing protection for native title rights and interests by prescribing procedures which must be complied with by Commonwealth, State and Territory governments before a 'future act' can be validly done. The Act also regulates Indigenous Land Use Agreements (ILUAs), which are voluntary agreements made with native title parties about the use and management of land and waters.

Native Title (South Australia) Act 1994 (SA)

The *Native Title (South Australia) Act 1994 (SA)* clarifies various native title issues, such as confirming the existing ownership of natural resources by the Crown and existing public access to and enjoyment of waterways and public places.

Native Title Claimants

A number of Aboriginal groups have claimed native title interest in the EIS Study Area (DEIS Figure 17.1). In 2005, BHPB signed a negotiation protocol with the Barngarla, Kokatha and Kuyani people that identified the basis on which BHPB and the three communities would negotiate a full agreement to address all native title and Aboriginal heritage issues arising from the proposed expansion of Olympic Dam (DEIS Section 17.2.2). The SEIS stated that BHPB consulted with all native title claimants in the area where it proposed to develop and reached agreement in the form of the Olympic Dam Agreement.

BHPB also undertook separate consultation with the Nukunu, Arabunna, Dieri and Adnyamathanha group because of their native title claims to land on which sections of the proposed gas pipeline would be constructed. BHPB also met with other Aboriginal people and communities in northern South Australia who expressed an interest in operations at Olympic Dam.

The Olympic Dam Agreement contemplates that an Indigenous Land Use Agreement (ILUA) would be registered which would allow the expansion to occur within the ILUA Area. In the absence of a registered ILUA the expansion could proceed in the ILUA Area provided it complied with procedures prescribed under any relevant provision of the *Native Title Act (NTA) 1993 (Cth)*.

Should the proposed expansion be approved, including project components on land outside of the Olympic Dam Agreement area, on which native title may exist, either an ILUA or compliance with any other relevant provision of the NTA would be necessary.

As required, BHPB would consult with other Aboriginal groups claiming an interest in any area where land disturbance might occur when preferred options were determined.

12.5.2.4 Olympic Dam Agreement

This agreement covers both the existing operations and the proposed expansion of Olympic Dam. It recognises the rights of Aboriginal people and the importance to them of land. Signed in January 2008 (DEIS Section 17.5.2, SEIS Section 18.2) the agreement includes:

A Heritage Management Protocol that contains a process for managing impacts of the expanded project on Aboriginal cultural heritage sites and an ongoing protection and management regime, as follows:

- Payments to be made by BHPB over the remaining life of the mine for the benefit of the Kokatha, Barngarla and Kuyani groups and other Aboriginal people living in the Olympic Dam Agreement benefit area (DEIS Figure 17.1);

- A trust for administering the payments;
- Employing a liaison officer whose duties include liaising between BHPB and Aboriginal people on Aboriginal cultural heritage;
- Establishing an Aboriginal employment and training plan;
- Cross-cultural awareness training for BHPB employees and contractors;
- A process for managing environmental issues;
- Agreement of the parties to the expansion and operation of the Olympic Dam project for its remaining life; and
- The parties' intentions regarding an Indigenous Land Use Agreement (ILUA).

12.5.3 Aboriginal Cultural Heritage

The DEIS stated that in the past 35 years BHPB and its predecessor Western Mining Corporation had undertaken a large number of cultural heritage surveys. The Aboriginal Heritage Branch of the Department of Premier and Cabinet holds copies of 46 of these reports. Predictive modelling carried out for the 1982 Environmental Impact Statement (EIS), which was based on archaeological surveys, had been extended and confirmed by subsequent surveys. The modelling and surveys showed the Olympic Dam area was rich in archaeological sites, comparable to other arid environments across the region.

BHPB conducted ethnographic assessments of land within the current EIS Study Area which would likely be affected by the proposed mine expansion. The assessments were undertaken in conjunction with the relevant Aboriginal groups and identified sites of potential significance in the vicinity of all project components. Information on the location and cultural significance of places and stories was omitted from the DEIS at the request of the Aboriginal groups.

The DEIS described the criteria for classifying sites as having high scientific or archaeological significance and concluded that most sites in the Olympic Dam region were of low scientific significance and no salvage potential. However, the Kokatha, Bargarla and Kuyani groups have agreed to a salvage program involving 137 sites across the EIS study area. BHPB has received approval from the South Australian and Australian governments to undertake this program over three to four years. The program involves further detailed recording of sites, excavation and preparation of the salvaged sites for storage where they would be available for further research purposes.

The Heritage Management Protocol, which forms part of the Olympic Dam Agreement, outlines the processes for identifying, recording, managing and protecting archaeological sites and cultural places of significance to the Traditional Owner groups. The agreement also acknowledges that where sites cannot be protected BHPB must seek authorisation to damage sites under the provisions of the *Aboriginal Heritage Act 1979* (in accordance with the *Roxby Downs (Indenture Ratification Act 1982)* or the *Aboriginal Heritage Act 1988* and provisions for minimising and mitigating impacts.

The DEIS stated that, wherever possible, infrastructure corridors and land disturbance would avoid places of significance and BHPB would undertake further survey work and consult with relevant Aboriginal groups when preferred options were determined.

BHPB has sought and obtained approvals to disturb an area containing items of Aboriginal heritage on and in vicinity of Olympic Dam under the *Aboriginal Heritage Act*. The approvals reflect agreements reached with the three Aboriginal groups about salvage and recovery programs for artefacts in up to 10 specific areas that are representational of different aspects of past Aboriginal use, occupation and cultural practice.

The archaeological program is a large-scale venture which is providing both cultural recognition and employment. Conditions attached to the statutory approvals include a process for regular administrative review of the archaeological work and the preservation of these representations of local cultural heritage.

The three groups with which BHPB has signed the Olympic Dam Agreement are recognised as 'speaking for country' in this part of the State. The AR considers it appropriate that cultural heritage matters have been progressed with those groups rather than with the wider Aboriginal community in South Australia.

12.5.4 Aboriginal services - Housing, Health, Justice

With an expanded Olympic Dam providing new employment opportunities, the number of Aboriginal people in Roxby Downs and other regional towns could increase. The DEIS noted there could be a related increase in demand for health, youth and other services and facilities.

The SEIS stated that extensive consultation, undertaken primarily with the Barngarla, Kokatha and Kuyani groups, had included discussions about health-related issues. One objective of the trust to be established under the Olympic Dam Agreement would be health promotion in the community. BHPB would support discussions with relevant local and regional organisations such as those recommended by the SA Department of Health in its submission (outlined in the next section).

The State and Commonwealth governments have entered into agreements for the supply and management of indigenous housing. An increase in workforce opportunities for Aboriginal workers would likely lead to an increase in the number of Aboriginal families seeking accommodation in nearby areas, such as Port Augusta. This would affect demand for housing and management of the Aboriginal housing program. However, the AR considers that the question of housing for Aboriginal workers and their families is part of a wider housing supply issue which will not be resolved in this AR, but considered a SA Government policy issue relating to the supply of government services.

12.5.5 Summary of submissions

12.5.5.1 SA Government submission

The SA Government submission on the proposed expansion of Olympic Dam acknowledged the extensive consultation with Aboriginal communities during the project planning phase. The SA Department of Health requested continued consultation and engagement with the communities, particularly with the Kalaya group at Roxby Downs, the Northern Health Advisory Council and the Aboriginal Health Forum for Country Health SA.

12.5.5.2 Public submissions

Public submissions raised the following matters in relation to indigenous issues:

- The impact of the Indenture on BHPB's statutory obligation to consult with traditional owners, and the level of protection they receive;
- Clarification on the process used to determine traditional owners and the adequacy of the consultation process;
- Additional detail on measures undertaken and proposed by BHPB to protect cultural heritage and to consult with relevant groups;
- The cultural significance of the Mound Springs and Great Artesian Basin to Aboriginal people; and
- Concern that Aboriginal people would inherit radioactive land and waters when the mine closed and that they should be included as stakeholders to be consulted post-closure.

12.5.6 BHPB EM Program and commitments

Environmental Management Program (EMP): To develop an Aboriginal Engagement Plan (Appendix U, ID 5.1 – Community Interactions) including:

- Detailing commitments under the Olympic Dam Agreement;
- Identifying people within the company with responsibility for Aboriginal engagement and delivery of the commitments;
- Cross-cultural training for all employees and contractors;
- Plans for employing and training local Aboriginal people, including training programs and apprenticeships, and identifying potential positions;
- Identifying contracting or subcontracting opportunities that could be made available to local Aboriginal businesses;
- Considering wider business or joint-venture opportunities for local Aboriginal businesses; and
- Supporting for local Aboriginal business development.

Commitments: To its obligations under the Olympic Dam Agreement, which include:

- Establishing a trust to manage payments by BHPB and to support community and business development initiatives for Aboriginal communities in northern SA (as defined in the agreement).
- Implementing the Heritage Management Protocol to manage and protect the Aboriginal ethnographic and archaeological values of the region (SEIS table 2.1 – Commitments, page 67).

12.5.7 Conclusion

An outline of the legislative framework and management measures to protect and provide for Aboriginal employment, heritage and people has been provided to highlight the findings of the AR that appropriate mechanisms are already in place for the management of indigenous people, employment and heritage. Cultural heritage matters will continue to be dealt with under separate legislation and agreed processes. Specifically in relation to the proposed expansion of Olympic Dam, BHPB would be required to comply with the necessary authorisation and reporting requirements of the *Aboriginal Heritage Act 1979 and the Aboriginal Heritage Act 1988*. Aboriginal housing and support needs would continue to be monitored and addressed by the SA and Commonwealth Governments and BHPB, and native title issues would be dealt with in accordance with the *Native Title Act 1993*.

Chapter 13

Effects on the environment



Chapter 13: Effects on the environment

13.1 General

A description of the potential general environmental impacts from the proposed expansion of the Olympic Dam mining operation is largely applicable to all project components. The information has been provided solely in this chapter of the Assessment Report (AR), as opposed to repeating it across all relevant project component chapters. A description of the existing environment for the Environmental Impact Study (EIS) covers:

- Native vegetation;
- Flora and fauna;
- Weeds and pests;
- Soils;
- Surface water and drainage;
- Meteorology and climate;
- Natural hazards; and
- Greenhouse gases.

A description of the existing environment has been provided for each of the seven areas listed above. However, an assessment of the associated issues has been provided only for native vegetation, flora and fauna, soils and greenhouse gases. The other areas are not considered to have any significant 'whole of project' assessment issues, as they have been adequately addressed in the Final Environmental Impact Statement (FEIS) or in some cases are specific to particular project components and have been addressed in the relevant component chapters.

Where the environmental impacts are specific to only one project component these issues have been addressed in the relevant project component chapter. As with the component-based chapters, the structure of this chapter is:

- Description of the existing environment;
- Summary of submissions;
- Assessment of the issues; and
- Conclusion

Issues specific to a particular project component have been assessed under the relevant chapter as follows:

Chapter 4: Mining operations and processing

- Impacts on native vegetation from plant and dust emissions;
- Impacts of mining activity on arid recovery;
- Impacts of the Tailings Storage Facility (TSF) on fauna;
- Impacts of drawdown on Yarra Wurta Springs; and
- Impact of dust, plant emissions, noise, light and radionuclides on fauna.

Chapter 5: Desalination plant

- Impacts on listed or significant species.

Chapter 10: Infrastructure corridors

- Impacts of open trenches on trapped fauna; and
- Impacts on birds of electricity transmission lines.

13.2 Existing environment

13.2.1 Native vegetation

The list of plant species provided in the Draft Environmental Impact Statement (DEIS) Appendix N3 was compiled from a variety of sources, including surveys in 1981, 1997, 2006, 2007 and 2008, ongoing monitoring by BHPB, and searches of the Biological Database of South Australia (BDSA).

The DEIS stated that native vegetation across most of the study area was relatively intact but some areas were highly disturbed. Grazing by livestock and rabbits has caused varying degrees of vegetation degradation.

The following Section describes the vegetation of the various project components.

13.2.1.1 Special Mining Lease (SML), Roxby Downs, gas pipeline corridors

The DEIS contained a list of vegetation associations in the Olympic Dam and Roxby Downs areas. Their distribution is controlled by soil types and landforms, summarised as follows:

- Woodlands on closely spaced dunes;
- Open woodlands and shrublands;
- More mobile dunes have sparse shrubby cover or grass;
- Understorey vegetation (grows under the leaf canopy and over the ground) on dunes is sparse and dominated by perennial grasses;
- Open woodlands and grassy or chenopod shrub understorey in the inter-dune corridors;
- Chenopod shrublands in tablelands exposed in swales; and
- A high diversity of vegetation associations in drainage lines and depressions in the dunefields.

The dominant vegetation types are *Acacia ramulosa* shrubland and *Acacia papyrocarpa* woodland (DEIS Appendix N, Figure N1.3). Surveys identified 242 native flora species and 261 native fauna species.

The DEIS indicated that while 44 non-indigenous plant species had been identified in the SML and the Roxby Downs area, there was a low density of introduced plants.

13.2.1.2 Southern infrastructure corridor

For the purposes of this chapter, the southern infrastructure corridor includes:

- Electricity and water supply pipelines;
- Landing facility, haul road, and pre-assembly yard;
- Pimba intermodal facility; and
- Road and rail infrastructure.

The southern infrastructure corridor crosses 12 land systems from north to south. Vegetation along the corridor varies from shrublands in the north, to woodlands in the centre and open shrublands in the south near Port Augusta. The number of native vascular plant taxa identified in the southern infrastructure corridor was about 400. No species of national conservation significance were recorded; there were three State-listed species. Extensive areas of the vegetation association *Acacia aneura* low woodland, which is the only vegetation association identified as being of conservation significance, occur at various points around Olympic Dam and in the southern infrastructure corridor (DEIS 15.3.2).

Desalination Plant

The DEIS identified 25 native flora and 110 native fauna species, and 13 introduced flora and 4 introduced fauna species, at the site of the proposed desalination plant (DEIS Appendix N). The site comprises a chenopod (Bladder Saltbush/Bluebush) low shrubland community, with a sparse understorey.

Yarra Wurta Springs

The DEIS described the following terrestrial characteristics of Yarra Wurta Springs:

- within the pool, layered, mat-like algal structures are present above the mud;
- vascular plants occur on damp soils approximately 0.5m above the surface water level of the spring vents and pool; and
- an open shrub layer dominated by samphire *Halosarcia halocnemoides longispicata* occurring on the sandy surrounds.

Within the drainage line surrounding the spring and continuing for about 40m north, patches of vegetation appear to be fed by groundwater (DEIS Plate 15.16). They consist of a low shrubland of *Lawrenzia squamata*, *Frankenia foliosa*, *Maireana cannonii* and *Halosarcia halocnemoides longispicata*. No flora or plant associations of conservation significance were recorded at the spring or surrounding areas (DEIS 15.3.9).

13.2.2 Flora and fauna

The DEIS provided a comprehensive list of native flora and fauna surveyed within the EIS study area, including where they were surveyed and, where relevant, their listing under the South Australian *National Parks and Wildlife Act 1972* (NPW Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DEIS Appendix N - Tables 6.2 and 6.4). This information was compiled by searching SA Government, BHPB and Arid Recovery databases, published literature and, where information gaps were identified, by conducting targeted flora or fauna surveys (DEIS Table 15.1 and figure N1.1).

Flora species in the EIS study area were identified during surveys for vegetation composition, and fauna surveys were carried out opportunistically during vegetation surveys. Flora and fauna surveys were based on methods of the Biological Survey of South Australia. Vegetation associations were classified according to dominant overstorey (uppermost layer of foliage) species and the vegetation structure for flora. Fauna was surveyed by trapping, recording bird sightings, searching litter, debris, hollows and bark, and spotlighting.

The following table shows the total number of native flora and fauna species identified in the different project areas in the DEIS:

	SML/ROXBY DOWNS	SOUTHERN INFRASTRUCTURE CORRIDOR	GAS PIPELINE CORRIDOR	DESALINATION PLANT
Flora species	242	414	419	25
Mammal species	29	14	14	7
Reptiles	47	63	51	20
Birds	184	174	169	83
Amphibians	1	1	4	0

The DEIS also investigated the presence of stygofauna (subterranean fauna) but no species were identified. BHPB concluded that while this did not preclude the presence of stygofauna in the Olympic Dam region, their presence was considered unlikely in the saline, low-permeability aquifers in the region.

13.2.2.1 Listed species

BHPB identified 34 listed flora and 101 listed fauna species of the native species identified in the DEIS that had been recorded or had geographical ranges that overlapped the EIS study area. A summary of national and State-listed species in the project area/project component area in which they were identified is contained in the DEIS Appendix N, Tables N3.1 and N5.1.

13.2.3 Weeds and pests

13.2.3.1 Weeds and introduced flora species

From an analysis of surveys, on-going monitoring surveys by BHPB and the SA Biological Database (SABD), BHPB identified the following numbers of introduced flora species in the EIS study area:

- 87 species of introduced flora in the proposed infrastructure corridors;
- 45 species in the proposed expanded SML and Roxby Downs;
- 28 species in the proposed gas pipeline corridor; and
- 12 species at the proposed Point Lowly desalination plant site.

The complete list is contained in the DEIS Appendix N4.

Declared pest plants requiring control under the *Natural Resources Management Act 2004*, and their location in the EIS study area were identified (DEIS Table 15.3). Some have been identified by Natural Resources Management (NRM) Boards as environmental pest plants requiring specific attention by the boards.

The majority of weed species were ephemeral species that could respond rapidly to favourable cool-season rains. Introduced-weed density was low within the SML, Roxby Downs and infrastructure corridors, but they were common along disturbed areas such as roadsides and tracks. *Brassica tournefortii* was identified as common at Olympic Dam and the northern part of the infrastructure corridor, and *Carrichtera annua* dominated the ground layer of specific vegetation communities in the southern part of the corridor (DEIS Section 15.3.5).

13.2.3.2 Pests and abundant animal species

Nineteen introduced pest animals were recorded in the EIS study area and a full list provided in the DEIS Appendix N5. BHPB identified the main introduced pests as the Red Fox (*Vulpes vulpes*), Cat (*Felis catus*), House Mouse (*Mus musculus*) and Rabbit (*Oryctolagus cuniculus*). Camels were run on two of BHPB's pastoral stations, and kangaroos were harvested for human consumption at all four BHPB stations under permit from the Department of Environment and Natural Resources (DEIS Section 9.3.1). Kangaroo harvesting was defined as a pastoral activity.

13.2.4 Soils

Field investigations were undertaken to confirm the soil types of the EIS study area, in particular the potential for erosion and presence of acid sulphate soils (ASS). The soil profile was logged and described in accordance with the *Australian Soil and Land Survey Field Handbook* (McDonald et al. 1990) and soil types were described in accordance with the unified soil classification system (USCS). Erosion potential was assessed at each test pit.

The collected samples were tested at National Association of Testing Authorities (NATA) accredited laboratories to quantify the physical and chemical properties of the material. Chemical analysis established baseline data for a range of physical and chemical parameters, including field pH and electrical conductivity, and concentrations of arsenic, cadmium, chromium, copper, lead, nickel, zinc, mercury, uranium ammonia, nitrogen, phosphorus and organic matter. The investigations primarily concentrated on those areas impacted by establishment of the infrastructure corridors, with some sampling and chemical analysis in the SML area.

BHPB compared the concentrations of metals and nutrients with the National Environment Protection Measures (NEPM) health and ecology-based investigation levels. Concentrations of uranium were compared to the United States Environmental Protection Agency health-based investigation level (US EPA 2004) because there were no published levels for South Australia or Australia. The soil sample tests showed:

- Concentrations of metals typical of background levels, with no concentrations above the NEPM health or environmental investigation levels;
- Uranium concentrations were below the US EPA health investigation level;
- Concentration of soil nutrients and organic matter was low to very low, considered to be typical of arid and semi-arid environments; and
- Sand dunes were highly susceptible to wind erosion and the clay pans susceptible to scalding from surface water.

The following Section describes the soils of the various project components.

13.2.4.1 Southern and northern infrastructure corridors

Engineering and environmental consultants URS Australia Pty Ltd conducted the soil assessments for the southern infrastructure corridor. It took samples from 91 sites in July 2006 for laboratory testing to assess characteristics relating to ease of excavation, erosion potential, fertility and dustability. URS also conducted soil assessments of 19 locations along the proposed southern rail alignment.

Houghton Environmental Management Pty Ltd conducted the soil assessments for the northern gas pipeline corridors, taking samples from 22 boreholes in the areas affected by the three pipeline alignment options proposed by BHPB.

The southern and northern infrastructure routes were located in a range of land systems and cross a range of land types with varying erosion potential, summarised as follows (DEIS Table 10.5).

- **Dunefields:** Moderate to high erosion potential due to wind erosion;
- **Parallel dunes with swales and clay pans:** Low to high erosion potential, dunes susceptible to wind erosion and bare clay pans susceptible to scalding from surface water;
- **Alluvial outwash plains:** Low erosion potential but high to very high at stream crossings and plains susceptible to sheet erosion;
- **Gibber plains and rises:** Low to high erosion potential when surface gibber layer removed, exposing dispersive subsoil;
- **Salt lakes and deposits:** High to very high erosion potential, susceptible to gullyng when surface cover removed; and
- **Shallow soils over Arkoona quartzite:** Low erosion potential.

ASS investigations were also undertaken along the southern infrastructure corridor. Of the sites investigated, 16 high and low-risk sites in both coastal and inland environments were assessed for ASS potential by HLA Envirosiences Pty Ltd.

Landing facility, private access corridor and pre-assembly yard

The soils at the proposed landing facility, private access road and pre-assembly yard sites were in the Tent Hill land system which is characterised by thin (up to 200mm) loamy topsoils overlaying clay and shallow sandstone, with well defined drainage paths. There were several large catchments and well defined creeks. Large creeks carried high water flows during storms. An unnamed creek running parallel to the Eyre Highway discharged into the sea at Port Augusta.

The shoreline was formed of low sand spits and mixed sand and cobble intertidal flats. An examination of aerial photographs showed 30 per cent of the proposed customs and quarantine layout area would be located on coastal sediments. The low-lying sediments were deposited by marine processes in modern times.

Hiltaba Village and airport

The soils in the vicinity of the proposed airport and Hiltaba Village were part of the Arcoona land system, described as having a thin (100mm) fine-grained topsoil, with gibber surface rocks over heavy clays providing natural protection from erosion.

Roxby Downs and SML

Roxby Downs and the SML were located in the Gawler Bioregion which consisted primarily of sand dunes running east-west, swales and clay pans of the Roxby land system. The dunes comprised red to reddish brown, highly permeable and alkaline sand, and the interdunal areas comprised low-permeability alkaline clays which expanded when wet and cracked when dry. The high permeability of the dunes let rainwater through and drain into the swales and clay pans. The clay pans retained water during periods of heavy rain.

The concentration of soil nutrients and organic matter was low to very low, typical of soils in arid and semi-arid environments, as evidenced by soil analysis undertaken by BHPB in similar areas (DEIS Appendix 1, Table 11.6). The conclusion drawn was that the sand dunes were highly susceptible to wind erosion and the clay pans susceptible to scalding from surface water, while the general area was rated as medium for erosion potential (DEIS Figure 10.6).

