4 PROJECT ALTERNATIVES

4.1 MINING

Issue:

The Draft EIS states that mining at the proposed scale is the preferred option and maximises the return on investment. Submissions have questioned the quantity of uranium to be extracted and processed on the basis that the uranium market is not predictable or stable.

Submissions: 50, 136, 302 and 391

Response:

The Olympic Dam ore body contains multiple metals, of which copper, uranium, gold and silver are currently extracted. These metals are distributed throughout the ore body (i.e. mixed together within the ore), therefore the quantity of uranium extracted is related to the quantity of copper, gold and silver extracted. In other words, it is not possible to just mine copper, gold and silver because uranium is contained within the same ore and is therefore mined at the same time.

The assessment of the cost of mining (which includes the financial capital and operating cost but also the environmental and social offsets) and the predicted return from the sale of the metals, receives considerable effort and attention during all phases of a mining operation, but none more so than the selection phase in which the Olympic Dam expansion currently sits. Many factors are taken into consideration during the exhaustive assessments undertaken to determine the viability of a new or expanding mine. These include the immediate conditions of market spot prices, the medium-term (generally three to seven years) contract prices, current primary and secondary production supplies, existing demand, and utilities projects under construction. However, and most importantly for a massive ore body and long-life mine such as Olympic Dam, long-term trends in supply and demand are studied in detail.

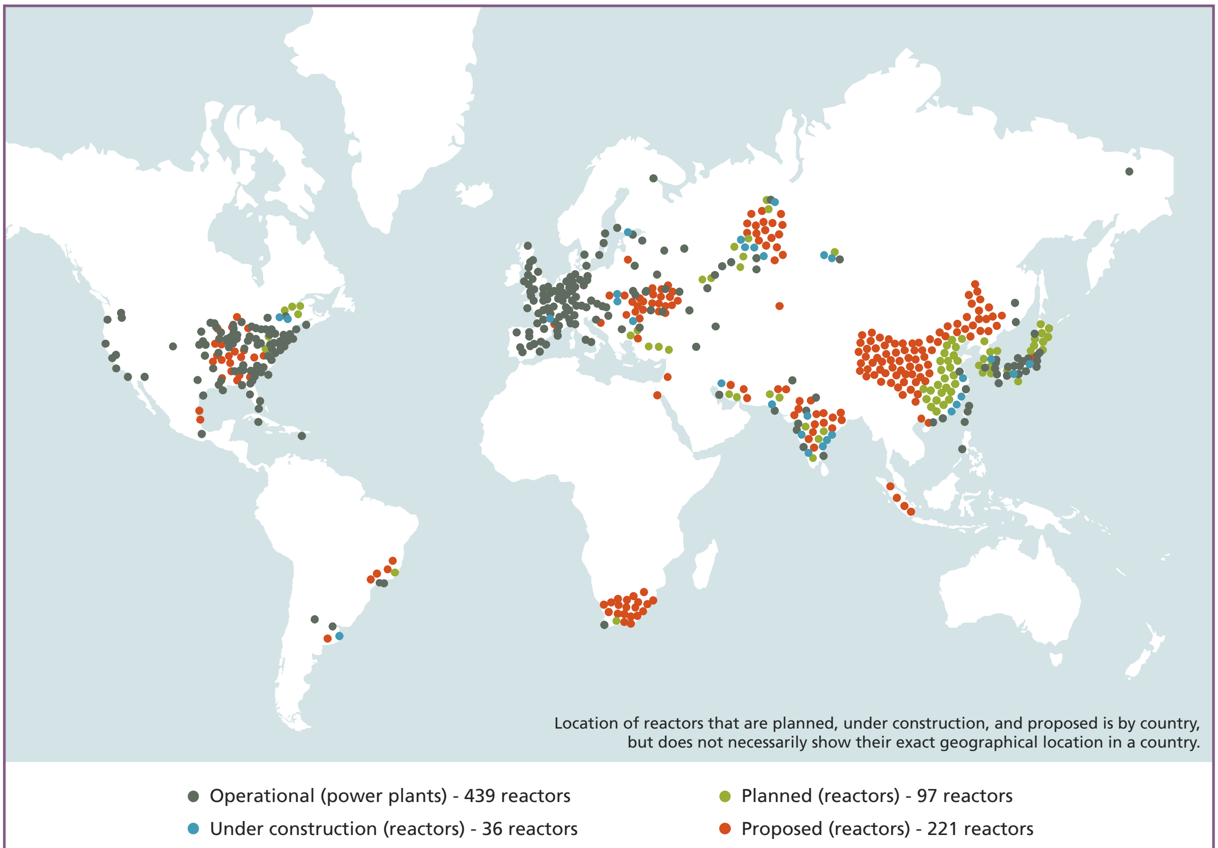
All mineral commodity markets tend to be cyclical (i.e. prices rise and fall substantially over the years), which often relates to the immediate demand and perceptions of scarcity or secure supply. However, the long-term trends are typically upward.

With respect to uranium oxide, Section 3.2.3 of the Draft EIS detailed the current and long-term forecasts for market demand and supply, with the data showing a strong long-term upward trend. Figure 3.11, reproduced here as Figure 4.1, illustrated the planned growth from 439 nuclear reactors currently in operation worldwide to 793 expected by 2030. The resulting demand chart for uranium oxide through to 2030 was shown in Figure 3.10, reproduced here as Figure 4.2.

The quantity of uranium oxide required to meet the 2008 global demand was 64,200 tonnes. The total supply from mines in that same year was 41,279 tonnes, with Olympic Dam the third largest uranium oxide producer in the world, contributing about 4,000 tonnes. The supply and demand gap from uranium mine production, even without the additional 354 nuclear reactors, was 22,921 tonnes. Olympic Dam is proposing an increase of 15,000 tonnes of uranium oxide per year when at full operating capacity, making an annual total production of 19,000 tonnes. With the additional nuclear reactors expected by 2030, about 92,000 tonnes per annum (tpa) of uranium oxide would be required. Therefore, the additional 15,000 tpa from Olympic Dam would be contributing to a demand gap of 50,721 tpa.

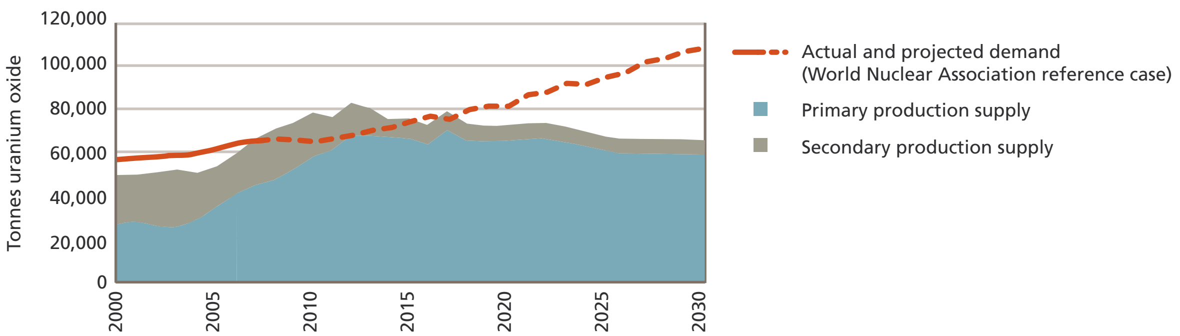
Following publication of the Draft EIS, an economic range analysis was undertaken to determine the implications of a slower than predicted growth in demand. Section 1.4 and Appendix A6 of the Supplementary EIS provide discussion on this scenario, and show that the expansion project would continue to demonstrate long-term social and economic benefits.

Olympic Dam has by far the largest known uranium resource, representing more than one quarter of the world's reasonably assured resources (Australian Mines Atlas 2008). While there will always be some uncertainty, the proposed increase in production of uranium oxide at Olympic Dam has been well considered and deemed feasible.



Sources: International Nuclear Safety Centre at ANL August 2005
World Nuclear Association 2008

Figure 4.1 Existing and proposed nuclear power reactors



Source: Adapted from World Nuclear Association 2007 and 2008a

Figure 4.2 Uranium oxide demand and supply

Issue:

BHP Billiton was asked to provide further justification for not partially or completely backfilling the open pit with waste rock and/or tailings, or disposing tailings, into sections of the existing underground operation towards the end of mine life.

Submissions: 2, 12 and 65

Response:

Complete backfill of open pit

As described and assessed throughout the Draft EIS, mining the open pit would occur for at least 40 years, with the massive size of the ore body suggesting that mining may occur for 100 years. To backfill the open pit, it would take approximately the same time as the original mining operation (i.e. between 40 and 100 years) and it would re-expose the material that was already encapsulated within the Rock Storage Facility and the Tailings Storage Facility. Not only would the cost of such an exercise be prohibitive; it would significantly increase the predicted environmental impacts. For example, it would significantly increase the greenhouse gas emissions by operating the electric rope shovels and haul truck fleet for double the planned mining timeframe, and the works would continue to generate dust and noise for the additional 40 to 100 years.

