# 5 DESCRIPTION OF PROPOSED EXPANSION

## 5.1 PROCESSING

### 5.1.1 SMELTING

**Issue:**

It was questioned whether the operating life of the existing smelter is sufficient to last for the assessed EIS period (i.e. 40 years). BHP Billiton was also asked whether it proposes to move all ore smelting from Olympic Dam to an offshore smelter(s).

**Submission:** 238

**Response:**

The existing smelting process and infrastructure have been operating at Olympic Dam since 1998 and would, with regular preventative maintenance (e.g. furnace brick relines, boiler recertifications), last for the duration of the 40-year period assessed in the Draft EIS for the proposed expansion.

At present, there is no proposal to move more smelting offshore, other than that already discussed in the Draft EIS.

### 5.1.2 PROCESSING OF OFF-SITE CONCENTRATES

**Issue:**

Further information was requested regarding the on-site processing of off-site concentrates, specifically related to the effect of these concentrates on the metallurgical process, potential volumes and methods of transport.

**Submission:** 2

**Response:**

The on-site processing of off-site concentrates is a common practice throughout the world and would have no material effect on the Olympic Dam metallurgical process.

The potential for on-site processing of concentrates generated off-site was discussed in Section 5.5.4 of the Draft EIS. This indicated that off-site concentrates may be added to the flotation feed tank before the flotation stage of the processing circuit. Detailed design studies undertaken since the Draft EIS was published suggest that off-site copper concentrate would more likely be added during the concentrate thickening stage of the feed preparation process, just before the material was dried and fed into the existing smelter. This is because the concentrate imported to the operation would most likely be a copper sulphide-based concentrate containing copper, sulphur and iron, plus minor amounts of gold and silver. There would, as a result, be no need for flotation and leaching of these concentrates as this would be performed during the manufacture of the concentrates.

Any off-site concentrates added to the metallurgical process would be screened to ensure that they were similar in mineralogy to those currently (and proposed to be) processed, so that they could be treated in the existing metallurgical plant. This approach is widely used by copper smelters throughout the world, the majority of which process imported concentrates. The volumes of concentrates that may be processed would depend on the availability of surplus metallurgical plant capacity and the concentrate supply market at the time.

Figure 2.8 of the Draft EIS (a section of which has been reproduced here as Figure 5.1) outlines the existing metallurgical process. This process would not change in the event that concentrates generated off-site were processed at Olympic Dam. In particular:

- the sulphur in the off-site concentrate would also be transformed into sulphur dioxide ($SO_2$) and captured in the existing acid plant, where it would be converted into sulphuric acid for use in the hydrometallurgical areas of the processing plant, potentially offsetting demand for imported elemental sulphur

- there would be no additional tailings associated with the processing of off-site concentrate
- copper, gold and silver would be sent to the refinery as anode copper for conversion to anode slimes (containing gold and silver) and cathode copper (final product). Gold and silver would be subsequently extracted in the Slimes Treatment Plant and cast into bullion.

One potential difference, depending on the mineralogy of the off-site concentrate smelted, would be the generation of iron in the form of silica slag in larger quantities than currently generated by the Olympic Dam concentrate. Should this occur, the silica slag would be re-treated via the existing slag milling circuit and there would be no environmental impacts beyond those assessed in the Draft EIS.

Concentrates would be transported to site either via the existing road network or via the proposed rail spur using wagons designed for the handling of bulk mineral concentrates. The volume of additional road or rail traffic would depend on the volume of concentrate imported to the operation, however is not expected to represent a significant increase relative to the traffic volumes discussed with Section 5.9.4 of the Draft EIS.

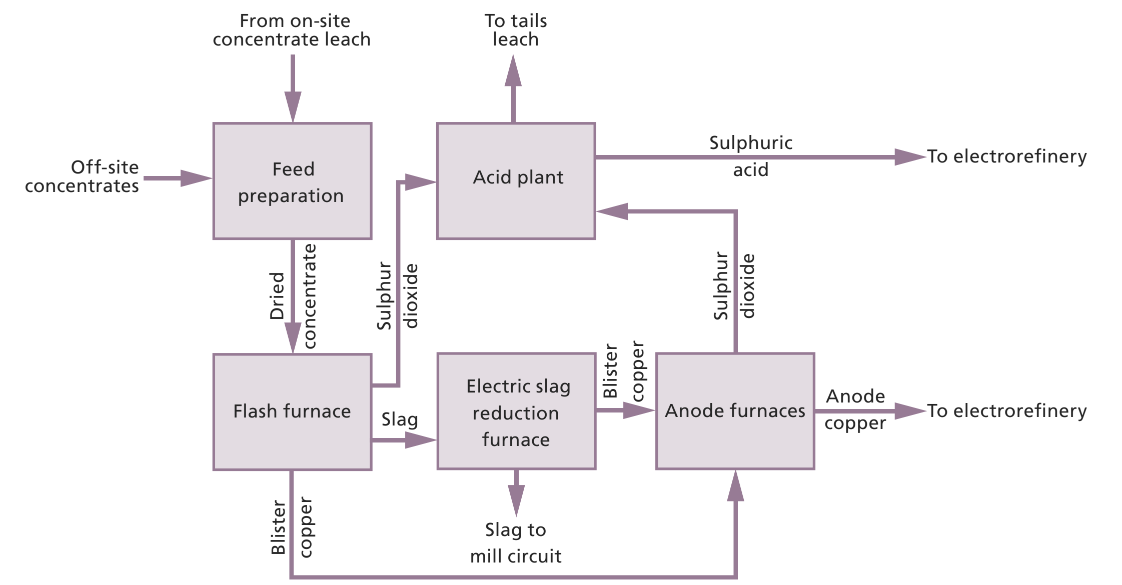



Figure 5.1 Existing metallurgical processes

## 5.2 ROCK STORAGE FACILITY

**Issue:**

Additional information was requested to confirm the stability of the rock storage facility (RSF) and open pit during operation and following closure of the mine. Further information was also sought in specific regard to the failure modes discussed in the Draft EIS (e.g. slip circle, multiple wedge failure), and the shear strength parameters used for RSF materials and foundations.

Additional information was also sought on any geotechnical investigations undertaken at the proposed site of the RSF to confirm the types and geotechnical characteristics of the soil (such as smectic clays), and the presence of karstic features in the limestone (i.e. irregular limestone in which erosion has produced fissures, sinkholes, underground streams or caverns). This information was requested to enable an assessment of the likely risk associated with exposure of acid sulfate rock in the event of instability.

**Submission:** 2

**Response:**

Several years of detailed geotechnical studies have been undertaken to understand and confirm the stability of the proposed open pit and RSF. These studies are discussed in Appendix C1 of the Supplementary EIS and summarised below.

### Open Pit

The key geotechnical investigations undertaken for the proposed open pit included:

- geotechnical drilling
- acoustic televiewer, core orientation, geotechnical logging and point load strength sampling and testing
- geotechnical assessment of key sections, including laboratory testing
- rockmass strength assessment
- probabilistic evaluation of rockmass properties for stability analysis
- statistical evaluation of structural data for slope design in both the cover sequence and basement
- collation of information on in-situ stress
- collation of geological and geotechnical information from the existing underground operation
- modelling of the interaction of the existing underground operation and proposed open pit
- evaluation of the geometallurgical alteration models for use in geotechnical studies
- development of a structural geological model
- development of geological lithography and alteration models
- hydrogeological investigations.

The results of the above studies were used to inform stability analysis, with the aim of complying with the open pit slope design criteria outlined in Table 5.1 below.

**Table 5.1 Proposed open pit slope design 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 |

The stability analysis provides an indication of the slope angles appropriate to achieve the above criteria and is different for the cover sequence and basement structures. The indicative slope angles are listed in Table 5.2.

**Table 5.2 Indicative open pit slope angles**

| Structural domain | Slope scale | Slope angle range (degrees) |
|---|---|---|
| Cover sequence | Bench | 85–90 |
| | Inter-ramp | 55–65 |
| Basement | Bench | 75–85 |
| | Inter-ramp | 50–65 |

An analysis of potential failure modes is presented in Appendix C1, the results indicating that capacity of the overall rock mass to manage stress with regards to overall circular failure is typically high for both the cover sequence and basement rock units. There are some weaker rock masses of limited extent, including the volcaniclastics and the highly altered granite breccia, which have less capacity but also have a limited impact on overall stability because they make up only a small proportion of the total rock mass. An analysis of the potential for circular failure of cutbacks suggested that factors of safety may be marginal and that depressurisation of the groundwater within this rock mass would be required. This was predicted and has been accounted for in the proposed expansion by means of pit dewatering in advance of mining cutbacks.

### Rock storage facility

The geotechnical stability considerations influencing the design of the RSF were outlined in Section 5.4.6 of the Draft EIS and the design is considered to be the equivalent of, or better than, RSF designs for existing South Australian mining operations, including the Leigh Creek coal mine and OZ Minerals' Prominent Hill copper/gold project. The risk of RSF instability resulting in exposure of acid-generating material was assessed across several possible risk events, each returning a 'moderate' risk rating based on a 'moderate' to 'serious' consequence and an 'unlikely' to 'rare' likelihood (refer Section 26.2 of the Draft EIS for risk look-up tables).

The basis of the RSF stability assessment assumed the following:

- rock fill would produce rill angles of about 35-40°
- lift heights of about 50 m would be used, except in poorer strength rock units, where lift heights may be reduced to 20-30 m
- operational berms would be installed such that overall slope angles do not exceed 30°
- the rock fill is expected to be free draining such that pore pressure build-up in the RSF is considered highly unlikely
- the dump foundation is above the water table and is predominantly sand with some discontinuous sandy clay layers of total depth ranging from 1-20 m, overlaying weathered limestone.

The vast majority of the rock proposed to be placed within the RSF is high to very high strength, and would be relatively durable and sound, with the exception of minor volumes of the shallow unconsolidated sediments and possibly some parts of the Tregolana Shale. The rock mass properties used in the stability assessment are provided in Table 5.3.

**Table 5.3 Strengths used in RSF stability analysis**

| Material | Unit weight (KN/m$^3$) | Cohesion (KPa) | PHI (°) |
|---|---|---|---|
| Rock fill | 18 | 50 | 35 |
| Surface sands and clays | 18 | 5 | 25 |

Based on the above, the overall factor of safety of the RSF slopes would be in excess of 1.2. Design earthquake loading of the RSF is expected to result in some settlement and displacement, and be within tolerable limits. Furthermore, the offset between the RSF and the open pit is sufficient to effectively decouple the stability performance of the RSF and the open pit, meaning that the RSF does not influence open pit stability, and vise versa. This is detailed further in Appendix C1.

Detailed mining plans, including the timing and placement of mine rock, would be developed prior to execution as rock sequencing depends on the mining schedule and would be subject to changes and variations in the mine plan as the mining operations progressed. The general timing of the extraction of class A, B, C and D material was presented in Figure 5.18 of the Draft EIS (repeated here as Figure 5.2), and the general approach to the placement of the benign class C and D material (and the encapsulation of the reactive class B material) was described in Section 5.4.6, and illustrated conceptually in Figure 5.16.
The general RSF construction sequence was shown in Figure 5.6a and 5.6b, showing the progression of the RSF outwards and upwards from the edge of the pit to its ultimate extent at Year 40.

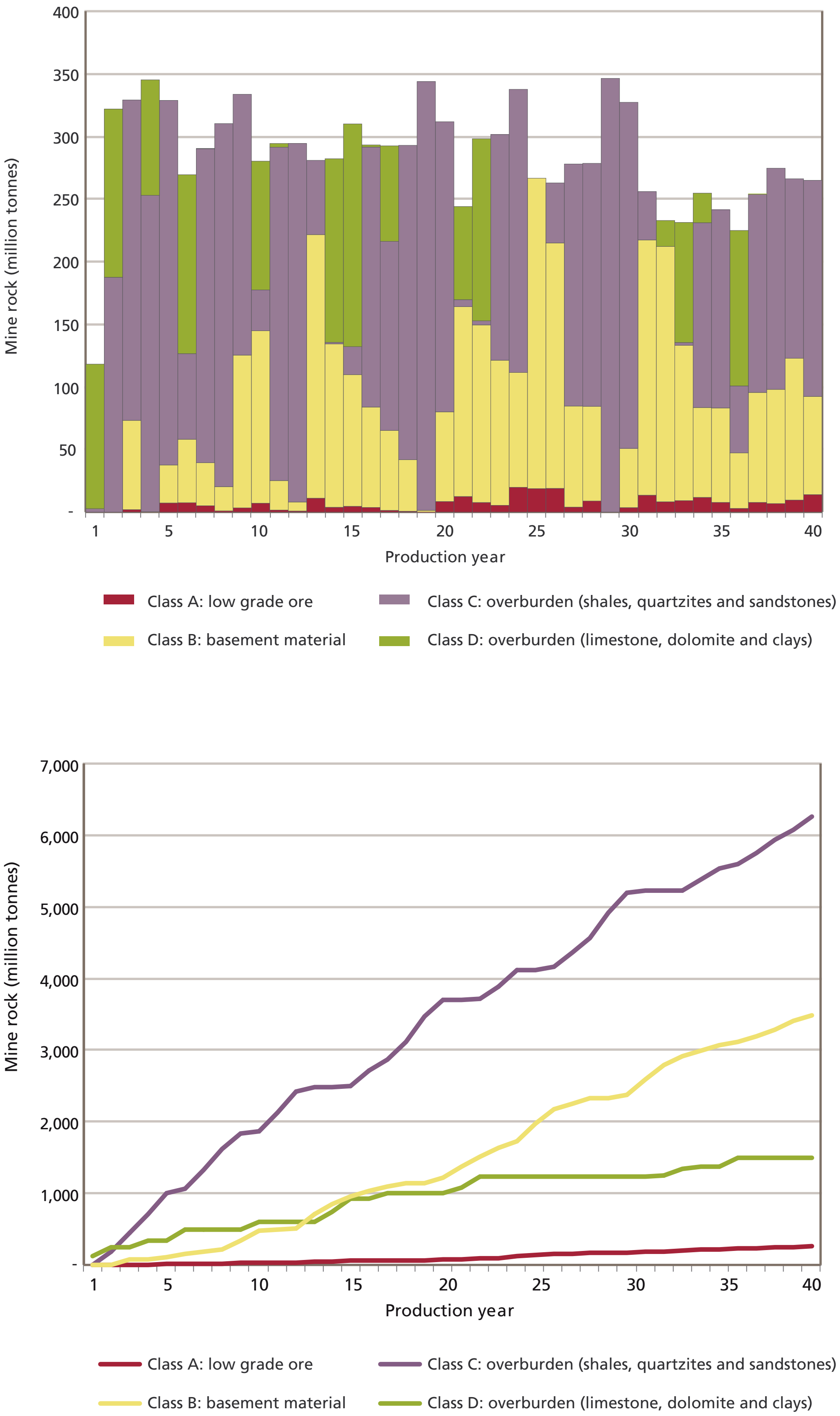



Figure 5.2 Mine rock extraction by class over time

The placement schedule for the different rock units has been further developed since the publication of the Draft EIS, based on the information summarised above, and Figure 5.3 of the Supplementary EIS shows the approximate areas of reactive (class B) and non-reactive (class C and D) material that would be exposed in any given year on the RSF (excluding class A material that would be stockpiled separately on the low-grade stockpile).

**Issue:**

Confirmation was requested of the rock expansion factor used in the assessment of the size and volume of the RSF.

**Submission:** 12

**Response:**

The dimensions of the proposed RSF were provided in Section 5.4.6 of the Draft EIS, indicating that it would have a footprint of around 6,720 ha, a height of about 150 m and an overall wall angle of around 30 degrees. The expansion factor (i.e. the increase in volume of mine rock that occurs from its natural *in situ* state to the volume it occupies following blasting and placement) used to determine the size of the RSF was 1.7. This is consistent with figures typically used in mining and quarrying (Engineering Toolbox 2010); the same expansion factor was used at the nearby Prominent Hill operation.

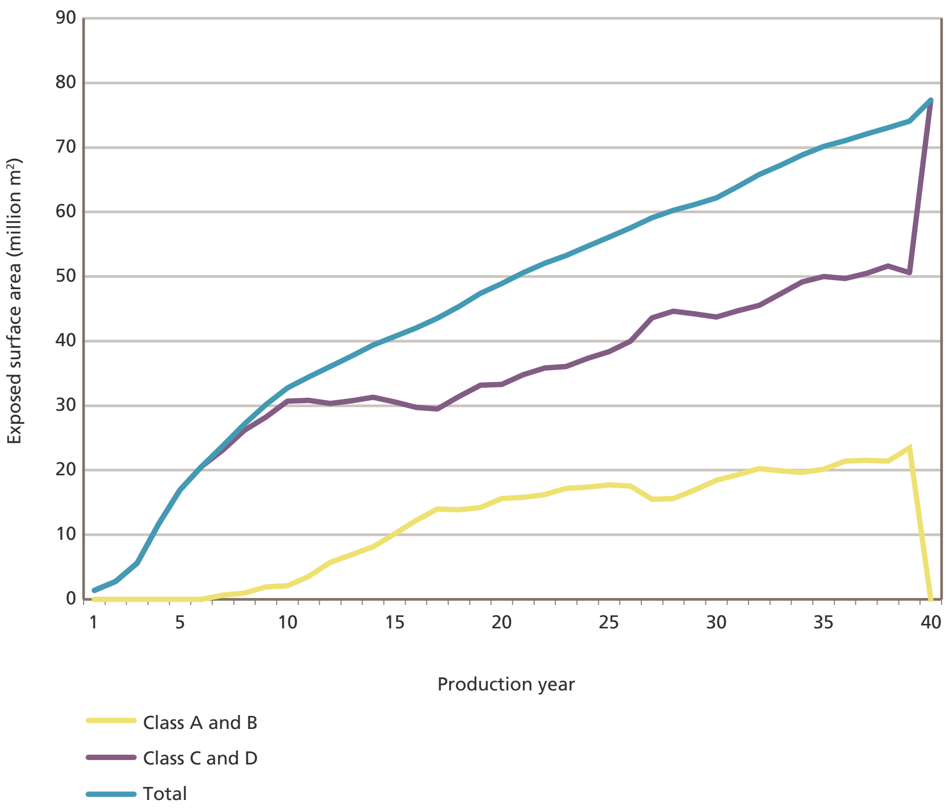



Figure 5.3 Area of exposed class A, B, C and D material on the RSF and low grade ore stockpile over time

## 5.3 TAILINGS STORAGE FACILITY

**Issue:**

Clarification was requested regarding some aspects of the design and operation of the proposed Tailings Storage Facility (TSF), specifically:

- the final height of the TSF and its stability, because some information presented in the Draft EIS noted heights of 40, 65 and 80 m
- the final overall outer embankment slope
- the dry density of the existing and proposed tailings
- the solids density target
- the design rate-of-rise
- the commissioning sequence for new TSF cells
- existing piezometers
- the volume of existing tailings production
- the estimated seepage rate of the existing and proposed TSF
- Figure 9.2 of Appendix F1.

Further information was also sought regarding the following design aspects:

- cell size, volume, locations and layout
- impacts associated with nested TSF cells
- balance pond construction
- liquor recirculation implications, lateral seepage and decant pond area
- beach slope angle and drying cycle
- permeability of consolidated tailings and effect of high-density polyethylene liner (HDPE)
- TSF stability
- seismic stability
- TSF drainage systems
- final rock armouring
- dusting from the TSF
- constituents of tailings.

**Submissions:** 1, 2, 8, 13, 27, 35, 37, 40, 43, 87, 116, 138, 163, 177, 185, 206, 208, 216, 233, 249, 255, 256, 266, 278, 287, 290, 331, 363, 377, 389 and 391

**Response:**

Each of the issues raised above is addressed separately below.

### Final height

The final height of the proposed TSF cells was specified in Table 5.16 of the Draft EIS as 65 m at Year 40.

The proposed TSF construction methodology (rockfill, centre-line raise) was analysed to a height of 80 m to demonstrate the feasibility of raising the cells beyond the 65 m in the Draft EIS. The positive stability results at 80 m in height sufficiently demonstrate the adequacy of the embankment stability at 65 m.