Desalination plant

Desktop and field investigations were conducted to assess the soils in the broader area of the proposed desalination plant, including the potential for ASS (DEIS Section 10.2.2). Nine sites in low-lying coastal areas near the landing facility and Point Lowly were identified as having the characteristics to generate acid conditions. The desalination plant site was identified as having high erosion potential.

The DEIS indicated soils could be contaminated from industrial uses around Point Lowly. If contaminated soils were uncovered, strategies to deal with the issue before construction of the desalination plant started would be included in the proposed Environmental Management Program.

13.2.5 Surface water and drainage

13.2.5.1 Southern infrastructure corridor

The DEIS stated that construction and operation of infrastructure within the southern corridor would have negligible effects on catchments, flow paths and flooding because of the relatively small area of the above-ground structures compared to the catchments in which they would be located. Changes would be short-term and reversed after a short construction period.

13.2.5.2 Northern infrastructure corridor

The proposed gas pipeline corridor would be located in two broad land systems - stony plains and tablelands, and dunefields, with similar landforms and drainage patterns (DEIS). The drainage lines are well defined and terminate in the large salt lakes. Runoff from the gibber plains also discharge to areas of gilgai (cracking clay). The proposed gas pipeline corridors would cross several ephemeral watercourses that drain into Lake Eyre South, Lake Eyre North and Lake Blanche. There was permanent surface water at Reedy Springs, Saint Mary Pool and Clayton Station and Montecollina bores.

In the dunefields system, surface water collected in the inter-dune areas. It did not normally flow from one catchment to another, with the exception of Strzelecki Creek and the broad inter-dune floodplains corridors of the Cooper land system. Large flows could occur along the Cooper Creek and Strzelecki systems.

13.2.5.3 Roxby Downs and SML

The dune-swale and clay pan catchments varied in area (10ha to 300ha) and length (1km to 3km). Water could be retained in the swales and clay pans for periods ranging from a few days to a few weeks. Ponds existing for more than a month only occurred after significant rainfall. Surface water in the individual catchments did not normally flow into another catchment (DEIS).

There was a direct relationship between land systems and surface water catchments. The mine and processing area was in the Roxby land system which was characterised by small, enclosed catchments bounded by sand dunes running east–west. The dunes were highly permeable.

There were no defined watercourses in the mining and processing area at Olympic Dam. Surface water flows, both high and low quality, were controlled by containing them in defined management areas. Run-off from operational areas was directed to on-site storage areas, such as evaporation ponds, the TSF, stormwater retention ponds, tertiary containment ponds and other minor storages.

Ponds that formed after major storms provided water for native fauna. There was no recorded information or monitoring points that provided information on the quality of surface water. BHPB stated that no stormwater from the existing operation discharged off the SML.

13.2.5.4 Desalination plant

Point Lowly is located in the Tent Hill land system, which is characterised by steep escarpments and plateaus separated by alluvial plains (DEIS Section 11.3.2). Well-defined drainage paths intercepted these landforms. Minor creeks from elevated areas joined to form large incised creeks as they entered the broad, flat floodplains. The large creeks carried high water flows during storms. Overland flow and creek flows were often highly turbid and of low salinity. Myall Creek was the most extensive catchment in this part of the study area. It terminated in a broad floodplain that discharged into the sea via a floodway across the Point Lowly access road.

13.2.6 Meteorology and climate

The Olympic Dam region is semi-arid, with an average annual rainfall of 167mm and annual pan evaporation rate of 3000mm (DEIS). There were an average 40 annual rain days, and intense and usually short rainfalls could occur at any time of the year.

Temperatures at Roxby Downs varied from an average monthly summer maximum of 36C to a minimum average monthly winter temperature of 5C. The average relative humidity for Roxby Downs in January was 17 per cent.

At Olympic Dam and Roxby Downs, 45 per cent of winds were from the south-west to south-east. Southerlies predominated in summer and autumn; winds were from the north to north-east in spring, with the north-easterlies more prevalent; in winter the winds were predominantly north to north-east and the south to south-west. Winter had the most calm days (average daily wind speed <0.5 m/s), followed by autumn, spring and summer. Wind speed and direction data were provided in the DEIS Figure 8.2.

13.2.7 Natural hazards

13.2.7.1 Seismic activity

The major seismic zone in South Australia occurs in the Adelaide Geosyncline (DEIS Section 12). The highest magnitude earthquake recorded in the vicinity of the study area in South Australia occurred 50km north-east of Port Augusta in March 1939, measuring 5.8 on the Richter scale. In the time BHPB was preparing the DEIS there were five earthquakes measuring more than 3.5 recorded in South Australia, the closest being north-east of Port Augusta about 70km from the study area. No earthquakes measuring more than 3.5 have occurred within 100km of Olympic Dam.

13.2.7.2 Flooding and storm events

Flooding has the potential to occur in the arid areas of South Australia and can vary from localised, short-term surface ponding to widespread flooding that can lead to major salt lakes being filled. Long-term storage of surface water was not common because of the high evaporation rates experienced in the Olympic Dam area. Storms could occur at any time of the year and were generally intense and short-lived. Thunderstorms occurred infrequently in the southern areas of central Australia.

13.2.7.3 Dust storms

Dust storms were common in dry, arid and semi-arid regions of Australia. Roxby Downs experienced two dust storms a year on average. The average frequency of dust storms in the proposed mine expansion project area is detailed in the DEIS Table 8.9.

13.2.7.4 Fire

South Australia's dry climate can result in frequent bushfires, mostly over summer, often associated with wild grasses thriving following significant rainfall and then drying off in the hotter months. Restrictions on lighting fires in the North West and North East Pastoral Districts, which included Olympic Dam and Moomba are imposed from 15 October to 31 March each year.

13.2.8 Greenhouse gases

The most significant emissions from both the existing and proposed Olympic Dam operation are carbon dioxide, related to the indirect combustion of hydrocarbons to produce electricity, and the direct combustion of hydrocarbons in vehicles and furnaces. Minor emissions of methane and nitrous oxide are generated as a result of some chemical processes and the decomposition of putrescible wastes in the on-site waste management facility.

Some hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) are used on-site, and this would continue; HFCs are used for on-site refrigeration and PFCs, in particular sulphur hexafluoride (SF₆), are used in electrical switchyards and transformers.

Total greenhouse gas emissions from all sources for the existing Olympic Dam operation are around 1.14 Mtpa of CO₂e, including 0.9 Mtpa reportable under the NGER reporting requirements (DEIS 13.2.3)

13.3 Summary of submissions

Submissions made by the SA Government and public on the general effects of the proposed mine expansion project on the environment have been grouped and summarised under the following headings:

- Flora and fauna;
- Soils; and
- Greenhouse gases.

13.3.1 Flora and fauna

13.3.1.1 SA Government submission

The concerns and requirements of the SA Government included:

- Further information was required to demonstrate that Significant Environmental Benefit (SEB) discounts were applicable, such as demonstrating rehabilitation works that would be carried out to maximise the potential for effective rehabilitation;
- Commitments were required from BHPB that it would work with the relevant NRM Boards to address vertebrate pest and prescribed weeds, and comply with the relevant provisions of the *Natural Resources Management Act 2004* when directed;
- A weed monitoring program was required to measure and assess the spread of introduced weeds and success of control works;
- The EIS did not clearly indicate that a key objective of the expansion should be to minimise vegetation clearance;
- Additional SEB clarification was required to confirm that cleared areas would be rehabilitated post-construction and ensure the affected areas would be restored as near as practicable to original condition;
- Additional clarification was required to confirm that the impact on groundwater-dependent vegetation within the Yarra Wurta Springs would be minimised;
- The existing Management and Monitoring Plan covering declared weeds and pest and management provisions for kangaroos would have to be upgraded;
- Assessment of kangaroos grazing potentially contaminated soil had not been discussed in the EIS;
- There had been inadequate discussion of land degradation by kangaroos and management measures that would be adopted; and
- Monitoring the Lake Eyre Hardyhead populations within the Yarra Wurta Springs was required to ensure no negative impacts.

13.3.1.2 Public submissions

The concerns and requirements of the public included:

- Impact of the project on species and habitat, including:
 - Inadequacy of surveys undertaken to identify all threatened species;
 - Displacement of fauna;
 - Discrepancies in calculated clearance area;
 - Weed invasion from vegetation removal;
 - Dust impacts, including dust suppression;
 - More information required on the consequences to biodiversity of vegetation removal;
 - Comprehensive monitoring, evaluation and reporting program needed; and
 - Increased public visitation.

- Adequacy of information provided on SEB; confusion regarding actual areas designated for clearance; need for true cost of SEB to be presented; SEB a last resort; information on future management of offset areas;
- Extent of vegetation clearance for the proposed expansion and the adequacy of the SEB; loss of vegetation because of dust impacts and water runoff;
- Impact of increased traffic on fauna road toll;
- Impacts of specific weeds / abundant species;
- Additional information on, and specific requirements for, the management and monitoring of weeds and abundant species;
- Requests for specific stakeholder involvement;
- Compliance with NRM legislation;
- Concern at dust impacts on vegetation and the Arid Recovery; and
- TSF should be fully covered to prevent bird deaths and impacts on other fauna (refer Chapter 4: 'Mining and processing').

13.3.2 Soils

13.3.2.1 Government submission

The concerns and requirements of the SA Government included:

- Insufficient information provided on the potential for increased land degradation through off-road activities between Roxby Downs and Andamooka;
- Management measures must be developed for wind-erosion control of disturbed areas; and
- Confirmation of the locations of all topsoil and sand stockpiles.

13.3.3 Greenhouse gases

13.3.3.1 SA Government submission

The concerns and requirements of the SA Government included:

- Opportunities to make significant greenhouse gas reductions were identified in the DEIS that required clear statements about the implementation of each abatement option, including conditions under which these options would be implemented;
- Statement required showing 1990 emissions levels and 2050 target emission levels;
- Commitment required to develop and publish a trajectory (projected carbon emission rate as an average over time) of interim emissions objectives for 2020, 2030 and 2040 and publicly report on progress each year;
- Commitment required that the SA Government would be represented on the committee undertaking the annual review of emissions reduction objectives and assessment of potential to introduce low-emissions technologies;
- Commitment required to publish a greenhouse gas management plan;
- A commitment required to maximise energy efficiency in the construction, design and operation of the expanded mine site;
- At least one additional greenhouse gas emissions scenario should be presented that included realistic assumptions about the impact of the Carbon Pollution Reduction Scheme (CPRS) and Mandatory Renewable Energy Target (MRET);
- International emissions performance comparisons should be included where there were suitable indicators;
- Information should be disclosed relating to carbon pricing assumptions made in greenhouse gas emissions modelling;

- Greenhouse gas emissions predictions should include an assessment of the level of accuracy at the aggregate level;
- Further information should be included on key variables and activity levels that impact on greenhouse emissions, including commodity prices;
- Scenarios should be included that incorporated the impact of new and likely commitments on greenhouse gas emissions;
- A more comprehensive picture of the project's greenhouse gas emissions impact should be presented by identifying a broader range of Scope 3* emissions and including Scope 3 emissions with material impact, or where a level of control could be exerted through the purchasing process;
- Reporting inclusions and exclusions should be clarified;
- Level of support for the development of an international agreement to reduce the risk of "carbon leakage" should be clarified;
- Further clarity required on commitments to using intelligent grid technologies in the development of distribution infrastructure in Roxby Downs;
- Details required on conditions under which renewable technologies would be implemented, at what scale, and the extent to which BHPB would involve itself in their early development;
- Further clarity required on the process by which the proposed transmission line from Olympic Dam to Port Augusta would be optimised; and
- Inconsistencies in the level of electricity consumption quoted throughout the DEIS needed to be resolved.

* The Greenhouse Gas Protocol Initiative categorizes emissions into three broad scopes:

- **Scope 1:** All direct GHG emissions;
- **Scope 2:** Indirect GHG emissions from consumption of purchased electricity, heat or steam; and
- **Scope 3:** Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, and outsourced activities.

13.3.3.2 Public submissions

The concerns and requirements of the public included:

- Greenhouse gas emissions should be detailed through all stages of construction and operation on a lifecycle assessment basis, including Scope 1, 2 and 3 emissions, emissions from road transport and diesel use at other sites;
- Consistency required in reporting GHG emissions. GHG emissions beyond Australia were excluded from the EIS yet BHPB claimed to be reducing emissions overseas by replacing coal-fired electricity generation with nuclear. Similarly, BHPB was claiming reduction in GHG emissions arising from uranium use overseas but reluctant to account for GHG emissions arising from coal exports;
- GHG emissions should be stated as a proportion of future State and Federal targets not as a proportion of BAU;
- BHPB should demonstrate how the mine could be expanded without GHG emissions;
- Inadequate commitment to GHG abatement, including renewable energy use;
- Commitment required to achieving interim greenhouse and renewable energy targets, and to making up shortfalls with GreenPower purchases;
- Greenhouse gas reductions must be in line with SA's commitments;
- Concern at increases in GHG emissions and SA's ability to meet its targets;
- Details required of GHG emissions from new construction and emissions generated from ore transport beyond Australia;

- Commitment required to recycling and waste management;
- Assessment required of GHG emissions from nuclear power on a full lifecycle basis if BHPB was to claim that nuclear energy reduced GHG emissions when compared to coal-fired power;
- Full public disclosure required of GHG emissions and BHPB abatement plans;
- Assessment should be expanded to include greenhouse emissions from all facilities and project components;
- The proposed mine project should not be allowed free carbon permits as a result of the introduction of the CPRS;
- There should be a commitment to promoting and/or supporting development of local renewable energy sources such as geothermal, solar and wind, including development of wind farms and transmission infrastructure on Eyre Peninsula;
- There should be a commitment to using 50-100 per cent renewable energy to produce all power, or at very least commit to 20 per cent renewable energy by 2014 in line with SA target and State of the Environment 2008 recommendations;
- There should be consideration given to using methane from effluent treatment as an energy source, and LNG at the mine site; and
- The development of nuclear power should be supported given that coal power was unsustainable in the long term.

13.4 Assessment of the issues

The key environmental impacts associated with 'whole of project' effects of the proposed mine expansion project are summarised under the following areas:

- Native vegetation;
- Threatened ecological communities;
- National and State-listed flora and fauna;
- Vulnerable listed fauna;
- Weeds;
- Pests and abundant species;
- Soils; and
- Greenhouse gases.

13.4.1 Native vegetation

13.4.1.1 Issues

Vegetation Clearance

The proposed expansion project would directly impact on approximately 17,000ha of relatively intact native vegetation. It could also have indirect impacts from airborne emissions, such as dust, saline aerosols and sulphur dioxide, and from an increase in human and vehicle traffic close to population centres.

The DEIS provided estimates of vegetation clearance over the life of the mine after 11 years (at the end of the construction period); after 20 years; and after 40 years (DEIS Table 15.4). The upper limit of vegetation cleared after 40 years was estimated at 17,269ha. Of this, 70 per cent would be cleared for the mining operation, including construction of the processing plant, comprising:

- Rock Storage Facility (RSF) and haul roads – 6721.4ha
- Tailings Storage Facility (TSF) – 4399.6ha
- Open-pit mine and perimeter – 1009.5ha
- Metallurgical plant and associated facilities – 977.7ha

Total: 13,108.2ha

The balance of 4161ha would be cleared for:

Accommodation and plant

- Desalination plant - 28.7ha
- Landing facility, access corridor and pre-assembly yard - 73.2ha
- Hiltaba and airport - 160.1ha
- Roxby Downs township expansion - 515ha

Total: 777 hectares

Infrastructure corridors

- Gas pipeline and facilities – 1342.2-1684.7ha
- Water pipeline – 992.9ha
- Electrical transmission line and substation – 166.5ha

Total: 2844.1ha

Road and rail transport:

- Pimba-Olympic Dam rail spur – 270ha
- Pimba Intermodal facility - 173.9ha
- Parking bays, Stuart Highway and Olympic Dam-Pimba road – 12ha
- Borefield Rd relocations – 41.4ha
- Borrow pits – 20.15ha

Total: 517.45ha

24 of the 66 broad vegetation associations in the EIS study area would undergo some degree of clearance should the proposed mine expansion be approved. The largest clearance in area and percentage would be 8142.9ha of Acacia shrubland, which would constitute 5.6 per cent of Acacia shrubland growing within the EIS study area (DEIS Table 15.5). Impact to Mulga woodland could be offset to some degree by the presence of Mulga woodland in several of the areas being considered as SEB set-aside areas, including McCormack Reserve, and Kookaburra and Wimbrina East paddocks.

Other vegetation associations that would form the bulk of the proposed clearance included:

- Chenopod shrubland – 5997.2ha (1.4 per cent)
- *Callitris glaucophylla* woodland – 671.1ha (2.6 per cent)
- *Sclerolaena* sp. low shrubland – 443.8ha (0.7 per cent)
- *Acacia papyrocarpa* woodland – 438.7ha (0.5 per cent)
- *Astrebla pectinata* grassland – 408.4ha (0.3 per cent)
- *Acacia aneura* woodland – 319.4ha (0.5 per cent)

All affected vegetation associations were widespread in South Australia and there would be no change in the conservation status of any group (DEIS Section 15.5.1). Initial vegetation clearance was categorized as having a moderate residual impact. However, through the implementation of a vegetation clearance offset strategy there would be a moderate residual benefit, as it would represent a long-term local benefit (SEB).

Where rehabilitation of cleared vegetation has been proposed, such as along infrastructure corridors, BHPB proposes that the SEB requirement be reduced by 50 per cent, as provided for in Native Vegetation Council (NVC) Policy 1.2.29. BHPB consider this to be consistent with the NVC's SEB guidelines for the mining industry.

Off-road vehicle use

Indiscriminate off-road driving at Hiltaba Village and Roxby Downs could result in damage to native vegetation. Contributing factors could include inadequate resident awareness, inadequate education and training of workers and/or failure to provide adequate alternative activities, and management system failures. Unauthorised vehicle movements could result in direct clearance of native vegetation, and contribute to soil erosion and spread of weeds, all of which would diminish the condition and availability of fauna habitat (DEIS Section 15.5.11).

Impacts of dust and processing plant emissions on vegetation

Refer to Chapter 4: 'Mining and processing'.

Habitat fragmentation

While the removal of vegetation could fragment habitats, introduce weeds and pose a barrier to fauna movement, the DEIS considered habitat fragmentation was a relatively minor issue in the context of the proposed mine expansion because of the generally sparse nature of the vegetation in the EIS study area (DEIS Section 15.6).

13.4.1.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.1:

- **Objective:** No significant adverse impacts to listed threatened species populations in the expansion project area as a result of BHPB's construction activities.
- **Criteria:**
 - No significant adverse impact on the Ampurta as a result of mine expansion activities; and
 - No significant adverse impact on an important population of the Pernatty Knob-tailed Gecko, Dusky Hopping-mouse or Plains Rat as a result of mine expansion activities.
- **Management plan:** To prepare a Vegetation Management Plan.
- **Commitments:**
 - To implement a significant SEB offset strategy by setting aside 126,650ha of land in the SA Arid lands NRM region or alternative arrangements as agreed with the SA Government (Supplementary Environmental Impact Statement (SEIS) Table 2.1 – Commitments, page 53).
 - To develop management plans for the nominated SEB areas in consultation with the Native Vegetation Council (NVC) and local NRM boards (SEIS Table 2.1 - Commitments, page 53).
 - To retain the services of a third party to facilitate the required set-asides to offsets for the Northern, and Yorke and Eyre Peninsula NRM Regions, and achieve SEB in compliance with the Native Vegetation Act 1991 (Commitments, page 53).
 - To make sufficient financial provision in the annual operational budget to fund management actions to achieve SEB for the operational life of the mine (Commitments, page 54).
 - To achieve a net gain for biodiversity over time, including (Commitments, page 54):
 - Implementing feral animal monitoring and control programs in the Olympic Dam region;
 - Collaborating with the Roxby Downs Council to reduce the impact of increased human activity on native flora and fauna in the region; and
 - Developing targeted weed management strategies, including control of declared and environmental species in consultation with relevant NRM Boards.

13.4.1.3 Assessment

Vegetation clearance

The clearance of native vegetation in South Australia is regulated under the provisions of the *Native Vegetation Act 1991* (NV Act) and associated Regulations. The general intent of the legislation is to prevent broad-scale clearance and reverse the long-term decline in the extent and quality of native vegetation cover, and reduce the rate of native vegetation clearance in SA. Native vegetation clearance²¹ can only occur where permitted by the NV Regulations. Proposals declared as Major Developments under Section 48 of the *Development Act 1993* are considered under Section 5(1)(c) of the *Native Vegetation Regulation 2003*.

Since the introduction of the NV Act in 1991, no clearance has occurred in South Australia on the scale proposed by BHPB to facilitate the Olympic Dam expansion project. The proposed removal of vegetation over approximately 17,000ha is therefore significant and would have the following potential impacts:

- Reduced abundance of fauna and flora, some of which are listed;
- Reduction in available habitat;
- Increase in erosion and flood potential; and
- Accelerated weed spread.

The impact of development on native vegetation should be minimised as far as is reasonably practicable. If total avoidance is not possible, the area of clearance should be confined to more disturbed or degraded areas and/or to areas containing less significant vegetation.

Areas of clearance identified in the DEIS were indicative of the maximum area of clearance likely to be required for each project component. The exact footprint for vegetation clearance could not be accurately defined in the DEIS as detailed designs and alignments have not been completed for all project components. However, further refinements in design and layout would likely result in the actual area of clearance being reduced down from 17,000ha.

Regulation 5(1)(c) of the *Native Vegetation Regulation 2003* requires BHPB to provide a SEB to offset the loss of vegetation as a result of the development. An SEB ratio of 8:1 has been applied to clearance across the entire Olympic Dam expansion proposal. Native Vegetation Council (NVC) Policy 1.2.11 requires an SEB ratio of 8:1 where the proposed clearance is of mostly intact overstorey and understorey vegetation, weed infestation is moderate to low, but the original vegetation is still dominant. Where the NVC considers vegetation removal to be at variance with the *Principles of Clearance of Native Vegetation* contained in Schedule 1 of the *Native Vegetation Act 1991*, an SEB of 8:1 also applies.

Clearance associated with the southern infrastructure corridor is not considered to have as great an impact as clearance associated with mining operations. The linear nature of clearance, commitments to avoid significant areas, and the capacity for post-construction rehabilitation and co-location with existing infrastructure would all contribute to the impacts of habitat fragmentation being reduced.

Clearance of approximately 13,000ha for the expanded SML would result in considerable loss of local biodiversity. The area of available habitat in the local region would be permanently reduced due to the presence of permanent features such as the open-pit mine, RSF and TSF.

²¹ *Native vegetation clearance as defined under the NV Act includes any naturally occurring local native plants.*

Due to the long term nature of the proposal, the final area of clearance has not been determined. Based on the upper level of predicted direct clearance, an estimation of the potential SEB would be $17269 \times 8 = 138,152\text{ha}$. Potential clearance from indirect impacts has not been included in this amount.