Partial backfilling open pit

Section 1.3.3 of the Draft EIS stated that 'While the Draft EIS presents the assessment of an expanded operation over 40 years, the massive ore body at Olympic Dam suggests that continued operation or future expansions beyond the scale and timeframe currently proposed are likely.' As it is likely that the open pit would continue to grow after the currently assessed 40 years, partial backfilling of one large, incomplete pit is not practical. This practice may be possible in mining operations that progressively develop and backfill multiple, smaller open pits (such as those associated with shallow ore bodies as per the Ranger mine in the Northern Territory).

Backfilling underground

As a normal part of the existing operation, underground voids are progressively backfilled with Cemented Aggregate Fill (CAF) to maintain ground stability while underground mining continues. Consequently, very few underground voids would remain at the end of mine life, limiting the potential for tailings disposal into such voids. It was also noted throughout the Draft EIS (see in particular Section 1.3.3) that the open pit is likely to expand beyond the extent currently assessed for a 40 year mine life, and as such it may ultimately include the remaining underground mining area. Should this occur, mining through sections of unconsolidated tailings and handling this material could compromise the potential for safe open pit mining in this area and would negate the placement of tailings underground.

Issue:

A cost/benefit analysis was requested to provide further justification for rejecting an expansion through continued underground mining.

Submission: 24

Response:

BHP Billiton invested considerable effort in assessing the mining methods for the proposed expansion and Section 4.1 of the Draft EIS detailed the reasons for selecting an expansion via open pit mining rather than continued underground mining. The primary reasons being:

- the open pit method enables a lower-cost bulk mining method, which suits the lower grade of ore in the southern part of the Olympic Dam ore body and facilitates the recovery of a greater proportion of the available resource
- the existing underground mining method, which is more selective, suits the northern area of the ore body, with its higher grade and more localised pockets of ore
- a greater proportion of the resource would be recovered with open pit mining – 98% of the mineral resource would be potentially recovered with the proposed open pit compared to 25% recovery with a more selective underground method (and, as such, continued underground mining for the southern part of the ore body would leave much of the mineral resource in the ground).
- As a result of BHP Billiton's extensive experience with large open pit mining, this option provides the company with the safest and lowest business risk option assessed. Also, and as described in the Draft EIS, open pit mining extends the life of Olympic Dam by at least 20 and potentially 80 years above that of continued underground mining. When this extended mine life is coupled with recovering about 98% rather than 25% of the mineral resource, the selected option generates by far the best outcomes in terms of economic and development benefits to all stakeholders.

4.2 PROCESSING

4.2.1 TAILINGS DISPOSAL

Issue:

It was requested that BHP Billiton present a tailings disposal solution that does not leak and that can demonstrate isolation of all mine tailings by pit disposal for the full 10,000-year isolation period required by existing federal environmental conditions for the Northern Territory Ranger mine.

Submissions: 10, 13, 24, 65, 92, 182 and 217

Response:

Section 4.1 of the Supplementary EIS discusses the impracticality of in-pit disposal of tailings for the proposed 40-year open pit mining operation at Olympic Dam. Section 5.5.6 of the Draft EIS presented the design features of the Tailings Storage Facility, including the measures to reduce seepage, to collect underdrainage, recycling of liquor back to the metallurgical plant and to demonstrate the exceedance of the Australian National Committee on Large Dams (ANCOLD) criteria for stability for a 1-in-10,000-year earthquake event (refer in particular Table 5.17 of the Draft EIS).

Chapter 12 of the Draft EIS and Section 12.3 of the Supplementary EIS demonstrate the effectiveness of the sediments underlying the Olympic Dam TSF to attenuate and 'filter' seepage.

At the time of decommissioning tailings cells, a cover of benign waste rock would be placed over the cells to securely contain the tailings and minimise radiation exposures and surface and groundwater contamination. Overburden material mined during the development of the open pit would provide a sufficient source of material to cover the tailings and meet the above-mentioned performance objectives.

Chapter 12 of the Draft EIS and Section 12.2 of the Supplementary EIS detail the groundwater modelling that investigated the potential impacts associated with the seepage of water from the proposed TSF, and demonstrate that the open pit would act as a regional groundwater sink, capturing all seepage from the TSF.

With regard to the Ranger uranium mine, this mine is located in a region very different to Olympic Dam with respect to geology, geography, rainfall and ecology. The potential impacts and risks associated with tailings storage at the Ranger uranium mine are different to those at Olympic Dam. The Olympic Dam Draft EIS and Supplementary EIS have demonstrated the ability to reduce impacts and risks for tailings storage to acceptable levels.

Issue:

Further information was requested about the opportunities for additional recycling of liquor from the tailings retention system.

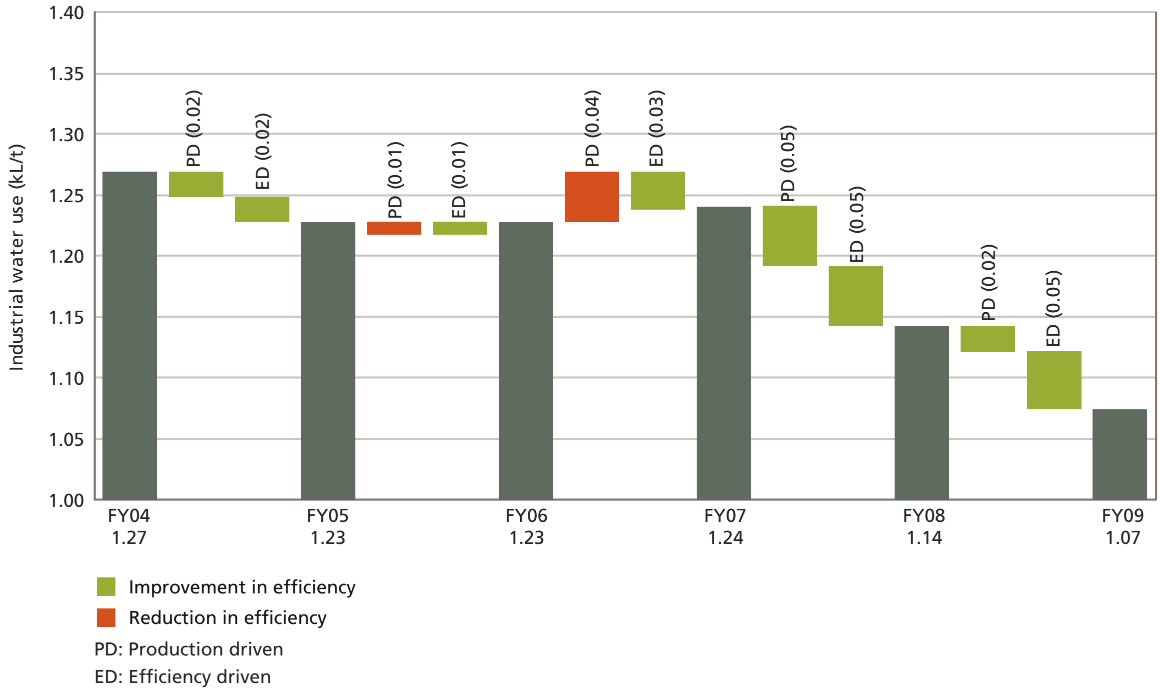
Submission: 2

Response:

There are no practical or proven technological opportunities for recycling liquor from the tailings retention system beyond that already proposed for the Olympic Dam expansion. The proposed tailings retention system improves on the existing operation's design and maximises the amount of acidic liquor recycled back to the hydrometallurgical plant to achieve a practical water balance based on proven technologies. The proposed design also provides the expanded operation with sufficient ability to manage variations with the water balance that may occur as a result of ore type and seasonal climate-related changes. As described further in the response below, increasing the liquor recycled from the tailings retention system back to the metallurgical plant beyond that proposed for the expanded operation would have no additional environmental benefit.

Once in operation there would be an ongoing and sustained focus on production-and efficiency-driven (i.e. technological advances) liquor recycling programs, as has been the culture at Olympic Dam over its operating life. Figure 4.3 demonstrates the water efficiency improvements that have been achieved over the past five years. These improvements have reduced the water consumed per tonne of ore milled from 1.27 kilolitres in the year 2004, to 1.07 for the current operation. The design point for the proposed expansion is 0.95 kilolitres of water consumed per tonne of ore milled, which is a further 11% improvement in efficiency.

New technologies are reviewed on a regular basis to assess if there are opportunities to further improve the efficient use of primary water and to increase the recycling of liquor from tailings. This will continue into the future and the expanded Olympic Dam would utilise technology improvements wherever practicable.



Source: C. Torrisi and P. Trotta 2009. Sustainable water use at Olympic Dam. Published by Maney on behalf of the AusIMM 2010.

Figure 4.3 Industrial water efficiency at Olympic Dam FY04 to FY09

Issue:

Further clarification was sought for the merits of storing tailings as described in the Draft EIS rather than the alternative methods investigated, such as neutralising the tailings or further thickening of tailings.

Submissions: 1, 2, 10, 24 and 265

Response:

The tailings storage method proposed for the expansion is leading practice in that it is fit for purpose to avoid and minimise the potential impacts and risks associated with tailings storage in the environment at Olympic Dam. Further clarification is provided in the following sections.