### Final overall outer embankment slope

The embankment slope used in geometric calculations (footprint area) and stability analyses is 1:2. The text accompanying the 'Slope/W' figures and the tables in Appendix F1 was rounded down to 25 degrees, but more correctly would have read 1:2 or 26.56 degrees.

The armouring placed adjacent to the outermost TSF slope at closure may be left at its constructed slope angle (30 to 37 degrees) to minimise the length of slope that would be susceptible to erosion. The armouring would effectively buttress the final TSF wall and would therefore increase the long-term stability of the TSF, while minimising the risk of erosion.

### Dry density of the existing and proposed tailings

The design assessed in the Draft EIS used dry density of 1.7 t/m$^3$ (refer Table 5.16 of the Draft EIS), the lower average density in the expected range (being 1.7–1.8 t/m$^3$). This was to ensure that the estimate of storage capacity required is sufficiently conservative to manage any uncertainty or error in the density measurements, and is consistent with the dry density of the existing tailings.

### Solids density target

Experience in processing at Olympic Dam for more than 20 years has established that during operations the actual deposition density would vary slightly as a result of standard operating parameters in the metallurgical processing of ore. A range of 52–55% was used in design considerations to ensure that the system could accommodate the expected range of solids density values. During detailed design, an operating target of 55% solids would be used to encourage better tailings drying and surplus water management. In addition, during detailed design, the water balance would be 'stress' tested well outside the target range to ensure that the system could accommodate out-of-balance events that may occur from time to time.

### Design rate-of-rise

The maximum rate of rise of tailings in the TSF is an upper limit that would not be exceeded to ensure that adequate drying and consolidation of the tailings mass occurred. This would ensure that the optimal tailings density and shear strength were achieved, and that the tailings could be stored within the capacity provided.

At Olympic Dam, the maximum rate of rise for upstream construction has been confirmed at about 2 m per annum. This value has been used for comparing design alternatives for the expanded operation. The proposed design included in the Draft EIS applies an average rate of rise, this varying between 1.1 and 1.7 m per annum (refer Table 6.3 of Appendix F1), depending on the stage of TSF development.

### Commissioning sequence for new TSF cells

In addition to the recently-approved TSF Cell 5, two TSF cells would be constructed initially, together with two balance ponds. Further TSF cells and balance ponds would be constructed to match the ramp-up in production until the full combined capacity of 72 Mtpa of ore throughput was reached (see Figure 5.4 of the Supplementary EIS for an indicative TSF commissioning schedule).

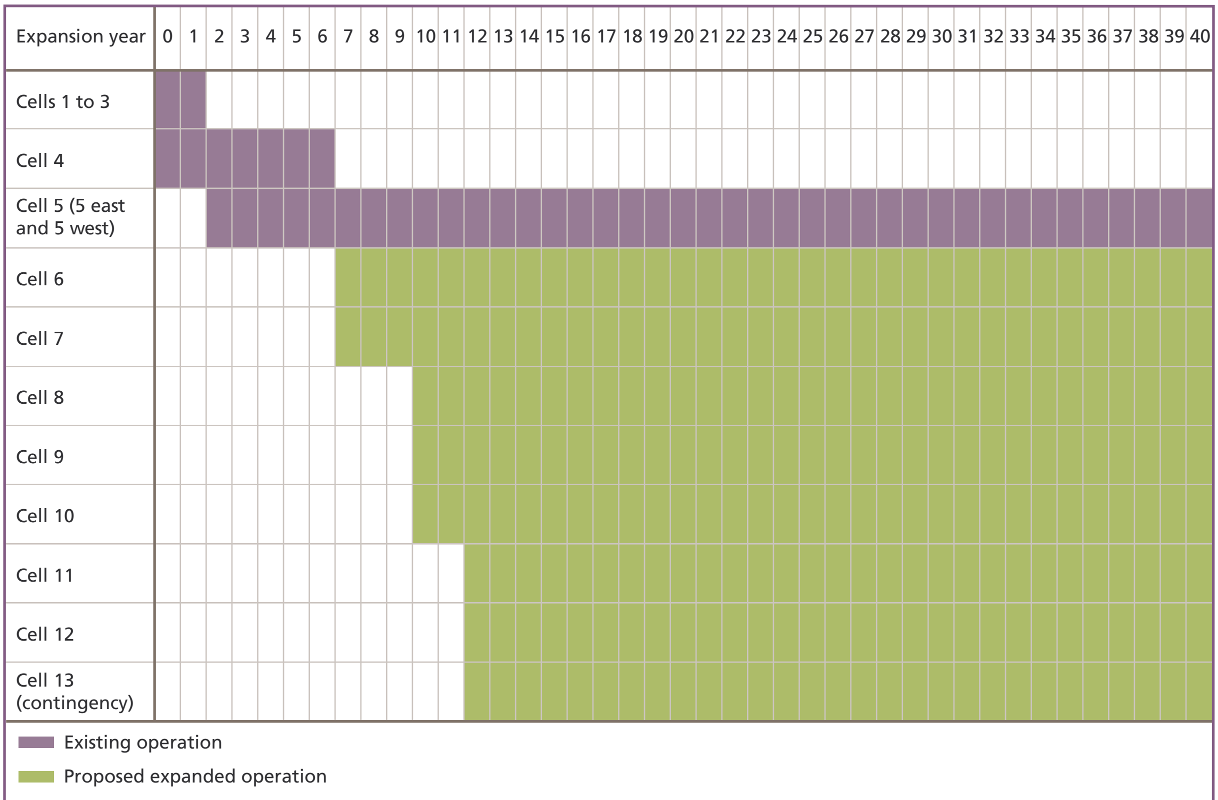



Figure 5.4 Indicative timing for tailings storage facility cell use

### Existing piezometers

The piezometer information provided in Appendix F1 of the Draft EIS was current at the time of publication. Olympic Dam has since installed a number of additional and replacement piezometers.

The assertion made in a submission, that most or all of the existing piezometers were declared to be unserviceable (and replaced by a new set), leading to the inference that the water level monitoring data may be questionable in terms of supporting design assumptions, is misleading.

In any upstream-raised tailings storage facility, piezometers need to be replaced as they become inaccessible. Under the acidic conditions at Olympic Dam, piezometers also become unserviceable or blocked over time. Olympic Dam has an ongoing monitoring and replacement system for piezometers, and on occasions investigations of a particular area of the tailings identify the need to replace the piezometers before their scheduled replacement or servicing.

In January 2010, a review of the current TSF measurement and reporting regime found:

> ... there is a detailed and comprehensive instrumentation system associated with the TSF. The original instrumentation has been supplemented by additional piezometers ... [and] ... the instrumentation and monitoring is of a good standard. Records are well kept, easily accessible and regularly reviewed (GHD 2010).

### Volume of existing tailings production

The existing TSF stores approximately 8 Mtpa of tailings, with approximately 0.4 Mtpa used in mine backfilling. The expansion described in the Draft EIS increases tailings production by up to 60 Mtpa, and optimisation of the current process increases the ore throughput to 12 Mtpa for a total of 72 Mtpa. Table 5.15 of the Draft EIS listed the tailings production rate for the combined existing and expanded operation at 69.6 Mtpa.

Table 5.1 of Appendix F1 listed the range of production rates for the various stages of the expansion. The combined tailings production (existing plus expanded operation) varies from around 20 Mtpa at start-up of the initial development stage, ramping up to 30 Mtpa during this stage (Year 0 to Year 6), and increasing later to around 70 Mtpa at full production.

### Estimated seepage rate of the existing and proposed TSF

Estimated seepage rates for the proposed expanded operation vary with time and were detailed in Sections 8.3 and 8.4 of Appendix F1 to the Draft EIS. The average steady-state seepage rate for the proposed TSF cells is estimated at about 1 $m^3$/ha/d, or about 400 $m^3$/d per TSF cell. The overall seepage rate for the combined TSF, including both expanded and existing TSF cells, is shown in Figure 5.5 of the Supplementary EIS.

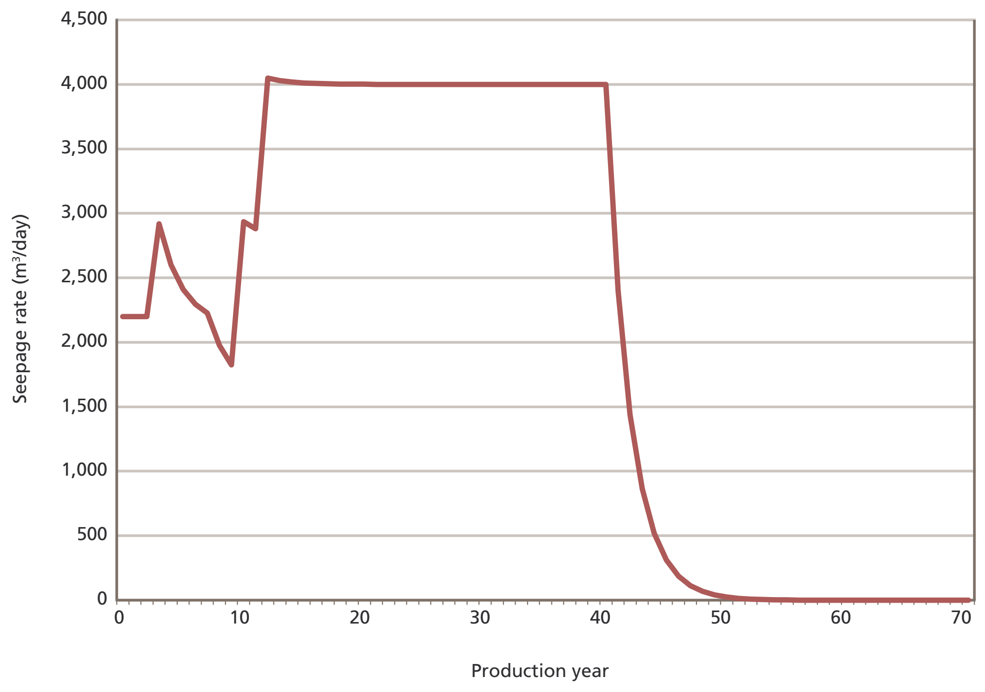



Figure 5.5 Indicative seepage over time for the combined tailings storage facility, with 53% solids

Following the completion of operations, the seepage rate would decrease over about 15 years as the tailings consolidated and dewatered, ultimately becoming a fraction of the natural infiltration rate associated with ambient rainfall.

### Figure 9.2 of Appendix F1 to be clarified

Figure 9.2 of Appendix F1 to the Draft EIS (reproduced here as Figure 5.6) illustrates a 'Seep/W' analysis. In this example, the downwards flux through the tailings (blue dashed arrow across the top) is in equilibrium with the downwards flux through the base (blue dashed arrow across the base).

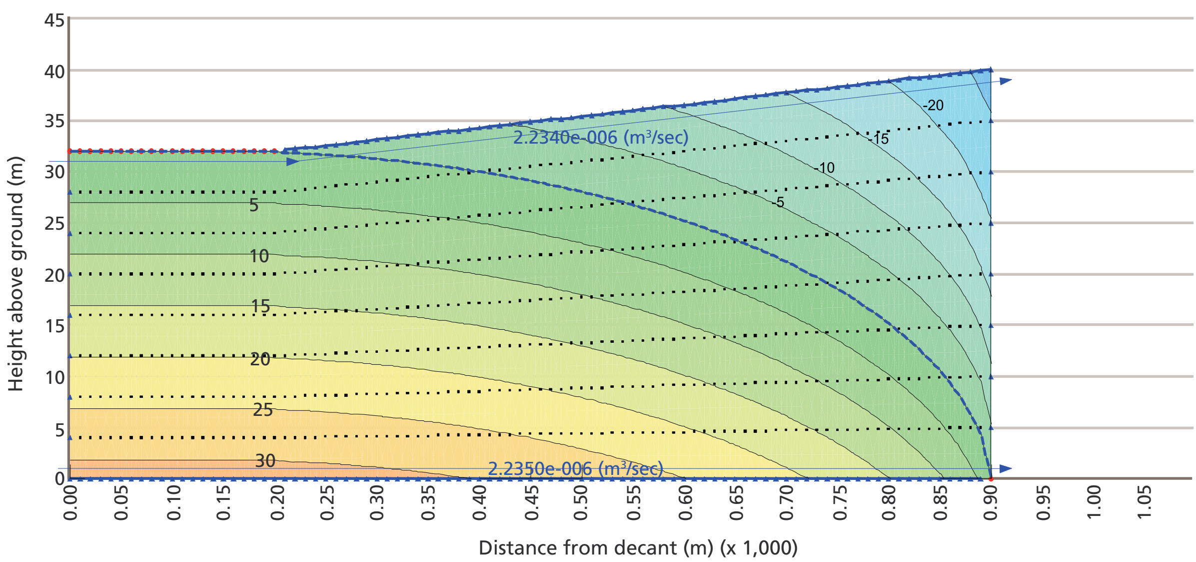
### Cell size, volume, locations and layout

The basic design details of the proposed TSF cells were provided in Table 5.16 of the Draft EIS, indicating that there would be up to nine new TSF cells of approximately 400 ha in surface area each, with an ultimate design height of 65 m. Since the publication of the Draft EIS, approval has been granted for the construction of TSF Cell 5 for the management of tailings associated with the existing operation. As a result, it is no longer considered that the contingency cell originally proposed in the Draft EIS is required (see Section 1.4 of the Supplementary EIS for details). The revised tailings cell features are detailed in Table 5.4.

The approval of the additional TSF cells for the existing operation has necessitated a review of the TSF cell locations for the proposed expanded operation. The revised TSF cell layout was discussed in Section 1.4 of the Supplementary EIS and illustrated in Figure 5.7.

### Impacts associated with 'nested' TSF cells

Information presented in Appendix F1 of the Draft EIS demonstrated that the rockfill embankment would effectively manage the potential environmental risks by comfortably accommodating the worst-case loads and pore pressure conditions. Where used in nested divider walls, the zoned rockfill design would not introduce additional complexities, or additional or increased environmental impacts. The free-draining rockfill would ensure that issues associated with lateral seepage observed in some sections of the current TSF were eliminated in the expanded TSF cells because all excess pore pressures in the potential failure zone of an embankment would be effectively drained.




Worst case seepage model - phreatic surface extends to outer drain.

Assumptions:
40 m high embankment
200 m diameter pool
kh/kv = 10

Source: Figure 9.2, Appendix F1 of the Draft EIS

Figure 5.6 Numerical model simulation of steady state combined beach and pond seepage

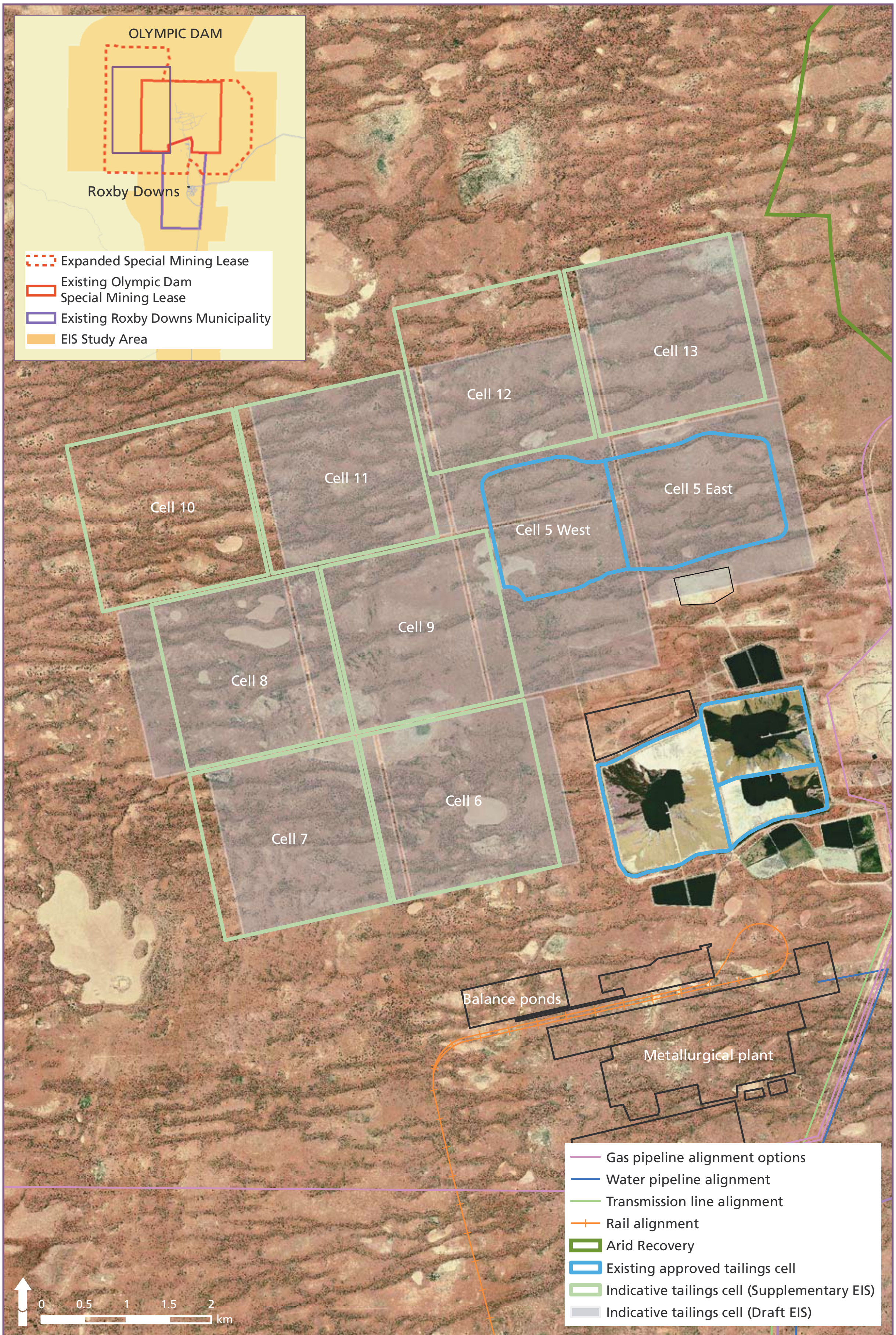



Figure 5.7 Revised layout of the proposed tailings storage facility cells

**Table 5.4 Indicative features of the proposed TSF**

| Features | Proposed expansion |
|---|---|
| Additional solids disposal rate (Mtpa) | 58 |
| Facility operating life (years) | 40+ |
| Number of TSF cells[1] | 7+1 |
| Design type | Paddock style with centreline raise using mine rock walls and central decants |
| Deposition solids concentration (%) | 52–55 |
| Maximum rate of rise for tailings (m/a) | 2 |
| Dry density of stored tailings (t/m$^3$) | 1.7 |
| Final height (m) | 65 |
| Embankment slope angle (degrees) | 25 |
| Estimated height of starter embankment (average) (m) | 10 |
| Estimated TSF wall raise height (m) | 10 |
| Crest width of external walls (m) | 10 |
| Area of central decant pond (ha per cell) | 9 |
| Rate of acidic liquor return to the metallurgical plant at 72 Mtpa ore (ML/d) | 24 |
| Area of balance ponds (ha) | 60 |
| Depth of balance ponds (m) | 10 |
| Estimated final footprint – including contingency cell (ha) | 4,000 |

[1] The indicative number of additional TSF cells required for the management of the tailings and acidic liquor is seven. However, an additional cell has been allowed as a contingency in the event of unforeseen issues such as plant failures or extreme rainfall events.

As described in Table 6.2 of Appendix F1, each embankment would undergo further detailed foundation investigation, seepage and stability analysis and detailed design along its length, whether serving as an external perimeter embankment or as a divider embankment when cells were nested. This would allow any specific features to be incorporated, such as variations in foundation materials and strength, which may enhance embankment stability. Each embankment would be designed to satisfy Australian National Committee on Large Dams (ANCOLD) stability criteria throughout its functional and post-closure life cycle.

The divider embankments lie in the proposed TSF footprint and would not add to or increase the environmental risk over and above that described in Appendix F1 and assessed throughout the Draft EIS. Further details regarding the design and construction of nested divider walls would be developed during detailed design as necessary to suit available construction materials and local foundation conditions prior to permitting.