Under the native vegetation legislation, a SEB can be achieved through on-ground works, payment into the Native Vegetation Fund, or a combination of the two. In accordance with Part (vi) of Regulation 5(1)(c) native vegetation clearance must be undertaken in accordance with a management plan that has been approved by the NVC²². Before approving the Native Vegetation Management Plan, the NVC must take account of the nature and extent of the proposed clearing and any commitments for restoration and maintenance, sufficient to satisfy themselves that there will be a significant environmental benefit.

The offset outcomes should also be consistent with principles agreed by the SA and Australian Governments.

The NVC, in its submission on the DEIS, recognised that exact details of the proposed SEB would be finalised following completion of the EIS. Should the expansion project be approved, further information would be required from BHPB to enable a final decision on SEB arrangements, including:

- Details regarding the proposed SEB location(s) and information regarding the vegetation communities in the proposed areas; and identification of any species or plant communities that were of conservation significance, including an outline of the overall biodiversity gain from the proposed SEB. Whilst the NVC supported the general principle of 'like for like' it was open to discussions of alternative options that would ensure a greater overall biodiversity gain in determining the final SEB; and
- Details regarding the ongoing management of the SEB areas. The NVC understood that exact details would be contained in native vegetation management plan(s) that BHPB would prepare should the mine expansion be approved. Accordingly a condition has been recommended requiring the preparation and implementation of Native Vegetation management Plan(s) for approval of the NVC.

The AR notes that the NVC would require additional information to support BHPB's proposal for a reduction in SEB (in recognition of rehabilitation works along the infrastructure corridors). Accordingly a note has been recommended to address this.

RECOMMENDATION

Accordingly, the AR concludes that reasonable measures have been demonstrated in the FEIS to manage potential impacts on native vegetation from clearing, subject to compliance with commitments made by BHPB and the following recommended conditions:

- Clearing of vegetation must not exceed that indicated in the Final EIS.
- The activities associated with the major development approved herein must not worsen the conservation status of any flora species listed under the *National Parks and Wildlife Act 1972*.
- The proponent must prepare and implement Native Vegetation Management Plan(s), in consultation with DENR. The final plans must be approved by the Native Vegetation Council (NVC), prior to any clearance occurring. The Native Vegetation Management Plan(s) must include (as a minimum):

²² The NVC is an independent body appointed by the Governor of South Australia and makes decisions on applications to clear native vegetation in South Australia, and establishes conditions under which the clearance must be carried out.

- Details regarding the proposed SEB locations and information regarding the vegetation communities within the proposed areas;
- Identification of any species or plant communities that are of conservation significance, including an outline of the overall biodiversity gain from the proposed SEB; and
- Details regarding the proposed ongoing management of the SEB areas.

The AR also recommended the following note to BHPB:

- Before approving the native vegetation management plan(s), the Native Vegetation Council (NVC) will be required to take account of the nature and extent of the proposed clearance and any commitments for restoration and maintenance, sufficient to satisfy themselves that there will be a significant environmental benefit (SEB).

13.4.2 Threatened ecological communities

13.4.2.1 Issues

The DEIS identified the following potential construction impacts on threatened ecological communities:

- Impacts from the construction of the proposed gas pipeline on the endangered 'ecological community of native species dependent on natural discharge of groundwater from the Great Artesian Basin (GAB)' which are located on the northern edge of the proposed gas pipeline corridor. Potential impacts to the Reedy Springs GAB Complex was also highlighted (DEIS Appendix U, ID 1.1) and a construction and gas pipeline risk assessment undertaken (SEIS Section 12.1.4); and
- Impacts from activities on the SML and the infrastructure corridors on the provisionally listed Mulga *Acacia aneura* low woodlands on sand plain ecological community ('Provisional List of Threatened Ecosystems of South Australia,' SA Department for Environment and Heritage (DEH) 2005).

The DEIS stated there would be no impact on the GAB-dependent vegetation community because BHPB proposed to design the gas pipeline corridor to avoid the vegetation and GAB springs by several kilometres. No water would be extracted from GAB springs or groundwater within 20km of the springs during gas pipeline construction. The DEIS included a risk assessment which looked at the consequences of drawdown on the mound springs which focused on the borefield extension option. Although this option was not implemented, the risk assessment undertaken was useful in responding to submissions. (SEIS Section 12.1.4 & 31.1.2).

The proposed expansion would result in 334ha of Mulga *Acacia aneura* low woodland being cleared. This equated to less than 1 per cent of this community in the EIS study area, with the total area given as 70,236 ha. Because of this BHPB assessed the residual impact of this clearance would be low, and have very little effect on the conservation status of the ecological community. The key threats to the community were identified as coming from grazing of immature trees. The DEIS stated that the minor impacts to this community could be partially offset by the presence of Mulga woodland in several of the proposed SEB offset areas under consideration, such as McCormack Reserve, and Kookaburra and Wimbrina East paddocks.

13.4.2.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP provided in relation to this issue.
- **Commitments:** No specific commitments made in SEIS in relation to this issue.

13.4.2.3 Assessment

The AR considers that draw-down of water from the Reedy Springs GAB Complex for construction of the gas pipeline has the potential to impact on this nationally listed threatened ecological community. BHPB identified this as a risk in the DEIS and proposed avoiding the area. The AR considers avoidance to be an adequate way of managing the risk to the springs in the project area and has recommended a condition to this effect.

The AR supports the representation of Mulga *Acacia aneura* low woodlands as an important ecological community. Whilst any clearance of this ecological community should be avoided, the AR considers that the proposed clearance would not be likely to compromise the status of the community. Where appropriate, rehabilitation should occur following completion of works. The presence of Mulga woodland in several of the SEB set-aside areas could contribute to off-setting the impact of vegetation clearance. However this would be subject to final SEB approval (DEIS 15.5.3). BHPB has presented a number of SEB options (Appendix N9) but the final SEB is yet to be determined and would require approval from the NVC as referred to in the recommended condition and note outlined above in Section 13.4.1.3.

St Mary's Pool on the McDonnell Creek has the potential to be partially or wholly dependent on the GAB. This site is the only known location for the Fly-specked Hardyhead outside of the Murray-Darling System. It is located upstream of the gas pipeline, but within 3-4km of the proposed route. The AR considers that it would be unlikely that construction works would impact on the site unless it was used as a water supply. Accordingly, it should be flagged as a site to be avoided by construction crews.

RECOMMENDATION

The AR concludes that reasonable measures have been demonstrated in the FEIS to manage potential impacts on threatened ecological communities, subject to compliance with commitments made by BHPB and the recommended conditions outlined in Chapter 10: 'Infrastructure corridors of this AR'.

13.4.3 National and State-listed flora and fauna

13.4.3.1 Issues

An assessment of 'credible risk' for all of the national and State-listed species identified in the EIS study area was undertaken to identify species that could be affected by the proposed expansion activities (DEIS Appendix N6 Table N6.1 for priority flora and N6.3 for priority fauna). Eleven listed flora species and 23 fauna species of significance, comprising 18 listed fauna species and 5 migratory species, were deemed to be at 'credible risk' and investigated further.

The analysis provided in the DEIS concluded that the impact to most listed species, even those under a "credible risk", from the proposed operations would be negligible because there would either be no direct impact or potential impacts could be managed by the proposed mitigation measures. 'Vulnerable species', those assessed as being at higher than negligible risk, were given further consideration. Discussion of vulnerable species is provided under the Section 13.4.4 below (vulnerable listed fauna).

Management measures proposed by BHPB included:

- Further field surveys to confirm the presence/absence of listed threatened flora species in the disturbance footprints of the linear infrastructure when alignments were finalised. The surveys would target vegetation types likely to support threatened species (refer Chapter 10: 'Infrastructure corridors');

- Where possible infrastructure alignments would be adjusted to avoid areas that contained listed threatened plants (refer Chapter 10);
- Before any construction started areas found to contain listed threatened plants in close proximity to disturbance works would be marked as no-go areas on design drawings and in the field with flagging tape and/or hazard fencing (refer Chapter 10);
- Adding the Desert Lime (*Citrus glauca*) to the monitoring program as a Category 2 species;
- Preparation and implementation of Trench Management Plan (refer Chapter 10);
- Seeking a SEB offset for *Amytornis textilis modestus*;
- Covering open water with netting or equivalent (refer Chapter 4: 'Mining and processing'); and
- Attaching markers to electrical conductors near ephemeral lakes (refer Chapter 10).

13.4.3.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.1:

- **Objective:** No significant adverse impacts to listed threatened species populations in the expansion project area as a result of BHPB construction activities.
- **Criteria:**
 - No significant adverse impact on the Ampurta as a result of BHPB construction activities; and
 - No significant adverse impact on an important population of the Pernatty Knob-tailed Gecko, Dusky Hopping-mouse or Plains Rat as a result of BHPB construction activities.
- **Management plan:**
 - To develop a Vegetation Management Plan;
 - To develop a Trench Management Plan; and
 - To continue Flora and Fauna Monitoring Programs.
- **Commitments:**
 - To achieve a net gain for biodiversity over time, including (SEIS table 2.1 – Commitments, page 54):
 - Implementing feral animal monitoring and control programs in the Olympic Dam region;
 - Collaborating with the Roxby Downs Council to reduce the impact of increased human activity on native flora and fauna in the region; and
 - Developing targeted weed management strategies, including control of declared and environmental species in consultation with relevant NRM Boards.
 - To develop a Trench Management Plan to address the collection and safe removal of animals that could fall into temporary open trenches during the installation of the water and gas supply pipelines (SEIS Table 2.1 – Commitments, page 60).

13.4.3.3 Assessment

Impacts on listed flora

The AR considers that BHPB conducted extensive surveys for listed plant species. It notes that the surveys were conducted in relatively dry years and species not identified have likely responded to recent rains and floods that have inundated the study area in recent times. Despite this, based on the survey and assessment methodology followed, the conclusions reached in the DEIS are considered to provide an accurate representation of listed flora species present, as well as likely impacts for surveys conducted in dry conditions.

The following two flora species were assessed as having a 'credible risk' from the proposed activities:

- Koch's Saltbush (*Atriplex kochiana*): As this species responds well to rainfall, surveys need to be timed for appropriate conditions. An appropriate buffer (50m) should be applied around any plants discovered. If this were not achievable, revegetation should be required.

- Large Adder's Tongue (*Ophioglossum polyphyllum*): The likely success of proposed management measures of survey/attempt to avoid would be questionable given the form and ephemeral habit of the plant. Other approaches to minimising the risk to this species could need consideration, such as surveys under appropriate environmental conditions, when the likelihood of the species being present would be greatest.

The AR supports BHPB's commitment to conduct further surveys to determine the actual presence/distribution of listed species, and how they could be affected, in the various project locations before designs are finalised, should the proposed expansion be approved. Where listed species were identified and vegetation clearance was unavoidable, the AR supports revegetation at other appropriate locations or within SEB areas.

The AR also supports BHPB's commitment to prepare a Trench Management Plan. Refer to Chapter 10: 'Infrastructure corridors' for a detailed assessment of this issue.

RECOMMENDATION

The AR concludes that reasonable measures have been demonstrated in the FEIS to manage potential impacts to listed flora, subject to compliance with commitments made by BHPB and the recommended conditions outlined in Chapter 10: 'Infrastructure corridors' of this AR.

Impacts on listed fauna

The AR considers that the fauna list compiled by BHPB is representative of species recorded through previous surveys and likely to occur within the EIS study area. The information presented, including current conservation status listing, is considered accurate based on current knowledge (DEIS Appendix N Tables N5.1-N5.3 and N6.4). While concerns have been raised that the fauna survey described in Appendix N7 is under-representative of the threatened species found in the study area because of unfavourable weather conditions at the time of survey, this has not impacted upon the representative species list. The 'credible risk' to most priority fauna species was assessed as negligible. The AR supports the assessment provided in the DEIS.

RECOMMENDATION

Accordingly, the AR concludes that reasonable measures have been demonstrated in the FEIS to manage potential impacts to listed fauna, subject to compliance with commitments made by BHPB and the following recommended condition:

- The activities associated with the major development approved herein must not worsen the conservation status for any fauna species listed under the *National Parks and Wildlife Act 1972*.

The AR also recommends the following note to BHPB:

- SEB offsets for fauna species management would need to be approved by the Native Vegetation Council (NVC).

Additional conditions for the protection of fauna in relation to the proposed linear infrastructure components are recommended in Chapter 10: 'Infrastructure corridors'.

13.4.4 Vulnerable listed fauna

13.4.4.1 Issues

The species assessed as having a higher than negligible risk from the proposed expansion project were assessed for 'residual impact' in the DEIS, following application of further mitigation measures.

The assessment of risks to vulnerable species re-introduced to Arid Recovery, and to listed and migratory bird species, are discussed in 'Chapter 4: Mining and processing'.

The following species were assessed as having a low to moderate risk from expansion activities (DEIS Section 15.5.5):

- State listed reptile Pernatty Knob-tailed Gecko (*Nephrurus deleani*), mammals Plains Rat (*Pseudomys australis*);
- Dusky Hopping-mouse (*Notomys fuscus*);
- Nationally listed endangered threatened mammal species, Ampurta (*Dasycercus hillieri*); and
- Nationally listed vulnerable threatened bird species, Thick-billed Grasswren eastern subspecies (*Amytornis textilis modestus*).

Pernatty Knob-tailed Gecko

The habitat of the Pernatty Knob-tailed Gecko (*Nephrurus deleani*) occurs in the dunes along a 50km Section of the southern infrastructure corridor between Island Lagoon and Dutton Lake (DEIS 15.5.5). The Gecko is considered vulnerable to the impact of construction of the proposed road upgrades, electricity transmission line and water pipeline, because it is territorial, not highly mobile and difficult to detect during the day, and susceptible to heat stress if, for example, it was trapped in an open trench during construction. Habitat loss (DEIS Section 15.5.5) and potential impacts on the gecko were considered important because it was one of the rarest reptiles in South Australia and has a limited range.

BHPB concluded that construction of the proposed infrastructure within the known range of the Gecko would result in only a short-term, low residual impact during construction, based on its commitments to the following management measures, in addition to those listed for the Trench Management Plan:

- Including the Pernatty Knob-tailed Gecko as a Category 1 species under BHPB's monitoring program because the species was critically reliant on its habitat;
- Developing a management plan prior to construction to ensure appropriate management and mitigation measures would be implemented;
- Undertaking pre-construction surveys to determine if final positions or alignments of infrastructure should be moved to minimise potential impacts on gecko habitat;
- Leaving trenches open for as little time as possible between kp 158–212;
- Placing water-soaked, sawdust-filled hessian bags in open trenches every 100m from kp 158–212; and
- Monitoring the open trench every morning and releasing any trapped geckos.

Plains Rat

The habitat of the Plains Rat (*Pseudomys australis*) occurs in environments with cracking clay soils over a wide area of the arid zone, possibly due to the lower predator numbers in this habitat type. Its most important habitat was the chenopod low shrubland on gibber plains and tablelands (DEIS).

The rat forms complex burrow systems often associated with drainage systems, and is characterised by a number of dynamic populations utilising a network of core areas, rather than populations being associated with particular sites. It is also known to increase in number, sometimes significantly, after significant rainfall, and vice-versa in times of drought.

BHPB identified this species in Arid Recovery, the SML and the northern Section of the infrastructure corridor which would include proposed the water and gas pipelines and electricity corridor. Some populations in the vicinity of the mine would be displaced because 2 per cent of suitable habitat would be lost during construction. However, the Plains Rat was expected to move into adjacent habitat. The DEIS concluded that construction impacts from the gas and water pipeline would be localised and short-term, thereby not significantly impacting rat populations.

BHPB assessed that through SEB offsets and the extended Arid Recovery, and by using standard mitigation measures to manage entrapment in open trenches, the proposed activities would have a moderate residual impact on the Plains Rat, reflecting a short-term impact to a sensitive receptor.

Dusky Hopping Mouse

The Dusky Hopping-mouse (*Notomys fuscus*) is known to occur in dune and sand plain systems in south-western Queensland and the Strzelecki Desert. While its numbers and distribution in the Strzelecki Desert are relatively unclear as a result of limited accessibility, BHPB stated that recent records²³ suggested its presence (DEIS Section 15.5.5).

Monitoring of known populations by DENR indicated that the Dusky Hopping Mouse was subject to a 'boom and bust' population cycle; dispersing during good climatic conditions and becoming locally extinct during dry conditions.

The DEIS concluded that the gas pipeline construction would result in a localised impact on this species through vegetation clearance, earthworks or trench entrapment. Regionally, the impact would be negligible, with a correspondingly low impact at a population level. BHPB said it would put an emphasis on monitoring the open trenches in areas where the Dusky Hopping Mouse was known to occur.

Ampurta

The Ampurta (*Dasycercus hillieri*) was described as a small marsupial that occurred in sand-dune habitats. It was listed under the Commonwealth EPBC Act as an endangered species. As the Ampurta could be present in the proposed gas pipeline corridor, the likely impacts of construction activity were assessed. The DEIS concluded that construction would have only a localised effect on any Ampurta in the vicinity. Vegetation removal, earthworks or entrapment could affect individual animals, but significant affects at a population level were not expected. BHPB has not proposed any mitigation measures beyond the standard trench management measures already outlined.

Thick-billed Grass Wren (eastern sub-species)

The Thick-billed Grasswren (eastern subspecies) (*Amytornis textilis modestus*) is a sedentary bird that occupies limited territories of 4-5ha. Its preferred habitat in the project area is emergent chenopod shrubland and, particularly, dense vegetation where rain run-off collects. Suitable habitat was found to be present in the proposed Hiltaba Village, airport and gas pipeline corridor project areas. BHPB stated in the DEIS that only a small area of habitat would be affected and this impact would be mitigated through the potential to protect preferred habitat in proposed SEB offset areas, resulting in a negligible residual impact for the Thick-billed Grasswren.

²³ No source provided in the DEIS

13.4.4.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.1:

- **Objective:** No significant adverse impacts to listed threatened species in the proposed expansion project area as a result of BHPB construction activities.
- **Criteria:** No significant adverse impact on the Ampurta and an important population of the Pernatty Knob-tailed Gecko, Dusky Hopping-mouse and Plains Rat as a result of BHPB construction activities.
- **Management plan:** To develop a Trench Management Plan for the construction and operation of the proposed expansion.
- **Commitments:** To develop a Trench Management Plan to address the collection and safe removal of animals that could fall into open trenches during installation of the water and gas supply pipelines (SEIS Table 2.1 - Commitments, pg 60).

13.4.4.3 Assessment

The AR supports the assessment that impacts to the Pernatty Knob-tailed Gecko, Plains Rat, Dusky Hopping-mouse, Ampurta and Thick-billed Grasswren (eastern subspecies) would be acceptable provided issues were managed as described in the DEIS and recommended conditions of approval were met.

Consideration would also need to be given to real-time impacts to those species subject to a 'boom and bust' cycle of wet and dry, in that localised impacts to the species could be more significant during extended drought conditions. Targeted trench monitoring in known habitat for the Dusky Hopping-mouse in dry periods, and targeted surveys for the Plains Rat to identify local populations for relocation before clearance should mitigate the risk during bust periods.

RECOMMENDATION

Accordingly, the AR concludes that BHPB has outlined reasonable measures in the FEIS to manage potential impacts to vulnerable listed fauna species, subject to it meeting its stated commitments and the following recommended condition:

- The proponent must update the Fauna Management Plan for the Pernatty Knob-tailed Gecko, Plains Rat, Dusky Hopping-Mouse, Thick-billed Grasswren and Ampurta for approval by the Indenture Minister, within 12 months of this approval.
- Prior to finalising the location of the parking bays on the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road, the proponent must conduct floristic surveys, following adequate rainfall if possible, to confirm the presence/absence of listed threatened species. In determining the final location of the parking bays, the proponent must avoid listed species, however if clearance is unavoidable, revegetation of these species must be reinstated or relocated to adjacent work areas, or as otherwise agreed by DENR.

13.4.5 Weeds

13.4.5.1 Issues

The AR recognises that the proposed mine expansion activities could result in the introduction and spread of weeds through vegetation clearance, soil disturbance and vehicles and equipment carrying weeds and seeds.

Weed management is the legal responsibility of the various Natural Resource Management (NRM) Boards, including the South Australian Arid Lands and Northern and Yorke and Eyre Peninsula NRMs which had jurisdiction over weed management within the EIS study area. Specifically, the NRM Boards develop the strategies that guide weed management, including the SA Arid Lands Pest Management Strategy 2005-2010.

The DEIS concluded that the residual impact of weeds from proposed project works would be low because BHPB would implement effective mitigation strategies and measures.

13.4.5.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 1.3:

- **Objective:** No material increase in the abundance or area of infestation of pest species as a result of BHPB's expansion activities in the expansion project area.
- **Criteria:**
 - No material increase in the abundance of existing declared pest species; and
 - No introduction of new self-sustaining declared pest populations.
- **Management plan:** To develop a Weed Management Plan and Mosquito Management Plan for the construction and operation of the proposed expansion.
- **Commitments:**
 - To update the regional weed management strategy developed between BHPB, Arid Recovery, Roxby Downs Council and Andamooka Progress Association to include components of the proposed mine expansion before construction began (SEIS Table 2.1 – Commitments, page 55);
 - To map the distribution of extreme and high-risk weed species as part of the flora monitoring program, with the information used to determine the need for amendments to the Weed Management Strategy, control activities or management measures (Commitments, page 55); and
 - To implement measures to mitigate the spread of weeds, including (Commitments, page 56):
 - Liaising with NRM Boards to develop targeted weed management strategies, including coordinated efforts to control high-priority species;
 - Ensuring the diligent cleaning of plant, equipment and vehicles before construction work began and after leaving areas infested with declared weeds;
 - Identifying areas where weed hygiene measures would be implemented by undertaking searches for declared weeds during field surveys to finalise infrastructure locations;
 - Minimising wherever possible disturbance caused by construction and operations;
 - Ensuring vehicles remained on designated tracks to minimise disturbance and weed spread;
 - Conducting follow-up surveys 12 months after the construction and/or after significant rains to determine the need for weed control; and
 - Undertaking control activities for declared and environmental species where they occurred on lands owned by BHPB.

13.4.5.3 Assessment

The AR notes that BHPB already has a weed-control strategy for Olympic Dam and surrounding residential areas, and refers to Arid Lands NRM staff as required on specific species control. The AR considers the strategies proposed in the DEIS for managing weed impacts from proposed expansion project activities, such as expanding the weed-control strategy for the Arid Lands NRM region and developing weed-control strategies in consultation with the Northern and Yorke and Eyre Peninsula NRM regions, are appropriate for minimising the risk of introduction and spread of declared pest plants.

Under the NRM Act the landholder has a legislative responsibility to notify the local NRM Board of outbreaks of Weeds of National Significance (WONS), so no general conditions of approval are required. However a note has been recommended.