Tailings neutralisation

To neutralise the 126 ML/d of contained liquor in the final tailings stream, based on the dolomite consumption of 105 tonnes/ML of process liquor, a total of five million tonnes of dolomite would be required each year (i.e. 5 Mtpa). This consumption is based on test work conducted on acidic liquor neutralisation. The preparation of this dolomite would also require additional water supply to that noted above and considerably more energy consumption.

To put the scale of this dolomite requirement into context, South Australia is Australia's largest producer of industrial-grade dolomite, producing 1.1 Mtpa, with 0.9 Mtpa of this coming from the largest dolomite mining operation in Australia at Ardrossan on the northern Yorke Peninsula (PIRSA 2010). Therefore, an operation more than five times greater than the largest currently operating mine in Australia would be required to meet the demand for dolomite.

In addition to the impracticality and cost of establishing a dolomite mine of this size at Olympic Dam, there is little benefit as the proposed water balance as presented in the Draft EIS already maximises the amount of recycled liquor that can be returned to the metallurgical plant.

For these reasons, neutralising the tailings at Olympic Dam is not a preferred option.

Thickened tailings

An assessment of the use of tailings thickened beyond that proposed for the expansion was presented in Section 4.7.2 of the Draft EIS and Sections 5.3 and 5.4 of Appendix F1 to the Draft EIS. This option was discounted because it would require a significant increase in area to the proposed tailings retention system footprint, including the addition of large-scale evaporation ponds to manage the acidic liquor generated through further tailings thickening. It is noted that the provision of additional evaporation ponds was ranked an extreme (and thus unacceptable) risk for the proposed expansion (as per Chapter 26 and Appendix C of the Draft EIS). Further clarification on the reasons for rejecting tailings thickening beyond that proposed in the Draft EIS is provided below.

The amount of thickening applied to (or density of) the tailings is intimately linked to the process water balance. Consequently, the proposed method of tailings disposal and water balance were designed as one integrated fit for purpose system developed in consideration of the following goals:

- reducing occupational health and safety and environmental risks
- the commitment that no additional evaporation ponds would be installed as part of the expanded operation
- minimising the area of acidic liquor ponding on the surface of the tailings cells
- maximising water recycle and minimising water supply requirements
- maximising recycle of acidic raffinate from the TSF
- operability of the process plant and TSF in response to seasonal variations, storm events and the full range of varying ore properties that impact on the performance of the facility.

The water balance for Olympic Dam is complex and incorporates a neutral and acidic circuit. As shown in Figure 4.4, ore from the open pit is combined with high quality water from the coastal desalination plant in the first stage of the process of copper extraction. Once this is complete, excess water is recovered and returned to the start of the neutral circuit. Acid is then added along with acidic liquor from the TSF to recover uranium.

Maximising the volume of liquor returned to the acid circuit from the TSF optimises the water balance and provides a number of benefits. Returning acidic liquor significantly reduces demand from the desalination plant, removes the need for evaporation ponds, reduces acid demand and provides and opportunity for additional metal recovery. As such, it is in BHP Billiton's interest to thicken tailings as much as practically viable. However, the return of liquor to the process plant is ultimately constrained by the accumulation of undesirable elements in the circuit (principally chloride and iron), the presence of which disrupts the metallurgical process. Operating experience and testing of the rheological properties of the process liquor has shown the maximum volume of liquor, at this scale, that can be returned to the process plant without significant disruption is 24 ML/d. Consequently, this constraint results in an optimised tailings density of 54% solids concentration for the combined operations. Increasing the solids density beyond this provides no additional benefit as any additional liquor removed from the tailings prior to deposition could not be recycled to the metallurgical plant and therefore would need to be stored in evaporation ponds for removal from the system via evaporation. For example, and as shown in Figure 4.4, increasing the tailings density for the combined operations to 60% solids would generate about 13 ML/d of liquor that would need to be evaporated in evaporation ponds. As shown in the response to the previous issue, neutralisation and treating this liquor to a quality where it can be returned to the front of the neutral circuit is not a viable option.

The option of using paste thickened or convey and stack tailings disposal methods was also raised in submissions. These options were rejected as they require very high density tailings creating same water balance constraints outlined above. Paste thickened and convey and stack methods also have the following disadvantages:

- steeper beach angle requiring a larger TSF footprint or mechanical spreading, thus introducing additional health and safety risks
- thin layer deposition is not possible, resulting in less efficient drying of thick layers and less consolidation
- paste is difficult to pump and thus energy consumption would increase.

Therefore, the TSF design and tailings solids density proposed in the Draft EIS provides the necessary flexibility required to manage the water balance efficiency and maintain the operability of the metallurgical plant.

Experience from the existing operations and pilot testing demonstrates that thickener performance in the neutral circuit and the rheological properties of the process liquor are sufficiently understood to ensure that the proposed water balance can be achieved. Nevertheless, additional design components have been included to provide a degree of protection and operational flexibility to manage liquor imbalances that may occur as a result of process upsets or extreme weather events. A covered balance pond has been included to allow for short-term water balance disruptions. An extra TSF cell has also been incorporated so liquor can be recycled into the tailings stream with more frequent beach rotation to increase evaporation as described in Section 5.3 of the SEIS.

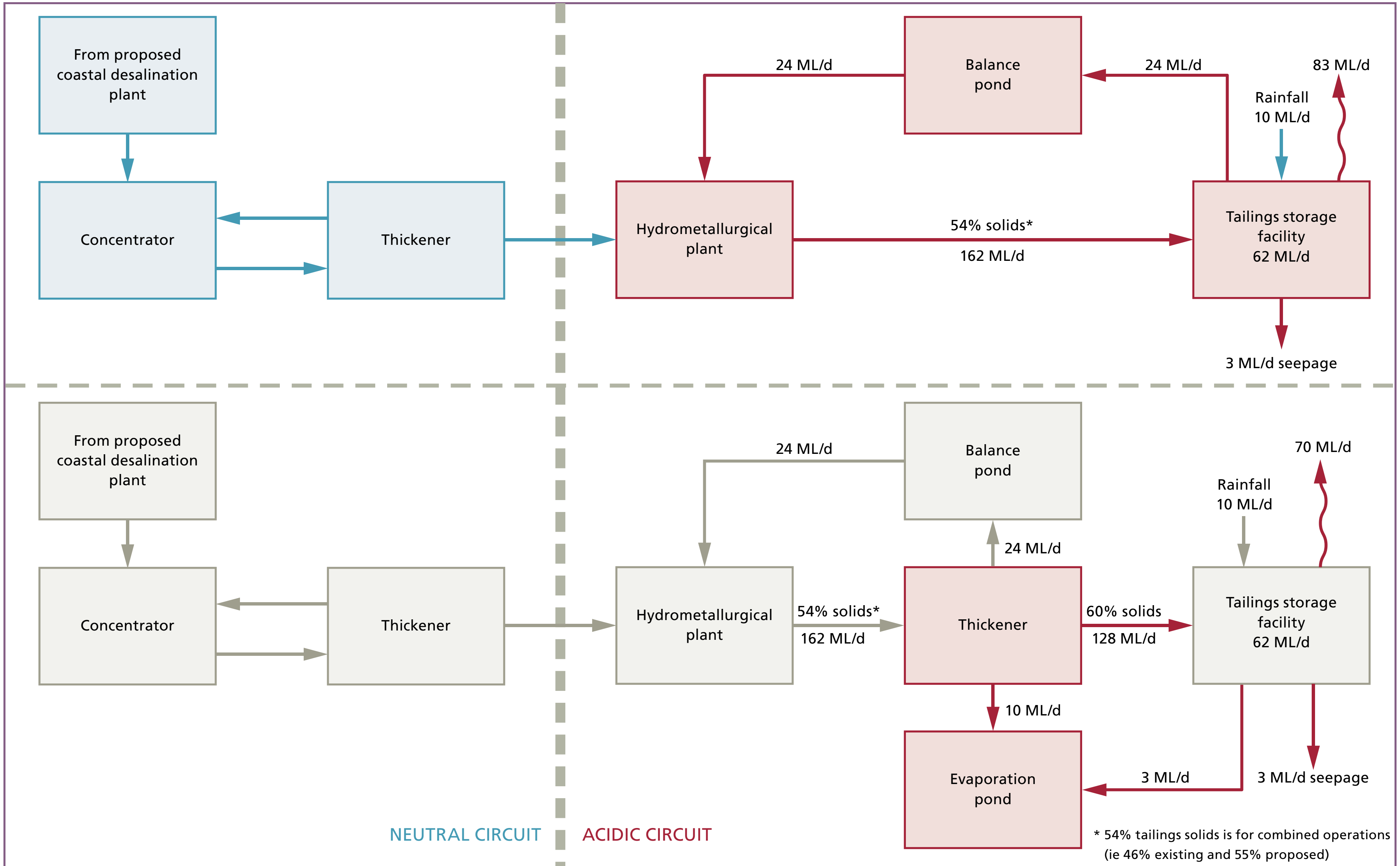


Figure 4.4 Conceptual water circuits for the proposed design compared to a 60% tailings solids alternative

Issue:

BHP Billiton was asked to undertake a risk assessment of the relative environmental impacts of storing tailings in above-ground facilities, compared with facilitating underground partial neutralisation and harvesting of recycled liquor.