### Balance pond construction

Four balance ponds, each approximately 15 ha in area and 10 m in depth, would be constructed to facilitate the return of acidic liquor from the TSF cells to the metallurgical plant, and to provide additional surge liquor capacity to manage seasonal variations in the water balance and high-rainfall events.

The balance ponds would replace the need for shallow evaporation ponds. The construction method would be similar to the existing evaporation ponds, that is, earthen embankments with a double liner comprising clay and high-density polyethylene (HDPE). The proposed balance ponds would be designed to reduce the potential for fauna access through the installation of a bird-resistant cover.

### Liquor recirculation implications, lateral seepage and decant pond area

The design of the expansion TSF has been calibrated using the water balance for the existing TSF. This has been used to determine the area required with no further evaporation ponds, taking into account other improvements that would be made. These include:

- higher-density tailings solids
- using balance ponds to manage water following metallurgical plant surges or storm events
- increased recycling of acidic liquor for reuse in the metallurgical plant.

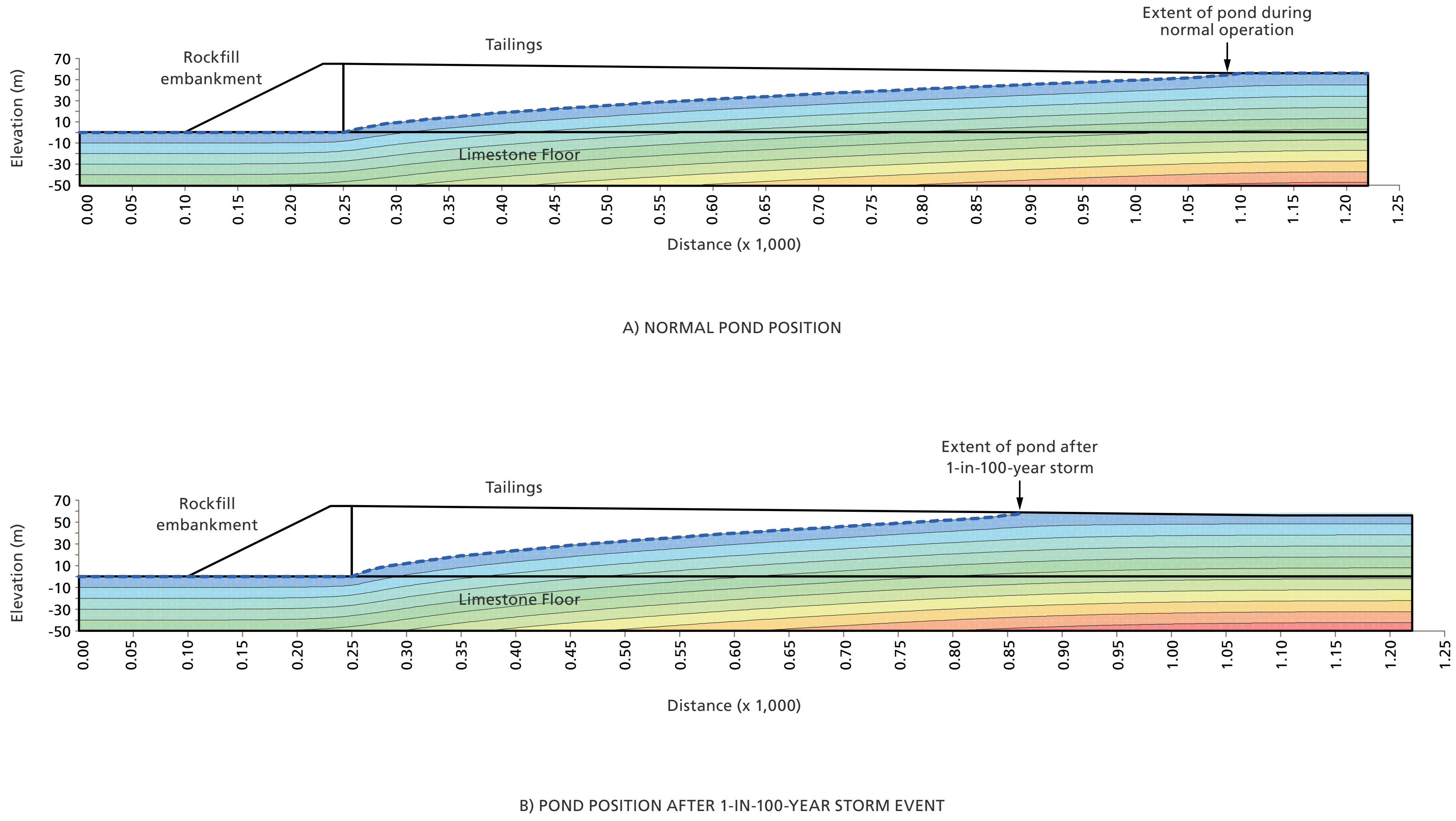



Figure 5.8 Steady state seepage from the proposed expanded tailings storage facility

This has resulted in a minimum requirement for seven TSF cells, each of around 400 ha in area. For this scenario, the decant ponds are predicted to be managed within a 300 m square decant area.

The Draft EIS demonstrated that the nine proposed TSF cells therefore provide more than sufficient evaporation capacity to manage the worst-case water balance and upset events (e.g. a rainfall event greater than a 1:100 annual recurrence interval (ARI). If all nine cells are used at the same time, a water deficit is predicted.

If, after maximising returns to the process, there was still an excess of water on the TSF cells (for example, after a large storm event), provision has been made to redirect this water to the balance ponds, and in the summer months to dispose of it by bleeding it into the tailings stream for redirection onto the tailings beaches to maximise evaporation. For example, a large quantity of water can be disposed of by diluting the solids density by only 1 or 2%, and depositing the slightly diluted tailings through more spigots (at lower flow rate), in thinner layers and with more frequent beach rotation. Adjusting the deposition in this way would result in little change to the beach slope or the pool size, but the more efficient use of the unused excess evaporation capacity in summer would significantly increase evaporation losses from the beaches, thereby facilitating the management of the ponds within the desired limits.

Modelling was undertaken of the effect of rainfall events on the phreatic surface in the TSF cells for the expanded operation. Figure 5.8 of the Supplementary EIS shows both a normal pond position and an indicative pond position after a 1:100 ARI event. The figure illustrates the steady-state seepage for the proposed 850 m beach for the 65 m final TSF height. For the beaches proposed in the Draft EIS, the phreatic surface from the pond only just reaches the perimeter embankment as it does not have sufficient vertical head to drive the water 850 m laterally through the low-permeability tailings. This is irrespective of the permeability of the embankment material (i.e. the phreatic surface in Figure 5.8 would be the same if clay were used in the embankment).

In addition, the scale of the proposed TSF reduces the risks associated with the phreatic surface: a change in the pond level on a smaller TSF has a significant impact on the phreatic surface, but negligible impact on the phreatic surface for the long TSF cell beaches proposed.

### Beach slope angle and drying cycle

The average beach slope on the existing tailings cells is around 0.8 to 1%. The beach slope proposed in the Draft EIS would be similar (around 1%).

The evaporative drying cycle presented in Figure 8.3 of Appendix F1 to the Draft EIS was developed based on information obtained from the operation of the existing TSF, and is directly applicable to the proposed expanded TSF design. While the volume of supernatant water would decrease, the moisture content of the freshly deposited/beached tailings would be in a similar range to that on the existing beaches.

### Permeability of consolidated tailings and effect of HDPE liner

On a small areal scale (one to 100 $m^2$), a HDPE liner may, for all practical purposes, be considered impervious. At the scale of the TSF under consideration (36 million $m^2$), liners have a permeability to water of up to $5 \times 10^{-10}$ m/s (Blight 2010).

As geosynthetic liners degrade over time, particularly in harsher acidic conditions such as in the existing and proposed TSF, the number and size of weld defects in the liner increases. As a result, the seepage rate achieved by the placement of low-permeability tailings can be expected to be comparable to a HDPE liner, particularly in the longer term.

With regards to the operational performance of the HDPE liner under the central decant area, a key lesson learned from the early operation of the first TSF cells at Olympic Dam was that the majority of seepage and hence the observed groundwater mounding under these cells was caused by the ponding of decant water on bare ground prior to the formation of a tailings layer. To minimise the potential for water to pond on bare ground, a central lined area is installed, effectively preventing a potential increase in the initial seepage rate. Until the original ground surface is covered with an effective low-permeability tailings layer, water is collected as quickly as possible and moved to the lined area, where it is stored and subsequently returned to the process for reuse.

During initial operation the liner can also play a role in underlining the central drainage area, helping to ensure that the seepage is collected in the drains, promoting consolidation of the tailings into a low-permeability liner/barrier under the central pond. This is, however, only of beneficial value if the central area is founded on permeable materials (i.e. the foundation is not clay or rock). If there is clay or rock under the central area, the HDPE liner provides no additional benefit over a consolidated tailings layer.

### TSF stability

*Linear failure surfaces and failure analyses*

The stability analyses provided in Section 7 of Appendix F1 to the Draft EIS illustrate that the rockfill embankment design is superior to the other identified TSF construction methodologies at the embankment heights considered. The analyses also demonstrate the low level of risk associated with stability for the proposed rockfill design.

Foundation investigations would be carried out during detailed design to determine the founding conditions for each embankment. Together with the strength and deformation data from the testing of the proposed embankment materials, rigorous stability analyses would then be carried out, including the consideration of block sliding or wedge-type failures, deformational analyses, and different loading conditions (drained and undrained) as appropriate to the particular case. The detailed design geometry would then be configured to ensure that the minimum safety factors were achievable at all stages of the operation.

Figure 5.9 of the Supplementary EIS illustrates a block-type analysis for the 65 m embankment on a weaker foundation, illustrating that the proposed embankment is stable for this case.

*Shear strength parameters*
An apparent inconsistency in the quoted shear strength parameters was identified between the Coffey Metago and Knight Piesold data presented in Section 7.2.2 of Appendix F1 to the Draft EIS.

The analysis of available data undertaken for the design of the recently approved TSF Cell 5 (URS 2009) included effective stress-drained triaxial strength envelopes for the impounded tailings. URS concluded that they 'agree with the comments provided in BHP Billiton's 2007 report that the high friction angle values reported by Coffey Metago could possibly be a result of confusion between the strength of compacted versus deposited tailings materials. It was also agreed that the low friction angle values reported by Knight Piesold were not a function of the tested material but were rather a function of the testing method. Knight Piesold used the Cone Penetration Test (CPT) correlations to estimate the effective stress drained friction angle for the impounded tailings. These correlations, which are derived for naturally deposited materials, are known to provide misleading results in tailings materials'.

To resolve this disparity between the reported values, URS re-evaluated the Consolidated Isotropically Undrained (CIU) triaxial test results by separating the tests that were completed on the compacted tailings samples from those completed on the 'undisturbed' tailings samples. After excluding test results for recompacted tailings, URS represent the drained strength of the impounded tailings for the approved TSF Cell 5 design as:

$c^1 = 0$ kPa; $\phi^1 = 30°$

In the Draft EIS design, as discussed in Appendix F1 of the Draft, the risk associated with the differences between the Coffey Metago and Knight Piesold shear strength parameters was effectively managed by the use of conservative shear strength parameters, and hence the stability analyses provided in the Draft EIS are conservative and remain valid.

*Shear strength parameters used in the stability modelling*
BHP Billiton acknowledges that there is a difference between the shear strengths and material properties presented in Table 7.4 and Figure 7.4 of Appendix F1 to the Draft EIS. The shear strengths presented in Figure 7.4 are incorrect.

To reaffirm the Draft EIS design conclusions, stability analyses (using GeoSlope 2007) have been conducted for the 65 m final height case, with the phreatic surface provided in Figure 5.8 of the Supplementary EIS and the design shear strength parameters listed in Table 5.5, which differs from Table 7.4 of Appendix F1 to the Draft EIS only in the allocation of a 5 kPa cohesion allowance for the sediment foundation shear strength.

The results of the revised stability analysis are summarised in Table 5.6, and the stability analysis outputs are shown in Figure 5.9. The correction to the cohesion allowance makes no material difference to the impact or risk assessment presented in the Draft EIS because a conservative assessment was undertaken and the upper boundaries assessed remain worst-case.

**Table 5.5 Shear strength parameters for slope stability analyses**

| Material | $c^1$ (kPa) | $\phi^1$ | $\gamma_{moist}$ (kN/m$^3$) | $\gamma_{sat}$ (kN/m$^3$) |
|---|---|---|---|---|
| **Deposited tailings** | 0 | 25 | 18 | 21 |
| **Embankment materials** | | | | |
| Compacted tailings/ clayey/general fill | 0 | 32 | 18 | 21 |
| Rockfill | 0 | 37 | 19 | 20 |
| **Foundation materials** | | | | |
| Sediments | 5 | 25 | 19 | 20 |
| Limestone foundation | 20 | 37 | 20 | 21 |

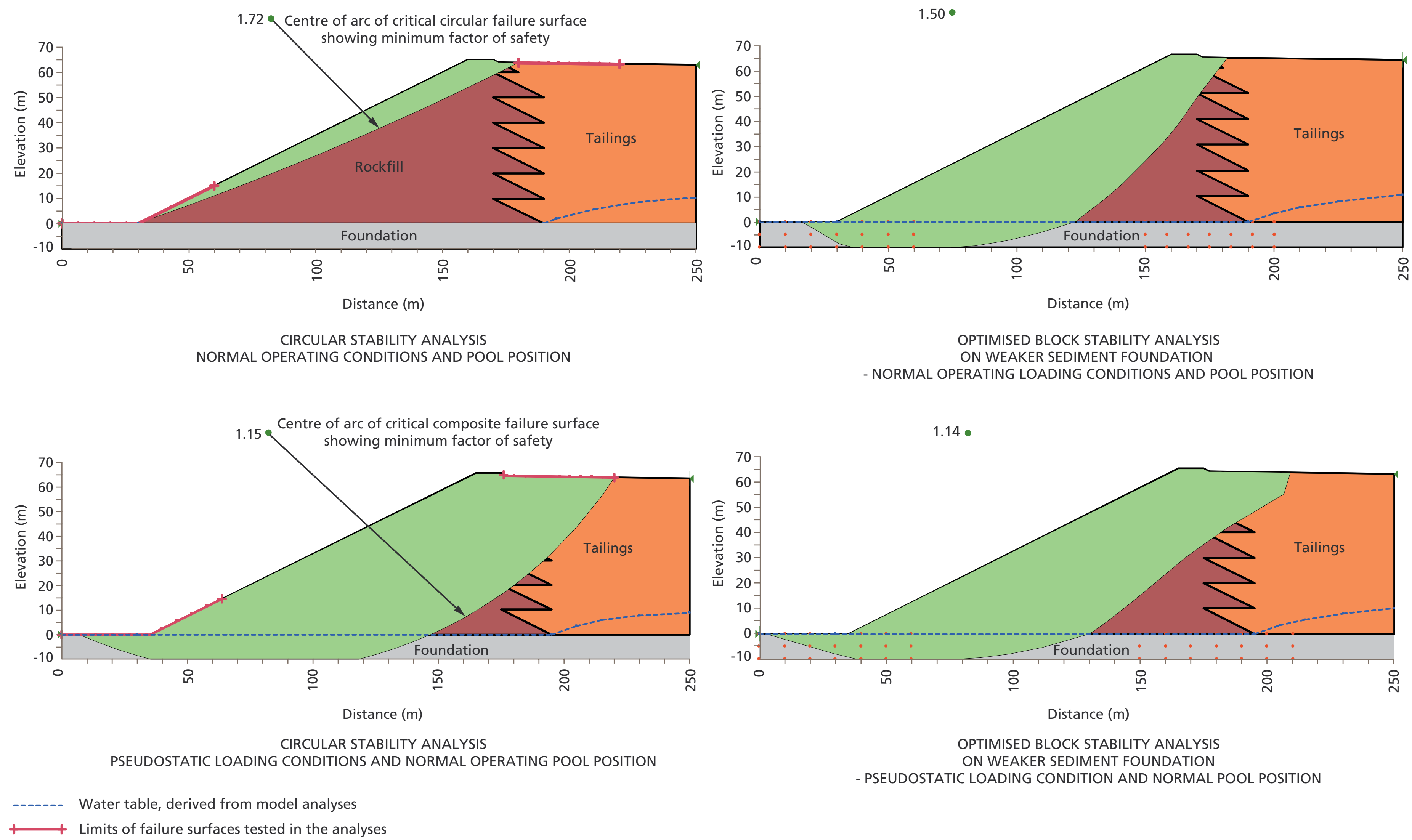



Figure 5.9 Stability analysis for the proposed 65 m high rockfill embankment tailings storage facility cells

**Table 5.6 Slope stability analysis results – 65 m high centre-line rockfill embankment, 1-in-2 slopes**

| Loading condition | Factor of safety | Minimum required (ANCOLD) |
|---|---|---|
| Normal operating – circular failure | 1.72 | 1.5 |
| High pool – circular failure[1] | 1.72 | 1.5 |
| Circular failure – pseudostatic[2] | 1.15 | 1.0 |
| Sediment foundation – optimised block failure | 1.5 | 1.5 |
| Sediment foundation – optimised block failure upstream pseudostatic | 1.14 | 1.0 |

1 The pool position does not influence the factor of safety compared with the normal operating condition as the critical failure surface does not pass beyond the upstream toe.
2 For pseudostatic analyses, the current revised ANCOLD Tailings Guidelines (1999) refers to a factor of safety of 1.0 recommended by US Corps of Engineers (USACE) for pseudostatic analysis and 1.1 for post-earthquake analysis with a recommendation for a deformational analysis in the event that the pseudostatic factor of safety is less than 1.0. There is some ambiguity in the ANCOLD Tailings Guideline (1999) recommended factor of safety for pseudostatic analysis with some practitioners using 1.0 and some using 1.1. The ANCOLD Tailings Guideline is currently being revised and is expected to be released in late 2011. The current draft of the revised guidelines clarify the ambiguity and recommends factors of safety of 1.1 for post–seismic and 1.0 for pseudostatic with deformation analysis if the factor of safety is less than 1.0.

### Seismic stability

In July 2009 URS reviewed the ground motions at Olympic Dam for the stability analysis of the recently approved TSF Cell 5, using the latest available data including earthquakes occurring in the Denison seismic source zone (about 90 km east of Olympic Dam in the Flinders Ranges). URS confirms that the peak ground acceleration values for return periods of 475 years, 1,000 years and 10,000 years are 0.022 g, 0.032 g and 0.10 g respectively. The seismic coefficient used in a pseudostatic analysis is generally taken (Duncan and Wright 2005) as 50% of the peak ground acceleration. A conservative pseudostatic analysis using a seismic coefficient of 100% of the peak ground acceleration, for a return period of 10,000 years, of 0.10 g results in a factor of safety of 1.14 for optimised block failure or 1.15 for circular failure, which are in excess of the recommended factors of safety in the current and draft revised ANCOLD Tailings Guidelines.

### TSF drainage systems

*Toe drain design*

Figure 5.23 of the Draft EIS proposed that some acidic liquor may be collected outside the TSF in the upstream toe drain. Very little liquor is anticipated to enter this drain once the beaches were established as there is no direct connection (flow path) between the drain and any body of water that would give rise to an ongoing flow of water to the drains. Once the beaches had been established, the rockfill and the drains would have a de-pressurisation function, promoting tailings consolidation and increasing stability.

Any liquor collected in the drains would be directed to lined sumps, together with any liquor collected from the embankment and the downstream toe. Depending on the location and distance to the surge pond, the liquor would be either pumped to the surge pond for recycling to the plant or pumped to the top of the embankment and disposed of onto the beach.

*Blocked drain condition*

The drain failure or 'blocked drain' case is not applicable to the rockfill embankment design because the rock materials used for wall construction would be as-mined, and therefore high in permeability (much higher than consolidated tailings and crushed rock). As a result, there are no potential impacts associated with the blocked drain case in the proposed expanded TSF design.

### Final rock armouring

Final rock armouring of the outer TSF walls for the expanded operation would occur at closure if deemed necessary. The closure design does not affect the operating embankment design. That is, the cross-section illustrated in Figure 6.3 of Appendix F1 to the Draft EIS would apply during operation. After closure, the armouring could provide additional stability and erosion protection if required.