Potential issues regarding the risks of introducing weed species from equipment arriving at the landing facility from overseas from overseas has been assessed in Chapter 6: 'Landing facility and pre-assembly yard').

The AR concludes that BHPB has outlined reasonable measures in the FEIS to manage potential impacts regarding the introduction and spread of weeds.

RECOMMENDATION

The AR recommends the following note:

- The proponent will be required to comply with Section 185 of the NRM Act that requires weed outbreaks to be reported to the relevant NRM Board.

13.4.6 Pests and abundant species

13.4.6.1 Issues

The various construction works associated with the proposed mine expansion and associated project components could have an impact on invertebrate pests abundant species, and likely result in increased numbers of species including feral dogs and cats, foxes and silver gulls (DEIS Section 15.5.11 and Appendix U).

BHPB proposed the following measures in the DEIS to manage feral animals:

- Continuing feral monitoring and control programs in the Olympic Dam area;
- Monitoring/controlling Silver Gulls, cats, and foxes;
- Continuing to collaborate with Roxby Downs Council on dog and cat management;
- Working with NRM boards to address vertebrate pest issues;
- Continuing regular monitoring/controlling over-abundant kangaroo populations in the SML;
- Continuing to publicise management/monitoring results in the Annual Environmental Management and Monitoring Report; and
- Possibly supporting Roxby Down Council in fencing landfill sites and improving landfill practices.

With these proposed measures in place it was considered the residual impact from feral animal populations would be moderate (DEIS Section 15.5.11).

The SEIS acknowledged the impact of abundant species, such as kangaroos in the SML area, as overabundance would likely have an adverse affect on vegetation and the success of rehabilitation measures and amenity plantings (SEIS Section 16.3). This issue was being addressed through quarterly kangaroo monitoring, as required under BHPB's Fauna Monitoring Program. Controls deployed to manage numbers would continue to be used for the proposed expansion project. BHPB would continue to monitor abundant species because of the adverse impact they could have on native vegetation and rehabilitation activities.

13.4.6.2 BHPB EM Program and commitments

Refer to Section 11.4.2.2 of this chapter.

13.4.6.3 Assessment

Managing declared pest animals is primarily the responsibility of land managers, with support and coordination through the NRM Boards. BHPB takes an active interest in this area and proposes to continue the practice with the feral animal monitoring and control program, and support Roxby Downs Council in its attempts to control impacts from domestic cats. It would also consider improving landfill management in conjunction with the council.

The AR considers that the FEIS sufficiently addressed the impacts that abundant species could have on vegetation condition and success of rehabilitation practices. It also recognises that abundant species are already monitored and controlled under the Fauna Monitoring Program.

The AR supports the DEIS assessment that the residual impact of proposed mine expansion activities on the proliferation of feral species would be moderate, subject to proposed management measures being implemented, because expansion works would not be the only factor affecting feral animal proliferation in the project area. The AR considers BHPB's proposed measures would be appropriate, including its commitment to updating the Fauna Monitoring Program to manage abundant species impacts.

RECOMMENDATION

Accordingly, the AR concludes that reasonable measures have been developed to manage potential impacts regarding the exacerbation of pest and abundant species, subject to BHPB complying with its stated commitments and the recommended condition outlined below:

- The proponent must update their Fauna Monitoring Program to monitor and manage feral and abundant species and their impacts as a result of the expanded operation, prior to construction commencing on the mine site.

The following notes are also recommended:

- In updating the Fauna Monitoring Program, the proponent should have regard to *The Kangaroo Conservation and Management Plan for South Australia 2008-2010* (DEH 2007).
- The proponent should work with NRM boards and Roxby Downs Council to address vertebrate pest issues.

13.4.7 Soils

13.4.7.1 Issues

Soil erosion

The EIS study area traversed a range of land systems, and land and soil types, and there was the potential risk of soil erosion during construction of the proposed mine expansion, including:

- 126km of the northern route gas pipeline corridor option had a high to very high erosion potential, while the southern route option had approximately 47km high to very high erosion potential; and
- 54km of the southern infrastructure corridor had a high to very high erosion potential (mapped in DEIS Figures 10.6-7).

It should be stressed, however, that even medium to low erosion potential areas could erode under certain conditions.

There would be the potential for wind and water erosion at sites disturbed by mine expansion activities, with wind the biggest threat in the SML. Soil loss would have an impact on BHPB's ability to rehabilitate the land. Sampling and analysis, including Emerson Class dispersion tests, electrical conductivity and field observations, were undertaken to determine risk of erosion in an expanded SML. Soils were found to have medium soil erosion potential, with areas to the north adjacent to the infrastructure corridor having low potential, and an area to the south-west having high potential.

Given the relatively flat terrain and the small, contained catchments for most of the EIS study area, BHPB concluded that standard engineering practices would control erosion in those areas with low to medium erosion potential. It would implement measures to manage the risk of erosion, such as minimising disturbance, and stockpiling topsoil and cleared vegetation that would be returned and spread over disturbed areas to promote regrowth (DEIS Section 10.5).

BHPB said it would implement additional measures in areas identified as having a high or very high potential for erosion, and develop Erosion and Sediment Control Plans (ESCPs) as part of an Environmental Management (EM) Program. Additional erosion control measures could include:

- Minimising the disturbance footprint;
- Minimising the length of pipeline trench open at any time;
- Reinstating ground cover as soon as practicable;
- Watering disturbed surfaces, especially during periods of high winds; and
- Limiting construction traffic movement over disturbed areas (SEIS Section 10.1).

It would monitor disturbed areas during construction, particularly after heavy rainfall and high wind, and, post-construction, monitor disturbed areas until they were stabilised.

The ESCP would include design drawings showing the location, extent and type of proposed erosion-control measures, such as silt fencing for terrestrial areas, silt curtains for marine areas, catch banks or drains and rock armouring for areas likely to experience concentrated stormwater flows. BHPB would implement erosion protection measures and standard engineering practices, such as shoring to maintain the structural stability of pipeline trenches, where soils of high erosion risk or instability had been identified.

The DEIS concluded that in this context the impacts of soil erosion would be low.

Acid Sulphate Soils (ASS)

Areas with the potential risk of Acid Sulphate Soils (ASS) were identified along the southern infrastructure corridors, especially several salt lakes. BHPB considered the residual impact of potential acid generation would be low because areas that supported ASS would generally be avoided or have low potential to generate acid if disturbed. Where this was not the case, BHPB would undertake additional ASS assessments and, before any land disturbance, develop an ASS Management Plan detailing soil-handling methods and lime-dosing rates. These measures would result in any residual impact of disturbance of ASS being low or negligible (DEIS Figure 10.7).

13.4.7.2 BHPB EM Program and commitments

- **Environmental Management Program (EMP):** No specific EMP relating to this issue.
- **Management plan:** To develop an Erosion and Sediment Control Plan and, should further investigations find that sample analysis exceeded applicable criteria, an Acid Sulphate Soils Management Plan.
- **Commitments:** No specific commitments made in relation to this issue.

13.4.7.3 Assessment

A proportion of the proposed infrastructure corridors have a high to very high erosion potential. The AR supports the following measures proposed in the FEIS as an appropriate means of managing soil erosion and potential ASS (DEIS Section 10.5.1 / SEIS Sections 10.1 and 10.2):

- Minimising disturbance, and stockpiling topsoil and cleared vegetation so it could be returned and spread on disturbed land;
- Developing Erosion and Sediment Control Plans (ESCPs) for areas of high to very high erosion risk to specifically address (1) dunefields, (2) removal of gibber surfaces in undulating areas, and (3) channel areas;
- Re-establishing protective vegetative cover and/or other long-term erosion control measures as a priority at channel and drainage depression areas and on sand dunes;
- Monitoring erosion and rehabilitation after potentially erosive water and wind events, with monitoring requirements determined during development of the Environmental Management Program and ESCP, and maintained until the affected areas were stabilised; and
- Preparing an ASS Management Plan should it be required.

Rehabilitation of the land as soon as possible after completion of construction and additional measures to promote rapid regrowth of vegetation would also need to be considered.

RECOMMENDATION

Accordingly, the AR concludes that reasonable measures have been developed to manage potential impacts regarding soil erosion and disturbance to acid sulphate soils, subject to BHPB complying with its stated commitments and the recommended condition outlined below:

- Preparation and implementation of an Acid Sulphate Soils (ASS) Management Plan, should additional investigations identify it as being necessary.

Further, a condition has been recommended in Chapter 6: 'Landing facility and pre-assembly yard' that requires preparation of a Construction Environmental Management and Monitoring Plan (CEMMP) for the landing facility. Part of the CEMMP requires the preparation and implementation of an Erosion and Soil Control Plan (ESCP), which includes the following measures as a minimum:

- Minimising areas disturbed.
- Rainfall landing above the disturbed areas to be diverted around the site.
- Installation and maintenance of erosion control measures.
- Progressive rehabilitation and stabilisation of disturbed areas.

13.4.8 Greenhouse gases

13.4.8.1 Issues

The expansion of Olympic Dam would result in a significant increase in greenhouse gas (GHG) emissions. BHPB estimated that at full operating capacity of 60-million tonnes per annum (tpa) of ore, the expanded mining operation would emit a peak of 4.7-million tpa of greenhouse gases, with a reportable component of 3.3-million tpa under the **National Greenhouse and Energy Reporting Act 2007** (Cth). This would be in addition to Olympic Dam's existing GHG emission of 1.1-million tpa. The performance of the expanded operation would include the positive effects of the cogeneration plant and use of renewable energy contracted through the National Electricity Market (NEM) for the desalination plant (DEIS Section 13.4).

GHG emissions for the expanded operation are predicted to represent 7-10 per cent of South Australia's future GHG emissions and 0.5-0.75 per cent of Australia's future emissions.

During the public exhibition period of the DEIS, the state government, through the Climate Change Office raised the following issues and risks concerning GHG emissions from the proposed expansion of Olympic Dam:

- Uncertainty about the total levels of emissions produced by the project, in particular the reduction in emissions that could be achieved over a business as usual (BAU) scenario;
- The extent to which greenhouse emissions could be minimised over the lifetime of the mine while maintaining the economic viability of the project;
- The implementation of greenhouse emission abatement measures beyond the specific commitments proposed by BHPB;
- Further information about the conditions under which abatement opportunities would be pursued;
- The potential greenhouse impact of key design choices;
- The accuracy of the potential greenhouse emissions identified;
- The extent to which BHPB could influence greenhouse emissions resulting from the project throughout the value chain, and, therefore, the scope of emissions that should be included in management and reporting;
- The extent that ongoing processes could ensure greenhouse emissions would continue to be managed and reduced where possible;
- The extent that ongoing processes could ensure potential emission reduction opportunities would continue to be identified and implemented where practical;
- The extent that ongoing processes could ensure greenhouse abatement opportunities would continue to influence design choices;
- The extent that ongoing processes could ensure greenhouse emission management would be subject to regular review, regular performance assessment and ongoing public accountability;
- The potential impact of the significant greenhouse emissions from this project on South Australia's ability to meet its greenhouse emission targets and, to a lesser extent, the potential impact on Australia's targets and international position with respect to greenhouse policy;
- The potential impact on carbon pricing and security of the energy and technology choices made in relation to the project;
- The impact of power requirements on available sources of power and implications for other users in South Australia and greenhouse gas-emission levels; and
- The use of a truck fleet to transport of ore and waste rock versus a conveyor system, and the implications for power use and greenhouse emissions.

13.4.8.2 BHPB EM Program and commitments

BHPB has set the following objective and criteria as part of its Environmental Management Program (EMP) which is detailed in DEIS Appendix U, ID 3.6:

- **Objective:** Contribute to stabilising global atmospheric gas concentrations to minimise environmental impacts associated with climate change.
- **Criteria:** Apply a management goal of reducing greenhouse gas emissions reportable under the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* by 60 per cent based on 1990 levels by 2050.
- **Management plan:** To develop a Greenhouse Gas and Energy Management Plan (GG&EM Plan), to be reviewed annually, that would:
 - Set interim goals, targets and timelines for emissions reduction-based projects;
 - Consider further renewable energy and greenhouse gas abatement opportunities identified in the FEIS;
 - Identify further greenhouse gas-reduction strategies and projects; and
 - Establish a model to forecast the likely emissions reduction pathway from commencement of operations to 2050.

- **Commitments:** BHPB has made the following commitments (SEIS Table 2.1):
 - To construct an on-site 250MW co-generation power station for recovering waste heat;
 - To source 35MW of renewable energy from the national electricity market (NEM) for the proposed desalination plant;
 - To produce an annual ‘road map’ that quantified emission-reduction opportunities and achievements;
 - To source 22MW of renewable energy from the NEM to power the pumping stations needed to transfer water from the Point Lowly desalination plant to Olympic Dam;
 - To install solar panels at the proposed new airport to supplement electricity from the NEM;
 - To install solar hot water systems at Hiltaba Village and Roxby Downs;
 - To support the SA Government in the development of a sector agreement on greenhouse gas and use of renewable energy;
 - To incorporate the Carbon Pollution Reduction Scheme (CRPS) into the economic modelling for the proposed mine expansion project when details of the scheme became available and there was certainty it would be implemented;
 - To comply with requirements of such a scheme if and when it was implemented; and
 - To include the effects of such a scheme on the viability of greenhouse gas abatement projects, and the projected emissions trajectory for the expanded operation in Olympic Dam’s Greenhouse Gas and Energy Management Plan.

13.4.8.3 Assessment

The AR recognises that the proposed Olympic Dam expansion project would have a large greenhouse gas emissions profile and there is a legitimate expectation that BHPB should remain accountable to the community with respect to its greenhouse gas emissions performance. The public submissions on the project reflected this expectation.

BHPB has stated it would consider, in the preparation of the GG&EM Plan, renewable energy and greenhouse abatement opportunities that had not yet been the subject of specific commitments, as well as setting interim targets and developing an emissions trajectory. The AR considers this an acceptable approach.

The additional information requested in submissions was mostly provided in the SEIS. The SA Government requested additional data and information to provide a clearer picture of projected emissions from the project and an understanding of the factors that would cause emissions to vary. BHPB responded that many estimates remained conservative and would overstate the emission levels associated with the proposed expansion.

BHPB stated that further analysis, modelling and projections would be carried out through the GG&EM Plan. The AR recommends that the detail of the GG&EM Plan should:

- Where relevant, incorporated issues raised in submissions;
- Provided a successful vehicle for managing greenhouse emissions on an ongoing basis; and
- Provided public accountability for the performance of the proposed project.

RECOMMENDATION

The AR considers that appropriate measures have been proposed in the FEIS (as outlined above in Section 13.4.8.2) to allow BHPB to make design and operational decisions around the management of its greenhouse gas emissions should the expansion project be approved. In particular, these measures include the 2050 goal, and the proposed Greenhouse Gas and Energy Management Plan. Accordingly, the following conditions are recommended:

- The proponent must prepare and implement an initial Greenhouse Gas and Energy Management Plan (GG&EMP) that addresses all project components. The GG&EMP is to be available within 12 months of the date of this approval, for approval by the Indenture Minister, with the objective of achieving:
 - A goal of reducing greenhouse gas emissions (reportable under the National Greenhouse and Energy Reporting (Measurement) Determination 2008) to an amount equivalent to at least a 60% reduction of 1990 emissions, by 2050; and
 - Any interim goals, targets and timelines set throughout the project.
 The Plan must include:
 - A comprehensive approach to energy efficiency, renewable energy and greenhouse gas abatement in the construction design and operation of the expanded mine site to ensure viable, cost-effective opportunities being maximised; and
 - Clear statements about the conditions under which opportunities will become viable and be implemented.
- The proponent must implement the approved GG&EMP.
- The proponent must produce and make available to the Indenture Minister, for public release, an 'annual road map' that quantifies:
 - Reporting on progress to meet targets determined in the approved GG&EMP; and
 - Emission reduction opportunities and achievements.

The following notes are also recommended to support the conditions recommended above:

Note: In order to satisfy the condition, the GG&EMP should incorporate:

- Interim goals, targets and timelines for emissions reduction based projects, including interim emission objectives for 2020, 2030 and 2040;
- Consideration of further renewable energy and greenhouse gas abatement opportunities, identified in the Final EIS (DEIS and SEIS);
- Identification and consideration of further greenhouse gas abatement opportunities;
- Identification and consideration of further opportunities to increase the proportion of renewable energy used and to further reduce electricity demand;
- A comprehensive approach to energy efficiency in the construction design and operation of the expanded mine site to ensure viable, cost-effective opportunities are maximised;
- Further work to identify and publicly report relevant Scope 3 emissions that can be reasonably included for management under the Plan in line with best practice for greenhouse management and reporting;
- Modelling to forecast, via an emissions trajectory, the likely emissions reduction pathway from commencement of operations to 2050, including information regarding accuracy and key variables;
- The relevant requirements of an emissions trading scheme, if and when it is implemented and the effect of such a scheme on abatement opportunities and the emissions trajectory; and
- Further commitments to be developed in the following areas:
 - Details of the scale of solar hot water and solar PV to be installed, particularly in residential developments;
 - Optimising the performance of the housing stock;
 - Involvement in the early development of renewable technologies;
 - Minimising greenhouse emissions through design of desalination plant, pumping and pipeline to best practice standards;
 - Best practice approaches to design and ongoing management for reducing greenhouse emissions across all elements of the expansion;
 - Future proofing of key investments such as the use of smart grid technologies; and
 - Greenhouse and Energy Management should also be the subject of a sector agreement, to be entered into with the Minister for Climate Change under Section 16 of the *Climate Change and Emissions Reduction Act 2007*.

Note: Greenhouse and Energy Management should also be the subject of a sector agreement, to be entered into with the Minister for Climate Change under section 16 of the *Climate Change and Emissions Reduction Act 2007*.

The AR also strongly supports BHPB's commitment to use renewable technologies at the desalination plant, Hiltaba Village, airport and at the mine site. To ensure these commitments are met, the AR recommends the following conditions that relate to the use of renewable/sustainable technologies:

- The proponent must construct an on-site cogeneration power station (approximately 250MW capacity) for recovering waste heat;
- Electricity requirements to power operation of the desalination plant and all four associated pumping stations must be drawn from renewable energy sources via the national electricity market;
- The proponent must install photo voltaic panels or an equivalent renewable technology, and associated power systems during construction of the airport;
- The proponent, or its contractor, must install a solar hot water system/s or an equivalent renewable technology at the airport; and
- The proponent, or its contractor, must install solar hot water systems or an equivalent renewable technology, for the permanent accommodation units at Hiltaba Village.

A discussion of the above sustainability measures has been provided in the relevant project component chapters of this AR.

The AR also recommends that BHPB:

- Uses of low carbon emission energy where practicable for the proposed expansion;
- Stays abreast of the progress of low-emission fuel technologies; and
- Support the Australian Government in formulating an international sectoral agreement.

In relation to the management of climate change impacts the AR recommends the following:

- The proponent should address, to the extent appropriate, the potential for variable environmental impacts arising from climate change. This matter should be addressed, where relevant, in the EMPs prepared by the proponent under the Olympic Dam Indenture.

13.5 Conclusion

This chapter provides a summary of the general environmental impacts relevant to the proposed construction and operation of an expanded Olympic Dam mine. Where environmental issues are specific to a particular project component they have been addressed in the relevant component chapter. It is considered that terrestrial matters, including native vegetation, fauna and soils, could be managed through the application of measures proposed by BHPB, including the development of an appropriate off-sets package to provide a significant environmental benefit (SEB), flora and fauna monitoring programs and the preparation of Erosion Control Management Plans and Acid Sulphate Plans where required.

In relation to the management of greenhouse gas emissions for the whole project it is expected that BHPB would continue to liaise with the SA Government on the preparation of the Greenhouse Gas and Energy Management (GG&EM) Plan, with the key outcomes of the plan and the 'road map' being made publicly available on an annual basis.

The AR concludes that through BHPB implementing its proposed measures and complying with the recommended conditions outlined in this chapter, the general effects on the environment from the whole expansion project could be managed appropriately.

Chapter 14

Recommendations and conclusions



Chapter 14: Recommendations and conclusions

14.1 Conclusion

In 2005, BHP Billiton Olympic Dam Corporation Pty Ltd's (BHPB) formally commenced the process of seeking approval from the Australian, South Australian (SA) and Northern Territory (NT) governments to significantly expand mining operations at Olympic Dam.

A collaborative assessment process was agreed with the Australian and NT governments. All three jurisdictions required the preparation of an Environmental Impact Statement (EIS) and accordingly one EIS was prepared by BHPB to address the requirements of the three levels of government. In SA, the EIS process was being undertaken in accordance with the requirements of the *Development Act 1993*.

The EIS was released for comment for an extended period of 14 weeks from 1 May 2009 to 7 August 2009. During this period four public meetings were held from late May 2009 at Roxby Downs, Port Augusta, Whyalla and Adelaide.

On 2 December 2010, BHPB submitted to the three governments its draft Supplementary EIS (SEIS), which sought to respond to the issues raised during the public consultation period. The draft SEIS was then subject to an "adequacy check", to determine whether sufficient information had been provided for the three jurisdictions to assess the proposed expansion. On 21 April 2011 BHPB was advised that the draft SEIS was adequate for assessment purposes.

This Assessment Report outlines the envisaged environmental, social and economic impacts and considers the safeguards or commitments proposed by BHPB to mitigate potential impacts. It concludes that on balance the environmental, social and economic impacts of the proposed Olympic Dam expansion are acceptable based on the proposed design of the various components, the associated mitigation and management measures proposed, and subject to the setting of appropriate conditions. It is also noted that a number of the project components will require subsequent permits and licensing approval from the Environment Protection Authority and other statutory bodies.

Conclusions for each project component have been provided throughout the AR (refer Chapters 4 – 13).

Should the Minister responsible for administering the Indenture (Minister for Mineral Resources Development) resolve to grant a development authorisation it is recommended that specific conditions be set so as to ensure appropriate development outcomes with respect to the following seven separate project components:

- Mining operations and processing;
- Desalination plant;
- Landing facility;
- Pre-assembly yard;
- Hiltaba Village;
- Roxby Downs airport; and
- Pimba Intermodal facility.

It is also recommended that conditions be separately defined with respect to:

- Road transport;
- Infrastructure corridors;
- Effects on communities; and
- Effects on the environment.

14.2 Implementation

It is anticipated that a SA Government body would oversee the implementation of the Olympic Dam expansion to ensure the project occurs in accordance with the conditions of the development authorisation. Various committees may be established in the future to oversee certain project components and/or issues but these would be defined at a later date.

14.3 Recommendations

A full summary of the recommended conditions, based on the above listed project components and whole-of-project issues, such as greenhouse gas emissions, vegetation clearance and social management, are outlined below.

As a point of clarity:

- 'Conditions' are provisions attached to the granting of a development authorisation, and compliance by BHPB (the proponent) with conditions is mandatory. Should compliance not be achieved, enforcement provisions are available to the SA Government under the *Development Act 1993*; and
- Whereas, 'notes' are provided to assist BHPB (the proponent) meet certain conditions and are not mandatory. Notes have also been recommended to remind BHPB of the 'secondary approvals' that may be required.