Submissions: 52, 77, 282, 301 and 318

Response:

The philosophy of the Olympic Dam tailings storage system is to reduce seepage of acidic liquor to groundwater. Of the seepage that does occur, studies detailed in the Draft EIS and the Supplementary EIS have found that the acidic liquor is neutralised by the sediments that underlie the tailings storage facility (TSF) (see Chapters 12 of the Draft EIS and Supplementary EIS for details). BHP Billiton currently extracts some of this liquor for reuse.

The submissions to the Draft EIS are suggesting that tailings should be allowed to seep more quickly into the sediments that underlie the TSF (i.e. the calcareous clay and limestone) because these sediments neutralise the acidic liquor. Once this natural process has occurred, the neutral liquor could then be harvested and recycled for beneficial use at Olympic Dam, the submissions suggest.

As noted in responses above, increasing the movement of tailings liquor from the surface to below the surface and to the groundwater is inconsistent with the South Australian Government's regulation of Olympic Dam. Also, there are technical constraints on how much recycled liquor can be used in the metallurgical plant due to the introduction of impurities. As such, facilitating underground partial neutralisation and harvesting of recycled liquor beyond that which currently occurs at Olympic Dam is not a preferred option.

4.2.2 PROCESSING OF CONCENTRATE

Issue:

It was questioned why BHP Billiton has chosen to use the rail line to the Port of Darwin rather than the rail line to Adelaide for the export of concentrate.

Submission: 317

Response:

Using the rail line to Adelaide and exporting concentrate via Port Adelaide was discussed in Section 4.6 of the Draft EIS and rejected for the following reasons:

- A new wharf would be required at Port Adelaide or Outer Harbor to accommodate the new bulk-loading facility, and this would need to be in a location with sufficient channel depth to allow access by the large Panamax-class vessels. Such a wharf, with the necessary spare capacity and deep-water access, already exists at the Port of Darwin, East Arm facility.
- Urban encroachment at Port Adelaide exacerbates the potential social issues surrounding the export of bulk materials such as concentrate. Again, this was overcome at the Port of Darwin when it was relocated from Darwin proper to East Arm.
- In addition, the Port of Darwin already supports the export of bulk materials, including copper concentrate from the Prominent Hill mine in South Australia, under the Australasian Trade Route major project, and Port Adelaide does not.

Issue:

It was suggested that BHP Billiton should process the 1.6 Mtpa of concentrate at Olympic Dam to maximise jobs in Australia, rather than export the concentrate and associated jobs to China.

Submissions: 10, 11, 13, 24, 44, 65, 78, 88, 108, 112, 134, 147, 159, 217, 224, 238, 248, 328, 330, 351 and 391

Response:

As discussed in Section 4.5 of the Draft EIS, this alternative was assessed and is not the preferred option for the following reasons:

- this would require an additional smelter to be constructed at Olympic Dam and the additional cost for the additional smelter would not provide the optimal return on investment
- the lower copper grade and lower copper to sulphur ratio of the ore body to be mined for the proposed expansion would necessitate different smelting technology from that currently used at Olympic Dam (i.e. two-staged smelting instead of single-staged smelting), thus increasing the complexity of on-site metallurgical processing by running two smelters with different technologies.

- Also, as discussed in Section 4.5, the selected processing option removes the operating constraint that is inherent in trying to match the design capacity of an on-site smelter with the volume of ore mined. This operating constraint would remain if all processing was to occur at Olympic Dam.
- In relation to employment, the proposed expansion would generate an additional 4,000 permanent jobs for the Olympic Dam workforce, about 6,000 jobs for the short-term construction workforce, 13,100 associated full-time equivalent statewide jobs and between 450 and 1,400 short-term jobs for temporary maintenance shutdowns. This was categorised in the Draft EIS as a high residual benefit.

Issue:

It was suggested that the Olympic Dam operation should not produce, for sale, uranium oxide or copper concentrate containing uranium.

Submissions: 10, 42, 44, 92, 141, 146, 180, 182, 205, 225, 230, 248, 265, 266, 299, 313, 326, 331 and 351

Response:

The proposed expansion would not be financially viable, and therefore would not proceed, if it did not produce and sell uranium products.

4.2.3 MINERALS PROCESSING

Issue:

It was suggested that the Olympic Dam ore body also contains rare earths and iron, and it was questioned whether BHP Billiton plans to mine these other substances and, if not, why not.

Submissions: 2, 110 and 249

Response:

It is correct that the Olympic Dam ore body contains rare earths and iron; both, however, at low grades.

For rare earths, the technology available to recover these is not economically viable at this point in time. Regular technology reviews are undertaken to identify any developments that would provide an economic option for the recovery of the contained rare earths at Olympic Dam.

With respect to iron, the ore grades are low relative to iron ore deposits such as those operated by BHP Billiton in Western Australia. In order to produce a marketable product, additional processing would be required and, based on the low iron grade, the economic evaluation of producing an iron product from Olympic Dam is not currently favourable.

Issue:

It was questioned why the water-intensive processing facilities (i.e. the concentrator and hydrometallurgical plant) were not relocated to Darwin, where sufficient stormwater and groundwater is available.

Submission: 151

Response:

As noted in Section 8.3.2 of the Draft EIS, the Darwin area has a higher annual average rainfall than that of Olympic Dam (1,700 mm compared with 167 mm per year). However, as noted in Table 5.26 of the Draft EIS, the annual average water demand for the metallurgical plant is substantially higher at 151 ML/d (megalitres per day), or approximately 55 GL per year. As such, the additional rainfall at Darwin would provide little, if any, contribution to the project’s water supply.

In addition, relocating these facilities to Darwin would require the transport of 60 Mtpa of ore to Darwin for processing, and the resulting need to either store approximately 58 Mtpa of tailings in this higher-rainfall environment, or returning the 58 Mtpa of tailings back to Olympic Dam for storage.

The benefits of locating these facilities in Darwin associated with the potential stormwater harvesting of an extra 1,533 mm of rainfall per year are not considered to outweigh the additional environmental and economic costs associated with this option.

4.3 WATER SUPPLY

4.3.1 DESALINATION PLANT LOCATION

Issue:

Further justification was sought for locating the proposed desalination plant at Point Lowly, rather than on the west coast of Eyre Peninsula and the Far West Coast. A common reason for seeking justification and preferring such a location was that return water could be discharged directly into the ocean and that additional water could be made available for public consumption by local communities to supplement the existing SA Water supply.

Submissions: 1, 2, 8, 10, 11, 12, 13, 24, 26, 27, 29, 36, 40, 41, 44, 46, 54, 57, 64, 65, 67, 68, 78, 79, 80, 81, 83, 84, 86, 88, 91, 92, 93, 96, 98, 100, 101, 106, 107, 109, 111, 115, 116, 117, 118, 119, 120, 121, 122, 124, 125, 127, 129, 131, 135, 138, 140, 141, 142, 147, 148, 149, 151, 153, 155, 159, 162, 169, 170, 171, 172, 173, 176, 177, 180, 181, 185, 192, 193, 194, 196, 199, 201, 202, 203, 207, 210, 211, 219, 226, 227, 228, 230, 238, 240, 241, 242, 243, 248, 250, 253, 261, 263, 269, 271, 272, 283, 284, 285, 288, 289, 290, 291, 294, 295, 299, 302, 306, 308, 315, 317, 319, 320, 322, 324, 326, 327, 329, 330, 331, 332, 334, 335, 340, 342, 343, 344, 346, 348, 349, 351, 352, 354, 356, 358, 364, 372, 374, 375, 376, 378, 385, 387 and 388

Response:

Summary of response

BHP Billiton used a number of criteria to assess the suitability of proposed locations for the desalination plant. Figure 4.3 of the Draft EIS, repeated here as Figure 4.5, showed the location of the six sites investigated, at Point Lowly, Port Augusta, Whyalla, south of Whyalla, south of Port Pirie and Ceduna (on the Far West Coast).

The assessment against each criterion for each of the six sites is also presented in Figure 4.5, highlighting the reasons for selecting Point Lowly as the preferred location and rejecting the other five locations assessed in the Draft EIS, including Ceduna. BHP Billiton acknowledges that submissions received on the Draft EIS have suggested that west coast locations other than Ceduna would be suitable for the Olympic Dam desalination plant; therefore these have been considered further (see Figure 4.6).

Following the assessment of additional sites, Point Lowly remains the preferred site because it best meets all of the assessment criteria in terms of environmental, logistical and financial considerations.

The alternative locations were found to provide no additional benefit over Point Lowly, and the constraints associated with these sites would pose the potential for greater environmental impact and greatly increased capital and operating costs. Contributing factors to these findings included lower current velocities, additional pipeline length, the potential impacts of pipeline alignment on conservation areas, the lack of suitable road and electricity infrastructure and access to suitable industrial land.

It is also noted that the supply of potable water to Eyre Peninsula communities was considered in the planning for the proposed desalination plant at Point Lowly. Point Lowly would be much better placed to provide potable water to these communities using the existing SA Water network than many of the alternative sites due to the location, capacity and current configuration of the network. Locating a desalination plant at an alternative site would require significant upgrades to, duplication of, or reversal of flow direction in, the existing SA Water pipeline infrastructure.