As noted in Appendix F1 to the Draft EIS, further investigations would be undertaken during the operation period to define the design aspects that require management in the lead-up to closure. The final closure methodology, including the selection of the most appropriate materials to be used, would be confirmed by conducting field trials during the operation period using the various cover sequence materials stockpiled for this purpose.

The Draft EIS refers to '…leaving the outer embankments of the TSF at their angle of repose'. It is acknowledged that this sentence could be interpreted as implying that the TSF slope may be steepened at closure, however that is not proposed. The outermost slope of the armouring placed adjacent to the outermost TSF slope at closure may be left at its constructed slope angle (30 to 37 degrees). The purpose is to minimise the length of slope that would be susceptible to erosion. The armouring would be constructed in lift heights and use materials that would ensure that segregation of larger boulders had no impact on the long-term stability of the armouring.

#### Dusting from the TSF

The extent of wind erosion is expected to be low during operations because the tailings surface is wet during deposition cycles. In addition, investigations over the past 20 years of operation at Olympic Dam show the crust of iron and salts on the tailings surface forms a wind-resistant competent surface for the tailings.

Studies undertaken for the two previous Environmental Impact Statements for Olympic Dam also support this conclusion. The 1982 Olympic Dam EIS (Kinhill-Stearns Roger 1982) presented findings from wind tunnel tests on the dried tailings with a range of moistures and wind speeds. Sampling showed that even at high wind speeds the driest samples failed to produce measurable dust, although there was some movement of salt flakes.

The 1997 Olympic Dam EIS (Kinhill 1997) demonstrated that dust monitoring around the perimeter of the TSF confirmed that this facility is not a major emission source. This is because the smooth, flat, even-size grain and moist surface of the tailings limits the processes, such as saltation and creep, that could lead to dust lift-off. The tailings also form a crust upon drying. The potential for dusting is increased during mechanical working of the tailings, particularly when tailings are used to construct the successive lifts of the walls, but water sprays are effective in limiting the release of dust. With the introduction of the open pit this risk would be eliminated because rock material from the open pit, instead of consolidated tailings, would be used to raise tailings walls.

More information regarding the impact of dust generation from the expanded operation was presented in Chapter 13 of the Draft EIS, and Chapter 14 of the Supplementary EIS.

#### Constituents of tailings

The composition of the existing tailings solids and liquor was detailed in Tables 5.18 to 5.21 of the Draft EIS. It is expected that the combined tailings associated with the expanded operation would remain similar to these existing values.

## 5.4 ON-SITE WASTE MANAGEMENT

### 5.4.1 LANDFILL

**Issue:**

Further information was requested regarding the design and operation of the proposed on-site landfill facility, including proposed licensing arrangements and risk mitigation features. A commitment to the waste hierarchy was requested.

**Submission:** 2

**Response:**

#### The waste management facility

The proposed on-site waste management system was described in Section 5.6 of the Draft EIS, with the location of the proposed facility shown in Figure 5.8. The new waste management facility would comprise:

- a waste transfer station that would be used for waste segregation
- a recyclable/reusable materials store located near the rail head
- a new general waste landfill facility of approximately 56 ha, which would have sufficient space for an expected service life of 60 years.

The proposed landfill facility would be designed and operated in accordance with the relevant sections of the SA EPA Environmental Management of Landfill Facilities Guidelines (EPA 2007a).

A conceptual design for the proposed landfill is shown in Figure 5.10 of the Supplementary EIS, showing the concept of individual cells with a life of about 12–24 months each, together with indicative foundation and landfill cover details. As outlined in the Draft EIS, the construction and operation of the proposed landfill is a low-risk activity, with potential risks being reduced through the:

- negligible proportion of putrescibles (i.e. less than 0.5% during operations)
- low-rainfall climate (i.e. annual average rainfall of 167 mm and only 40 days of rain per year on average)
- separation from ground and surface waterbodies greater than that specified in the SA EPA Guideline
- largely inert composition of the waste stream
- significant current and proposed resource recovery activities
- promotion of waste management practices that divert the hazardous waste stream to alternative locations, and appropriate methods for recovery, treatment and disposal.

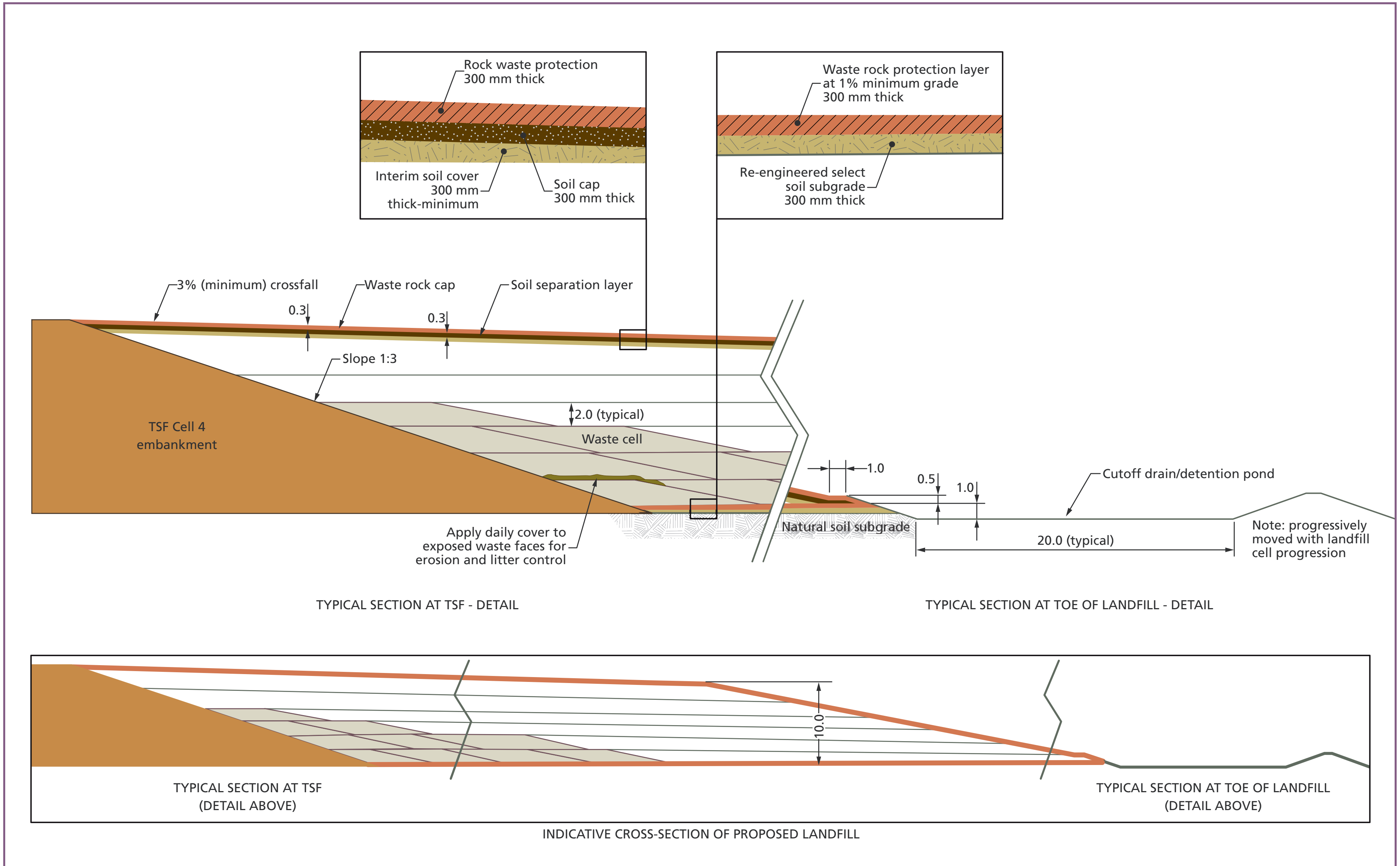



Figure 5.10 Indicative cross-section of the proposed on-site landfill

### Waste hierarchy

BHP Billiton currently operates a waste management system based on the waste hierarchy (as illustrated in Figure 5.11 of the Supplementary EIS) and this would continue during the design, construction and operation phases of the expanded operation. Table 5.22 of the Draft EIS detailed the range of reuse and recycling opportunities being investigated for those materials that comprise the majority of existing and potential future landfill wastes, and there are additional investigations under way regarding the reuse or recycling of spent acid plant catalysts and haul truck tyres (see Sections 5.4.2 and 5.4.3 of the Supplementary EIS, respectively). The existing site Waste Management Environmental Management Plan (EMP) would be updated to detail reduction, reuse and recycling schemes for all waste material streams where environmentally and commercially satisfactory arrangements are possible.

The following are examples of potential opportunities for the expanded operation:

- improved 'at-source' sorting into appropriately placed and colour-coded bins and skips
- innovative methods for clearly delineating wastes that are unlikely to be contaminated (with audit protocols to determine the effectiveness of this strategy)
- implementing a widespread education campaign to inform the workforce and contractors of the high costs associated with waste management, and how to reduce this without compromising safety
- improved procurement protocols to place greater responsibility on suppliers to reduce imported materials that would contribute to waste (e.g. packing materials and cases).

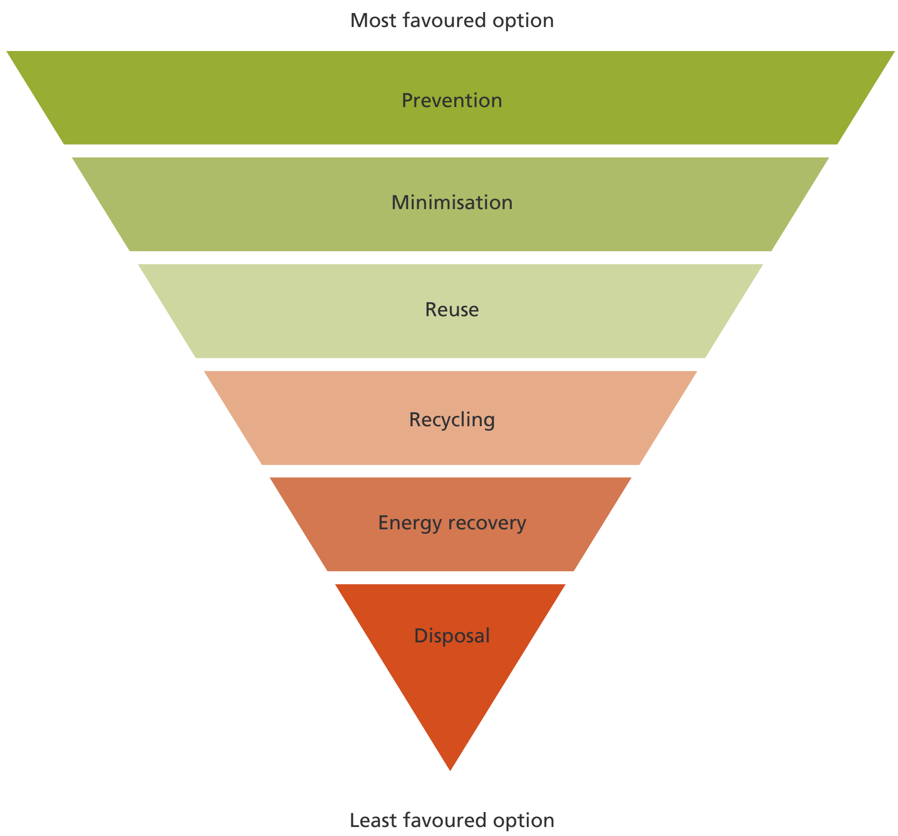



Figure 5.11 Waste hierarchy

### 5.4.2 SPENT CATALYST

**Issue:**

Clarification was sought on the proposed disposal method for spent acid plant catalyst, with respect to the waste hierarchy.

**Submission:** 2

**Response:**

Investigations into the reuse and recycling of spent acid plant catalyst continue. In the absence of a viable, cost-effective recycling or reuse solution, the current practice of disposing of spent catalyst in the tailings storage facility (TSF) would continue.

In order to efficiently and effectively convert sulphur dioxide ($SO_2$) generated from both the smelting operation and the additional elemental sulphur burning into sulphur trioxide ($SO_3$), the high $SO_2$ off-gas is passed through a converter, which is essentially a tower containing multiple beds of a catalyst as described in Section 5.5.4 of the Draft EIS. The resultant $SO_3$ is subsequently used to produce sulphuric acid in the absorption sections of an acid plant.

Typically, the catalyst that is used consists of either vanadium pentoxide or caesium-coated (6–9% by mass) silica rings of around 1–2 cm diameter. Periodically, the catalyst requires screening in order to maintain conversion efficiency as the silica rings break down, resulting in the compaction of the catalyst beds and a reduction in the surface area available to facilitate the conversion reaction. As discussed in Section 5.6.6 of the Draft EIS, the installed capacity of acid plant catalyst would be around 4.1 ML.

Routine maintenance is undertaken to screen the fine catalyst material from the gas converter beds, with the first bed being screened every three years, the second bed every six years and the third and fourth beds every nine to 12 years. On average, such screening is expected to generate around 225,000 litres of catalyst fines every three years, which would initially be transferred to lined steel drums and stockpiled for disposal or recycling.

As discussed in Section 5.6.6 of the Draft EIS, numerous options are being investigated for the reuse, recycling and/or disposal of spent catalyst, a summary of which is presented below. The existing operation currently disposes of spent catalyst to the TSF, and it is likely that, in the absence of a viable, cost-effective recycling or reuse solution, this method would continue for the expanded operation.

BHP Billiton waste management practices are aligned with the waste hierarchy, and several reuse and recycling options have been, and in some cases continue to be, investigated for the treatment of spent acid plant catalyst fines, including (see Appendix C2 of the Supplementary EIS for further details):

- the on-site amalgamation of fines into a useable product suitable for reuse in a gas converter
- the reuse of the catalyst fines in a smaller-capacity gas converter
- the return of the spent catalyst to the manufacturer for remanufacturing into catalyst
- the 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 is 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
- burial in landfill or charged into stopes as backfill material together with cement aggregate fill (CAF).

To date, however, no viable alternative over the burial in the TSF has been identified.

### 5.4.3 TYRES

**Issue:**

Further information regarding the alternatives for disposal of waste tyres was requested.

**Submissions:** 2, 13 and 224

**Response:**

It is estimated that around 8,000 tonnes of waste tyres would be generated per annum by the expanded operation when operating at full capacity. Section 5.6.3 of the Draft EIS detailed the options currently being assessed for the management of waste tyres, specifically:

- options to increase the life of haul truck tyres
- retread and repair of used tyres

- reuse of waste tyres for road demarcation, fencing and berms
- energy recovery through shredding and combustion.

The primary focus at present is the extension of haul truck tyre life and trials associated with creating tyre crumb for reuse.

The extension of haul truck tyre life is an important factor in maintaining the required mining rate, and can influence not only the number of tyres required per annum, but also the down-time of the haul trucks, and hence the number of trucks required. Several factors can influence haul truck tyre life, including:

- the type of tyre used
- the size, speed and load-carrying ability of the haul trucks
- the haul road surface.

Many of these factors require consideration of the trade-off of tyre life against other operational requirements. For example, a high-quality hard-surface haul road results in greater tyre wear, but requires less maintenance and may result in fewer dust emissions. Investigations regarding initiatives to increase tyre life would be progressed during detailed design.

Haul truck tyre granulation trials have been undertaken as part of the expansion project. For the trials, the tyres (with a total weight of around four tonnes each) were sliced into segments of around 50 kg and passed through a proprietary granulation process. These trials indicate the steel can be separated from the rubber of a haul truck tyre, and the rubber can then be granulated. The tyre crumbs were subsequently converted to a 'rebounded rubber' that has physical characteristics virtually identical to those of the vulcanised rubber that made up the original tyre. The uses for this rebounded rubber product require further investigation but may include:

- conveyor rollers
- machine pads
- matting
- sleepers
- collision pads/bumpers
- rubberised asphalt.

Alternatively, the crumb may be used in kilns and furnaces as tyre-derived fuel (TDF).

While the tyre recycling trials to date have shown promise, some issues require further investigation. These include the handling and processing of the large and heavy mine truck tyres at the required scale; potential issues associated with radiation concentrations in used tyres; and the distance from Olympic Dam to either potential recyclers or to potential markets for rubber crumb, both of which increase the costs (and therefore reduce the potential markets) associated with tyre crumb products.

As discussed above, these recycling and reuse studies are ongoing. No commitments can be made until the technologies and market are demonstrated to be practicable at the scale required. The Draft EIS proposed a base case management practice of disposing of the waste tyres in the rock storage facility (RSF). This is a standard practice in open-pit mining operations, and is considered to be an acceptable management method in the absence of other reuse and recycling opportunities. A procedure would be developed, similar in content to that currently used at the BHP Billiton Iron Ore operations in Western Australia, and would contain some site-specific variation of the following general requirements:

- tyres to be positioned in neat rows and as close as possible to the toe of the RSF
- disposal of tyres at noses in the RSF geometry to be avoided
- tyres to be positioned in depressions in the RSF so they are more easily covered by a smooth dump progression
- heavy vehicle tyres to be stacked no more than four high
- light vehicle tyres to be placed in heavy vehicle tyres
- no more than 100 tyres to be exposed at any one time
- inert material to be used to cover the tyres
- geotechnical advice would be sought to determine the appropriate depth of cover to ensure RSF stability.

Temporary tyre storage would comply with relevant legislation, and be consistent with the requirements of the SA EPA Guidelines for Waste Tyres (EPA 2007b) and the SA Fire Services General Guidelines for the Outdoor Storage of Used Tyres.

### 5.4.4 LOW-LEVEL RADIOACTIVE WASTE

**Issue:**

Further information was requested about the disposal of low-level radioactive waste.

**Submission:** 2

**Response:**

As described in Section 5.6.5 of the Draft EIS, low-level radioactive wastes consisting of used personal protective equipment and laboratory wastes generated during the operation of the expanded mine and processing facilities would be diverted to designated areas of the tailings storage facility (TSF) for disposal. This is a continuation of existing practice, and would be undertaken consistent with the requirements of relevant codes and legislation. It is estimated that around 48 $m^3$ of these wastes would be generated per annum.

The requirements for disposing of waste materials into the TSF are summarised in a site procedure, which details the required communications, assessments and record keeping associated with this waste disposal pathway. This procedure would be updated as required for the proposed expansion. All equipment and material that left the expanded operation would be subject to a radiation clearance check to ensure compliance with relevant requirements.

Materials and infrastructure that were used on-site and were determined, through the site radiation clearance process, to be unsuitable for disposal off-site, would be disposed of in the site waste management facility as per existing practice.

### 5.4.5 TEMPORARY STOCKPILES

**Issue:**

The location of temporary sand and topsoil stockpiles was requested.

**Submission:** 2

**Response:**

Most of the sand and topsoil would be generated during the initial stripping phase of open-pit construction, and therefore would be central to the proposed disturbance footprints associated with the development of the processing plant and RSF. In order to avoid additional vegetation clearance, it is likely that wherever possible temporary sand and topsoil stockpiles would be placed in areas proposed for future RSF disturbance (refer to Figure 5.8 of the Draft EIS for the location of the proposed RSF footprint). In addition, Section 23.9.1 of the Draft EIS confirmed that the reuse of topsoil within one to two years would be targeted to maximise the potential for biological stock to remain in the soil.

### 5.4.6 SPILL MANAGEMENT

**Issue:**

A commitment was sought regarding the standard of bunding that would be installed in applicable areas of the expanded operation.

**Submission:** 2

**Response:**

Section 22.6.8 of the Draft EIS stated that 'bulk storage facilities would be designed and constructed in accordance with applicable standards and legislation'; that commitment remains unchanged. As stated in the Draft EIS, as a minimum, the SA EPA bunding guideline (EPA Guideline 080/07) (EPA 2007c) would be used. This requires a bund to have amond other things, a minimum volume of 120% of the largest tank contained within it, and 133% for flammable and combustible liquids.

## 5.5 WATER SUPPLY

### 5.5.1 DESALINATION PLANT

**Issue:**

Clarification was sought regarding exclusion zones for fishing around the intake and outfall pipes for the proposed seawater desalination plant at Point Lowly.