14.3.1 General conditions

1. Except where amendments may be required by other legislation, or by conditions imposed herein, the proposed Major Development for the Olympic Dam Expansion must be carried out in accordance with the following documents:
 - Development applications dated 4 October 2005 and 19 September 2008;
 - Olympic Dam Expansion Draft Environmental Impact Statement 2009 (Main Report Volumes 1 and 2 and Appendices) (DEIS);
 - Olympic Dam Expansion Supplementary Environmental Impact Statement 2011 (Volumes 1 and 2 and Appendices) (SEIS);
 - The Consolidated List of Commitments provided in Table 2.1 of the SEIS (dated 2011); and
 - Correspondence from BHPB to the Olympic Dam Task Force dated 1 September 2011 containing a drawing entitled Port Augusta pre-assembly yard.
2. Before any building is undertaken on the site, the building work is to be certified by a private certifier, or by some person determined by the Minister for Urban Development and Planning and the City of Adelaide, as complying with the provisions of the Building Rules (or the Building Rules as modified according to criteria prescribed by the Regulation.

14.3.2 Mining and processing

14.3.2.1 General conditions

1. For the purposes of section 48(11)(b) of the *Development Act, 1993*, the proponent must commence the development by substantial work on the site of the development within 5 years of the date of this authorisation, failing which the authorisation may be cancelled.
 - 1a. The proponent must have substantially commenced construction of the open pit within 5 years of the date of this authorisation.
2. The proponent must not produce more than 750,000 tonnes per annum of refined copper.

14.3.2.2 Noise

No condition for noise (refer Hiltaba Village)

Note: In order to achieve relevant criteria prescribed in the *Environment Protection (Noise) Policy 2007* truck horn testing within the mine maintenance and industrial areas at Olympic Dam may require a warehouse-type building with suitable acoustic insulation to reduce noise emissions.

14.3.2.3 Vibration

3. The proponent must achieve the human comfort criteria defined in the Australian Standard AS2187.2 (2006) (or as amended) and monitor and report air blast overpressure and vibration levels in Roxby Downs and Hiltaba Village to demonstrate ongoing compliance with that standard.

14.3.2.4 Site contamination

4. The hazardous and dangerous substances storages areas and/or activities within the SML must be designed to ensure that substances are stored in bunded and sealed compounds/areas capable of preventing the escape of material into the soil, surface waters or underground water resources.
5. All stormwater retention ponds which are designed to constitute a component of a tertiary containment system for chemical spills must be designed and constructed to prevent the escape of material into the soil, surface waters or underground water resources.

Notes (to support conditions 4 and 5):

The EPA Guidelines '*Bunding and Spill Management (2007)*' and '*Wastewater Lagoons (Draft 2010)*' contains information that can assist the proponent to comply with the chemical storage and containment requirements above.

14.3.2.5 Groundwater

6. The proponent must review and update on a 3 yearly basis the regional groundwater model presented in the EIS used to predict regional groundwater drawdowns. Review of the groundwater model is to be undertaken by an independent expert in accordance with the Murray-Darling Basin Commission Modelling Guidelines (as the nationally recognised groundwater modelling guidelines), as amended from time to time. In reviewing and updating the regional groundwater model a report must be prepared that includes at least the following specific items:
 - Updated understanding of the hydrogeology of the Torrens Hinge Zone;
 - Updated aquifer parameters for the Torrens Hinge Zone to be used in modelling upgrades;
 - Updated understanding of the recharge mechanisms to the Stuart Shelf, including recharge from rainfall and inflow from the Arckaringa Basin; and
 - Updated understanding of impacts to the regional groundwater system resulting from the open pit void.
7. Outside of the Designated Area prescribed pursuant to the Olympic Dam Indenture the proponent must offset drawdown impacts to existing third party users identified in the EIS resulting from the proposed expansion during the operational phase of the mine.

Note (to support condition 7):

Note: Clause 13 of the Olympic Dam Indenture makes special provision for the company to maintain water supply to existing 3rd party users within the Designated Area around the water supply wellfields.

8. The proponent must prepare a Regional Groundwater Management and Monitoring Program for the GAB and Yarra Wurta Springs to manage potential impacts from the Olympic Dam Expansion, for approval by the Indenture Minister, within 12 months of the date of this decision. The Regional Groundwater Management and Monitoring Program must include the following:
 - Ecological monitoring, measured spring flow rates (taking into account local variations in barometric pressure, tidal influences and evaporation rates), open pit dewatering volumes resulting from both the dewatering activities and pit inflows, groundwater levels, salinities and water chemistry and comparison between baseline measurements and ongoing monitoring;
9. The proponent must implement the approved Regional Groundwater Management and Monitoring Program.
10. Monitoring data must be used to update the Regional Groundwater Management and Monitoring Program, the regional model (as required above) and to develop trigger points for action.
11. If an update of the regional groundwater model and/or monitoring indicates that a trigger point is reached, the proponent must develop mitigation strategies and, if necessary, contingency options (for example relocation of Lake Eyre Hardyheads to alternate habitat).

Notes (to support the groundwater conditions):

Note 1: If the action triggers are exceeded during extraction from the Motherwell Saline Wellfield, and, in the opinion of the Indenture Minister the exceedence constitutes a significant risk to the environmental values of the Yarra Wurta Spring complex, the Minister may direct the proponent to cease extraction from the Motherwell saline wellfield, or to take action to maintain pressure levels.

Note 2: The results of monitoring within the Yarra Wurta Springs and GAB Springs, should be reported in the annual Environmental Management and Monitoring Report, including updated research as follows:

- The significance that declines in groundwater levels in the Andamooka Limestone may have on the Springs;
- The groundwater processes supporting the Yarra Wurta Springs;
- Regarding the structural controls that exist between Yarra Wurta Springs and the open pit; and
- The storage buffering of Lake Torrens to the drawdown of groundwater levels within the Andamooka Limestone.

Note 3: The proponent will be required to establish a monitoring program required for the Motherwell Wellfield and other water supply wellfields in accordance with requirements under the Olympic Dam Indenture (Special Water Licence), and that monitoring data would include as a minimum:

- Total abstraction and individual well abstraction on a monthly basis;
- Water pressure and levels in monitoring and production wells; and
- Water quality at monitoring and production wells on an annual basis.

14.3.2.6 Groundwater dependent ecosystems - impacts on the Yarra Wurta Springs and resident population of Lake Eyre Hardyhead

No conditions.

Notes (about groundwater dependent ecosystems):

Note 1: Detailed baseline information for the Yarra Wurta Springs should be developed with enough statistical power to account for natural variation and 'noise' including:

- Spring flow rate, wetland area and salinity;
- An assessment of the flow would need to be carried out that accounted for local variations in barometric pressure, tidal influences and evaporation rates; and
- Baseline data on the relative abundance/health of the Hardyheads and microbial mats.

Note 2: The monitoring program would have to adequately account for the likely impact timeframe i.e. from the Motherwell Saline Wellfield and the mine pit drawdown, respectively.

Note 3: To enable the development of mitigation strategies in the event that potential impacts emerge at the Yarra Wurta Springs that are attributable to the operation of the Motherwell wellfield, the proponent should develop action triggers, based on the groundwater model and monitoring at key points.

14.3.2.7 Solid waste

No conditions.

Notes (about Solid Waste):

Note 1: The landfill facility will require authorisation under the *Environment Protection Act 1993*. As part of the licensing process the EPA will likely require detailed designs, drawings and specifications for the proposed onsite solid waste landfill facility at Olympic Dam prior to such a facility being constructed. Specifically, the EPA will require the following details:

- Design and proposed construction detail of new landfill cells in accordance with the SA EPA Guidelines: Environmental Management of Landfill Facilities (municipal solid waste and commercial and industrial general waste) including:
 - Detailed design drawings;
 - A Landfill Construction Quality Assurance Plan;
 - A Landfill Construction Management Plan; and
 - A Landfill Environmental Management Plan incorporating details of the closure and post closure management;

Note 2: Any application for licensing of the new onsite waste landfill must include a risk assessment that considers the location and management requirements of the adjoining Tailings Storage Facility.

Note 3: It is likely that a requirement to prepare a General Waste and Used Tyre Management Plan which incorporates all waste streams for the waste management facility prior to receipt of waste at the waste management facility would become a condition of license under the *Environment Protection Act 1993*.

Note 4: 'As Construct' Reports of the onsite landfill cells must be provided to the EPA for approval prior to waste being deposited within any landfill cell. Refer to the draft SA EPA Guideline: *Guideline for construction specifications and reports – For landfills, leachate ponds, composting facilities and wastewater lagoons (2009)*.

14.3.2.8 Wastewater from staff facilities

No conditions.

Notes (about Wastewater):

Note: The wastewater facility will require authorisation under the *Environment Protection Act 1993*. As part of the licensing process the EPA will likely require detailed designs, drawings and specifications for the on-site sewage treatment system at Olympic Dam must be provided to the EPA for approval prior to the on-site sewage treatment plant being constructed. Specifically, the EPA will require the following details:

- Type of wastewater inflows (including an outline of on-site sources) to be accepted into the treatment plant;
- Maximum design capacity of the treatment plant in ML/day and population equivalents;
- Type of wastewater treatment plant to be used;
- Standard of treatment to be achieved;
- Where and how treated wastewater reuse will occur; and
- Schematic plans showing location and design of the proposed treatment plant and reuse areas including pipework layout.

14.3.2.9 Surface water and drainage

12. The proponent must prepare and implement a Site Groundwater and Surface Water Monitoring Program designed to achieve the following outcomes as measured against the respective approved criteria, for approval by the Indenture Minister, before commencing construction of the RSF or TSF:

OUTCOME	CRITERIA
No adverse impact on vegetation as a result of seepage from the tailings storage facility and rock storage facility.	<i>Compliance criteria:</i> Groundwater level outside the perimeter of the tailings storage facility must not be higher than 80 metres AHD or as otherwise agreed by the Minister.
No compromise of current and future land uses on the Special Mining Lease or adjoining areas as a result of seepage from the tailings storage facility and rock storage facility.	<i>Compliance criteria:</i> A numerical groundwater simulation model confirmed by Monitoring that continues to demonstrate that all movement of TSF and RSF seepage is captured by the final open pit. A numerical geochemical model confirmed by monitoring that continues to demonstrate that all TSF and RSF seepage is attenuated within the Special Mining Lease.
No adverse impact on local drainage patterns and water quality that would compromise existing use and water dependent ecosystems.	<i>Compliance criteria:</i> Any surface water outside of containment structures designed to manage runoff must comply with the Environment Protection (Water Quality) Policy 2003

Notes (to support condition 12):

Note 1: Each portion of the Rock Storage Facility (RSF), including the proposed low grade ore stock pile, should incorporate an engineered structure designed to capture all the run-off from the RSF during a 1-in-100 year rainfall event and avoid contaminated runoff leaving the area of the Special Mining Lease.

Note 2: Each Tailings Storage Facility (TSF) cell should include upstream and downstream toe drains to manage near surface lateral seepage (i.e. capture the seepage). Measures should be put in place to manage any observed seepage from the toe drains for the TSF cells, to reduce the potential for surface water impacts. These measures should include the transfer of captured seepage in interception systems to be returned to the TSF or evaporation ponds.

Note 3: Licence conditions that relate to monitoring and management of such surface water containment facilities may be imposed under the *Environment Protection Act 1993*.

Note 4: The proponent will need to apply to the EPA for an exemption to the *Environment Protection (Water Quality) Policy 2003* or seek to have the current environmental values applying to groundwater at Olympic Dam modified in the *Environment Protection (Water Quality) Policy 2003*.

13. A report by a suitably qualified independent consultant which certifies that the final designs for the TSF and RSF are likely to achieve the each outcome of Condition 12 when measured against the respective approved criteria must be provided to the Indenture Minister prior to commencement of construction of the TSF and prior to the placement of rock within the RSF.

14.3.2.10 Radiation

14. The proponent must achieve the following outcomes as measured against the respective approved criteria:

OUTCOME	CRITERIA
Radiation doses to the public arising from the expanded Olympic Dam operations and radioactive waste management are below internationally agreed levels and are as low as reasonably achievable.	<p><i>Compliance criteria:</i> Radiation doses to the public must be within the dose limits recommended in the Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA 2005 or, as amended).</p> <p><i>Leading Indicator:</i> A reference level must be set for public doses at Roxby Downs and Hiltaba. The reference level must be 0.3mSv/yr unless otherwise agreed by the relevant Minister.</p>
Radiation doses to non-human biota arising from the expanded Olympic Dam operations and radioactive waste management area as low as reasonably achievable.	<p><i>Leading Indicator:</i> The proponent must set a reference level for impacts on non-human biota (interim criteria for non-human biota may be set until such time as an agreed national approach is determined).</p>
Radiation doses to the public and non-human biota arising from the transport of radioactive material are below internationally agreed levels and are as low as reasonably achievable.	<p><i>Compliance criteria:</i> Transport of radioactive material complies with the Code of Practice for the Safe Transport of Radioactive Material (ARPANSA 2008 or, as amended).</p>

Notes (to support condition 14):

Note 1: When seeking authorisation from the SA EPA to undertake construction (as required under the conditions of the *Radiation Protection and Control Act 1982* licence), the proponent must submit a summary report on the results of the radiation protection optimisation program. This report will be in addition to the Radiation Management Plan and Radioactive Waste Management Plan that need to be submitted though it is expected that the findings of the radiation protection optimisation program will be incorporated into those plans. The radiation protection optimisation program should include consideration of the current design of the smelter and other relevant plant infrastructure to determine engineering controls to support the increase in production rate.

Note 2: When undertaking the radiation protection optimisation study during the design phase of the new plant and open pit mine, the proponent must also consider the design of the existing smelter and other relevant existing plant infrastructure to determine engineering controls to support the increase in production rate.

Note 3: In keeping with the EPA's regulatory practice to enact national codes of radiation protection, the proponent will be required to seek authorisation to commence each stage of the project; that being construction, operation and decommissioning and rehabilitation of the site. Each authorisation will require a Radiation Management Plan and Radioactive Waste Management applicable to the project stage and approved by the EPA. These plans must address all risks of radiation exposure to workers, the environment and the public and the control methods and monitoring that will be employed to ensure that doses will be as low as reasonably achievable.

Note 4: The proponent is reminded of its routine reporting requirements under licence conditions and radiation accident or emergency reporting pursuant to Regulations 31 & 32 of the *Radiation Protection and Control (Ionising Radiation) Regulations 2000*.

Note 5: It is expected that the proponent will incorporate the following requirements within the Radiation Management Plan (RMP) that must be approved by the EPA as conditions of the licence under the *Radiation Protection and Control Act 1982* to conduct expanded mining or milling of radioactive ore at Olympic Dam:

- The proponent will conduct radon emanation measurements on the overburden, waste rock and exposed ore as the pit develops. This data should be used to model Radon Decay Product exposures within the pit;
- The proponent will undertake real-time gamma, radon, dust and pit atmospheric monitoring during the development of the pit and Rock Storage Facility to assist the development of control strategies associated with different sources of dust and radon;
- The Radon Decay Product dose assessments must be re-modelled for the pit and underground mine, should the International Commission on Radiological Protection introduce a change to the recommended RDP dose conversion factor;
- The proponent must develop a program to derive realistic respiratory protection factors for use in the smelter and elsewhere in the Plant to provide an accurate estimation of dose.

Note 6: It is expected that the proponent will incorporate the following requirements within the Radiation Waste Management Plan that must be approved by the EPA as conditions of the licence under the *Radiation Protection and Control Act 1982* to conduct expanded mining or milling of radioactive ore at Olympic Dam:

- A comprehensive rehabilitation and closure plan for the landfill containing low-level radioactive contaminated material, to ensure it meets international best practice for disposal (either in situ, or moved to a more appropriate location);
- A plan to address the recycling where appropriate, of large lightly contaminated equipment items in accordance with international best practice;
- The conduct of regular (e.g. 5 – 10 years) soil surveys within and outside of the Special Mining Lease as part of the RWMP, to assess the radiological impacts of dust deposition for the expanded operations using appropriate models (e.g. ERICA).

Note 7: It should be noted that any Radiation Management Plan and Radioactive Waste Management Plan that is approved by the EPA under the *Radiation Protection and Control Act 1982* for the expanded Olympic Dam operation will be subject to regular review to ensure monitoring and control methods demonstrate best practice and exposures are as low as reasonably achievable (ALARA).

14.3.2.11 Hazards

No conditions.

Notes (about hazards in general at the mine):

Note 1: Detailed planning for the storage and transport of bulk ammonium nitrate will be required to be undertaken prior to construction occurring at the mine site, and in consultation with the South Australian explosives regulatory authority, SafeWork SA to satisfy licensing requirements under the South Australian *Explosives Act 1936*.

Note 2: There may be a requirement for Major Hazard Facility licensing under SA Work Health and Safety (WHS) Regulations (to be effective as from 1 January 2012) when Schedule 15 chemicals threshold quantity level is triggered.

Note 3: In order to achieve compliance with clause 24 of the State Emergency Management Plan, pursuant to Section 9(e) of the South Australian *Emergency Management Act 2004*, the proponent would be required to update the Emergency Response Plan in consultation with SafeWork SA. The MHF-related operational hazards and risks should be reviewed during the pre-commissioning, commissioning and operational phases, in consultation with SafeWork SA.

14.3.2.12 Impacts of the TSF on fauna and migratory species

15. The proponent must prepare and implement a Bird Impact Management and Monitoring Plan (BIMMP) relating to listed migratory species and Banded Stilts, for approval by the Indenture Minister, prior to the commissioning and operation of the new tailings storage facility (TSF), that is designed to minimise, record and report actual and extrapolated/modelled bird mortalities as a result of exposure to the TSF. The BIMMP must:
 - Outline a process to identify, monitor and respond to potential impacts on birds. To this end the plan should include indicators and/or criteria that will be applied to measure success in achieving environmental protection objectives, and as far as possible mitigating any adverse impacts;
 - Consider knowledge gaps in scientific understanding, and associated key uncertainties;
 - include a process for management measures or controls to address uncertainty and key risk; and
 - include processes and accountabilities for monitoring, analysing and contributing to adaptive management and continuous improvement processes.
16. The proponent must annually prepare and submit a monitoring report to report against the actions and criteria contained in the BIMMP.
17. The proponent must review the BIMMP in accordance with the EPMP required under Clause 11 of the Olympic Dam Indenture, or as required by the Minister.

Notes (to support condition 15):

Note: In preparing the Bird Impact Management and Monitoring Plan it is recommended that the proponent considers the following principles and actions:

- uses best practice technology to decrease attractiveness of tailings to avifauna, and to deter and disperse avifauna;
- A set of environmental protection objectives aimed at mitigating any adverse impacts to birds from the TSF;
- The development and implementation of a rigorous TSF monitoring program with the aim of reducing the degree of uncertainty around actual mortality numbers; and

- The investigation, development and implementation, if practicable, of an ongoing real-time surveillance system, and automated deterrence/hazing systems, to detect the approach and arrival of flocking bird species and deter them from entering the TSF.
18. Prior to finalising the location of the parking bays on the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road, the proponent must conduct floristic surveys, following adequate rainfall if possible, to confirm the presence/absence of listed threatened species. In determining the final location of the passing bays, the proponent must avoid listed species, however if clearance is unavoidable, revegetation of these species must be reinstated or relocated to adjacent work areas, or as otherwise agreed by DENR.

14.3.2.13 Traffic impacts

19. The road shoulders over the entire length of the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road must be sealed, at the proponent's cost, within twelve months of this development authorisation.
20. Where Over-Dimensional (OD) and Over Mass (OM) loads enter or exit BHP facilities onto the sealed arterial road network, the proponent must design, construct and maintain sealed junctions in accordance with DTEI standards to minimise deterioration to the edge of the sealed carriageway and prevent debris being carried onto it, including (but not limited to):
- to/from the Pimba Intermodal;
 - all entry/exit points to rest areas (parking bays) for use by existing road users; and
 - all access points used by OD/OM vehicles.
21. The proponent must determine baseline road conditions for the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road to the satisfaction of DTEI, prior to the movement of OD/OM loads for the expansion project.

Note (to support condition 21):

Note: The proponent is advised that permits issued for the movement of OD and OM vehicles will include the standard condition that applies to all permits issued for the movement of OD and OM loads with respect to the obligation to pay the road authority (council and/or DTEI) *for the reasonable costs of making good damage caused as a result of the passage of a vehicle or combination travelling under a permit*

22. The proponent must construct sufficient parking bays on the Stuart Highway between Port Augusta and Pimba, and the Olympic Dam to Pimba Road, to ensure a maximum delay of 30 minutes for the travelling public, to the satisfaction of DTEI.
23. The proponent must prepare and implement a Traffic Management Plan for approval of the Indenture Minister, with the concurrence of DTEI, prior to the movement of escorted OD/OM loads associated with the major development approved herein. The Traffic Management Plan must include the following:
- Details about traffic volumes, proposed transport routes, required road infrastructure maintenance and/or upgrades, transport scheduling and road safety;
 - Measures to restrict OD/OM movements in extreme hot weather, with a temperature limit being identified to avoid road closures during these events;
 - Measures to restrict OD movements during peak times (as informed by Culway data²⁴);

²⁴ Culway Data is used to optimise traffic movement information gathered by other systems such as Counters and Classifiers.

- An education and media information strategy regarding road closures be implemented in the lead up to and during the expansion project;
 - The plan must incorporate a provision that, 12 months prior to commencing any program to move escorted OD loads associated with the project, the proponent will advise and consult with DTEI and SAPOL;
 - Road Safety Management Plans to be prepared in consultation with SAPOL and DTEI; and
 - Consideration of vehicle mix in the parking bays (i.e. vehicles carrying dangerous goods should be corralled separately from general vehicles due to increased risks and compliance with the Dangerous Goods Code).
24. The re-alignment of the Borefield Road must be established in accordance with DEIS Figure 5.5.
25. Construction of the re-aligned Borefield Road must be complete before the exiting Borefield Road is closed due to 'pre-strip' construction activities.
26. The proponent must comply with the relevant DTEI standards for the realignment of Borefield Road, with all costs being the responsibility of the proponent.

Notes (to support conditions 19-26):

Note 1: The proponent will be required to obtain relevant approvals/permits from DTEI for the movement of OD/OM loads under the *Road Traffic Act 1961*.

Note 2: The proponent has not provided sufficient evidence of any of the requested four (4) matters to allow any change in the standard conditions as set out in the DTEI policy document, '*Transport of Oversize and Indivisible Loads and Vehicles*'. Further consultation on this matter between the proponent, DTEI and SAPOL is required to discuss contingencies for breakdowns and moving traffic past the loads, including the following four (4) matters:

- Risk mitigation regarding vehicle breakdowns;
- Scheduling of operations;
- Proposed convoy configurations; and,
- Evidence that the proposal would be strongly supported from a road user perspective.

Note 3: The Traffic Management Plan should include details for Restricted Access Vehicle (RAV) routes. As RAV's (i.e. B-doubles, over-dimensional vehicles) will be using the state road network to access the Olympic Dam site it will be necessary for the routes to be assessed and appropriate upgrades made prior to DTEI issuing approval for these vehicles to utilise the surrounding road network.