Description of assessment criteria

Section 4.9 of the Draft EIS presented the criteria against which six locations were assessed to determine the most appropriate location for the proposed Olympic Dam desalination plant. The criteria used were:

proximity to Olympic Dam with clean, deep (>20 m) and fast-flowing water (i.e. water of high plant intake quality and a high-energy environment in which to dilute and disperse return water safely)

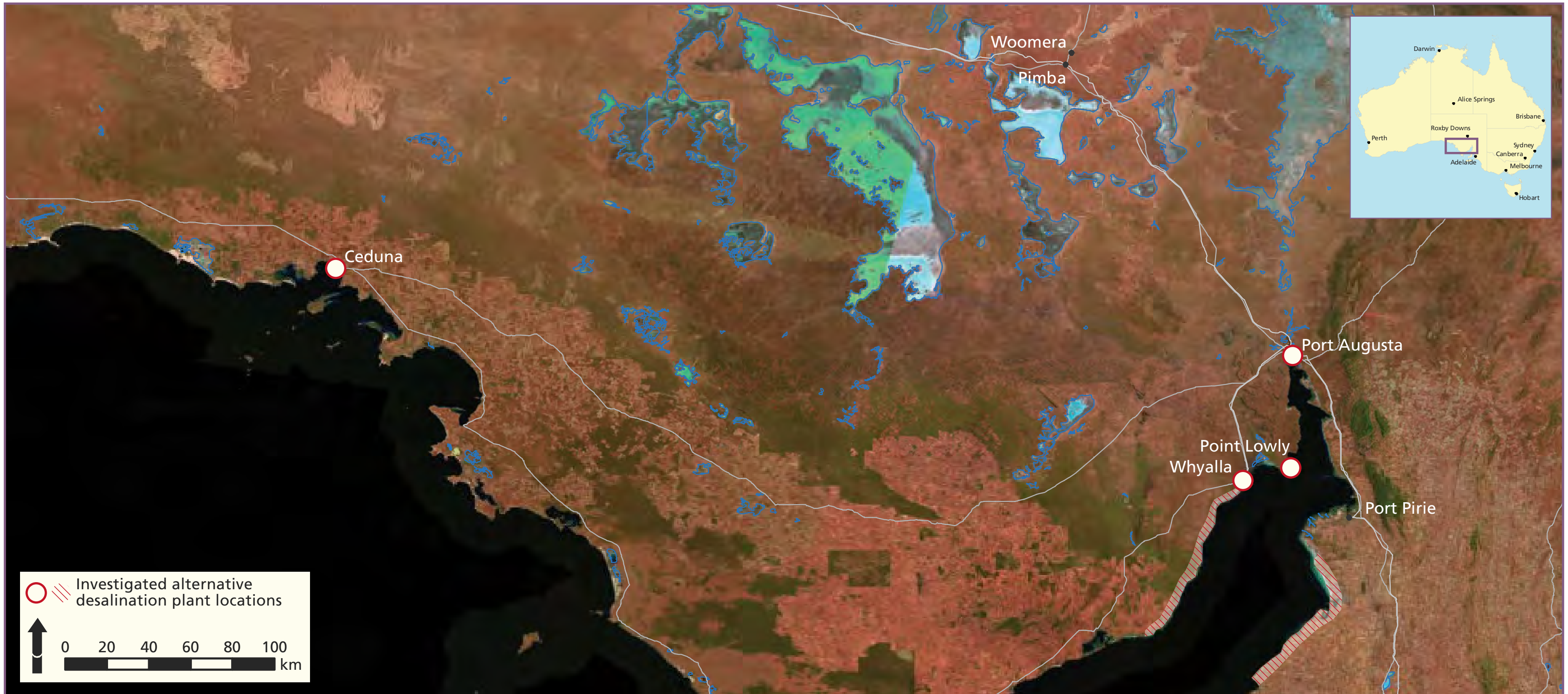
- accessibility and constructability of the water supply pipeline
- availability of land and established utilities such as power, roads and telecommunications infrastructure.

These criteria are discussed in detail below.

Criterion 1: Proximity to Olympic Dam with clean, deep (>20 m) and fast-flowing water (i.e. water of high plant intake quality and a high-energy environment in which to dilute and disperse return water safely)

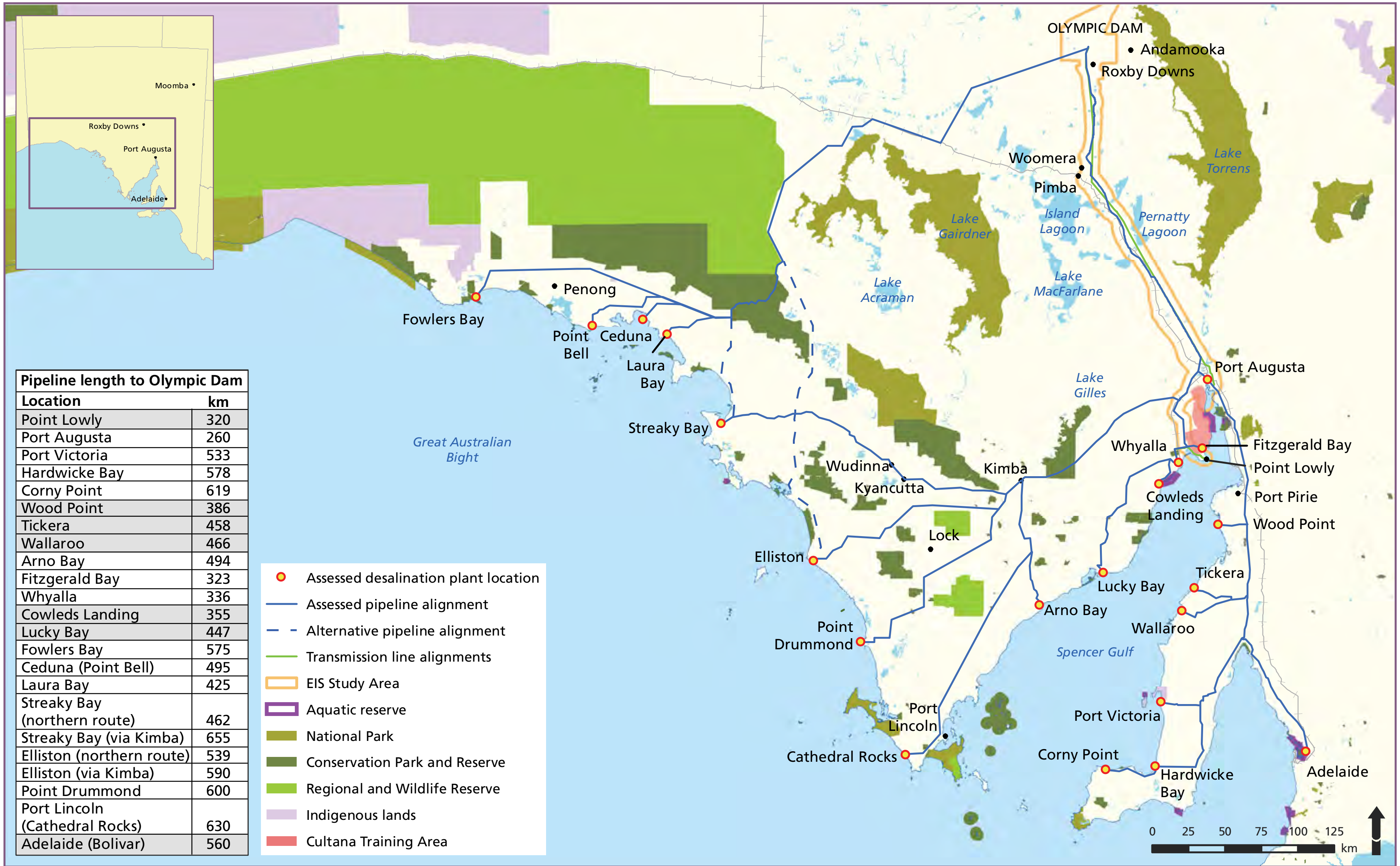
This criterion was listed first in the Draft EIS because it is of considerable importance for three reasons.