**Submission:** 227

**Response:**

Exclusion zones would be established around the pipelines during the construction phase, as barges and other heavy equipment would be operating. The size and nature of the zones would be determined in consultation with the construction contractor and designed to protect the safety and well-being of the public and construction staff.

A benchmarking study of exclusion zones around other similar desalination plant infrastructure throughout Australia has been undertaken as part of the Supplementary EIS, with a view to establishing best-practice safety standards for the proposed plant. The study indicated that all major coastal desalination plants recently constructed or proposed in Australia either established or have proposed exclusion zones during the construction phase. However, no exclusion zones have been permanently established (that is, during operations). The intake and outfall are typically marked on relevant marine charts, and in some cases a beacon is established over these structures. Commercial fishing and trawling operations are likely to be restricted in the immediate vicinity of the underwater infrastructure (pipelines and diffuser) to mitigate the risk of damage. Recreational fishing activities are unlikely to be restricted during the operation phase.

The nature and size of exclusion zones and markers (if any) around the proposed pipeline intake and outfall during operation have not been determined yet, but would be detailed in operational management plans, which would be communicated to the public once finalised.

**Issue:**

It was questioned whether potable water could be made at the proposed desalination plant, with the respondent suggesting that this may be difficult given the elevated salinity levels in the Point Lowly area. The use of nanofiltration and hypofiltration desalination technologies to achieve higher-quality water was suggested.

**Submission:** 219

**Response:**

Potable water can be produced via the reverse osmosis desalination process from seawater of any salinity, including that which occurs at Point Lowly (which is typically between 40 and 43 g/L). It is common for desalination plants to produce different water streams with a range of qualities (for example, the existing Olympic Dam desalination plant produces three different water qualities). The proposed desalination plant would produce up to 80 ML/d of potable water to meet the South Australian Government allocation, should this be progressed. The further 200 ML/d would not nominally produce potable water because the nature of the proposed expanded operation, for which this water would be used, does not demand water of this quality; rather, it requires industrial water, and therefore it is not intended to implement nanofiltration or hypofiltration technologies. Any high-quality water required for the operation would be further treated in the on-site desalination plant as required.

A pilot desalination plant has been operating at Point Lowly for three years. Tests performed on the output from this plant have established that the water off Point Lowly can be readily desalinated to meet the criteria required for the proposed expansion.

Water for Roxby Downs and Andamooka would be a blend of on-site desalinated Great Artesian Basin (GAB) water (as presently supplied) and coastal desalination water. The blend would be treated as appropriate to meet the relevant Australian Drinking Water Guidelines (ADWG) for aesthetic quality.

**Issue:**

It was suggested that the Draft EIS included a number of inconsistencies regarding the existing and proposed water demand from the GAB and the proposed coastal desalination plant. Clarification was requested to address the concern that the plant may be undersized for the projected water demand and possible future changes in groundwater availability.

**Submissions:** 2, 27 and 219

**Response:**

The Draft EIS assessed a coastal desalination plant of sufficient capacity to provide up to 200 ML/d to the proposed expanded Olympic Dam operation, plus an additional 80 ML/d for use by the South Australian Government if required. The 200 ML/d demand is the predicted peak demand (i.e. greater than the anticipated average demand of 186 ML/d) to ensure that the assessment of potential impacts on the marine environment was conservative (i.e. local impacts were overestimated rather than underestimated).

The average daily demand water use for the existing Olympic Dam operation assumed in the Draft EIS is approximately 37 ML/d from the GAB (i.e. existing operation plus the proposed optimisation), with some additional water reclaimed from local saline wellfields (particularly dewatering of the Mashers Fault system) and from groundwater wells around the existing tailings storage facility (TSF). For this reason, some tables and figures in the Draft EIS carried the disclaimer 'does not include all sources' or similar.

The apparent inconsistencies noted in the submissions relate to figures in Table 5.26 in the Draft EIS, which total about 191 ML/d, rather than the stated average of 186 ML/d. This is because existing off-site water use (i.e. usage associated with Roxby Downs, Andamooka and the existing Olympic Dam Village) is included in the total. Therefore, the additional water demand to support the expanded operation remains as quoted at 186 ML/d (average daily demand) as per the Draft EIS.

The assessment of the potential impact of the proposed desalination plant has been undertaken using the assumptions outlined above. Any further expansion of the plant or increase in capacity beyond that described in the Draft EIS would be subject to further government approvals.

**Issue:**

Clarification was requested about the volume of desalination plant backwash solids that would require land disposal, and whether there was any potential for further processing or use of the waste from the desalination plant to prevent or reduce the volume going to landfill. Clarifications regarding potential lagoon sizes and the potential for generation of odours were also sought.

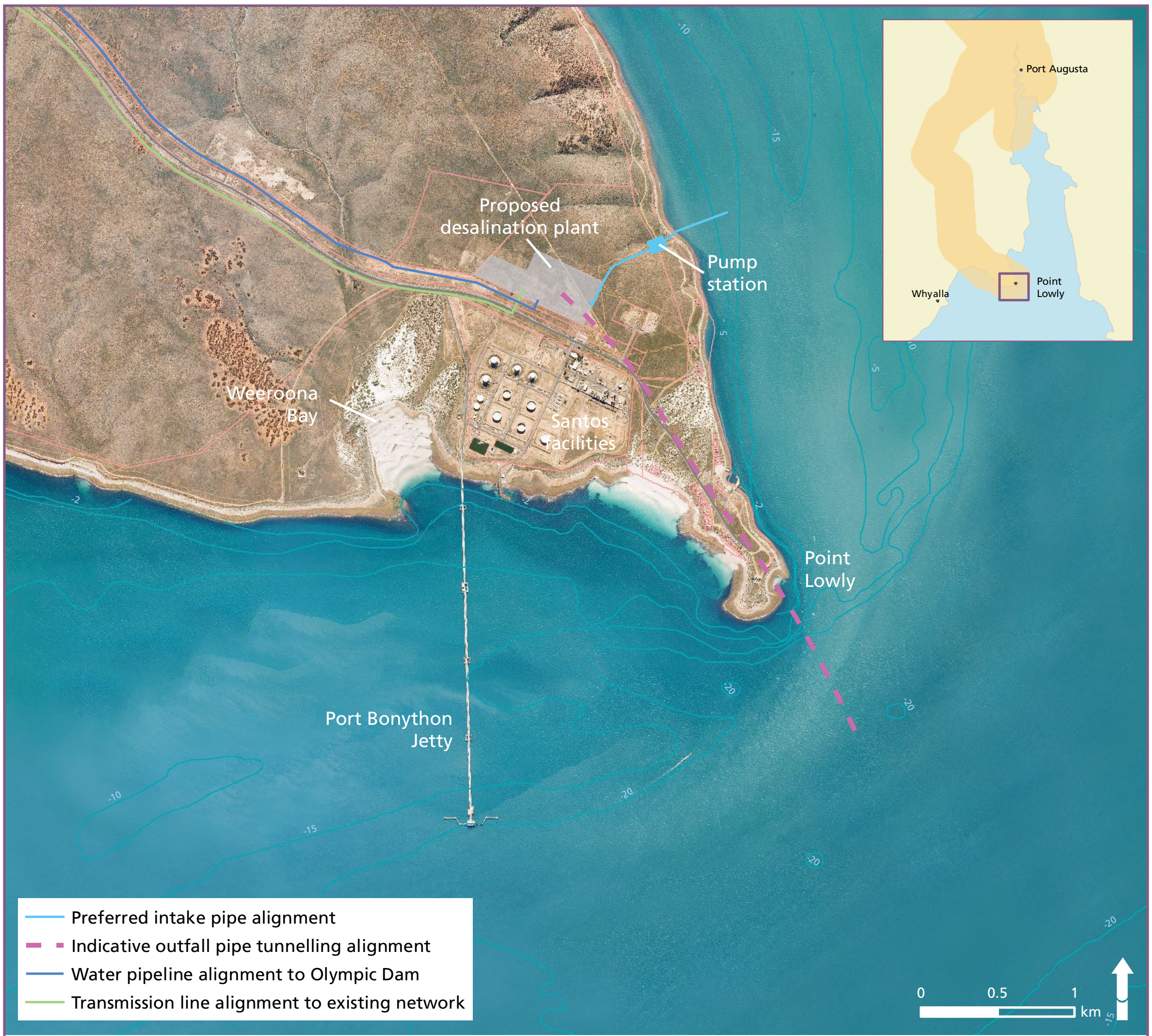
**Submissions:** 90 and 212

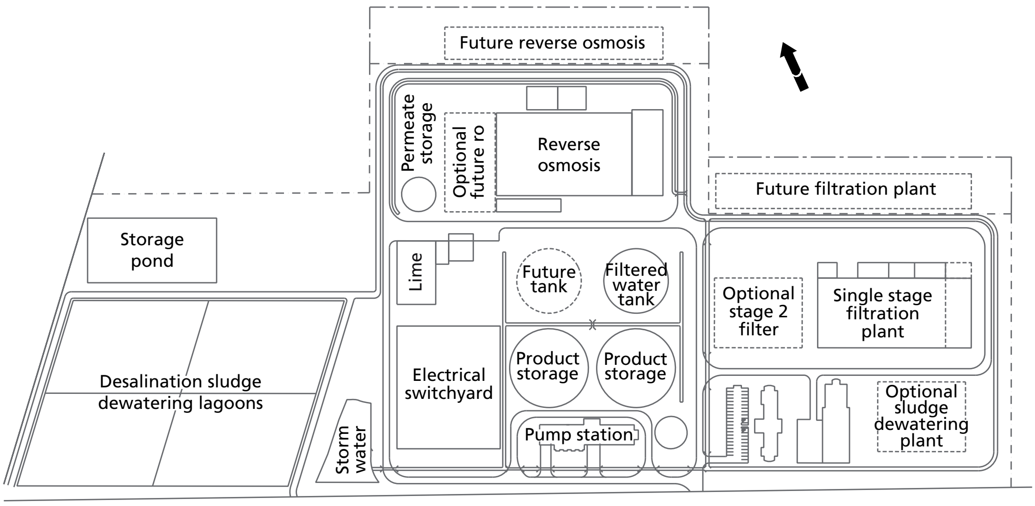
**Response:**

If operated at the peak capacity of 280 ML/d (i.e. 200 ML/d for the Olympic Dam expansion plus the 80 ML/d allocated to government use) the proposed desalination plant would generate about 6,600 tonnes of backwash sludge per year from about 28.3 ML/d of backwash wastewater. The sludge would contain around 1,425 tpa of suspended solids (at 6 mg/L) and 2,965 tpa of ferric chloride (at 12.5 mg/L), together with around 50% residual water. The volumes and frequency of waste generation would change depending on the final waste management option chosen. Both the mechanical dewatering and sludge lagoon options would result in the generation of about 5,700 $m^3$ of waste per year, however the mechanical dewatering waste would be disposed of weekly (approximately 110 $m^3$ per week), whereas sludge lagoons would be emptied approximately every six months (with a volume of around 2,850 $m^3$ per cycle).

As discussed in Section 13.5.3 of the Draft EIS, the backwash sludge has the potential to generate odour as a result of the decay of organic matter. However, maintaining shallow ponds with a high rate of water inflow and outflow, together with six-monthly sludge disposal, is expected to minimise odours. Mechanical dewatering, if chosen, would result in little or no odour being generated, based on the experience at other, similar facilities. As the final backwash management solution has not been chosen, the sludge lagoon design has not been finalised. However, at least two ponds with a capacity of at least 2,800 $m^3$ would be required. At 1 m depth (shallow to encourage greater evaporation), the required area would be about 5,600 $m^2$, or approximately 75 m square, and each would be lined with a low-permeability material to prevent leaching from the ponds. The proposed location of the sludge lagoons was presented in Figure 5.30 of the Draft EIS, and is repeated here as Figure 5.12.

Disposal of the generated backwash sludge/solids would nominally be by truck to an appropriately licensed landfill facility, consistent with other recent desalination plant proposals. However, there exists some potential for beneficial reuse of the sludge material, particularly as a substitute construction material/fill, landfill cover material or as organic fertiliser. BHP Billiton would welcome the opportunity to discuss these options further with interested parties.




Indicative layout

Figure 5.12 Desalination plant showing desalination sludge dewatering lagoons

**Issue:**

The Draft EIS discussed the allocation of up to 80 ML/d from the desalination plant to replace River Murray water currently supplied to the Eyre Peninsula. It has been asked whether the South Australian Government is still committed to this, whether it has agreed to pay for whatever infrastructure would be necessary to supply the water, and whether the water produced would be of drinking quality. It was also asked whether, if River Murray water was replaced and the desalination plant encountered problems, BHP Billiton would reduce flows to the operation in preference to maintaining supply to the Eyre Peninsula, and whether the existing Murray pipeline network would be maintained as a backup.

**Submissions:** 238 and 322

**Response:**

In February 2006, BHP Billiton and the South Australian Government entered a Memorandum of Understanding (MoU) to jointly assess the potential impacts and benefits associated with a 280 ML/d coastal desalination plant, of which 200 ML/d would be available to the proposed Olympic Dam expansion and 80 ML/d to the South Australian Government. This was reflected in the Draft EIS (as per Section 5.7.4 of the Draft EIS), which assessed the potential impacts and benefits of the proposal on the basis of this total water volume. Since the development of the Draft EIS, the South Australian Government has stated publicly that it is not progressing its involvement in the proposed Point Lowly coastal desalination plant.

While BHP Billiton has maintained the impact assessment for the full 280 ML/d in the Supplementary EIS to retain the possibility of future government use of the 80 ML/d, water supply to the Eyre Peninsula and the use and maintenance of the water network from the River Murray will continue to be the responsibility of the South Australian Government.

**Issue:**

The question was raised that if the brine dispersion was as efficient as noted in the Draft EIS, then why are the intake and outfall pipes not located in the same area or even the same trench? Clarification was also sought on the size of the intake pipe.

**Submissions:** 26 and 346

**Response:**

Consistent with most desalination plants, the intake and outfall pipelines are placed in separate trenches as the desalination plant intake does not require high current and therefore the shortest route from the plant to the intake location is preferred.

Furthermore, locating the intake and outfall pipelines in separate trenches minimises potential engineering complications (e.g. the foundation rock at Point Lowly is particularly hard and would make it difficult to construct a trench large enough to seat the two pipelines) and provides separation between intake and outfall to eliminate the potential of short-circuiting, that is, to prevent more saline water from the outfall entering the intake because any increase in salinity, no matter how small, means more energy is required for desalination. Having separate pipeline trenches also simplifies maintenance and pipeline inspections, as required.

As presented in Table 5.28 of the Draft EIS, the proposed volume of intake water would be 650 ML/d, requiring an intake pipeline 3 m in diameter.

### 5.5.2 SALINE WELLFIELD

**Issue:**

Further information was sought regarding the potential uses for local saline and mine dewatering water – including local desalination – in preference to using it for dust suppression. Concerns regarding management measures, including management of excess water and licensing requirements, were also raised.

**Submissions:** 2, 27, 102 and 213

**Response:**

The primary water supply source for the existing Olympic Dam operation would continue to be the existing Great Artesian Basin (GAB) wellfield, and the primary source for the expanded operation would be a coastal desalination plant. The reasons for selecting the desalination water supply option over other alternatives investigated was detailed in Section 4.8 of the Draft EIS (see also Section 4.3 of the Supplementary EIS for further discussion).

The water supply for the construction of the on-site infrastructure associated with the expanded operation would be sourced from the regional saline wellfields as described in Section 5.7.7 of the Draft EIS and shown here in Table 5.7.

**Table 5.7 Indicative saline wellfield abstraction rates**

| Saline wellfield | Average abstraction rate (ML/d) |
|---|---|
| Open pit depressurisation wells | 5–15 |
| Motherwell wellfield | 25 |
| Local saline wellfields | 10 |

This regional water would be used for the duration of the construction phase. Ongoing refinement to modelling of the aquifer's response to the extraction would determine whether the option of continuing to use the Motherwell wellfield as a source of low-quality water could be sustained beyond the construction phase. An area to the west of the proposed wellfield (and within the Woomera Prohibited Area), has been identified as a future possible alternative for the continued supply of saline water to the expanded operation. Further investigation of this area may be conducted to determine the suitability and availability of this area as a future supply option.

The abstracted water would be used for general construction activities such as foundation compaction, and also used for dust suppression for the mining operation during the pre-stripping phase. As detailed in Section 5.7.7 of the Draft EIS, the salinity of the saline wellfield water is around 50,000 mg/L of total dissolved solids, which could be desalinated via the relocated on-site desalination plant if there was sufficient demand for high-quality water. However, it is proposed that high-quality water would continue to be sourced from the GAB, which has an average salinity (electrical conductivity) of around 3,000–4,000 µS/cm (GAB Wellfields Report 2009). This makes desalination significantly less energy- and maintenance-intensive for GAB water than local saline water.

Extracting water from the saline wellfield would be managed so that large quantities of excess water were not generated. Lesser volumes of excess water would be used for additional dust suppression activities. Trials of water reinjection into the Motherwell wellfield (i.e. managed aquifer recharge) were not progressed beyond the planning stage once the water demand was found to be greater than the likely supply. As such, neither the Draft EIS nor the Supplementary EIS seeks approval for managed aquifer recharge.

In relation to licensing requirements, the extraction of water from the saline wellfields, with the exception of extraction associated with mine depressurisation, would require a Special Water Licence sought under the Roxby Downs Indenture.

### 5.5.3 ON-SITE DESALINATION

**Issue:**

It was requested that the location of the new on-site desalination plant be confirmed in the Supplementary EIS to ensure it is not affected by the location of the RSF. Clarification on the operation of the on-site desalination plant and the management of the brine generated from the plant was also requested.

**Submissions:** 2 and 119

**Response:**

The location of the proposed relocated on-site desalination plant was shown in Figure 5.12 of the Draft EIS. This figure, together with the addition of the proposed RSF boundary, is reproduced here as Figure 5.13. This location would maintain connection to the borefield pipeline with minimal new pipeline installation required. After the new on-site plant had been commissioned, the existing plant would be decommissioned and removed.

As with the existing plant, the new plant would continue to supply about 14 ML/d of desalinated water to the operation and regional users, with the brine generated from the reverse osmosis desalination process being added to the remaining GAB extraction to form 'process water' for use in the processing plant where high-quality water is not required. No permanent on-site or off-site disposal of brine from the new plant would be required.

The existing on-site plant, used to desalinate GAB water for use as drinking water in Roxby Downs and Andamooka and for high-quality water in the existing metallurgical process, is immediately south of the proposed open pit. Although not immediately affected by the open pit operations, the site is likely to fall within the proposed blasting exclusion zone designed to protect personnel from fly-rock. As a consequence it would need to be evacuated before each blast, and shielding would need to be installed to protect the asset itself. Ultimately, this desalination plant would need to be relocated.