Note 4: The proponent will be required to comply with all relevant DTEI standards for the upgrading of road infrastructure.

Note 5: The South Australian Police (SAPOL) will require at least six (6) months notice of OD scheduling from the proponent to manage its Police Escort Group capacity.

14.3.2.14 Rail spur from Pimba to Olympic Dam

27. The rail spur from Pimba to Olympic Dam must be operational prior to the first movement of copper concentrate, derived from the open pit.
28. Rail wagons used for transporting sulphur and copper concentrate to and from Olympic Dam must achieve no release containment.

Notes (to support condition 28):

Note 1: The proponent is reminded of its general environmental duty, as required by section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities associated with the construction and operation of new private roads (including the haul road from the barge landing facility to pre-assembly area in Port Augusta) do not pollute the environment in a way that causes or may cause environmental harm. It should be noted that dust suppression by watering or chemical methods are possible methods of achieving this requirement.

Note 2: As a condition of licence under the *Radiation Protection and Control Act (1982)* to conduct expanded mining or milling of radioactive ore at Olympic Dam, the following requirements should be included in the Radiation Waste Management Plan for approval by the SA EPA:

- Conduct background gamma dose rate measurements and soil sampling at representative locations along the rail corridors prior to the commencement of operations, to clearly establish background radionuclide concentrations; and
- Include routine monitoring of the transport corridors as part of the Radioactive Waste Management Plan.

14.3.2.15 Air quality

29. The proponent must prepare and implement an Air Quality Management and Monitoring Program (AQMMP), for approval by the Indenture Minister, with the concurrence of the EPA, that incorporates the following:

- A Dust Management Plan; prior to the commencement of open pit mining;
- A Process Emissions Management Plan (including point and diffuse source emissions) prior to the commencement of processing; and
- An Air Quality Monitoring Program, linked to the above management plans.

30. The proponent must ensure the following criteria are contained in its AQMMP:

Ground level PM₁₀ and PM_{2.5} dust concentrations at Roxby Downs and Hiltaba Village derived from construction and operational sources at Olympic Dam must not exceed the following criteria:

PARTICULATE SIZE FRACTION	AVERAGING PERIOD	GROUND LEVEL AMBIENT AIR QUALITY CRITERIA
PM ₁₀	24 hour	50 µg/m ³
PM _{2.5}	24 hour	25 µg/m ³
	Annual	8 µg/m ³

Ground-level SO₂ concentrations at Roxby Downs and Hiltaba Village derived from operational sources at Olympic Dam must not exceed the following criteria:

POLLUTANT	AVERAGING PERIOD	GROUND LEVEL AIR QUALITY CRITERIA
SO ₂	1 hour	450 µg/m ³
SO ₂	24 hours	228 µg/m ³
SO ₂	Annual	57 µg/m ³

Ground-level air pollutant concentrations at Roxby Downs and Hiltaba Village derived from operational sources at Olympic Dam must not exceed the following criteria for design of the expansion:

POLLUTANT	AVERAGING PERIOD	GROUND-LEVEL AIR QUALITY CRITERIA
Nitrogen dioxide (NO ₂)	1 hour	158 µg/m ³
carbon monoxide (CO)	1 hour	29 mg/m ³
Lead (Pb)	Annual	0.5 µg/m ³
Fluoride (as HF)	24 hour	2.9 µg/m ³

31. The proponent must ensure the following requirements are addressed in its AQMMP:

- The installation of four meteorological and air quality monitoring stations to be located in Roxby Downs, Hiltaba Village, and north and west of the Olympic Dam mine site and processing operations;
- Each meteorological station to be sited and designed in accordance with relevant Australian standards and be capable of continuously monitoring wind speed and direction, temperature, and humidity, and at least one station to also monitor solar radiation, atmospheric pressure, rainfall and evaporation;
- Each air quality monitoring station to be sited and designed in accordance with relevant Australian standards for the continuous measurement of PM₁₀ and PM_{2.5};
- The meteorological and air quality monitoring stations to have real-time data download to a central location (preferably at Olympic Dam) so that necessary pre-emptive or responsive action can be taken to deal with likely or actual exceedences of ground-level air quality criteria arising from operational sources;
- The meteorological and air quality monitoring system to be capable of differentiating the contribution that background TSP, PM₁₀ and PM_{2.5}, and operationally generated TSP, PM₁₀ and PM_{2.5} make to total TSP, PM₁₀ and PM_{2.5} concentrations over short periods (daily and hourly);
- Real-time radon (or radon decay product) monitors to be located at each meteorological and air quality monitoring stations to better model radon transport from the mine and mineral processing areas to Roxby Downs and Hiltaba Village;
- Continuous monitoring of SO₂ concentrations must be provided for the main smelter stacks and the tail gas stack exit of each individual acid plant; and
- Detailed information on the proposed pollution management measures to reduce SO₂ emissions during acid plant start-up, shutdown and abnormal conditions, and abnormal smelter conditions.

Notes (to support condition 29-31):

Note 1: The proponent in preparing the Air Quality Management and Monitoring Plan (AQMMP) should consider the following:

- Providing relevant detail on:
 - The detailed siting and design of meteorological and air quality monitoring stations;
 - Process management appropriate to air quality emissions;
 - Updated air emissions inventory for point, diffuse and fugitive dust emissions;
 - Air pollution control equipment and stack and vent configuration;
 - point source air emissions test facilities and stack testing program to demonstrate compliance with the AQMMP;
 - Control of fugitive dust emissions;

- Incident responses to exceedences or particular climatic conditions;
 - Community consultation and engagement;
 - Engagement with local health services for identifying and responding to any relevant health impacts (e.g. asthma management protocols); and
 - The continuing review of the literature on the impact of emissions to inform both monitoring and response.
- In relation to preparing the Dust Management Plan (as part of the AQMMP) providing specific detail on:
 - Pre-emptive particulate controls such as dust suppression on haul roads and conveyors, and best practice measures for minimising dust generation from unloading points, material stockpiles, crushers, rock storage facilities, and other potential fugitive dust emission sources; and
 - Identification of remedial action at specific operational dust sources in response to actual or impending exceedences of the-24 hour average ground-level PM₁₀ and PM_{2.5} air quality criteria referenced above, as determined from an air quality monitoring program established in accordance with an approved AQMP.

Note 2: The proponent's licence under the *Environment Protection Act 1993* and the *Radiation Protection and Control Act 1982* would likely be amended to encompass changes that would be necessary to accommodate the expansion project.

Note 3: A requirement to implement, report on and update an approved AQMMP would likely be incorporated into the proponent's licence under the *Environment Protection Act 1993* to conduct activities of environmental significance at Olympic Dam.

Note 4: A requirement to ensure compliance with the ground-level air quality criteria listed above would likely be incorporated into the proponent's licence under the *Environment Protection Act 1993* to conduct activities of environmental significance at Olympic Dam.

Note 5: It may become a requirement of the licence issued under the *Environment Protection Act 1993* for periodic independent auditing of the AQMMP.

Note 6: A requirement to report on radon (or radon decay product) monitoring results for each of the meteorological and air quality monitoring stations would likely be a condition of the licence approval under the *Radiation Protection and Control Act 1982* for expanded mining and milling of radioactive ore at Olympic Dam.

Note 7: All particulate data to be reported with attribution of results, where clear evidence is available, to broad-scale natural events such as dust storms that might cause exceedences of the above standards. For other events, contributions from the mine/processing site would also need to be reported. The mechanism of apportioning particulates to mine/processing site will need to be resolved by the proponent in consultation with the EPA prior to any major earthworks associated with the expansion project commencing at Olympic Dam.

32. The proponent must undertake a research study to determine the threshold levels for effects of SO₂ on flora of the region. The scope of the research study must be agreed with the Indenture Minister within twelve months of the date of this decision.
33. Prior to the operation of additional metallurgical plant the proponent must install and operate monitoring stations to continuously monitor SO₂ at Roxby Downs and Hiltaba Village.

14.3.2.16 Rehabilitation and closure

34. The proponent must develop and submit to the Indenture Minister for approval a Mine Closure and Rehabilitation Plan within 2 years from the date of this decision, or prior to construction of the TSF, whichever date is the earliest. The plan must:
- Include a set of environmental outcomes that are anticipated to be able to be achieved indefinitely post mine closure. An outcome is a statement of the acceptable impact on the environment caused by the proposed mining activity; and
 - Include assessment criteria that are clear and unambiguous and are specific to the achievement of the agreed environmental outcomes and should include:
 - Specific parameters to be measured and monitored;
 - Specification of the locations where the parameters will be measured, or how these locations will be determined;
 - Clear statement of the acceptable values for demonstrating achievement of the outcome, with consideration of any inherent errors of measurement;
 - The frequency of monitoring; and
 - Identification of what background or control data is to be used or specifying how these will be acquired if necessary.
 - Include an updated risk assessment of the project developed in consultation with relevant stakeholders, to determine the long-term risk to the public and the environment from the mining and processing operations, tailings storage facility and rock storage facility, including radioactive emissions. The updated risk assessment must inform the potential environmental outcomes that can be achieved indefinitely post mine closure, must consider the potential for and impacts resulting from early, unplanned closure or suspension of operations and demonstrate that all practical options for progressive rehabilitation have been addressed.
35. The proponent must implement the approved Mine Closure and Rehabilitation Plan.
36. The proponent must review the Mine Closure and Rehabilitation Plan as required by the Indenture Minister.

Notes (to support conditions 34-36):

Note 1: The existing TSF Cells 1, 2 and 3 closures should be used to conduct long -term (decades) testing of seepage rate decline, modelled rehabilitation structures, and processes.

Note 2: The existing TSF Cells 1, 2 and 3 should be used as a test bed for closure assessment to evaluate identified risks including, water infiltration, slope erosion and wind scour processes.

Note 3: During operation the proponent should undertake site trials of the preferred covers that have been determined from the modelling on the completed Tailings storage facility Cell 1-3 of the existing operations in accordance with a program detailed in the approved Closure and Rehabilitation Plan.

14.3.2.17 Environmental management

37. The proponent must prepare an Environmental Protection Management Program (EPMP) (in accordance with Clause 11 of the Indenture) for approval by the Indenture Minister and must include the following:
- The scope of the area and proposed operations covered by the EPMP;
 - Environmental outcomes relating to potential environmental impacts;
 - Compliance criteria, to demonstrate the clear and unambiguous achievement of the environmental outcomes;

- Leading indicator criteria to provide an early warning that compliance criteria may not be met;
- Target criteria to reflect a level of impact that is as low as reasonably achievable;
- The specific parameters to be measured and monitored;
- Information about the strategies and other measures the proponent intends to implement to achieve the outcomes or to investigate and respond to any non-compliance with the compliance, leading indicator, or target criteria (without limiting the measures that may be implemented to those specified in the plan);
- Information on the proponent's management systems that will be relied upon to ensure compliance with the compliance criteria, leading indicator criteria, and target criteria;
- Protocols for reporting to the Indenture Minister any non-compliance with the compliance criteria as soon the approval holder becomes aware of the non-compliance; and
- Any other specific obligations and management or monitoring plans specified by these conditions or required by other State legislation.

All criteria in the EPMP must specify:

- The specific parameters to be measured and monitored;
 - The locations at which monitoring will take place, or how these locations will be determined;
 - The acceptable values for demonstrating achievement of the outcome, with consideration of any inherent errors of measurement;
 - The frequency of monitoring or how it will be determined; and
 - The baseline or control data to be used or how it will be acquired (if necessary).
38. The proponent must prepare an annual environmental management and monitoring report (in accordance with Clause 11 of the Indenture) to report on compliance with the EPMP.
39. The proponent must implement the approved EPMP.

14.3.2.18 Sustainability

40. The proponent must construct an on-site cogeneration power station (250MW capacity) for recovering waste heat.

14.3.2.19 General mining and processing notes

Note 1: The proponent is reminded of its general environmental duty, as required by section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities associated with the construction and operation of the mine and mineral processing facilities do not pollute the environment in a way that causes or may cause environmental harm.

Note 2: An environmental authorisation in the form of a licence issued under the *Environment Protection Act 1993* is required for the operation of the open cut mine, rock storage facility, metallurgical plant and tailings storage facility components of the project approved via this notice. The proponent is advised to contact the EPA before acting on this approval to ascertain licensing requirements.

Note 3: The following activities are likely to require a licence under the *Environment Protection Act 1993* in relation to the components of the development application hereby approved and/or requiring future approval:

- Chemical storage and warehousing facilities;
- Chemical works: inorganic;
- Petroleum production, storage or processing works of facilities;

- Abrasive blasting;
- Concrete batching works;
- Ferrous and non-ferrous metal melting;
- Metallurgical works;
- Mineral works;
- Waste or recycling depot;
- Activities producing listed wastes;
- Crushing, grinding or milling: rock, ores or minerals;
- Fuel burning: rate of heat release exceeding 5 megawatts;
- Extractive industry;
- Sewage treatment works; and
- Fuel burning.

Note 4: There may be a requirement for Major Hazard Facility licensing under SA Work Health and Safety (WHS) Regulations (to be effective as from 1st Jan 2012) when Schedule 15 chemicals threshold quantity level is triggered.

Note 5: As many of the above activities are listed on the current licence under the *Environment Protection Act 1993* for BHP Billiton's operations at Olympic Dam, the proponent should contact the EPA to ensure that the current licence is appropriately amended to reflect any additional activities and/or expansion of existing activities prior to such activities commencing operation.

Note 6: The proponent is reminded of its notification requirements pursuant to section 83 of the *Environment Protection Act 1993* if serious or material environmental harm from pollution is caused or threatened in the course of an activity.

Note 7: The proponent is also reminded of its notification requirements pursuant to section 83A of the *Environment Protection Act 1993*, if the proponent becomes aware of the existence of site contamination at the site or in the vicinity of the site (whether arising before or after the commencement of this section) that affects or threatens water occurring naturally under the ground or introduced to an aquifer or other area under the ground.

Note 8: If polluted soils and/or groundwater are identified at the site during the detailed design or construction stage, then an assessment must be carried out by a suitably qualified and experienced environmental consultant to ensure that the site is suitable for the proposed use. Any such assessment must be undertaken in accordance with Schedules A and B of the *National Environment Protection (Assessment of Site Contamination) Measure, 1999*. The assessment must be in a form of an environmental assessment report and include a definitive statement that the site is suitable for the proposed use.

14.3.3 Desalination plant

14.3.3.1 Timing

1. Construction of the desalination plant must be substantially commenced within twelve years of the grant of this authorisation.
2. If the construction of the desalination plant is not substantially commenced within 12 years of the grant of this authorisation, the Governor or the Indenture Minister may advise the proponent that construction of the desalination plant shall permanently halt or not commence, as the case may be, and in that case the proponent shall not continue or commence, as the case may be, construction of the plant.

14.3.3.2 Additional ecotoxicity testing

3. To demonstrate that the final design of the return water diffuser and alignment are optimised at the time of construction, the proponent must undertake further ecotoxicity testing on at least five (5) species from at least four (4) taxonomic groups (one of which must be the Australian Giant Cuttlefish *Sepia apama*) using simulated effluent representative of the effluent that will be discharged from the operational desalination plant (i.e. including all water treatment chemicals and anti-scalants that will be discharged from the final plant). As part of the work to be undertaken, the proponent must undertake the following:
 - Prior to commencing further ecotoxicity testing, a panel of ecotoxicity experts (approved by the SA EPA, but at the cost of the proponent) must provide recommendations on the appropriateness of the species selected, the necessary experimental design to be used, and acceptable criteria for quality assurance/control for those species tests that do not have existing standards or, where an existing standard test is being used, they must confirm that the accompanying quality assurance/control criteria are adequate;
 - A copy of the expert panel recommendations must be provided to the SA EPA and the laboratory or laboratories that will conduct the ecotoxicity testing prior to testing commencing;
 - The required ecotoxicity tests must be conducted by a commercial or research laboratory that has experience in conducting ecotoxicity tests on, or laboratory-based experiments with, Giant Cuttlefish or similar species;
 - Immediately on completion of the additional ecotoxicity test, the panel must review the data and the quality of procedures adopted to ensure the experimental design and data acceptability criteria have been met. The ecotoxicity data must be analysed, a dilution factor calculated to theoretically protect 99% of all species and a report written by a scientist employed (or contracted) by the proponent; and
 - The report required and the raw data generated by the ecotoxicity testing must be provided to the SA EPA for independent review.

14.3.3.3 Design of outfall infrastructure

4. The proponent must design and construct the outfall infrastructure in general accordance with SEIS Figure 17.13 within the zone shown on SEIS Figure 1.7 (unless modified by the EPA through licensing conditions).
5. The proponent must design and/or operate the outfall infrastructure to achieve the following criteria:
 - A design dilution factor of 1:70 must be achieved beyond 100 metres from the diffuser as demonstrated by near-field modelling;
 - An operational dilution factor of 1:85 must be achieved at all cuttlefish breeding areas during all tidal conditions (including dodge tides) and all operating conditions, including under low discharge flow rates;
 - The discharge plume must not interact with the water surface at any time and dilution of the plume is maximized when it reaches the seabed;
 - The use of bypass flows or other measures to ensure the achievement of the approved dilution factor, particularly under low discharge flow rates; and
 - Shall be capable of being extended and modified to achieve the approved dilution rates.

6. To demonstrate that the final design of the return water diffuser is optimised the proponent must undertake further near-field and mid-field modelling to describe dispersion and mixing of return water under a range of flow scenarios with each of the production stages (e.g. 70ML/d, 135ML/d and 200ML/d). If the 1st percentile exceeds the dilution factors described in condition 5, mitigation measures must be included in the final design that improved dilution to meet the approved dilution factor. The outputs from this work and associated mitigation measures must be approved by the Indenture Minister with the concurrence of the EPA prior to the outfall infrastructure being constructed.
7. The proponent must design and/or operate the desalination plant to achieve the following outcomes:
 - No change to the long term salinity in the USG attributable to the desalination plant beyond that predicted in the Final EIS (DEIS and SEIS).
 - No significant decline in the condition and extent of known native species or their associated ecological communities attributable to the desalination plant beyond 100m of the diffuser;
 - No measurable adverse impacts on the abundance and distribution of the Australian Giant Cuttlefish as a result of construction and operation of the desalination plant;
 - The proponent must develop contingency plans to increase dilution from the diffusers at 100m to ensure diffuser performance remained acceptable under all conditions. Contingencies must include measures to shut down all discharges to the marine environment if dilution factors were exceeded at EPA-specified locations; and
 - No introduction of marine invasive organisms attributable to the construction, operation or maintenance of the desalination plant.

14.3.3.4 Design of the intake infrastructure

8. The proponent must design and construct the intake structure in general accordance with DEIS Appendix F2 Drawing Nos ODP3672-D0-0022 and ODP3672-D4-0004 within the location shown in DEIS Figure 5.30. To demonstrate that the final design and alignment are optimised, the proponent must undertake:
 - Further site-specific quantitative monitoring of marine organisms (particularly planktonic larvae) and habitats in the proposed water intake area with the aim of optimising the intake location to minimise impingement and entrainment of marine organisms; and
 - An updated analysis of best available technology to achieve the lowest practically possible flow rates between the bars and into the intake pipeline to minimise entrainment and entrapment.

The outputs from this work must be approved by the Indenture Minister with the concurrence of the EPA prior to the intake structure being constructed.

14.3.3.5 Further testing and modelling prior to operation

9. The proponent must monitor dissolved oxygen at the seabed in natural bathymetric depressions close to the proposed return water discharge diffuser to adequately establish a minimum 12 month baseline condition for dissolved oxygen in these locations prior to any construction work commencing on the desalination plant.
10. The proponent must monitor light levels, turbidity, and suspended solids concentrations in waters near the proposed intake pipeline at the nearest down current shallow subtidal reef habitat (or likely depositional area) for a minimum three (3) month period (outside of the Giant Cuttlefish breeding season), prior to construction commencing on the desalination plant.

11. The proponent must annually survey the intertidal and subtidal reef condition in the area of the proposed intake pipeline for at least three years prior to construction.
12. The proponent must continue to undertake an annual survey of the Giant Cuttlefish during the breeding season to record numbers and distribution between Black Point and Backy Point.
13. For at least three years prior to operation of the desalination plant commencing, the proponent must undertake an annual quantitative and qualitative survey of marine ecology within the sponge garden community near the proposed return water outfall.
14. The proponent must establish a salinity and current monitoring system at Point Lowly and in the Upper Spencer Gulf to collect a minimum of 12 months continuous data in order to further refine the near-field and mid-field hydrodynamic models.
15. All ecological monitoring must be designed in accordance with the principles of a Beyond BACI sampling methodology, or as approved by the EPA.
16. The results of all water quality and ecological monitoring programs must be reported to the EPA.

Note to support conditions 9-16:

Note: Following the commissioning and operation of the desalination plant, monitoring and reporting is likely to be required in accordance with license conditions issued under the *Environment Protection Act 1993*.

14.3.3.6 Design of site infrastructure

17. The desalination plant site infrastructure must be designed to provide:
 - Enclosure of the following plant/equipment to comply with the Environment (Noise) Protection Policy 1997:
 - The seawater pumps associated with the intake pipeline; and
 - The reverse osmosis component of the desalination plant and associated water pump station;
 - Maintenance of pre-development stormwater flows around the desalination plant site;
 - Any off-site stormwater discharges to comply with the *Environment Protection (Water Quality) Policy 2003* or more recent equivalents;
 - All loading/unloading of bulk chemicals to be carried out within an impervious bunded area designed to contain any spills;
 - Construction of the sludge and evaporative lagoons must be in accordance with the EPA's Guidelines for Wastewater Lagoons or more recent equivalents; and
 - Any chemicals used at the desalination plant to be stored within a bunded area which has a capacity of at least 120% of the volume of the greatest container to be stored within the bund and which is designed and constructed to prevent the escape of material into surface or underground water resources.

14.3.3.7 Construction impacts

18 The proponent must prepare a Construction Environmental Management and Monitoring Plan (CEMMP) which must be developed in consultation with the EPA and approved by the Indenture Minister with the concurrence of the EPA before the commencement of construction activities. The CEMMP must be implemented by the proponent and include measures that at a minimum address the following:

- Groundwater management and monitoring, including storage, treatment and disposal of groundwater if dewatering is required during construction.

Note 1: Spoil from construction of the outfall and intake pipelines has the potential to be contaminated or to contain acid sulphate material. Such materials will need to be contained, classified, treated and/or disposed of in accordance with relevant SA EPA standards and guidelines.

Note 2: The discharge of any excess water associated with construction of the outfall pipeline tunnel must comply with the *Environment Protection (Water Quality) Policy 2003*.