First, the proximity of the desalination plant to Olympic Dam establishes the length of the water supply pipeline. The length of the pipeline will directly affect the cost, area of vegetation clearance, and the number of pumping stations (and thus energy requirements and greenhouse gas emissions) required to pump water from the assessed location to Olympic Dam. The pipeline would also require a power supply along its length to power the pumping stations, which affects construction cost and



Criteria	Ceduna	Sites south of Whyalla	Whyalla	Point Lowly	Port Augusta	Sites south of Port Pirie
Length of water supply pipeline (km)	380	>340	320	320	280	>340
Distance to a water depth > 20 m (km)	4	5	7	0.3	>20	10
Suitable available land and infrastructure (e.g. road access and electricity)	No	No	Yes	Yes	Yes	No
Other considerations	Water supply pipeline would need to traverse a conservation park, regional reserves and Defence's Woomera Prohibited Area	Coastline is typified by mangroves and shallow seabed slopes	Extensive seagrass beds in the area and existing dredging would affect intake water quality	Strong tidal currents to maximise dispersion of return water	Existing seawater inlet and outlet infrastructure available but poor dispersion of return water	Coastline is typified by mangroves and shallow seabed slopes

Figure 4.5 Desalination plant location options



Pipeline length to Olympic Dam	
Location	**km**
Point Lowly	320
Port Augusta	260
Port Victoria	533
Hardwicke Bay	578
Corny Point	619
Wood Point	386
Tickera	458
Wallaroo	466
Arno Bay	494
Fitzgerald Bay	323
Whyalla	336
Cowleds Landing	355
Lucky Bay	447
Fowlers Bay	575
Ceduna (Point Bell)	495
Laura Bay	425
Streaky Bay (northern route)	462
Streaky Bay (via Kimba)	655
Elliston (northern route)	539
Elliston (via Kimba)	590
Point Drummond	600
Port Lincoln (Cathedral Rocks)	630
Adelaide (Bolivar)	560

Figure 4.6 Additional sites assessed for the location of the desalination plant

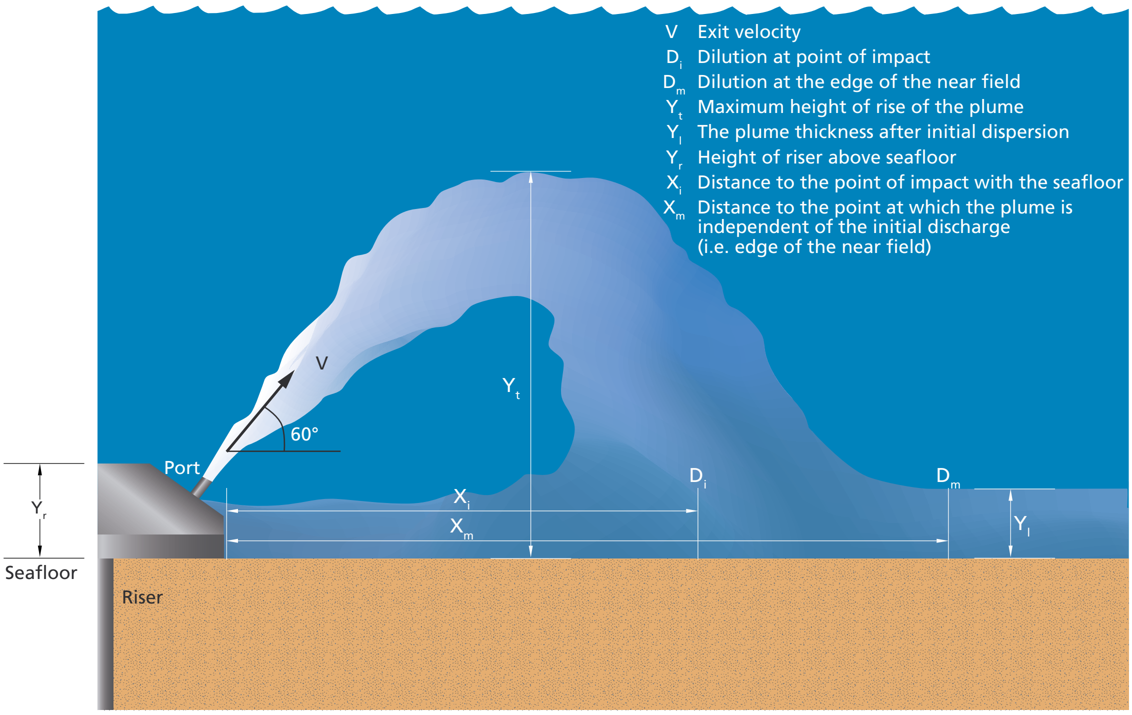
vegetation clearance. Note that the cost of pipeline construction is estimated to be approximately $2 million per kilometre and the cost of constructing an electricity transmission line (to power both the plant itself and the pump stations along the pipeline) is estimated to be approximately $1 million per kilometre. This assumes an appropriate route can be identified, taking into account heritage and biological factors.

Second, a source of 'clean' water for the intake of a desalination plant is important; the cleaner the intake water, the less pre-treatment or chemical treatment is required, and the less energy is required to desalinate the water.

Third, the requirement for 'deep (>20 m) and fast-flowing water' enables the return water to be dispersed rapidly, which is the most important mechanism for reducing the impact on the local marine environment. This is explained further below.

Deep water
As the return water is more saline than the sea, it has a greater density, and therefore sinks towards the seafloor. Therefore, locating the outfall in deep water allows the return water to be injected under pressure high into the water column, facilitating its immediate vertical dispersion. This initial dilution, or primary mixing, has been confirmed by both modelling results and field-measured data from operating desalination plants. Further dispersion, or secondary mixing, follows as the return water falls back towards the seafloor due to tidal, wave and current movements (see Figure 4.7). Dispersion modelling has revealed that tidal currents provide significantly better dilution and dispersion of return water than waves generated by wind (see Section 17.7.1 of this Supplementary EIS for details).

Fast-flowing water
Secondary mixing by currents and, to a lesser extent wave action, contribute to the dispersal of return water (Svensson 2005; see also Chapter 16 of the Draft EIS and Section 17.7 of the Supplementary EIS for details). Higher-energy current velocities in the marine environment at the outfall will result in more rapid dilution and dispersion of the return water and a smaller area of potential impact in the local marine environment.



Source: Roberts et al. (1997)

Figure 4.7 Profile of a return water plume from a single port

Criterion 2: Accessibility and constructability of the water pipeline

The main objectives associated with the criterion of accessibility and constructability of the water pipeline are to determine the land tenure and use of the areas that would be traversed and to gain an appreciation of the terrain and geology of the areas as an indicator of the time, cost and safety of construction.

In general, preference is given to a pipeline alignment that:

- minimises the number of third party properties affected
- avoids conservation areas and known heritage areas
- maximises the length of the alignment located within already granted tenure for public purposes (e.g. road reserves, energy or telecommunications easements)
- avoids steep and/or highly variable terrain (this element also affects operating costs as alignment through steep or variable terrain would incur extra pumping costs)
- avoids soil types that require additional engineering to lay or secure the pipeline trench (e.g. granites or similar hard rock that may require blasting; sandy soils that may require additional shoring of trenches to provide a safe working environment; and large salt lakes).

Criterion 3: Availability of land and established utilities such as power, roads and telecommunications infrastructure

Having regard to this criterion, preference is given to land that is:

- close to the coast to minimise the length of the intake and outfall pipelines
- appropriately zoned (i.e. for industrial use) to enable the site to be used for a desalination plant
- close to an existing, suitable power supply (132 kV being required)
- close to existing road networks to enable access during the construction period
- relatively flat for the location of the desalination plant, and preferably with low elevation and level topography so that laying the intake and outfall pipes is easy and cost-effective
- ideally, located in an area that already supports some industrial/semi-industrial land uses.

Aligning a water supply pipeline taking into account the considerations listed above would reduce the length (and therefore the environmental impact) of the intake and outfall pipelines, reduce disturbance to existing land uses and users, eliminate any requirement for rezoning by locating the plant in areas of appropriate zoning and land use, and reduce the amount of new infrastructure required to service the desalination plant.

Alternative sites assessed

A review of the submissions received on the Draft EIS suggested Elliston, Ceduna, Point Drummond and Port Lincoln as suitable sites. These, along with other sites on western Eyre Peninsula and on either side of Spencer Gulf, have been assessed against the same criteria.

Along with Point Lowly, the following alternative sites have been assessed:

Eastern Spencer Gulf:
- Port Augusta
- Port Victoria
- Hardwicke Bay
- Corny Point

Sites south of Port Pirie:
- Wood Point
- Tickera
- Wallaroo

Western Spencer Gulf:
- Arno Bay
- Fitzgerald Bay
- Whyalla

South of Whyalla:
- Cowleds Landing
- Lucky Bay

West Coast:
- Fowlers Bay
- Ceduna
- Laura Bay
- Streaky Bay
- Elliston
- Point Drummond
- Port Lincoln (Cathedral Rocks).

Figure 4.6 shows the locations of the assessed sites. Tables 4.1–4.4 provide a summary of the assessment findings for each of the additional locations.