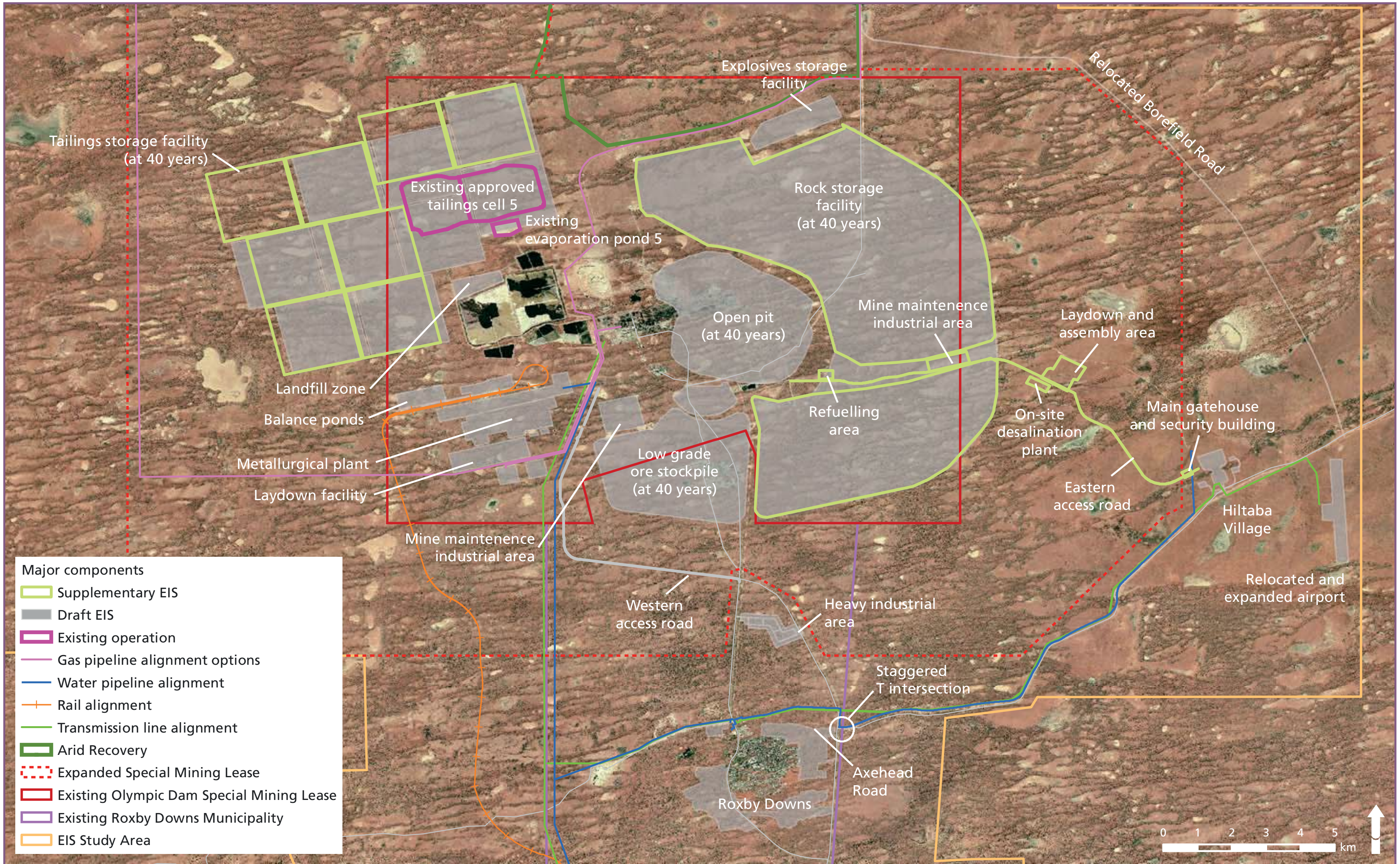



Figure 5.13 Indicative location of the on-site desalination plant and rock storage facility

### 5.5.4 WATER BALANCE AND WATER REUSE

**Issue:**

Questions were raised regarding the quality and quantity of water required to undertake metallurgical processing for the expanded operation, and the opportunities for implementing water reuse and recovery projects to reduce water demand.

**Submissions:** 2, 24, 102 and 391

**Response:**

Water quality

The quantity and a description of the source of the water associated with the proposed expansion was summarised in Table 5.26 of the Draft EIS, and illustrated in Figure 5.26 of the Draft EIS, indicating that the expanded metallurgical plant would require an additional 151 ML/d of water. The proposed expanded metallurgical plant would use water for a range of purposes. The quality of water required varies depending on the purpose. Similarly the existing operation uses water with varying qualities to suit particular applications in the metallurgical process. Specifically:

- desalinated GAB water (potable water) is used in the solvent extraction phase of the hydrometallurgical plant
- process water (which consists of 'raw' GAB water mixed with the brine generated during on-site desalination) is used in the concentrator and for various low-quality uses across site, including dust suppression and vehicle washdown
- high-quality water (demineralised water) is used in the refinery and slimes treatment plant, and for cooling water in the smelter.

The expanded metallurgical plant would similarly require water in a range of different qualities, and the operation of the coastal desalination plant would be optimised to provide water of a quality sufficient for use as both potable and process water. The existing on-site desalination plant (currently and after relocation) would produce demineralised water for use in the expanded operation as required. Low-quality water, such as that abstracted from the saline wellfields and mine depressurisation, would be used for dust suppression, vehicle washdown and general construction activities.

#### Water reuse and recycling opportunities

A number of significant water reuse and water saving opportunities have been identified and implemented in the proposed expanded operation. The most significant of these focus on maximising the reclaim and reuse of liquor from the tailings storage facility (TSF) by creating a demand for acidic liquor in the metallurgical plant.

The water circuit for the expanded operation comprises two components or circuits: acidic water and neutral water. The separation of these two circuits is fundamental to creating the necessary water demand (see Figure 5.14 of the Supplementary EIS). Section 5.5.4 of the Draft EIS provided details of the new flotation tails thickening stage added to the concentrator process. This allows a significant proportion of the neutral water used during the grinding and flotation stages of the process to be separated from the flotation tails material using a series of deep cone thickeners, which thicken the slurry to about 65–70% solids. The neutral water obtained during the thickening process is returned to the grinding mills and reused, with additional neutral water obtained from the proposed coastal desalination plant. The thickened slurry is transferred to the hydrometallurgical plant, where it is repulped using acidic liquor recycled from the TSF and mixed with sulphuric acid from the new sulphuric acid plants in the tails leach tanks. The degree of flotation tailings thickening is therefore intrinsically linked to both the volume of acidic liquor that can be returned from the TSF and desalinated (neutral) water used in the concentrator plant. Further investigations into maximising the potential thickening efficiency would continue to be progressed through detailed design and into operations.

Another significant water conservation measure is the proposal to use TSF balance ponds in preference to additional evaporation ponds. Designed to temporarily store liquor reclaimed from the TSF, these ponds would be deeper and smaller in surface area than the existing evaporation ponds, in order to maximise the volume of liquor available for return to the metallurgical plant. Similarly, new groundwater wells would also be commissioned around the TSF to reclaim water from the aquifers beneath the TSF for use in the metallurgical plant.

The use of low-quality water from mine depressurisation and local saline aquifers for dust suppression activities avoids the need to use more expensive and more energy-intensive desalinated water for this purpose, and the use of chemical suppressants and water fogging systems could potentially result in further reductions in overall water usage. These measures would be investigated further during detailed design.

Section 4.2.1 of the Supplementary EIS provides further commentary on the water efficiency improvements made at Olympic Dam for the existing operation and the proposed expansion.

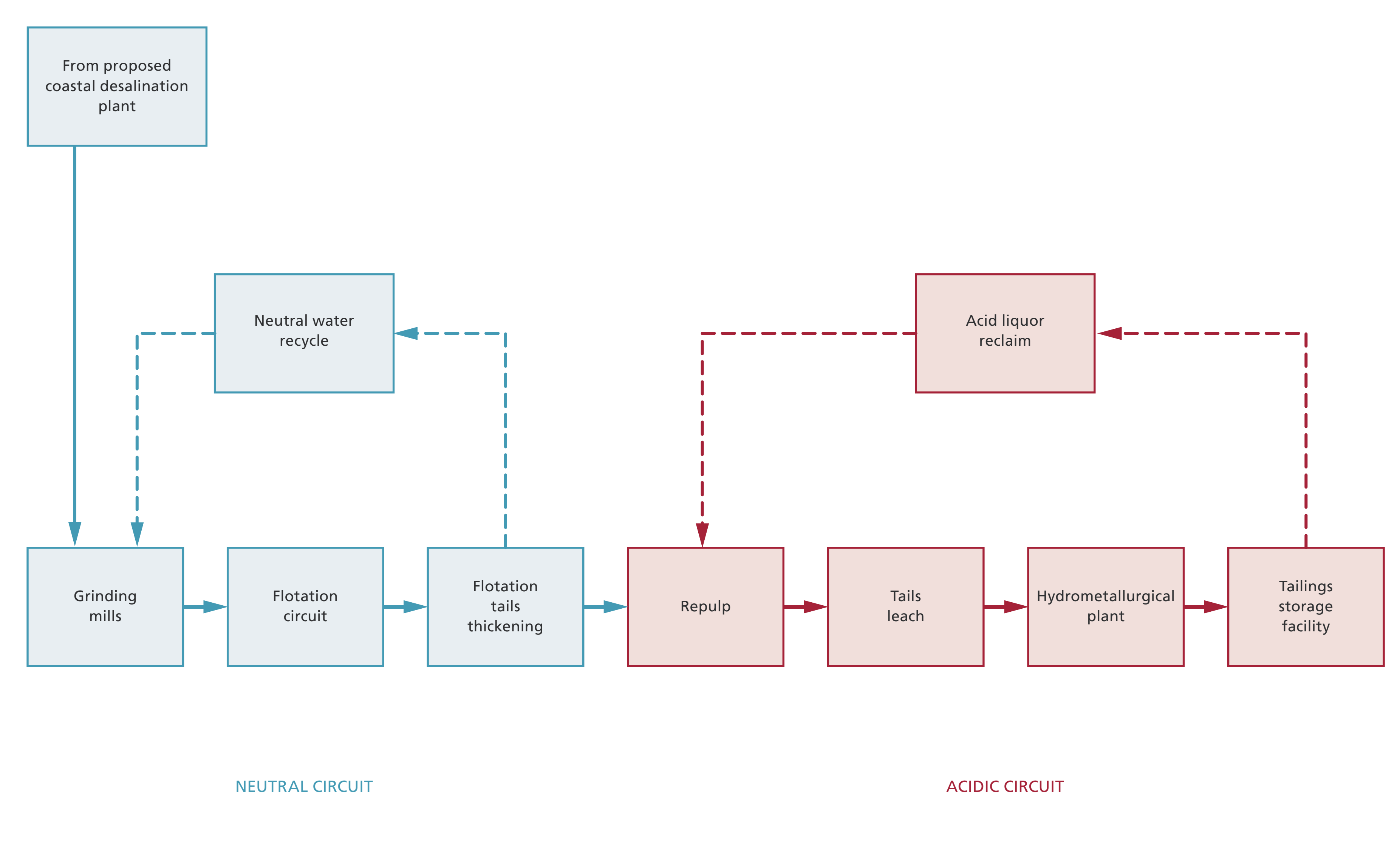



Figure 5.14 Conceptual water circuits for the expanded operation

## 5.6 ENERGY SUPPLY

### 5.6.1 ELECTRICITY SUPPLY

**Issue:**

Clarification was sought regarding the expected electricity usage for the proposed expansion and combined operation.

**Submission:** 2

**Response:**

The existing and proposed electricity usage was detailed in Table 5.36 and 5.37 of the Draft EIS, and is included here as Table 5.8.

**Table 5.8 Indicative electricity demand for the combined operation**

| Electrical loads | Maximum demand (MW) | Annual consumption (GWh) |
|---|---|---|
| Open pit mine (including the MMIA) | 95 | 283 |
| New concentrator plant | 300 | 2,365 |
| New hydrometallurgical plant | 40 | 315 |
| Expanded smelter | 3 | 24 |
| Expanded refinery | 12 | 95 |
| New on-site administrative | 4 | 18 |
| Acid plants | 42 | 331 |
| Process infrastructure | 20 | 158 |
| Desalination plant | 35 | 245 |
| Water supply pipeline | 22 | 154 |
| Transmission line (losses) | 7 | 61 |
| Gas supply pipeline | 0 | 0 |
| Rail line | 0 | 0 |
| Pimba intermodal facility | 3 | 16 |
| Port – Darwin | 5 | 26 |
| Port – Outer Harbor | 5 | 26 |
| Landing facility | 2 | 11 |
| Airport | 1 | 4 |
| Roxby Downs and other off-site | 42 | 184 |
| Hiltaba Village | 8 | 35 |
| Total additional demand | 646 | 4,351 |
| Existing operation demand | 125 | 900 |
| Total demand (combined operation) | 771 | 5,251 |
| Co-generation electricity supply (at full capacity) | 250 | 1,533 |
| Total net demand (combined operation) | 521 | 3,718 |

Note that commitments contained in the Draft and Supplementary EIS state that electricity for the proposed desalination plant and associated water supply pipeline (57 MW and an estimated annual consumption of 339 GWh) would be sourced from renewable electricity from the National Electricity Market (see Chapter 2 of the Supplementary EIS for the consolidated list of project commitments).

### 5.6.2 DESALINATION PLANT

**Issue:**

Further information was sought regarding the nature and extent of the renewable electricity supply commitment for the proposed coastal desalination plant.

**Submissions:** 2, 27, 39, 65, 117, 302 and 348

**Response:**

The electricity demand for the expanded operation, including demand associated with the proposed desalination plant and water supply pipeline, were detailed in Table 5.37 of the Draft EIS, the relevant sections of which are reproduced here as Table 5.8. The demand for the proposed desalination plant is 57 MW, with an annual consumption of around 399 GWh.

Section 13.2.2 of the Draft EIS detailed the commitments associated with greenhouse gas abatement for the expanded operation, and in particular committed to sourcing renewable electricity (35 MW) from the National Electricity Market for the coastal desalination plant. These commitments refer to the electricity demand associated with operating the desalination plant, including the electricity required for the first pumping station. The remaining three pumping stations along the water supply pipeline (i.e. the balance of 22 MW) were not included in the scope of the original commitment, nor does the commitment extend to the abatement of construction and embedded (life cycle) emissions.

Subsequent to the publication of the Draft EIS, a further commitment has been made to meet the operational electricity demand for the remaining three water supply pipeline pumping stations from renewable electricity sources accessed from the National Electricity Market (i.e. the full 57 MW and predicted annual consumption of 399 GWh). Together, these commitments would reduce the greenhouse gas emissions associated with the proposed expansion by an estimated 335,160 tonnes of $CO_2$-e per annum (see Table 5.9).

**Table 5.9 Estimated annual electricity demand and greenhouse gas abatement associated with the desalination plant**

| Electricity loads | Maximum demand (MW) | Annual consumption (GWh) | Estimated annual greenhouse gas abatement (t $CO_2$-e)[1] |
|---|---|---|---|
| Desalination plant | 35 | 245 | 205,800 |
| Water supply pipeline | 22 | 154 | 129,360 |
| Total | 57 | 399 | 335,160 |

[1] Using the emission factor of 840 g $CO_2$-e per kWh of electricity consumed to be consistent with the assessment presented in the Draft EIS.

### 5.6.3 DIESEL SUPPLY

**Issue:**

Confirmation was sought of the quantity and source of diesel to be used for the expanded operation. Concerns over the capacity available in South Australia, and the potential impact on diesel pricing for members of the public, were also raised. Further information was requested with regards to potential future alternatives to diesel.

**Submissions:** 2, 12, 224 and 267

**Response:**

#### Existing and proposed supply and demand

Table 5.2 of the Draft EIS indicated that the total volume of diesel required for the expanded operation was approximately 403 ML/a, in addition to the existing 26 ML/a consumed by the existing operation. The more detailed breakdown of diesel consumption per facility is shown in Table 5.10 of the Supplementary EIS.

**Table 5.10 Indicative diesel consumption for the combined operation**

| Facility/operation | Diesel consumption | |
|---|---|---|
| | ML/a | ML/d |
| Existing operation | 26 | 0.07 |
| Open pit mining operations | 350 | 0.96 |
| Expanded metallurgical plant | 16 | 0.05 |
| Transport and logistics | 36.5 | 0.10 |
| Total | 429 | 1.18 |

The diesel would be sourced under contract via the existing fuel storage facility at Birkenhead, South Australia, and would be transported to Olympic Dam. The existing Birkenhead fuel storage facilities, consisting of three separate facilities, have a combined capacity of around 158 ML of fuels (petroleum, Jet A1 and diesel, with diesel comprising 55.4 ML of the available capacity) on any single day, and this is currently replenished by around seven fuel tanker imports per month (RAA 2007). Additional fuel storages at Port Lincoln (7 ML) and Mount Gambier (2.5 ML) are operated by private companies to meet their own fuel requirements.

A diesel storage and refinery facility was recently approved (Government of South Australia 2010) for construction at Port Bonython. This facility would initially have a storage and distribution capacity of 100 ML and 500 ML/a of diesel respectively, ramping up over time to deliver in excess of 1,000 ML/a of diesel (Stuart Petroleum Limited 2010).

As shown in Table 5.11 of the Supplementary EIS, the existing South Australian diesel consumption (including the existing Olympic Dam operation) is estimated at around 3 ML/d or around 1,100 ML/a (RAA 2007).

**Table 5.11 Indicative diesel consumption for the combined operation**

| Consumer | Diesel (ML/d) |
|---|---|
| Existing South Australian demand (including existing operation) | 3.0 |
| Estimated expanded Olympic Dam demand | 1.1 |
| Existing South Australian distribution capacity | 5.7 |
| Proposed additional South Australian distribution capacity | 2.7 |

As a consequence of the significant diesel storage capacity in South Australia relative to the state's existing and proposed consumption, and having regard to the additional fuel storage and distribution capability soon to be constructed, it is considered that the potential impact on the public with regards to diesel shortages and resultant price rises is negligible. The economic assessment of the proposed expansion has assumed that the existing diesel subsidies would continue into the future, although the continuation of these subsidies is ultimately an issue for the Australian Government (see Section 24.2.1 of the Supplementary EIS for further information).

### Alternatives to diesel

BHP Billiton aims to keep abreast of new technologies that have the potential to reduce or offset traditional fossil fuel-generated diesel. The use of waste oil as a blasting medium, the development and implementation of hybrid or LNG-powered haul trucks and light vehicles, and investigations into the use of second- and third-generation biofuels (originating from algal sources) are areas of current research as detailed in Section L1.6.4 and L1.6.5 of Appendix L of the Draft EIS. Ultimately these technologies would need to be trialled and proven before large-scale implementation, but BHP Billiton recognises that such technologies may become viable on a large scale as they mature, and commits to staying up to date with their progress.

## 5.7 TRANSPORT

### 5.7.1 SULPHUR HANDLING FACILITY

**Issue:**

Further details were requested regarding the location, design and operation of the sulphur handling facility. Clarification was sought about the dust and fire risk mitigation measures.

**Submissions:** 2, 22, 66 and 72

**Response:**

A detailed description of the proposed sulphur handling facility was provided in Section 5.9.5 of the Draft EIS and the broader location of the facility was outlined in Figure 5.51 of the Draft EIS. A more detailed diagram of the location is provided as Figure 5.15 in the Supplementary EIS.

Elemental sulphur is imported as a prill, which is a cylindrical product of around 5 mm diameter and 10 mm in length. The Olympic Dam operation has been handling elemental sulphur for more than 20 years and understands that the prill itself does not dust, although some dust can be generated when the prill is broken down through abrasion or crushing during transport and loading/unloading operations. In order to reduce the impact and risk of dust emissions from the facility, the following mitigation measures have been proposed:

- an enclosed-screw ship unloading system would be used rather than a traditional bucket or scoop arrangement, with the screw unloader fitted with spillage and washdown collection devices
- covered conveyor transfer points, including dust curtains at conveyor entry and exit points and dust suppression mist sprays in the conveyor skirts after the loading points
- a telescopic chute in the storage shed to minimise drop distances, and hence reduce the potential for breakdown of the prill


Figure 5.15 Conceptual layout of the proposed Sulphur Handling Facility at Outer Harbor

- an automatic reclaim system feeding onto an enclosed conveyor to reduce the need for a front-end loader, and therefore reduce the potential for the loader to crush the prill and generate fines
- using sealed rail wagons, so sulphur could not escape while en route to Olympic Dam.

Sulphur prill is classified as a hazardous substance (it is a flammable solid) and can be corrosive in the presence of moisture (such as may occur during sea transport as a result of ship-hold ventilation). The specification of an impervious floor and corrosion-treated concrete walls are to ensure the integrity of the proposed sulphur handling facility and the containment of the material for the duration of the proposed expansion. Fire suppression systems would be fitted to the facility in accordance with relevant Australian Standards to minimise the extent of any combustion, and the facility design would eliminate the risk of static charges that may provide a source of ignition. The potential for fires arising from failures of the dust collection/suppression and materials handling systems was assessed during the Draft EIS risk assessment process and was categorised as a low-to-medium risk; the likelihood of this occurring was rated as 'unlikely' and the environmental, social or occupational consequences would be minimal.