- Intake pipeline construction methods, including an analysis of construction techniques using best available technology and management methods to avoid adverse ecological impacts, including potential impacts on nearby aquaculture operations and Giant Cuttlefish breeding grounds.
- Management of noise and vibration, including:
 - Identification of all construction activities with the potential to have an adverse noise or vibration impact on nearby sensitive receivers;
 - Identification and details of noise mitigation measures, preventative maintenance programs and operational protocols proposed to secure compliance with the requirements for construction noise as outlined in Part 6 of the *Environment Protection (Noise) Policy 2007* (Noise EPP);
 - Identification and details of how vibration impacts arising from construction of the proposed facility and associated pipeline infrastructure will be managed to meet the requirements of the following standards:
 - Integrity of buildings: DIN 4150
 - Human Exposure: AS 2670.2-1990;
 - Management of underwater noise to ensure that there are no adverse impacts on cetaceans and other marine fauna. Management must use the best available information and include a marine mammal exclusion zone of no less than 600m from significant underwater noise sources; and
 - A communication plan identifying how all nearby sea cage aquaculture operators, local dive shops and affected residents will be notified prior to and during construction and how concerns raised will be addressed and managed.
- Management of soil erosion and drainage, including:
 - Minimising areas disturbed;
 - Rainfall landing upstream of disturbed areas to be diverted around the site;
 - Installation and maintenance of erosion control measures; and
 - Progressive rehabilitation and stabilisation of disturbed areas.
- Dust and odour management, including:
 - Minimising the area and extent of earthworks required and ensuring disturbed areas are protected and revegetated in a timely manner;
 - Specific measures to manage dust and limit emissions, including covered construction vehicles to prevent any loss of load; and
 - Management of any odours from any organic and other sources.

- Minimisation and management of wastes, including:
 - Management of spoil generated from the outfall shaft/tunnel and intake pipeline trench construction, including:
 - Suitable location and design of spoil stockpiling areas to avoid pollution of surface water and/or groundwater;
 - Use of a suitably qualified and experienced environmental consultant to sample and classify spoil as it is generated to enable appropriate stockpiling, reuse and/or disposal;
 - Suitable sampling and analysis program (including laboratory analysis) to assess the extent and nature of any contaminants within the stockpiled spoil; and
 - Details of stockpile management and characterisation of spoil should be specified in accordance with the SA EPA Standard for the production of Waste Derived Fill and the EPA Guideline for Stockpile Management. Waste and Waste Derived Products for Recycling.

Note 1: Spoil from construction of the outfall and intake pipelines has the potential to be contaminated or to contain acid sulphate material. Such materials will need to be contained, classified, treated and/or disposed of in accordance with relevant SA EPA standards and guidelines. In preparing the CEMMP, the proponent should consider the following:

- Mixed construction and demolition wastes should be stored in an undercover area or within skip bins with removable lids capable of preventing the infiltration and ponding of stormwater within that waste and timeframes for removal to an appropriately licensed waste depot;
- Describe the on-site waste storage facilities;
- Identify waste loading and offloading areas;
- Describe routes taken by waste disposal vehicles;
- Identify locations for off-site waste disposal; and
- Describe steps taken to minimise waste generation and maximise reuse and recycling.

Note 2: Waste oil to be stored and any other substance that may have the potential to pollute surface or groundwater must be stored in accordance with the SA EPA Guidelines for Bunding and Spill Management.

- Identification of exclusion zones for construction in order to protect areas of high conservation value and/or high erosion potential.
- Avoidance of any trenching or blasting in the marine environment during the 1 May to 31 October period as this is the Giant Cuttlefish breeding period.

14.3.3.8 Shipwrecks

19. The proponent must conduct a pre-disturbance survey of the seabed for the presence of historic shipwreck remains in the area of the desalination plant to be impacted by construction activities. Results of the survey must be provided to DENR.
20. If shipwreck remains are located by the survey or from monitoring of the construction activities, DENR must be contacted to ascertain if the in situ remains are historic and for directions on how to prevent impacts on the remains.
21. Should historic shipwreck remains be located as a result of a pre-disturbance survey or monitoring of the construction works, monitoring for accelerated in situ deterioration of the remains due to changes in the marine environment will be required. Any accelerated deterioration is to be reported to DENR.

14.3.3.9 Renewable energy

22. Electricity requirements to power operation of the desalination plant and all four associated pumping stations must be drawn from renewable energy sources via the national electricity market.

14.3.3.10 Traffic and access

23. Access and egress to the site (including internal movements within the site) during construction must be undertaken in accordance with a Traffic Management Plan (as part of the CEMMP) approved by the Indenture Minister, with the concurrence of DTEI, prior to the commencement of construction works. The Traffic Management Plan must identify:
 - The preferred access route;
 - Outline measures to manage and mitigate traffic impacts to the local community and industry during construction; and
 - The internal access route and on-site parking arrangements for bus parking and vehicles sufficient to service the workforce.
24. The proponent must comply with the relevant DTEI and Whyalla City Council standards (as appropriate) for the access arrangements to and from the desalination plant, and any upgrades required on the Port Bonython Road as a result of additional traffic associated with desalination plant, with all costs being the responsibility of the proponent.
25. Signage must be installed at the Point Lowly Boat Ramp showing the exclusion zone for the desalination plant operations.

14.3.3.11 Visual amenity

26. The Desalination Plant must be established in general accordance with DEIS Figure 5.27 and DEIS Appendix F2 Drawing ODP3672-DO-0002 (Desalination Plant – Site Infrastructure).
27. The proponent must prepare and implement a detailed Landscaping Plan that includes a 3m vegetated buffer along the front of the development (along the boundary facing the Port Bonython Road), using locally indigenous species. The plan must indicate the mature height and density of species used to screen the desalination plant along the perimeter. The Landscaping Plan must be lodged with Indenture Minister for approval prior to the operation of the plant.

14.3.3.12 Other

28. The Whyalla City Council must be given 1 months notice, before the commencement of works, and shall be provided with the name and contact details of a person who shall be responsible for co-ordinating site works.

14.3.3.13 General notes on the desalination plant

Note 1: The proponent is reminded of their general environmental duty, as required by section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities associated with the construction and operation of the desalination plant do not pollute the environment in a way that causes or may cause environmental harm.

Note 2: An environmental authorisation in the form of a licence issued under the *Environment Protection Act 1993* is required for the construction and operation of the desalination plant component of the project approved via this notice. The proponent is advised to contact the EPA before acting on this approval to ascertain licensing requirements.

Note 3: The following activities in relation to the components of the development hereby approved and/or requiring future approval will require licences under the *Environment Protection Act 1993*:

- *Earthworks Drainage:* the conduct of earthworks operations in the course of which more than 100 kilolitres of waste water containing suspended solids in a concentration exceeding 25 milligrams per litre is discharged directly or indirectly to marine waters or inland waters;
- *Dredging:* removing solid matter from the bed or any marine waters by any digging or suction apparatus, but excluding works carried out for the establishment of a visual aid to navigation and any lawful fishing or recreational activity; and
- *Discharge to Marine or Inland Waters:* the conduct of operations involving discharges into marine water when the total volume of discharge exceeds 50 kilolitres per day.

Note 4: It is likely that as a condition of such licences the Environment Protection Authority will require the licensee to carry out specified environmental monitoring of water quality and to make reports of the results of such monitoring to it. For the purposes of the Discharge to Marine Waters licence the SA EPA will require, as a minimum, for the operator to monitor and report on:

- Discharge water quality, including whole effluent ecotoxicity testing;
- diffuser performance validation;
- Process monitoring to confirm that performance is within the acceptable range as originally designed;
- Water quality and ecological impacts on the marine environment (including the use of multiple reference sites based on previous Beyond BACI monitoring described above); and
- Identify management responses to exceedances of the trigger values/criteria used in association with monitoring programs.

Note 5: As the proposed desalination plant is located next to the Santos Port Bonython oil and gas facility which is a Major Hazard Facilities (MHF) site, the proponent needs to review the storage quantity of hazardous chemicals with regard to the threshold quantity of current MHF National Standard Schedule 1 Chemicals. In addition, the strategic location of the hazardous chemical storage facility on desalination plant site needs to be reviewed with respect to the consequential risk assessment of the location factor either affecting or being affected by the neighbouring Santos facility. As a consequence, the proponent should conduct an internal and external consequential risk analysis of the desalination plant in consultation with Santos and SafeWork SA.

Note 6: The shotfirer who conducts and blasting associated with construction of the desalination plant and associated intake pipeline is legally required to hold a Blaster's Licence under the SA Occupational Health, Safety and Welfare Act 1986. They must carry out an assessment of all risks (including fly rock, vibration and noise) and implement measures to prevent or minimise the risk of injury to persons and damage to plant.

Note 7: Before tunnel construction commences, an appropriate geotechnical evaluation and assessment of risks associated with tunnelling should be undertaken by the proponent. Such a risk assessment should address the risks of mud and water inrush into the tunnel.

Note 8: The operational hazards and risks associated with the construction and operational management of the desalination plant should be assessed and a safety review conducted during the construction, commissioning and operational phases in consultation with SafeWork SA.

14.3.4 Landing facility

14.3.4.1 Hazards and contaminants

1. The landing facility must be designed to ensure that hazardous and dangerous substances are stored in banded and sealed compounds/areas capable of preventing the escape of material into the soil, surface waters or underground water resources.

Note (to support condition 1):

Note: The South Australian Environment Protection Authority (EPA) Guideline - Bunding and Spill Management contains information that could help the proponent comply with this requirement.

General note (in relation to hazards):

Note: In order to comply with clause 24 of the State Emergency Management Plan, in relation to section 9(e) of the South Australian *Emergency Management Act 2004*, an Emergency Response Plan for the landing facility should be prepared prior to construction, in consultation with the appropriate state authority that provides for the proponent's response arrangements for product recovery and site normalisation.

14.3.4.2 Safety (including navigation)

2. Movement of the proponent's marine traffic must be undertaken in accordance with a Maritime Safety Plan prepared in consultation with DTEI. The Maritime Safety Plan at a minimum must include a traffic management system covering the movement of the proponent's marine traffic.
3. The proponent must review and upgrade the deep water markers from the deep water mooring site to the landing facility to comply with OHS&W standards.

Notes (to support condition 2):

The following notes are recommended in relation to the proponent's obligations under the *Harbors and Navigation Act 1993*:

Note 1: Additional surveys, including hydrographic surveys required to demonstrate safe navigation and transit of material from 'bank to ship' prior to the operation of the landing facility (survey methods to be developed in consultation with DTEI).

Note 2: Should the proponent plan to moor heavy lift vessels at the holding site in deep water, a safe independent mooring location will need to be identified with an exclusion zone of 0.5 nautical miles radius around the mooring location to enable ships to off-load equipment on to the barges.

Note 3: Should 'tugs' be used by the proponent to tow barges from the mooring site to the Landing Facility then the adequacy of the tugs will need to be addressed by the proponent (to comply with relevant DTEI standards), and will have to be manned by qualified crew with pilotage exemption certificates.

14.3.4.3 Air quality/soil erosion/marine ecology/surface water

4. All works and site activities must be undertaken in accordance with a Construction Environmental Management and Monitoring Plan (CEMMP) to be approved by the Indenture Minister, with the concurrence of the EPA prior to the commencement of construction activities for the landing facility. The CEMMP must, as a minimum, address the following:
 - Measures to address air quality, including management of dust issues at the quarantine lay down and hard stand areas, and access corridor;

- Preparation and implementation of an Erosion and Soil Control Plan, which includes the following measures as a minimum:
 - Minimising areas disturbed;
 - Rainfall landing above the disturbed areas to be diverted around the site;
 - Installation and maintenance of erosion control measures; and
 - Progressive rehabilitation and stabilisation of disturbed areas.
 - Preparation and implementation of an Acid Sulphate Soils (ASS) Management Plan, should additional investigations identify it as being necessary.
 - Identify and address:
 - Known and potential noise and vibration impacts; and
 - Known and potential marine impact issues including:
 - turbidity management;
 - underwater noise; and
 - management of marine pests.
 - Preparation and implementation of a Traffic Management Plan.
5. The landing facility must include stormwater management measures that will ensure:
- The quality of surface water drainage complies with the general obligations and associated water quality criteria contained in the SA Environment Protection (Water Quality) Policy 2003 or as amended;
 - Surface water drainage off the site does not exceed pre development flow rates; and
 - Rain falling upstream of the landing facility is diverted around the site.
6. Operations at and in the vicinity of the landing facility must be undertaken in accordance with an Operational Environmental Management and Monitoring Plan (OEMMP) to be approved by the Indenture Minister, with the concurrence of the EPA prior to commencing operation of the landing facility, laydown yard and pre-assembly yard. The OEMMP must, as a minimum, address the following:
- Measures to address air quality, including management of dust issues at the quarantine lay down and hard stand areas, and access corridor; and
 - Identify and address:
 - Known and potential noise and vibration impacts, particularly under worst case operating and meteorological conditions; and
 - A Marine Pest Management Plan to address the management of introduced marine pests at the landing facility (and in neighbouring marine waters).

14.3.4.4 Noise and vibration

7. Operations at the landing facility must not exceed the following noise criteria at any noise sensitive receivers:
- $L_{Aeq, 15 \text{ minutes}} = 47 \text{ dB(A)}$ (day, 7am to 10pm)#
 - $L_{Aeq, 15 \text{ minutes}} = 40 \text{ dB(A)}$ (night, 10pm to 7am)#
 - $L_{Amax 15 \text{ minutes}} = 60 \text{ dB(a)}$ (night, 10pm-7am)
- # When measured and adjusted in accordance with the *Environment Protection (Noise) Policy 2007*.
8. All noise-generating operations at the landing facility must not be undertaken between the hours of 7pm to 7am.

Note (to support conditions 7-8):

Note: The proponent is reminded of its obligation to comply with the construction noise provisions contained in Part 6 Division 1 of the *Environment Protection (Noise) Policy 2007*. These requirements include restrictions on the noise levels that can be generated at certain times of the day and certain days of the week.

14.3.4.5 Visual amenity

9. Final designs for the Landing Facility must be constructed in accordance with DEIS Figures 5.52 and 5.53.
10. The proponent must prepare and implement a detailed Landscaping Plan that includes a 3m vegetated buffer along the southern and northern boundaries, using locally indigenous species. The plan must indicate the mature height and density of species used to screen the facility along the perimeter. The Landscaping Plan must be lodged with Indenture Minister for approval prior to the operation of the landing facility.
11. All lighting required on the landing facility site must only illuminate the minimum areas required, through the use of low profile, directional lighting.

14.3.4.6 Social impacts

12. The proponent must cease operation of the landing facility at the end of the expansion construction period, or within 16 years of opening the landing facility, whichever occurs first. This condition is subject to variation on the proponent demonstrating to the government's satisfaction that the impacts to the local community can be managed in the longer term. Should this not be demonstrated, the infrastructure on land and the pier infrastructure located above low water mark must be removed and the site rehabilitated to the satisfaction of the Indenture Minister within one year of closure.
13. The Landing Facility must be operated as an import only facility for the sole importation of materials and products associated with the Olympic Dam project.

14.3.4.7 Traffic and access

14. Construction of the landing facility must be:
 - Substantially commenced within ten years of this approval, otherwise the approval given in this notice for the component of the Olympic Dam Expansion will lapse; or
 - In time for the movement of large pre-assembled modules required for the metallurgical plant required for the major development approval herein; whichever occurs first.
15. The proponent must comply with the relevant DTEI standards for the access arrangements to and from the landing facility, with all costs being the responsibility of the proponent.
16. Material imported on vessels/barges must not be transported from the landing facility to the pre-assembly yard until the dedicated access road is operational.

Note (to support condition 16):

Note: The proponent will be required to comply with all relevant DTEI standards for the upgrading of road infrastructure associated with the landing facility.

14.3.4.8 Introduction and/or spread of weeds from expansion activities

17. A vehicle and plant wash down/inspection facility must be installed within 3 months of the site becoming operational to manage the introduction and spread of weeds at the landing facility. The location and type of wash down/inspection facility must be approved by Department of Environment and Natural Resources (DENR) before any construction.

Note (applies to whole of project and not specific to landing facility):

Note: The proponent needs to consult with the NRM Board over arrangements to minimise the risk of spreading weeds during works.

14.3.4.9 Other

18. The Indenture Minister must be given 6 months notice before construction work commences at the landing facility.
19. The Port Augusta City Council must be given 1 months notice, before the commencement of works, and shall be provided with the name and contact details of a person who shall be responsible for co-ordinating site works.

14.3.4.10 Waste management

No conditions.

Note: Any on-site wastewater management system at the landing facility must be approved by the relevant authority in accordance with the requirements of the *SA Waste Control Regulations 2010* (or current equivalent regulatory requirements at the time of application).

14.3.5 Pre-assembly yard

14.3.5.1 Hazards and contaminants

1. The pre-assembly yard must be designed to ensure that hazardous and dangerous substances are stored in bunded and sealed compounds/areas capable of preventing the escape of material into the soil, surface waters or underground water resources.

Note (to support condition 1):

Note: The *EPA Guideline – Bunding and Spill Management* contains information that can assist the proponent to comply with this requirement.

14.3.5.2 Noise and vibration

2. The pre-assembly yard in Port Augusta must be designed to ensure that noise generated from ongoing operations at the facility does not exceed 51 dB(A)Leq between 7am to 10pm (day) and 43 dB(A)Leq during 10pm-7am (night) at the nearest noise sensitive receiver when measured and adjusted in accordance with the *Environment Protection (Noise) Policy 2007*.

Note (to support condition 2):

Note: The proponent is reminded of its obligation to comply with the construction noise provisions contained in Part 6 Division 1 of the *Environment Protection (Noise) Policy 2007*. These requirements include restrictions on the noise levels that can be generated at certain times of the day and certain days of the week.

14.3.5.3 Visual amenity

3. Final designs for the Pre-Assembly Yard must be constructed in accordance with DEIS Figure 5.48 and the plan subsequently lodged by the proponent on 1 September 2011, entitled Port Augusta Pre-Assembly Yard.
4. The proponent must prepare and implement a detailed Landscaping Plan that includes a 3m vegetated buffer along the eastern boundary, using locally indigenous species. The plan must indicate the mature height and density of species used to screen the facility along the perimeter. The Landscaping Plan must be lodged with Indenture Minister for approval prior to the operation of the pre-assembly yard.

14.3.5.4 Introduction and/or spread of weeds from expansion activities

5. A vehicle and plant wash down/inspection facility must be installed within 3 months of the site becoming operational to manage the introduction and spread of weeds at the pre-assembly yard. The location and type of wash down/inspection facility must be approved by Department of Environment and Natural Resources (DENR) before any construction.

14.3.5.5 Surface water

6. The pre-assembly yard must include stormwater management measures that will ensure:
 - The quality of surface water drainage complies with the general obligations and associated water quality criteria contained in the SA Environment Protection (Water Quality) Policy 2003 or as amended;
 - Surface water drainage off the site does not exceed pre development flow rates; and
 - Rain falling upstream of the landing facility is diverted around the site.

14.3.5.6 Traffic

7. The proponent must comply with the relevant DTEI standards for the access arrangements to and from the pre-assembly yard, with all costs being the responsibility of the proponent.

14.3.5.7 Other

8. The Port Augusta City Council must be given 1 months notice, before the commencement of works, and shall be provided with the name and contact details of a person who shall be responsible for co-ordinating the site works.

14.3.6 Airport

14.3.6.1 Greenhouse gases and sustainability

1. The proponent must install photo voltaic panels or an equivalent renewable technology, and associated power systems during construction of the airport.
2. The proponent, or its contractor, must install a solar hot water system/s or an equivalent renewable technology at the airport.

14.5.6.2 Visual amenity

3. Final design of the Airport must be constructed in accordance with DEIS Drawing ODP 3152-D0-0001 (Andamooka Road Airport Site Layout) and DEIS Drawing ODP 3152-D5-0001 (Andamooka Road Airport Terminal Building).²⁵

14.3.6.3 Access and traffic

4. The proponent must comply with the relevant DTEI standards for the access arrangements to and from the airport, and any upgrades required on the Andamooka Rd as a result of additional traffic associated with the expansion project, with all costs being the responsibility of the proponent.

14.5.6.4 Natural hazard management

5. The proponent must prepare and implement a Fire Study for Hiltaba Village and the airport that must address (as a minimum) the following matters:
 - The ability of Hiltaba Village management to provide adequate first response to emergency incidents (Fire, Rescue, Hazmat);
 - The structure and resources that the proponent (or its contractors) will have (i.e. suitable appliances to deal with the size of the aircraft, as well as details of staff training and numbers);
 - The appropriate rescue capacity in case of an aircraft crash;
 - Supply of fire fighting foam, foam delivery systems and appliances;
 - Adequate water supplies; and
 - Details of compliance with the Building Code of Australia (i.e. installation of fire alarm systems and residential sprinklers throughout Hiltaba Village etc).

The Fire Study must be lodged with Indenture Minister for approval prior to the operation of the airport and Hiltaba Village.

14.3.7 Hiltaba Village

14.3.7.1 Noise

1. Accommodation units at Hiltaba Village must be designed and constructed so that external noise sources do not exceed 30dB(A) when measured within sleeping areas at all times of the day when windows are closed.

14.3.7.2 Surface water

2. Apart from storm events that cause local flooding, runoff into the proposed northern and southern stormwater storage basins at Hiltaba Village (as shown on DEIS Figure 11.6) must be reused, and in particular must be reused to reduce dust levels and to irrigate landscaped areas around the village.

14.3.7.3 Access and traffic

3. The proponent must comply with the relevant DTEI standards for the access arrangements to and from Hiltaba Village, and any upgrades required on the Andamooka Rd as a result of additional traffic associated with the expansion project, with all costs being the responsibility of the proponent.

²⁵ Refer DEIS Appendix F2

14.3.7.4 Sustainability

4. The proponent, or its contractor, must install solar hot water systems or an equivalent renewable technology, for the permanent accommodation units at Hiltaba Village.

14.3.7.5 Natural hazard management

5. The proponent must prepare and implement a Fire Study for Hiltaba Village and the airport that must address (as a minimum) the following matters:
 - The ability of Hiltaba Village management to provide adequate first response to emergency incidents (Fire, Rescue, Hazmat);
 - The structure and resources that the proponent (or its contractors) will have (i.e. suitable appliances to deal with the size of the aircraft, as well as details of staff training and numbers);
 - The appropriate rescue capacity in case of an aircraft crash;
 - Supply of fire fighting foam, foam delivery systems and appliances;
 - Adequate water supplies; and
 - Details of compliance with the Building Code of Australia (i.e. installation of fire alarm systems and residential sprinklers throughout Hiltaba Village etc).

The Fire Study must be lodged with Indenture Minister for approval prior to the operation of the airport and Hiltaba Village.

14.3.7.6 General notes about Hiltaba Village

Waste Management

Note 1: If treatment and disposal of wastewater is proposed to take place at Hiltaba Village, approval would need to be given by the SA Department of Health and the SA EPA and the following details would need to be contained in any application:

- Maximum design capacity of the treatment plant;
- Type of wastewater treatment plant to be used;
- Standard of treatment to be achieved;
- Where and how treated wastewater would occur; and
- Schematic plans showing location and design of the proposed treatment plant and reuse areas including pipe work layout.