Summary of assessment

Point Lowly

As shown in Tables 4.1–4.4, an assessment against the site selection criteria listed above shows the location of a desalination plant

Table 4.1 Evaluation of potential desalination plant sites against the primary assessment criteria (with more favourable aspects than the Point Lowly plant denoted by bold type)

Potential Site		Direct distance to Olympic Dam (km)	Pipeline				Distance to deep water >20 m (km)	Distance to 132 kV electricity supply[4] (km)	Current speed (cm/s)	
			Length (km)[1]	Energy consumption (GWhpa)[2]	GHG emissions (kt CO_2pa)[2]	Veg clearance[3] (ha)			Max	Ave
	Point Lowly	300	320	154	120	993	0.3	25 (Cultana)	154.1[5]	48.0[5]
Eastern Spencer Gulf	Port Augusta	**250**	**260**	**125**	**98**	**807**	>20	**0**	50[6]	n.a.
	Port Victoria	455	533	257	200	1,654	2	27	15.3[7]	6.3[7]
	Hardwicke Bay	500	578	278	217	1,794	10	28	15.1[7]	5.7[7]
	Corny Point	500	619	298	232	1,921	1	69	39.2[7]	13.6[7]
Sites south of Port Pirie	Wood Point	340	386	186	145	1,198	10	**20**	35.0[7]	14.5[7]
	Tickera	380	458	220	172	1,421	10	42	56.2[7]	25.5[7]
	Wallaroo	395	466	224	175	1,446	5	50	56.8[7]	22.1[7]
Western Spencer Gulf	Arno Bay	385	494	238	185	1,533	2	38	38.6[7]	15.4[7]
	Fitzgerald Bay	290	323	155	121	1,002	5	**25**	35.1[7]	13.6[7]
	Whyalla	300	336	162	126	1,043	7	**0**	100[6]	n/a
Sites south of Whyalla	Cowleds Landing	320	355	171	133	1,102	10	**19**	30.6[7]	11.6[7]
	Lucky Bay	365	447	215	168	1,387	2	80	43.7[7]	18.5[7]
West Coast of Eyre Peninsula	Fowlers Bay	455	575	277	216	1,784	<2	347 (Wudinna)	6.4[7]	2.4[7]
	Ceduna	355	495	238	186	1,536	5	259 (Wudinna)	n.a.	n.a.
	Laura Bay	350	425	205	159	1,319	>15	191 (Wudinna)	10.1[7]	3.4[7]
	Streaky Bay	380	655	315	246	2,033	2	148 (Wudinna)	24.6[7]	10.1[7]
	Elliston	400	590	284	221	1,831	<1	100 (Kyancutta)	30[8]	6[8]
	Point Drummond	440	600	289	225	1,862	1	100 (Lock)	n.a.	n.a.
	Port Lincoln (Cathedral Rocks)	500	630	303	236	1,955	<1	**0**	n.a.	n.a.
	Adelaide (Bolivar)	500	560	270	210	1,738	n.a.	**0**	n.a.	n.a.

Notes

1 Estimated pipeline routes have been aligned along existing road corridors where possible, and avoid salt lakes, Woomera Prohibited Area, elevated/mountainous areas and conservation areas where possible.

2 Annual energy consumption and greenhouse gas (GHG) emissions for electric pumps based on projected consumption of 154 GWhpa for proposed Point Lowly plant and pro-rated for distance.

3 Vegetation clearance assumes pro-rated based on the estimated vegetation clearance for Point Lowly (993 ha), as reported in Section 15.5.1, Table 15.4 of the Draft EIS.

4 Assuming electricity easement alignment adjacent to existing roads where possible.

5 BMT WBM 2008 and 2010, Point Lowly ADCP monitoring results.

6 Harris and O'Brien 1998.

7 P. Lauer (PIRSA), pers. comm., 26 May 2008.

8 BMT WBM 2010, Elliston ADCP monitoring results – see Appendix B1 and Table 4.6.

n.a. Not available.

Table 4.2 Comparison of estimated construction costs for water supply pipelines and electricity transmission lines for Point Lowly and alternative sites

	Potential site	Pipeline length (km)[1]	Electricity supply to site from nearest 132 kV (km)	Electricity supply to pipeline pump stations (km)	Pipeline cost ($m)[2]	Power line cost ($m)[3]	Total construction cost ($m)	Comparison to Point Lowly
	Point Lowly	320	25	0	640	25	665	n.a.
Eastern Spencer Gulf	Port Augusta	260	0	0	520	0	520	✚
	Port Victoria	533	27	0	1,066	27	1,093	▲
	Hardwicke Bay	578	28	0	1,156	28	1,184	▲
	Corny Point	619	69	0	1,238	69	1,307	▲
Sites south of Port Pirie	Wood Point	386	20	0	772	20	792	●
	Tickera	458	42	0	916	42	958	◆
	Wallaroo	466	50	0	932	50	982	◆
Western Spencer Gulf	Arno Bay	494	38	0	988	38	1,026	◆
	Fitzgerald Bay	323	25	0	646	25	671	●
	Whyalla	336	0	0	672	0	672	✚
Sites south of Whyalla	Cowleds Landing	355	19	0	710	19	729	●
	Lucky Bay	447	80	0	894	80	974	◆
West Coast of Eyre Peninsula	Fowlers Bay	575	347	425	1,150	772	1,922	▲
	Ceduna (Point Bell)	495	259	345	990	604	1,594	▲
	Laura Bay	425	191	275	850	466	1,316	▲
	Streaky Bay	655	148	40	1,310	188	1,498	▲
	Elliston	590	80	0	1,180	80	1,260	▲
	Point Drummond	600	100	0	1,200	100	1,300	▲
	Port Lincoln (Cathedral Rocks)	630	0	0	1,260	0	1,260	▲
	Adelaide (Bolivar)	560	0	0	1,120	0	1,120	▲

Notes
1 Assumes alignment route permitted through conservation area and Woomera Prohibited Area.
2 Estimated pipeline construction cost $2 million per kilometre
3 Estimated electricity transmission line construction cost $1 million per kilometre.

✚ Estimated cost equivalent or less than estimated costs for Point Lowly
● Moderate additional cost – under $200 million more than estimated costs for Point Lowly
◆ Significant additional cost – between $200 million and $400 million more than estimated costs for Point Lowly
▲ Extreme additional cost – over $400 million more than estimated costs for Point Lowly

Table 4.3 Screening of potential desalination plant sites against selection criteria in comparison to Point Lowly

Potential Site		Pipeline distance[1] >50 km extra = ◆ >100 km extra = ▲	Pipeline alignment through conservation areas/mountain ranges/salt lakes[2]	Zoning and/or land use constraints for site and/or pipeline route	Vegetation clearance >125% more = ◆ >150% more = ▲	Distance to suitable electricity supply >25 km = ◆ >100 km = ▲	Distance to sufficient water depth >300 m = ◆ >2 km = ▲	Low current speeds (inferior dispersion) <70% slower = ◆ >70% slower = ▲	Other considerations
	Point Lowly	✚	✚	✚	✚	✚	✚	✚	✚
Eastern Spencer Gulf	Port Augusta	✚	✚	✚	✚	✚	▲	▲	High-salinity source water
	Port Victoria	▲	✚	Little available industrial-zoned land	▲	◆	◆	▲	✚
	Hardwicke Bay	▲	✚	Little available industrial-zoned land	▲	◆	▲	▲	Road access may not be sufficient
	Corny Point	▲	✚	Little available industrial-zoned land	▲	◆	◆	▲	Road access may not be sufficient
Sites south of Port Pirie	Wood Point	◆	✚	Little available industrial-zoned land	✚	✚	▲	▲	Road access may not be sufficient
	Tickera	▲	✚	Little available industrial-zoned land	◆	◆	▲	◆	Road access may not be sufficient
	Wallaroo	▲	✚	✚	◆	◆	▲	◆	Operation of port may raise sediment – water quality issues
Western Spencer Gulf	Arno Bay	▲	✚	Little available industrial-zoned land	◆	◆	◆	◆	Limestone reef to 400 m offshore
	Fitzgerald Bay	✚	✚	Little available industrial-zoned land	✚	✚	▲	▲	Road access may not be sufficient
	Whyalla	✚	✚	✚	✚	✚	▲	▲	Operation of port may raise sediment – water quality issues
Sites south of Whyalla	Cowleds Landing	✚	▲	Conservation (Cowleds Landing Aquatic Reserve, Munyaroo CP)	✚	✚	▲	▲	✚
	Lucky Bay	▲	▲	Little available industrial-zoned land	◆	◆	◆	◆	✚
West Coast of Eyre Peninsula	Fowlers Bay	▲	▲	Conservation (Fowlers Bay CP, Yellabinna RR, Yumbarra CP, Pureba CP) No available industrial-zoned land	▲	▲	◆	▲	Road access may not be sufficient
	Ceduna (Point Bell)	▲	▲	Conservation (Yellabinna RR, Yumbarra CP Pureba CP, Point Bell CR)	▲	▲	◆		✚
	Laura Bay	▲	▲	Conservation areas (Yumbarra CP, Gawler Ranges NP, Pureba CP)) Little available industrial-zoned land	◆	▲	▲	▲	✚
	Streaky Bay	▲	◆	Conservation areas (several) Little available industrial-zoned land	▲	▲	◆	▲	✚
	Elliston	▲	◆	Conservation (Lake Newland CP) Water Protection zoning Little available industrial-zoned land	▲	▲	✚	▲	Coastline typified by rocky cliffs
	Point Drummond	▲	✚	No available industrial-zoned land	▲	▲	✚	▲	Coastline typified by rocky cliffs
	Port Lincoln (Cathedral Rocks)	▲	✚	Conservation (Lincoln NP, Lincoln CR, Coffin Bay NP) No available industrial-zoned land Rural zoning – Coastal/Water Protection	▲	✚	✚		Coastline typified by rocky cliffs

Notes
[1] Pipeline distance comparisons based on distance of pipeline from Point Lowly to Olympic Dam (320 km)
[2] Pipeline route assumed to be aligned along existing road, rail or other infrastructure corridors to reduce environmental and land use impact.
✚ Negligible constraints under this criterion
◆ Moderate constraints under this criterion compared to Point Lowly
▲ Significant constraints under this criterion compared to Point Lowly

Table 4.4 Assessment of marine and coastal environmental values at potential desalination plant sites