### 5.7.2 LANDING FACILITY

**Issue:**

Further information was requested regarding the design and operation of the proposed landing facility, specifically:

- whether dredging of Upper Spencer Gulf would be required
- what restrictions/exclusion zones would be placed around the facility
- what would be the nature and timing of operations
- what infrastructure would be constructed
- what wastes would be generated
- whether third party users would be granted access for import/export of other materials.

**Submissions:** 2, 41, 67, 68, 102, 122, 211, 263, 267, 310, 333, 355 and 386

**Response:**

#### Dredging requirements

The alternative locations investigated for the landing facility were discussed in Section 4.14 of the Draft EIS and a significant issue contributing to the selection of the chosen location was that it avoids the need to dredge a navigational channel. Rather, BHP Billiton has identified vessels that can operate in the existing water depths of the chosen Upper Spencer Gulf location.

The three most significant considerations in this were:

- The unconsolidated sand waves (0.5 m high) on the seabed indicate that the sediments are highly mobile. Any dredging in these areas is likely to quickly in-fill as the sand waves move along the gulf floor. The direction of sand movement would change daily with the tides. Maintenance dredging would therefore probably be required regularly.
- Seabed sediments were either shell grit or coarse sand with indications of silt/mud substrate. Although the surface sediments are coarse and would settle out relatively quickly, they may overlie fine sediments. The strength of the currents and turbidity in the area suggests that a sediment plume associated with dredging fine sediments would potentially be large.
- The disposal of dredged material would likely require a land-based solution, which would also require associated settling ponds and other land-based infrastructure, increasing potential amenity impacts.

#### Exclusion zones and access restrictions

Details of the likely access limitations in the area around the proposed landing facility were detailed in Section 19.5.6 of the Draft EIS, and are expected to include only minor limitations with respect to swimming, diving, mooring or anchoring in the immediate vicinity of the landing facility – similar to the restrictions in place surrounding the Port Augusta boat ramp – and around vessels during berthing, unloading and departure. This 'safety zone' was shown in Figure 19.24 of the Draft EIS, and is reproduced here as Figure 5.16. It consists of a 25 m zone surrounding the landing facility and any berthed vessels that would be considered active when the facility was in operation. The safety zone would not apply during non-operational times, however the facility would remain private property and no public access would be permitted.

Vessels, tugs and barges associated with the proposed expansion would be restricted to the channel when accessing the landing facility. As currently occurs, recreational and other marine boat owners would be able to use the channel, in coexistence with other vessels. As larger vessels have limited ability to deviate from their course or manoeuvre quickly, and may not always be able to sight

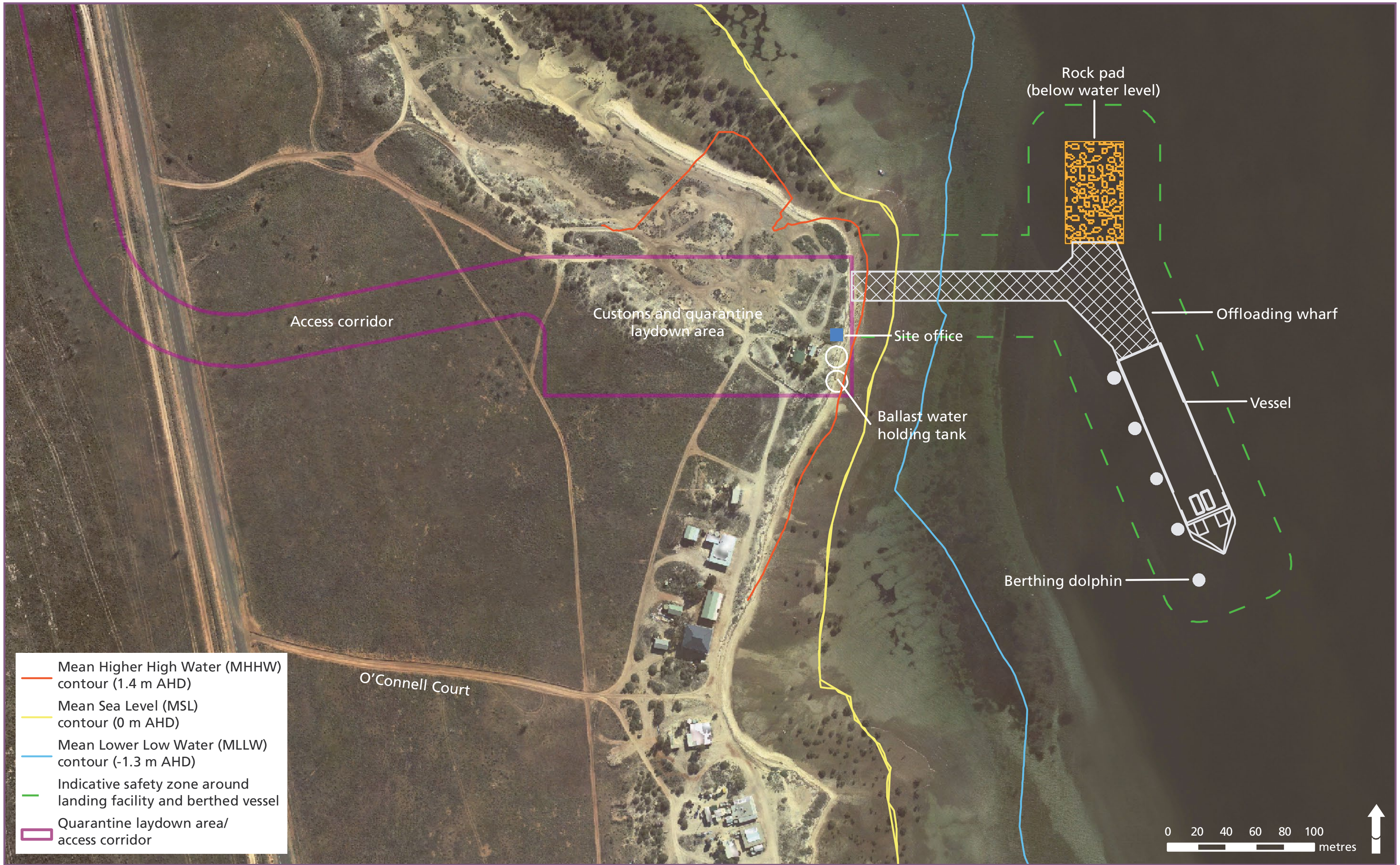



Figure 5.16 Layout of the proposed landing facility showing indicative exclusion zones

smaller boats (for example, when berthing and departing from the landing facility), boat operators would be expected to continue to adopt practical measures to maintain a safe distance, steer clear of other marine traffic, avoid boating accidents and comply with other marine safety requirements. Under the Harbors and Navigation Regulations 2009, it is illegal to anchor in channels.

### Timing of operations

As stated in Section 5.9.5 of the Draft EIS, the landing facility is expected to operate between 7am and 7pm for two to three days every 11 days to facilitate the unloading of about 280 vessels or barges with imported pre-assembled modules and prefabricated items for the proposed expansion. Unloading would take place only between these hours.

It is also anticipated that there should be sufficient time during this period to not only complete unloading operations but also commence the movement of pre-assembled modules and prefabricated items from the landing facility along the access corridor to the proposed pre-assembly yard on the western outskirts of Port Augusta. It is possible, but not planned, that some vessel unloading and/or transport operations may occur outside these times under exceptional circumstances. Should this be required, such operations would be undertaken in consultation with the South Australian Department of Transport, Energy and Infrastructure.

### Facility infrastructure

Details of the landing facility infrastructure were provided in Section 5.9.5 of the Draft EIS, and include:

- construction of a concrete-decked piered jetty, approximately 200 m x 20 m, for the berthing of ocean-going heavy lift vessels
- an underwater rock pad, 80 m x 50 m, to facilitate barge landings
- a quarantine laydown area of approximately 2 ha to meet Australian customs and quarantine requirements
- a hardstand laydown area for the temporary storage of off-loaded modules before transport to the Port Augusta pre-assembly yard via the proposed access corridor
- a small site office with basic amenities for the workforce
- ballast tanks to temporarily hold ballast water used to stabilise the barges during off-loading.

Operations at the proposed landing facility would be limited to unloading vessels and barges, and vehicle movements associated with the transport of pre-assembled modules and prefabricated items to the Port Augusta pre-assembly yard via the access corridor.

### Potential third party use of the landing facility

The landing facility and access corridor would be purpose-built by BHP Billiton for the delivery of construction materials in the form of pre-assembled modules and prefabricated items to support the proposed expanded operation. Additional use by third parties is not proposed.

Section 5.9 of the Draft EIS detailed the proposed logistical arrangements for the transport of materials into and out of the expanded operation. It is proposed that the majority of reagents and products during the operational phase would be transported via road, rail or a combination of both. The landing facility would be used for the import of construction-related materials and modules during the construction phase, and may be used on an infrequent basis and in combination with other transport methods, for the ongoing import of maintenance and operational equipment during the operational phase.

**Issue:**

Further information was requested regarding the location of the tanks that would temporarily store the discharged ballast from vessels at the landing facility.

**Submission:** 213

**Response:**

The ballast water storage tanks would be located within the quarantine area designated for the landing facility. This area was shown on Figure 5.52 of the Draft EIS and has been reproduced here as Figure 5.16. The specific size and location of the tanks in this footprint area would be determined during the detailed design phase. Ballast water would be pumped to barges as necessary and returned to the tanks following completion of loading operations. Minor volumes of make-up water may be required, and these would be obtained from either local seawater or the state potable water system. It is noted that Australia has adopted international conventions regarding vessel management systems for ballast water, and that these conventions require ballast water to have been exchanged outside of, and therefore before entry into, Australian waters. Any international shipping required for the proposed expansion would arrive at an Australian declared entry port, as the first port of call, where it would be inspected by representatives

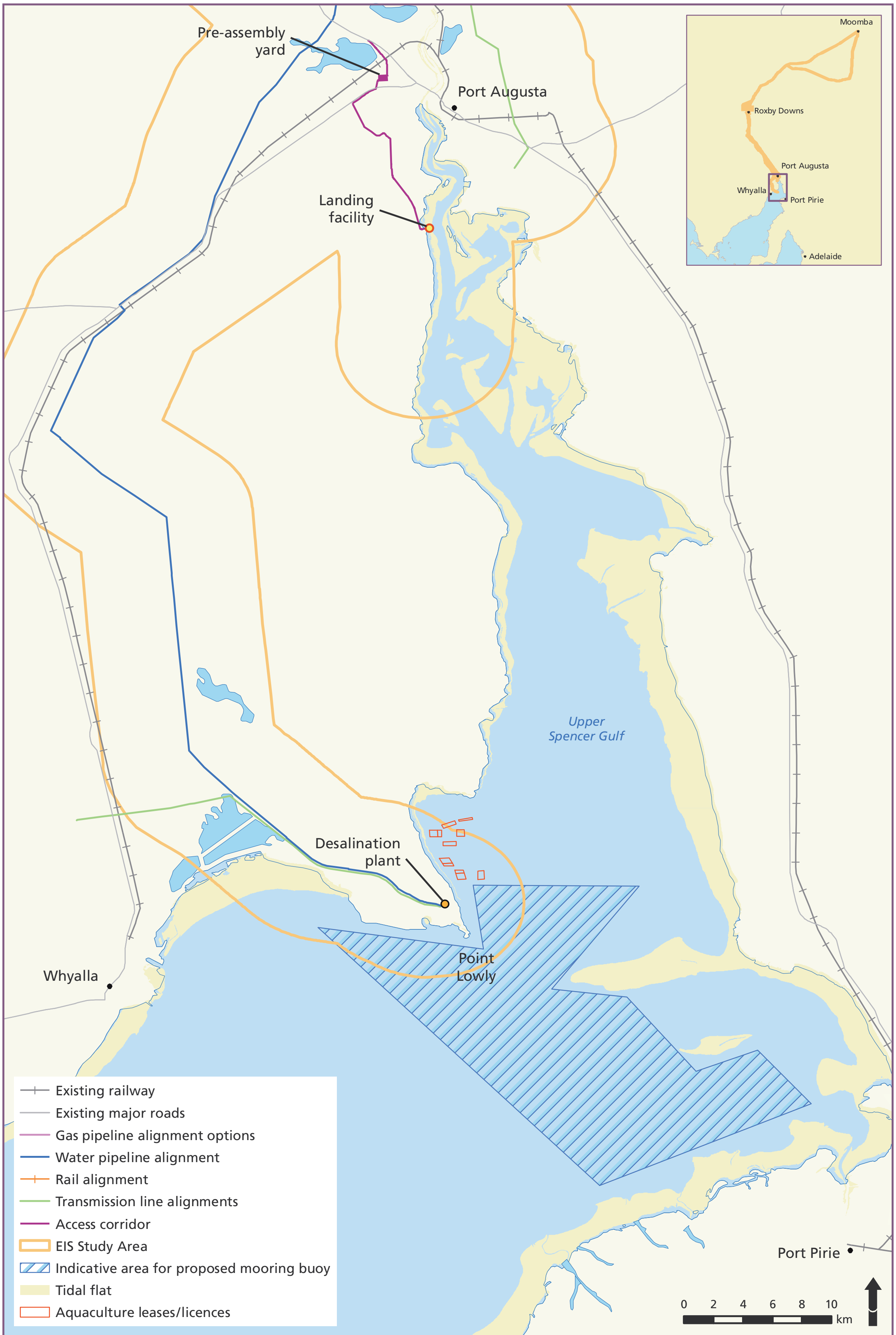



Figure 5.17 Indicative location of the proposed heavy vessel and barge transit mooring buoy

of the Australian Customs Service and Australian Quarantine Inspection Service. These inspectors would certify that, among other border protection issues, the master of the vessel had complied with a ballast management program as stipulated under Australian law. It is proposed that the landing facility would be designated an Australian declared entry port.

**Issue:**

Further information was requested regarding the location, design and operating strategy for the proposed heavy ship mooring site in the Upper Spencer Gulf, and for the berthing of tugs and barges when they were not in use.

**Submissions:** 2, 84 and 302

**Response:**

The mooring or anchoring of heavy vessels and in-transit barges in the Upper Spencer Gulf is currently being investigated, and would be finalised in coordination with the South Australian Department of Transport, Energy and Infrastructure (DTEI) and the vessel operators. It is likely that the preferred alternative would consist of one or both of the following options:

- Heavy lift vessels would use anchors to secure themselves in water around 20–25 m deep while unloading operations were under way. This would allow for the vessel operators to best position the ships, taking into account the nature of the cargo, the prevailing wind, swell, wave height and current speed, in order to most effectively and safely transfer the cargo.
- A free-swinging mooring would be established, also in 20–25 m of water, for use by barges transiting to and from the landing facility. The mooring would consist of a sea anchor on the seafloor, with a mooring buoy attached by chain. The location of the proposed mooring buoy has yet to be finalised but would take into account seafloor conditions, water depths, wind speeds and environmental issues as well as the marine safety issues of introducing a buoy (e.g. security, night marker lights, inclusion on the nautical maps). An indicative area for establishing such a mooring buoy is shown on Figure 5.17 of the Supplementary EIS.

Vessels and barges would be in constant use, and as such would not be berthed at the landing facility, or anchored or moored in the Upper Spencer Gulf for any period longer than it took to unload their respective cargoes (predicted in the Draft EIS to be up to three days). Tug services would be provided through existing regional operators, and tugs would continue to be berthed at either Whyalla or Port Pirie.

### 5.7.3 ACCESS CORRIDOR

**Issue:**

Further details were sought regarding the design, construction, operation and maintenance of the proposed access corridor between the landing facility and the pre-assembly yard. Specific concerns regarding the potential for dust emissions and proposed mitigation were also raised.

**Submissions:** 2, 41, 68, 90, 106, 158, 183, 211, 212, 261, 263, 272, 273, 274, 290, 310, 341, 357 and 385

**Response:**

An overview of the construction and operation of the proposed access corridor was provided in Section 5.9.4 of the Draft EIS, and the location of the preferred transport route between the landing facility and the pre-assembly yard was shown on Figure 5.48 of the Draft EIS. Subsequent to the publication of the Draft EIS, and in response to submissions received, a revised access corridor route has been developed, locating the road further from residences and thereby reducing the potential impacts (see Figure 5.18 of the Supplementary EIS for the proposed realignment and Section 1.4 for more details).

The proposed access corridor would be approximately 10 km long and 15 m wide, and would be an all-weather surface constructed of compacted crushed rock and gravel to minimise dusting and maintenance requirements. Drainage culverts would be installed to maintain existing drainage patterns, and it is anticipated that cut-and-fill operations along the route should be sufficient to ensure a reasonably level surface, negating the need for borrow pits to be established. The distance of the revised access corridor alignment from residences as shown on Figure 5.18 would minimise potential noise, dust and amenity impacts.

In operation, the proposed access corridor would have around five to 10 heavy vehicle movements per week, with around 10 light vehicle movements per day when barges were unloading at the landing facility. During these operational phases, a water cart would be used to water the access corridor as necessary to minimise dust generation. It is unlikely that chemical suppressants would be used for this purpose, as it is not expected that dust generation would be significant. However, if such agents were to be used, a risk assessment would be undertaken before their use to ensure there was no impact on health and safety.


Figure 5.18 Revised access corridor routing and Port Augusta pre-assembly yard

### 5.7.4 PRE-ASSEMBLY YARD

**Issue:**

Further information was sought on tree planting proposed for the landing facility, access corridor and the pre-assembly yard (e.g. species, extent of planting, watering regime). In addition, clarification was sought on the operation of the pre-assembly yard in terms of how and why it would be used, hours of operation and general activities.

**Submissions:** 2, 67 and 211

**Response:**

Specific details of the tree planting regime (including species, extent of planting and watering regime) associated with the proposed facilities have not yet been determined and would be undertaken during the detailed design phase. BHP Billiton or its nominated contractor would liaise with relevant authorities and interested parties in selecting species and determining an appropriate maintenance regime.

As described in Section 5.9.4 and illustrated in Figure 5.48 of the Draft EIS, infrastructure arriving by sea would be unloaded at the proposed landing facility and transported along a dedicated access corridor to a pre-assembly yard located on the north-western outskirts of Port Augusta. This yard was previously used during the 1997 expansion of Olympic Dam and covers 23 ha. The land continues to support:

- a large hardstand area of approximately 2,500 $m^2$
- a vehicle inspection building of approximately 545 $m^2$
- a disused laboratory of approximately 200 $m^2$ and other smaller maintenance/storage sheds and temporary office facilities
- connections to utilities such as telecommunications, power, water and sewerage.

The activities proposed for the pre-assembly yard at Port Augusta would include:

- staging the movement of over-dimensional modules between the landing facility and Olympic Dam
- storing the transport and related equipment when it was not being used to transport the modules
- some off-site fabrication and construction, as occurred with the 1997 expansion at Olympic Dam, including lifting deliveries from/to truck to ground by forklift or crane
- the use of cranes in the assembly of prefabricated modules
- the use of industrial pneumatic/electric and hand-held tools to assemble modules
- the temporary storage of dangerous and hazardous materials that would be handled, separated and stored in compliance with recognised industry standards such as the Australian Dangerous Goods Code for each product and BHP Billiton's own internal procedures for such products. As a minimum, this would necessitate all relevant personnel using appropriate personal protective equipment for such materials, and appropriate bunding arrangements and spill containment measures
- abrasive and related cleaning activities associated with on-site assembly
- painting
- coordinating the transport planning required for the movement of over-dimensional modules. Relevant agencies such as SA Police, the Department of Transport, Energy and Infrastructure (DTEI) and the Australian Rail Track Corporation (ARTC) may have representatives based in the offices at the yard.

To support these activities, the hardstand areas used previously would be re-established and expanded, and additional office space would be provided. The exact requirements would be established as more detailed project planning was completed.

The site is located in the Industry Zone of the Port Augusta (City) Development Plan and more specifically in the Industry Zone Policy Area 4: Transport. The zone contemplates industrial activities and the policy area contemplates major transport activities; light industry and road transport terminals are complying forms of development in the industry zone.

The operating hours at the pre-assembly yard would be limited to the hours permitted for sites within 60 m of a residential zone, as outlined in the City of Port Augusta regulations. While no night-time construction activities are planned for the pre-assembly yard, some over-dimensional loads may be moved at night on the public road network to minimise traffic congestion (depending on further discussions with DTEI). There may also be short periods of after-hours transport-related activity under portable lighting at the pre-assembly yard, but any such activities would be completed before 10pm.