Note 2: The proponent should engage early with the Municipal Council of Roxby Downs about the disposal of solid waste to the council's waste management facility to ensure the availability of landfill space and the suitability of cell design and construction.

Note 3: In order to achieve the waste management objective contained in the SA *Environment Protection (Waste to Resources) Policy 2010* solid wastes generated at the Hiltaba Village and the airport should be managed according to the waste management hierarchy by promoting waste avoidance, reduction, recycling, recovery ahead of waste treatment and/or disposal to the Roxby Downs landfill facility.

14.3.8 Roxby Downs township

No conditions proposed as the DPA will manage future growth in the town. Accordingly "Roxby Downs expansion" will not appear in the Gazette Notice, however a whole chapter has been devoted to the growth of the town in the Assessment Report

14.3.9 Pimba Intermodal facility

14.3.9.1 Hazard and risk

1. The Pimba Intermodal facility must be designed to ensure that hazardous and dangerous substances are stored in bunded and sealed compound/areas designed to prevent the escape of material into the soil, surface water or underground water resources.

Note (supporting condition 1):

Note: The SA Environment Protection Agency (EPA) Guideline – Bunding and Spill Management contains information that could help the proponent comply with this requirement.

14.3.9.2 Noise, vibration and dust

2. The Pimba Intermodal facility must be designed to ensure that it does not generate noise levels at the façades of noise sensitive receivers in Pimba that exceed 51 dB(A)_{Leq} between 7am to 10pm (day) and 43 dB(A)_{Leq} between 10pm to 7am (night) when measured and adjusted in accordance with the *Environment Protection (Noise) Policy 2007*.
3. A report, prepared by an acoustic engineer, detailing the methods and results of noise monitoring undertaken post construction, as well as any recommended noise mitigation measures to ensure compliance with the noise criteria contained in condition (2) above must be submitted to the SA EPA within three months, or within such a time as otherwise approved by the Indenture Minister, of the commencement of operations at the Pimba intermodal facility. The noise monitoring must be of sufficient duration to encompass all operational situations, including night time operations, the full range of operational equipment noise sources and adverse weather conditions.

Notes (to support conditions 2 and 3):

Note 1: The proponent is reminded of its obligation to comply with the construction noise provisions contained in Part 6 Division 1 of the *Environment Protection (Noise) Policy 2007*. These requirements include restrictions on the noise levels that can be generated at certain times of the day and certain days of the week.

Note 2: The proponent is reminded of its general environmental duty, as required by section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities associated with the construction and operation of the Pimba Intermodal facility do not pollute the environment in a way that causes or may cause environmental harm.

14.3.9.3 Surface water

4. The Pimba Intermodal facility must be designed to ensure that erosion-control devices are constructed on drainage outlets from the site to ensure that concentrated stormwater runoff does not cause scouring and erosion of downstream drainage lines and watercourses.
5. The Pimba Intermodal facility must be designed to ensure the quality of surface water draining from the Pimba intermodal facility complies with the general obligations and associated water quality criteria contained in the SA *Environment Protection (Water Quality) Policy 2003 (Water EPP)*.

14.3.9.4 Traffic and access

6. The proponent must comply with the relevant DTEI standards for the access arrangements to and from the Pimba Intermodal facility, with all costs being the responsibility of the proponent.
7. The proponent must complete construction, and commence operation of the Pimba Intermodal facility within 2 years from the date of this decision.

14.3.9.5 Visual amenity

8. Final designs for the Pimba Intermodal facility must be constructed in accordance with DEIS Drawing G1500 (Pimba Transit Terminal)²⁶.
9. All lighting required on site must be low-profile, directional lighting that illuminates only those areas required to be illuminated.

14.3.9.6 General notes about the Pimba Intermodal

Waste Management

Note: The proposed on-site wastewater management system at the Pimba intermodal facility must be approved by the relevant authority in accordance with the requirements of the SA *Waste Control Regulations 2010* (or current equivalent regulatory requirements at the time of application).

Radiation

Note: It is expected that the proponent will incorporate the following requirements within the Radiation Waste Management Plan that must be approved by the SA Environmental Protection Authority (EPA) as conditions of the licence under the Radiation Protection and Control Act (1982) to conduct expanded mining or milling of radioactive ore at Olympic Dam:

- Conduct background gamma dose rate measurements and soil sampling at representative locations along the rail corridor before operations commence to clearly establish background radionuclide concentrations; and
- Include routine monitoring of the transport corridors as part of the Radioactive Waste Management Plan.

14.3.10 Infrastructure corridors

14.3.10.1 Corridor alignments for water, electricity and rail spur

1. Final alignment of the water supply pipeline from the Point Lowly desalination plant to Olympic Dam must be constructed in accordance with DEIS Figures N1.4 (a) – (f) (refer DEIS Appendix N).
2. The final alignment of the 275kV electricity line from Port Augusta to Olympic Dam must be constructed in accordance with DEIS Figures N1.4 (a) – (f) (refer DEIS Appendix N).
3. The final alignment of the 132kV electricity transmission line from Cultana to Point Lowly must be constructed in accordance with Figure N1.4(f) (refer DEIS Appendix N).
4. The final alignment of the water supply pipeline, sewerage pipeline and electricity transmission line from Roxby Downs to Hiltaba Village and the airport must be constructed in general accordance with DEIS Figure 5.5 and SEIS Figure 5.13.
5. The final alignment of the rail corridor from Pimba to Olympic Dam must be constructed in accordance with DEIS Figures N1.4(a) – (b) (refer DEIS Appendix N).

²⁶ Refer DEIS Appendix F2

14.3.10.2 Terrestrial impacts

6. The proponent must prepare and implement a Trench Management Plan for the gas pipeline and water supply pipeline that includes measures to respond to a significant increase in fauna mortalities. A 'significant increase' must be defined in the Trench Management Plan, and submitted to the Indenture Minister for approval, prior to construction commencing on the water supply and gas pipeline corridors.
7. Within 6 months of completing the water and gas pipeline construction activities, or within such time as otherwise approved by the Indenture Minister, the proponent must provide records of species recovered and removed from the easements, including their GPS location in a form suitable to the Department of Environment Natural Resources (DENR) for inclusion in the Biological Databases of South Australia (BDBSA) database.
8. Except in areas of permanent clearance, revegetation of impacted areas for the construction of the linear infrastructure components must commence within 6 months of construction activities concluding, or within such time as otherwise approved by the Indenture Minister, environmental conditions permitting.
9. Within 6 months of completing the construction activities for the linear infrastructure components, or within such time as otherwise approved by the Indenture Minister, the proponent must commence rehabilitation of the cleared areas of Mulga *Acacia aneura* low woodlands on the sand plain, except in areas of permanent clearance, weather conditions permitting.
10. No new groundwater wells are to be located within 20km of GAB springs for water extraction during gas pipeline construction.
11. Prior to finalising the detailed route alignment for the linear infrastructure components the proponent must conduct floristic surveys, ideally following adequate rainfall, to confirm the presence/absence of listed threatened species. The surveys must target vegetation types that are likely to support threatened species, in particular:
 - *Atriplex kochiana* (Koch's Saltbush);
 - *Ophioglossum polyphyllum* (Large Adder's Tongue);
 - *Atriplex eichleri*;
 - *Gratwickia monochaeta*;
 - *Bulbostylis turbinata*;
 - *Calandrinia sphaerophylla* Bead Purslane;
 - *Eleocharis plana* Flat Spike-rush; and
 - *Frankenia cupularis*.
12. If clearance of listed species is unavoidable, the proponent must reinstate or relocate these species to adjacent work areas; or as otherwise agreed by DENR.
13. All identified listed plants will require a buffer zone of at least 50m from construction and operational activities for the linear infrastructure components. If it is impractical to provide a 50m buffer zone for the listed species and it will be impacted directly, the species must be reinstated or relocated to adjacent work areas; or as otherwise agreed by DENR.
14. Prior to finalising the detailed route alignment for the linear infrastructure components (including the parking bays on the Stuart Highway) the proponent must undertake surveys of listed fauna populations, including targeted surveys for the Pernatty Knob-tailed Gecko and Plains Rat. The final alignment must avoid populations of listed fauna, where practicable.

15. The proponent must prepare guidelines, in consultation with DENR, to determine the methodology of final corridor realignment to avoid listed species, including definition of practical construction limitations, prior to construction of the water and gas supply pipelines, rail spur and electricity transmission lines.
16. The proponent must attach highly visible reflective markers to conductors at 30m intervals on sections of the transmission line within 2km of ephemeral lakes and coastal areas, in a manner suitable to ElectraNet.

Notes (to support conditions 11-14):

Note: Where possible threatened flora should be used in revegetation programs, ensuring that species are only planted in suitable habitat.

14.3.10.3 Surface water

17. Final route alignment for the gas pipeline must identify St Mary's Pool and Reedy Springs as 'no go' zones to be avoided by construction activities.

14.3.10.4 Hazard and risk

18. To ensure electricity stability and network security, the proponent must comply with the technical standards in the National Electricity Rules (NER) to the satisfaction of the Technical Regulator (as the Jurisdictional System Security Coordinator).

14.3.10.5 General notes in relation to the infrastructure corridors

Note 1: The proponent is reminded of its general environmental duty, as required by section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities associated with the construction and operation of the service corridors do not pollute the environment in a way that causes or may cause environmental harm. In order to comply with this requirement, particular care should be given to dust management and soil erosion controls, including rehabilitation of disturbed areas, during the construction process.

Note 2: A pipeline licence will need to be applied for under the *Petroleum and Geothermal Energy Act 2000*. With the Pipeline Licence and approved SEO in force, an activity notification must be submitted to PIRSA in accordance with Regulations 18 and 20 of the *Petroleum and Geothermal Energy Regulations 2000*. This notification must be accompanied by detailed information relating to the design, construction, operation and maintenance of the gas pipeline. The Minister's written approval would be required before pipeline construction can commence. A further approval is then required following completion of the hydrotest and prior to the introduction of gas into the pipeline. Further, a pipeline licence cannot be issued over a regional reserve without the approval of the minister administering the *National Parks and Wildlife Act 1972*. Accordingly, should the proponent seek to pursue option 1 or 3, approval would be required from the Minister administering the *National Parks and Wildlife Act 1972*.

Note 3: The proponent is reminded of their obligation to ensure that construction noise complies with the requirements of Division 1 of Part 6 of the *Environment Protection (Noise) Policy 2007* at all times. Supplementary information on construction noise management can be found in the Guidelines for the Use of the *Environment Protection (Noise) Policy 2007* and Construction Noise Information Sheets (available at: www.epa.sa.gov.au).

Note 4: On-site wastewater management systems associated with proposed service corridor construction camps must be approved by the relevant authority in accordance with the requirements of the SA *Waste Control Regulations 2010* (or current equivalent regulatory requirements at the time of application).

Note 5: In order to achieve the waste management objective contained in the SA *Environment Protection (Waste to Resources) Policy 2010* domestic and building wastes generated at temporary construction camps and/or from service corridor construction activities should be managed according to the waste management hierarchy by promoting waste avoidance, reduction, recycling, recovery ahead of waste treatment and/or disposal to licensed landfill facilities.

14.3.11 New roads

14.3.11.1 Road upgrading

Refer draft mining conditions.

14.3.11.2 Port Augusta access corridor (from the landing facility)

1. The access road from the landing facility to the pre-assembly yard in Port Augusta must be constructed in accordance with the alignment shown on SEIS Figure 22.3.
2. The proponent must cease operation of the Port Augusta access road at the end of the expansion construction period, or within 16 years of opening the access road, whichever occurs first. This condition is subject to variation on the proponent demonstrating to the government's satisfaction that the impacts to the local community can be managed in the longer term. Should this not be demonstrated, the site must be rehabilitated to the satisfaction of the Indenture Minister within one year of closure.
3. The proponent must comply with the relevant DTEI standards for the access road from the landing facility to the pre-assembly yard, with all costs being the responsibility of the proponent.

14.3.11.3 Access road from Hiltaba to Olympic Dam

4. The eastern access road from Hiltaba Village to the mine site must be established in accordance with the alignment shown on SEIS Figure A6.2 (refer SEIS Appendix A5).
5. The proponent must comply with the relevant DTEI standards for the eastern access road from Hiltaba Village to the mine site, with all costs being the responsibility of the proponent.

14.3.11.4 Road overpass (associated with the rail spur)

6. The proponent must comply with the relevant DTEI standards for the road overpass (associated with rail spur operation), with all costs being the responsibility of the proponent.

14.3.11.5 Relocation of Borefield Road

Refer draft mining conditions.

14.3.11.6 General notes

Transport safety and emergency response

Note 1: Detailed planning for the storage of bulk ammonium nitrate will be required to be undertaken prior to construction occurring at the mine site, and in consultation with the South Australian explosives regulatory authority, SafeWork SA to satisfy licensing requirements under the South Australian *Explosives Act 1936*.

Note 2: In order to comply with the South Australian *Dangerous Substances (Dangerous Goods Transport) Regulations 2008*, a Transport Emergency Response Plan (TERP) should be prepared, in consultation with SafeWork SA and other relevant authorities. The TERP should include the proponent's response arrangements for product recovery and site normalisation for Concentrate and Uranium Oxide that would include requirements for safely storing and transporting uranium oxide, including, amongst other matters, the emergency response to potential incidents along routes.

Noise and vibration

Note 3: The proponent is reminded of their obligation to ensure that construction noise complies with the requirements of Division 1 of Part 6 of the *Environment Protection (Noise) Policy 2007* at all times. Supplementary information on construction noise management can be found in the Guidelines for the Use of the *Environment Protection (Noise) Policy 2007* and Construction Noise Information Sheets (available at: www.epa.sa.gov.au).

14.3.12 Whole of project environmental impacts – native vegetation and greenhouse gases.

14.3.12.1 Native vegetation clearance

1. Clearing of vegetation must not exceed the total area indicated in the Final EIS.
2. The proponent must prepare and implement Native Vegetation Management Plan(s), in consultation with DENR. The final plans must be approved by Native Vegetation Council, prior to any clearance occurring. The Native Vegetation Management Plans must include (as a minimum):
 - Details regarding the proposed SEB locations and information regarding the vegetation communities within the proposed areas;
 - identification of any species or plant communities that are of conservation significance, including an outline of the overall biodiversity gain from the proposed SEB.
 - Details regarding the proposed ongoing management of the SEB areas.

Note (to support condition 2):

Note: Before approving the native vegetation management plan(s), the Native Vegetation Council (NVC) will be required to take account of the nature and extent of the proposed clearing and any commitments for restoration and maintenance, sufficient to satisfy themselves that there will be a significant environmental benefit (SEB).

3. The activities associated with the major development approved herein must not worsen the conservation status of any flora species listed under the *National Parks and Wildlife Act 1972*.

14.3.12.2 Impacts to fauna

4. The activities associated with the major development approved herein must not worsen the conservation status for any fauna species listed under the *National Parks and Wildlife Act 1972*.
5. The proponent must update the Fauna Management Plan for the Pernatty Knob-tailed Gecko, Plains Rat, Dusky Hopping Mouse, Thick-billed Grass-wren and Ampurta for approval by the Indenture Minister, within 12 months of this approval.
6. The proponent must update their Fauna Monitoring Program to monitor and manage feral and abundant species and their impacts as a result of the expanded operation, prior to construction commencing on the mine site.

Notes (to support condition 6):

Note 1: In updating the Fauna Monitoring Program, the proponent should have regard to *The Kangaroo Conservation and Management Plan for South Australia 2008-2010* (DEH 2007).

Note 2: SEB offsets for fauna species management would need to be approved by the Native Vegetation Council (NVC).

Note 3: The proponent will be required to comply with section 185 of the NRM Act that requires weed outbreaks to be reported to the relevant NRM Board.

Note 4: The proponent should work with NRM boards and Roxby Downs Council to address vertebrate pest issues.

14.3.12.3 Soils

7. Preparation and implementation of an Acid Sulphate Soils (ASS) Management Plan, should additional investigations identify it as being necessary.

14.3.12.4 Greenhouse gas emissions

8. The proponent must prepare and implement an initial Greenhouse Gas and Energy Management Plan (GG&EMP) that addresses all project components . The GG&EMP is to be available within 12 months of the date of this approval, for approval by the Indenture Minister, with the objective of achieving:
 - A goal of reducing greenhouse gas emissions (reportable under the National Greenhouse and Energy Reporting (Measurement) Determination 2008) to an amount equivalent to at least a 60% reduction of 1990 emissions, by 2050; and
 - Any interim goals, targets and timelines set throughout the project. The plan must include:
 - A comprehensive approach to energy efficiency, renewable energy and greenhouse gas abatement in the construction design and operation of the expanded mine site to ensure viable, cost-effective opportunities being maximised; and
 - Clear statements about the conditions under which opportunities will become viable and be implemented.
 - The proponent must implement the approved GG&EMP.

Notes (to support condition 8):

Note 1: The GG&EMP should incorporate:

- Interim goals, targets and timelines for emissions reduction based projects, including interim emission objectives for 2020, 2030 and 2040;
- Consideration of further renewable energy and greenhouse gas abatement opportunities, identified in the Final EIS (DEIS and SEIS);
- Identification and consideration of further greenhouse gas abatement opportunities;
- Identification and consideration of further opportunities to increase the proportion of renewable energy used and to further reduce electricity demand;
- A comprehensive approach to energy efficiency in the construction design and operation of the expanded mine site to ensure viable, cost-effective opportunities are maximised;
- Further work to identify and publicly report relevant Scope 3 emissions that can be reasonably included for management under the Plan in line with best practice for greenhouse management and reporting;
- Modelling to forecast, via an emissions trajectory, the likely emissions reduction pathway from commencement of operations to 2050, including information regarding accuracy and key variables;
- The relevant requirements of an emissions trading scheme, if and when it is implemented and the effect of such a scheme on abatement opportunities and the emissions trajectory;
- Further commitments to be developed in the following areas:
 - Details of the scale of solar hot water and solar PV to be installed, particularly in residential developments;
 - Optimising the performance of the housing stock;
 - Involvement in the early development of renewable technologies;
 - Minimising greenhouse emissions through design of desalination plant, pumping and pipeline to best practice standards;
 - Best practice approaches to design and ongoing management for reducing greenhouse emissions across all elements of the expansion; and
 - Future proofing of key investments such as the use of smart grid technologies.

Note 2: Greenhouse and Energy Management should also be the subject of a sector agreement, to be entered into with the Minister for Climate Change under section 16 of the *Climate Change and Emissions Reduction Act 2007*.

9. The proponent must produce and make available to the Indenture Minister, for public release, an 'annual road map' that quantifies:
 - Reporting on progress to meet targets determined in the approved GG&EM plan; and
 - Emission reduction opportunities and achievements.

14.3.13 Whole of project – social management

1. The proponent must collaboratively prepare and implement a Social Management Plan (SMP) within 12 months from the date of the approval (in consultation with the State Government and key stakeholders) for approval by the Indenture Minister that includes (amongst other matters) measures to achieve the following:
 - Maintain a minimum rental housing vacancy rate in Roxby Downs of 5%;
 - Provide for a minimum of 7% affordable rental and home purchase opportunities within all new developments, adjusted in accordance with affordability thresholds provided in the SMP;
 - Monitor rental rates, rental availability and housing stress in Whyalla, Port Augusta, Andamooka and Woomera;
 - Inclusion of community health and social well-being indicators to manage social well being within Roxby Downs and other affected communities;
 - Thresholds for the delivery and monitoring of social infrastructure provision;
 - Set performance indicators/targets in relation to employment and training;
 - Consultation procedures to facilitate cooperation and consultation with SAPOL in respect to:
 - the percentage reduction in victim recorded crime; and
 - the questions to be asked in the ‘perceptions of crime’ survey of Roxby Downs and Andamooka;
 - A dispute resolution mechanism that supports an active response to community and stakeholder concerns about social impact issues; and
 - A Stakeholder Engagement Strategy which contains a list of key stakeholders and describes their interest in the project, actions and outcomes.
2. The SMP must establish the roles and responsibilities of the proponent, government, stakeholders and communities throughout the life of the project.
3. A ‘Social Management Partnership’ must be established to provide a forum for key stakeholders to discuss and respond to the social effects of the Olympic Dam expansion. At a minimum the ‘Social Management Partnership’ must include representatives from the proponent, the SA Government, the Roxby Downs Community Board and Roxby Downs Council.

Acronyms and glossary



Acronyms and glossary

ACRONYMS

ANCOLD	Australian National Committee on Large Dams
ABS	Australian Bureau of Statistics
AQIS	Australian Quarantine and Inspection Service
AQMMP	Air Quality Management and Monitoring Program
AR	Assessment Report
ARI	Annual Recurring Interval
ASS	Acid sulphate soils
BCA	Building Code of Australia
BHPB	BHP Billiton Olympic Dam Corporation Pty Ltd
BSDSA	Biological Survey Database of South Australia.
CASA	Civil Aviation Safety Authority
CEMMP	Construction Environment Management and Monitoring Plan
CEMP	Construction Environmental Management Plan
CPTED	Crime Prevention Through Environmental Design
CTA	Cultana Training Area
CTAF	Common Traffic Advisory Frequency
DAC	Development Assessment Commission
DEIS	Draft Environmental Impact Study
DENR	Department of Environment and Natural Resources
DETEI	Department of Transport, Energy and Infrastructure
DoD	Department of Defence
DPA	Development Plan Amendment
DPLG	Department of Planning and Local Government
EMP	Environmental Management Program
EPA	South Australian Environment Protection Authority
EPP	Environment Protection Policy
ERI	Environmental Impact Report
ERP	Emergency Response Plan
ESCP	Erosion and Sediment Control Plan
FEIS	Final Environmental Impact Study
LDCs	Long-distance commuters
MDD	Major Development Declaration
LGAs	Local Government Areas
MSP	Maritime Safety Plan
Mtpa	Million tonnes per annum
NATA	National Association of Testing Authorities
NBN	National Broadband Network
NEPM	National Environment Protection Measure
NEM	National Electricity Market
NER	National Electricity Rules
NPI	National Pollutant Inventory
NVF	Native Vegetation Fund

NVMP	Native Vegetation Management Plan
OD	Over-dimensional
OEMMP	Operational Environment Management and Monitoring Plan
PIRSA	Department of Primary Industries and Resources of South Australia
RNE	Register of the National Estate
RSF	Rock Storage Facility
SAPOL	South Australian Police
SEB	Significant Environmental Benefit
SEIS	Supplementary Environmental Impact Study
SEO	Statement of Environmental Objectives
SIMPs	Social Impact Management Plans
SML	Special Mining Lease
SMP	Social Management Plan / Social Management Framework / Social Management Partnership
USG	Upper Spencer Gulf
WONS	Weeds of National Significance
WPA	Woomera Prohibited Area

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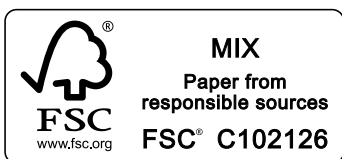
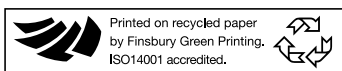
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