Light vehicles moving in and out of the pre-assembly yard would use the existing Press and Madland roads that connect with the Eyre and Stuart highways respectively. It is anticipated that on average around four to eight commercial vehicles per day, from small trucks to B-doubles, would arrive at and leave the site. A workforce of approximately 50 to 100, including site management, would work or be stationed at the site. Most would arrive and depart by private vehicle. A traffic management plan would be developed for the site.

### 5.7.5 RAIL

**Issue:**

Consideration of the construction of a rail line between Pimba and Roxby Downs was sought.

In addition, clarification of the rail operating hours in Adelaide and the subsequent impact was requested.

**Submissions:** 63 and 66

**Response:**

The construction of a rail spur from the Australian Rail Track Corporation (ARTC) operated Port Augusta to Tarcoola rail line at Pimba to the proposed Olympic Dam operation has been proposed and is detailed in Section 5.9.2 of the Draft EIS and shown in Figure 5.19 of the Supplementary EIS. With regard to potential public access to the rail line, it is considered that the existing transport infrastructure to and from Roxby Downs, including airline and bus services and the public road network, would likely result in little demand for a public train service and would not warrant the construction of an additional rail spur between the proposed Olympic Dam to Pimba rail line, plus a passenger terminal in Roxby Downs.

About 28 rail movements per week are proposed between Outer Harbor and Olympic Dam in addition to the existing 52 weekly rail movements leaving Adelaide. These movements would occur at all hours as necessary to align with the schedules of ARTC, which manages the network, including train operations, train paths and operating procedures, and to the requirements of the expanded operation, which would operate continuously. Maximum noise and vibration levels would not be different from those currently experienced by residents living adjacent to the rail line. The relatively small increase in traffic (an additional four trains per day) would result in a low to negligible impact (refer Section 5.9.2 of the Draft EIS for details).

**Issue:**

Further information was requested regarding the proposed arrangements for transporting ammonium nitrate.

**Submission:** 2

**Response:**

Subsequent to the publication of the Draft EIS and in discussion with the South Australian Government, the proposed transport arrangement has been modified, and would now consist of a road-based solution, with ammonium nitrate (AN) being transported via double road trains from interstate locations directly to Olympic Dam (see Section 1.4 for further details). This is consistent with the AN transport arrangements used for the existing operation. The AN product is currently delivered to site in one-tonne bulk bags, although it is likely that the AN for the proposed expansion, if originating in Australia, would be transported in 20-foot bulk containers.

In terms of traffic volumes, it is expected that a peak of approximately 3,840 containers would be delivered to site per year, equivalent to around 11 traffic movements per day. AN is classified as an explosive under South Australian legislation, and UN Class 5.1 dangerous goods under the Australian Dangerous Goods (ADG) Code (NTC 2007). The proposed road solution would comply with the relevant laws, regulations and security requirements for ammonium nitrate road transport.

The general basis of the proposed transport plan would be:

- AN would be sourced preferentially from Australian suppliers and be transported directly to Olympic Dam by road in dedicated 20-foot bulk containers
- the transport system would operate on a one-for-one basis; that is, for every dedicated bulk container delivered to site, one would be returned to the point of supply.

BHP Billiton would continue to work with the South Australian Government and appropriate agencies to identify sustainable longer-term solutions whereby a rail transport solution could be used.

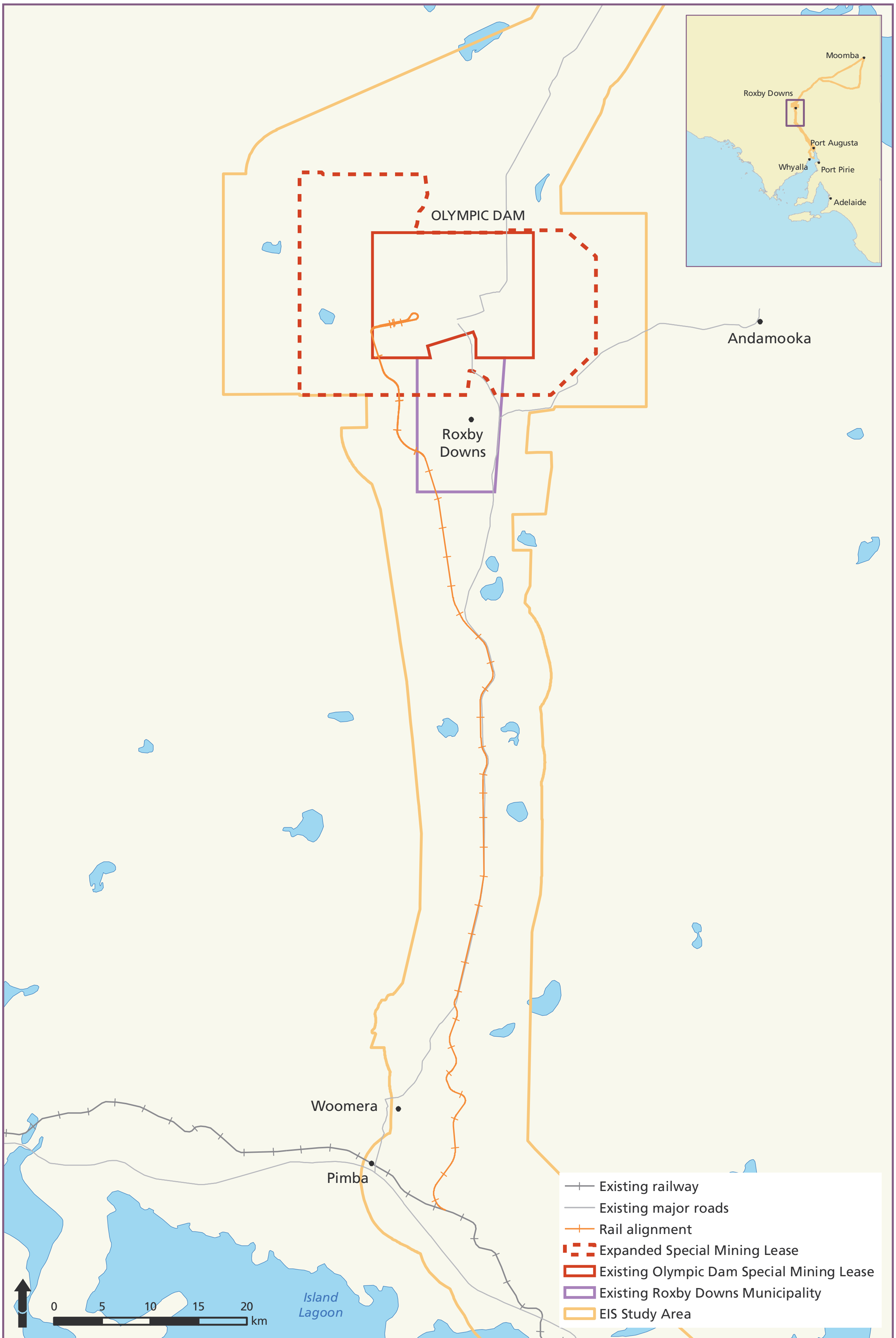



Figure 5.19 Rail spur alignment between Pimba and Olympic Dam

### 5.7.6 INTERMODAL FACILITY

**Issue:**
Clarification was sought about the level of services to be provided to the intermodal facility: specifically power, water, broadband access and waste. Details of proposed dust suppression were also requested.

**Submission:** 2 and 62

**Response:**

Details regarding the development of the Pimba intermodal facility, including an indicative configuration, were provided in Section 5.9.3 of the Draft EIS. The major components of this facility are:

- a hardstand area for the loading, unloading and temporary storage of imports and exports to and from Olympic Dam
- an additional 400 m of rail to allow for train access off the main Port Augusta to Tarcoola line
- a small, portable-style office and amenities building
- a maintenance shed incorporating a bunded fuel store for on-site equipment.

In terms of the level of services to be provided, the final configuration has yet to be finalised. However, it is likely to include:

- a septic system for the treatment of on-site sewage waste
- connections to the state potable water network to cater for minor on-site needs
- telephone and internet connections, either to the existing regional network or via satellite
- connection to the National Electricity Market (NEM) grid
- temporary storage bins for the collection of inert waste before disposal in a licensed waste management facility.

Unloading operations would be undertaken on a hardstand surface of crushed rock and/or gravel. This compacted surface would minimise potential dust emissions. However, a water cart would be used as necessary to ensure that dust generation from the intermodal facility was minimised.

### 5.7.7 AIRPORT

**Issue:**
Clarification was sought on whether the proposed new Olympic Dam airport would handle international flights and, if so, comment was requested on quarantine and biosecurity issues.

**Submission:** 1

**Response:**

Section 5.9.6 of the Draft EIS outlined the proposed design for a new airport at Olympic Dam. The airport is planned to have a maximum 2,400 m runway designed for A320 Airbus and Boeing 737–800 aircraft operating day and night flights on Australian domestic routes only.

As currently applies, flights of international origin would complete Australian border protection requirements (e.g. Customs, quarantine, immigration) at nominated state and territory capital city airports. The proposed new airport would not seek accreditation from Australian border protection authorities to become a designated Australian international entry or exit location.

## 5.8 ACCOMMODATION

**Issue:**

Further information was requested regarding the design and operation of the proposed off-site sewage treatment plant at Roxby Downs, specifically in regard to the ability of the system to harvest stormwater.

**Submissions:** 2, 84 and 88

**Response:**

A development application submitted by the Roxby Downs Council was approved in February 2009 to upgrade the existing wastewater treatment plant (WWTP) in Roxby Downs. A brief description of this plant was provided in Section 5.10.2 of the Draft EIS, indicating that it would be designed to manage an average daily flow of around 2.9 ML/d, with a peak flow of up to 5.9 ML/d.

The treatment system would include an HDPE-lined aeration lagoon of about 12.5 ML/d capacity and a settling/sludge lagoon system of about 20.5 ML capacity (see Figure 5.20 of the Supplementary EIS). The wastewater from Roxby Downs and Hiltaba Village would then undergo tertiary treatment, consisting of disinfection and filtration. The sludge from filtration would be periodically removed and disposed of at a licensed landfill facility. The system would be designed for the combined peak population of Roxby Downs and Hiltaba Village, and also be capable of operating efficiently with a smaller population as the peak construction workforce declined. The facility would be located at least 400 m from the nearest proposed residence, exceeding SA EPA requirements (refer Figure 5.47 of the Draft EIS for location). Treated wastewater from the storage lagoons would be reticulated to public and government open-space areas to irrigate landscapes and sports facilities, including the golf course, community and school ovals, civic gardens, hospital grounds and streetscape plantings.

There have previously been some issues associated with stormwater harvesting in the existing Roxby Downs WWTP. This was a result of the introduction of stormwater to the ponds via the sewer pump stations, and subsequently into the treatment lagoons, where the additional water had the potential to negatively impact retention times, and thus treated water quality.

To overcome the problem and allow stormwater to be harvested opportunistically when space exists in the lagoons, it is now proposed to enable stormwater to be pumped into the final storage lagoons from detention basins, but only when the lagoons' capacity would not be compromised. The primary objective of this design modification is to optimise stormwater reuse without compromising the integrity of the wastewater treatment process.

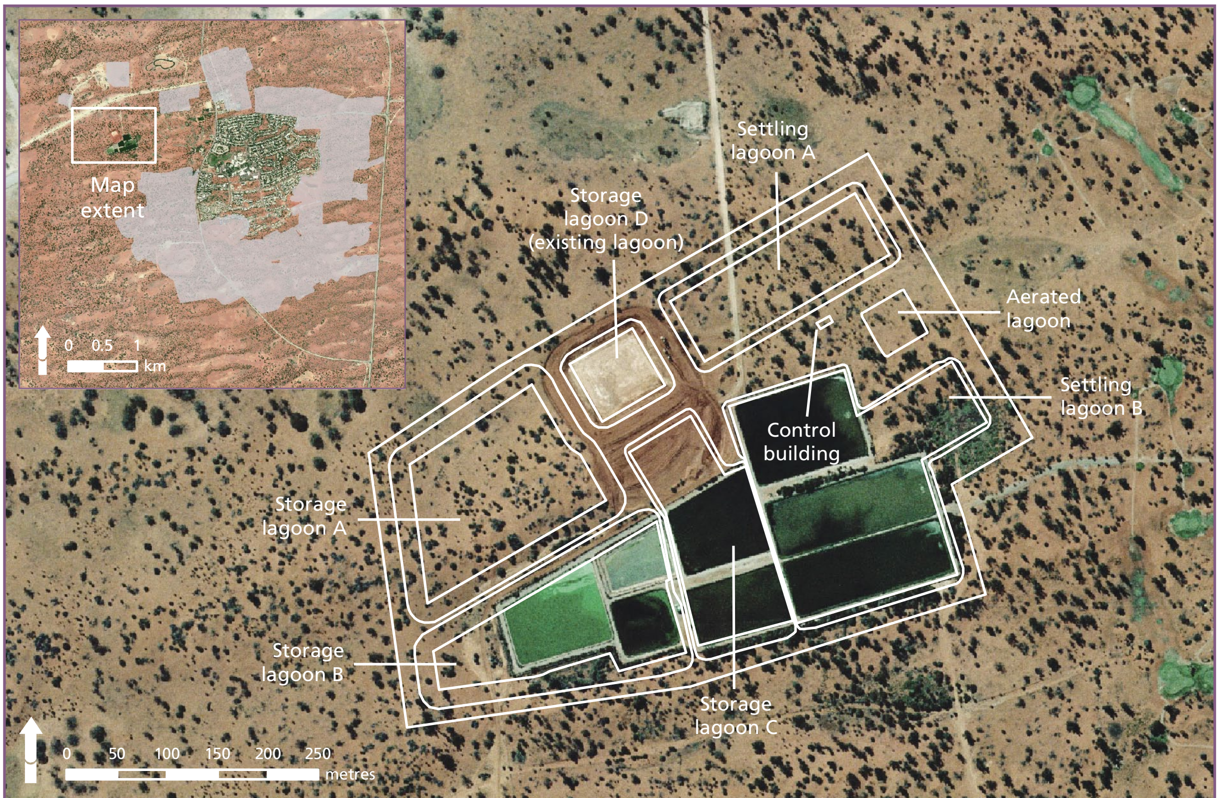



Figure 5.20 Conceptual layout of the proposed Roxby Downs wastewater treatment plant

**Issue:**

Clarification was requested of inconsistencies between the Draft EIS and Landfill Environmental Management Plan regarding design volumes and life of the proposed Roxby Downs regional landfill facility.

**Submissions:** 2 and 65

**Response:**

The Roxby Downs Council submitted the Landfill Environmental Management Plan (LEMP) to the SA EPA, (and it has been subsequently approved by the SA EPA) outside the proposed expansion EIS process. Information was provided in the Draft EIS in order to understand the additional land disturbance associated with the use of the facility for 40 years.

The landfill design, location and operational philosophy described in Section 5.10.2 of the Draft EIS are consistent with the approved LEMP. However the total required 40-year capacity of the proposed landfill as reported was overestimated. The Draft EIS quoted a worst-case waste volume requirement of 2 million $m^3$ over 40 years. This figure has been corrected as per Table 5.12 and is consistent with the approved LEMP.

**Table 5.12 Estimated landfill volume requirement for the regional landfill**

| Waste cell | Estimated volume (at 40 years) ($m^3$) |
|---|---|
| Inert landfill cell(s) | 480,000 |
| Putrescible waste cell(s) | 1,200,000 |
| Total waste cell volume | 1,680,000 |

In addition, the text in Section 5.10.2 of the Draft EIS underestimated the total required landfill area for a 40-year facility life. The putrescible landfill cell illustrated in Figure 5.57 of the Draft EIS (and reproduced here as Figure 5.21), with an area of about 5.6 ha, is considered sufficient for about five years' supply of putrescible wastes. Additional cells would be constructed after this time as detailed in the approved LEMP.

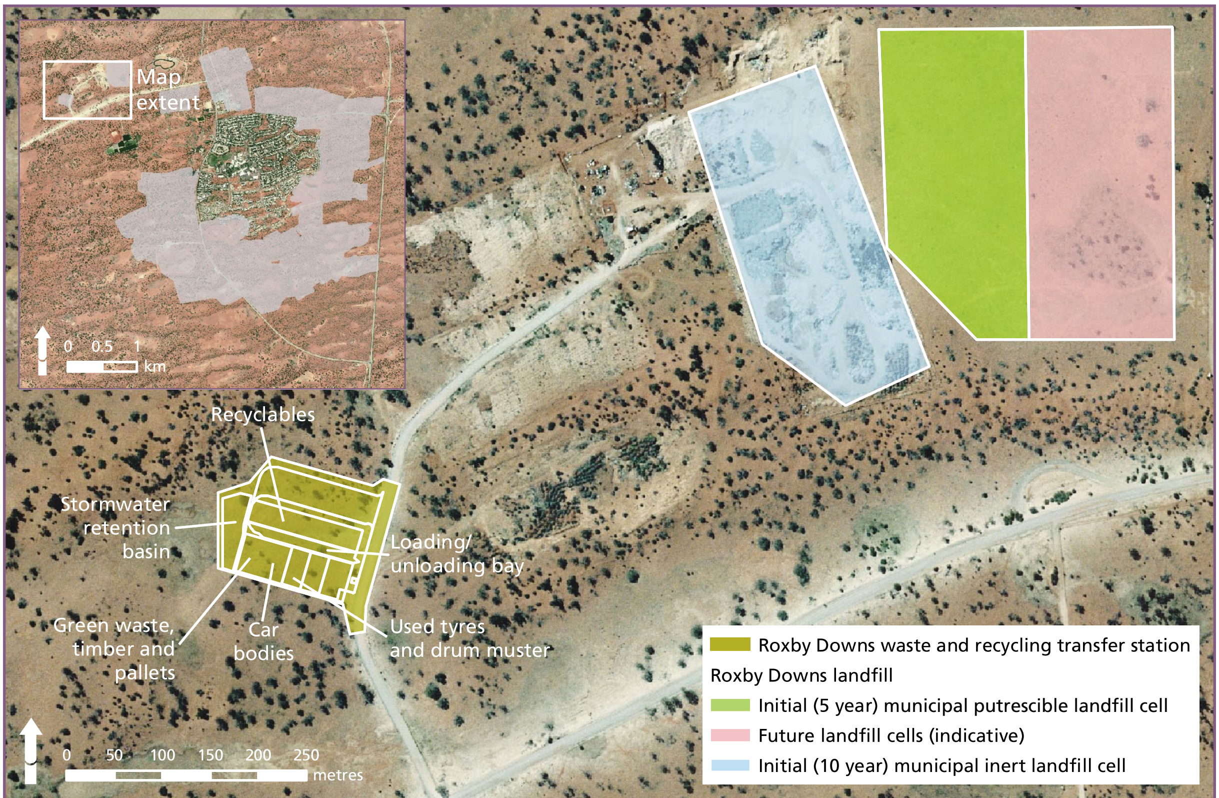



Figure 5.21 Indicative configuration of the proposed Roxby Downs waste management facilities

The approved LEMP also proposed that the initial 10 years' inert waste would be stored on cells constructed above the existing landfill cells before closure (see Figure 5.21 of the Supplementary EIS) and that additional inert cells would be constructed as required beyond this. The exact location of these cells would be determined by the Roxby Downs Council as necessary. For the purpose of the Olympic Dam expansion EIS, Table 5.13 describes the total required disturbance area for the landfill at the waste generation rates specified in the LEMP using the same proposed inert and putrescible landfill cell design.

**Table 5.13 Estimated 40-year disturbance footprint for the municipal landfill[1]**

| Waste type | Approximate disturbance footprint (ha) |
|---|---|
| Inert waste cells | 17.8 |
| Putrescible cells | 44.8 |
| Transfer station | 1.5 |
| Total | 64.1 |

[1] Based on waste generation rates and inferred landfill design from the approved LEMP.

The total area of the current municipal landfill allotment is about 81 ha, which is sufficient to provide for over 40 years of inert and putrescibles wastes at the waste generation rates described in Table 5.12.