Potential Site		Natural (undisturbed) environment	Scenic quality	Recreational amenity	Reef communities	Seagrass communities	Mangrove/salt marsh communities	Important breeding or nursery habitat	Other values	Principal issues and possible contingencies/ control measures	Would control measures effectively protect environmental values?
	Point Lowly	◆	◆	◆	▲	●	✖	▲	Sponge garden	Australian Giant Cuttlefish breeding in near shore, shallow reef communities. Can avoid by tunnelling and discharging return water in deep water offshore. Position outfall to minimise/ avoid effects on sponge community.	Yes
Eastern Spencer Gulf	Port Augusta	●	◆	✖	✖	◆	▲	▲		Mangroves. Could avoid by tunnelling	Yes
	Port Victoria	◆	◆	◆	✖	▲	✖	●	Australian Fur Seal colony	Seagrass communities. Could avoid by tunnelling	Yes
	Hardwicke Bay	◆	◆	◆	✖	▲	✖	●		Seagrass communities. Could avoid by tunnelling	Yes
	Corny Point	◆	▲	▲	◆	▲	✖	●		High scenic quality and tourist area	No (Scenic quality)
Sites south of Port Pirie	Wood Point	◆	◆	✖	✖	▲	▲	▲		Salt marshes and seagrass communities. Could avoid by tunnelling	Yes
	Tickera	◆	◆	✖	✖	▲	✖	●		Seagrass communities. Could avoid by tunnelling	Yes
	Wallaroo	◆	◆	▲	◆	▲	✖	●		Seagrass communities. Could avoid by tunnelling	Yes
Western Spencer Gulf	Arno Bay	◆	◆	◆	◆	▲	●	◆	Aquaculture	Seagrass communities. Could avoid by tunnelling	Yes
	Fitzgerald Bay	◆	▲	●	▲	◆	◆	▲	Aquaculture	Scenic quality	Yes
	Whyalla	✖	●	✖	●	▲	◆	▲		Remnant seagrass communities. Seagrasses could be avoided by following shipping channel	Yes
Sites south of Whyalla	Cowleds Landing	▲	◆	●	✖	▲	▲	▲	Onshore and offshore conservation areas	Mangroves, seagrass communities, aquatic reserve and natural, undisturbed environment	No (Conservation area)
	Lucky Bay	◆	◆	◆	●	▲	◆	◆		Seagrass and saltmarsh communities. Could avoid by tunnelling	Yes
West Coast of Eyre Peninsula	Fowlers Bay	▲	▲	◆	▲	▲	✖	✖	Onshore conservation areas	Seagrass communities, relatively natural and high scenic quality	No (Scenic quality, natural environment)
	Ceduna (Point Bell)	▲	▲	◆	▲	◆	◆	●	Onshore and offshore conservation areas	Seagrass and mangrove communities could be avoided by tunnelling. Point Bell has high scenic quality and undisturbed natural environment.	No (Scenic quality, natural environment)
	Laura Bay	◆	◆	●	●	▲	◆	◆		Seagrass, saltmarsh and mangrove communities. Could avoid by tunnelling	Yes
	Streaky Bay	◆	▲	▲	◆	▲	◆	◆		High scenic quality, and seagrass and mangrove communities. Could avoid by tunnelling	Yes
	Elliston	◆	▲	▲	◆	✖	✖	●	Aquaculture. Onshore and offshore conservation areas. Sea lion colony.	High scenic quality	Yes
	Point Drummond	▲	▲	●	▲	✖	✖	●		Natural environment and high scenic quality	No (Scenic quality, natural environment)
	Port Lincoln (Cathedral Rocks)	▲	▲	●	▲	✖	✖	●	Undisturbed native vegetation	Natural environment and high scenic quality	No (Scenic quality, natural environment)

▲ = high priority value
◆ = moderate priority value
● = low priority value
✖ = no priority value

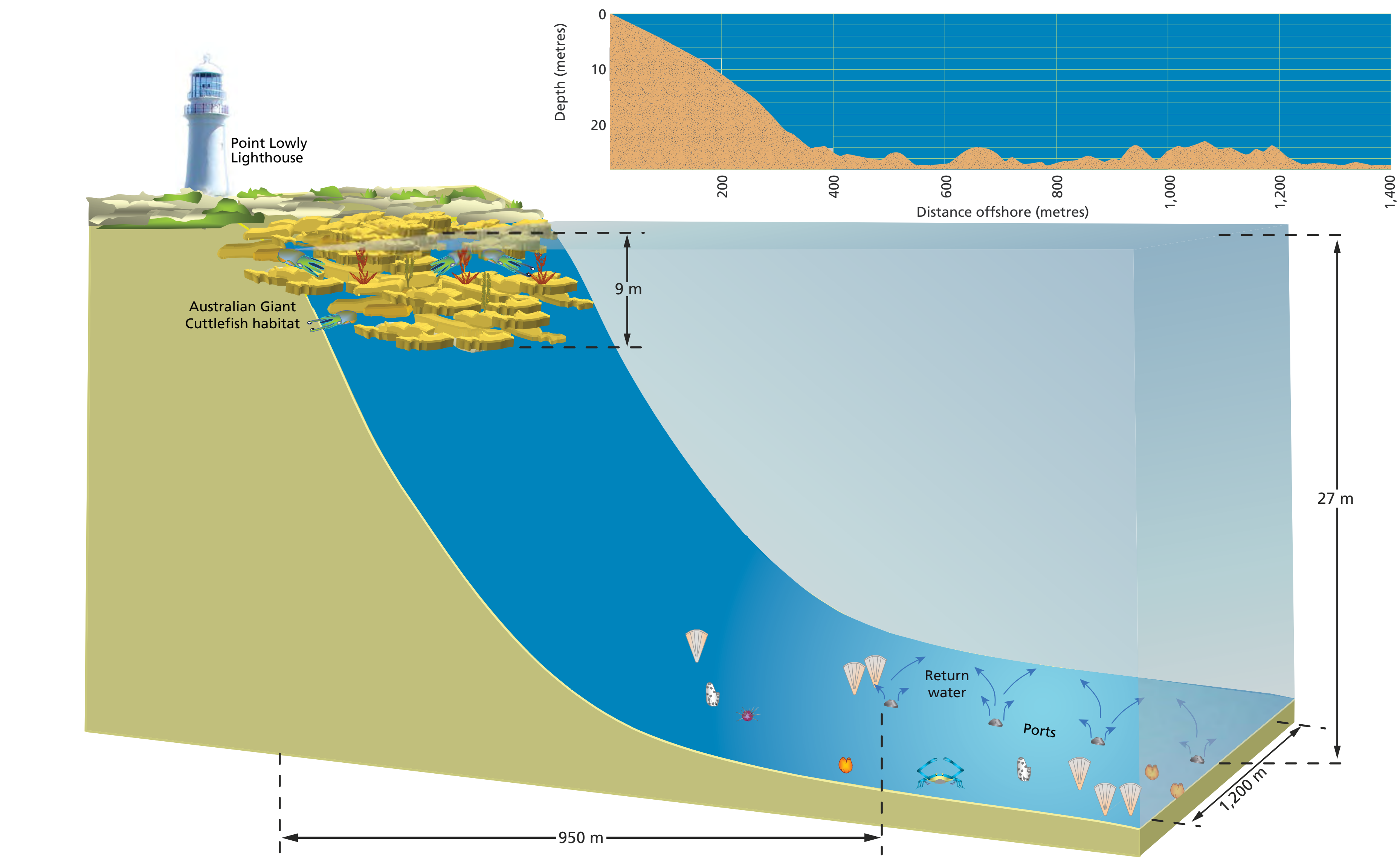


Figure 4.8 Cross-section of seafloor elevation off Point Lowly

Figure 4.9 Land use and electricity transmission network around Point Lowly

at Point Lowly is much more preferable to the other sites evaluated. Assessment against the criterion of proximity shows that Point Lowly is not the closest potential location to Olympic Dam; Port Augusta and Fitzgerald Bay are closer. These locations, however, were rejected for other reasons that are outlined further in the sections below.

Point Lowly provides access to the coast and to deep, clean and fast-flowing water.

The waters in Fitzgerald Bay (the location of the intake structure) are undisturbed by industrial emissions, shipping disturbance or contaminated terrestrial run-off, and therefore provide a source of clean intake water.

The seafloor off Point Lowly dips sharply, reaching depths in excess of 20 m within 300 m of the shore (see Figure 4.8), providing sufficiently deep water to facilitate the rapid dispersion of the return water plume, and requiring only a relatively short outfall pipeline.

The current speeds off Point Lowly are among the fastest in South Australia. Other areas assessed in Spencer Gulf and on the West Coast have maximum current speeds below 60 cm per second (P. Lauer, PIRSA, pers. comm., 26 May 2008), while maximum velocities measured at Point Lowly have exceeded 150 cm per second (see Chapter 16 of the Draft EIS and Chapter 17 of the Supplementary EIS for details). Average current speeds off Point Lowly are more than double that predicted for most other locations (as shown in Table 4.1). Therefore, the dispersion of return water due to currents would be greater at Point Lowly than at any of the alternative sites assessed. Many of the suggestions for alternative sites, including Elliston, included discussion of the perceived benefits of disposing of the return water into the 'open' ocean, rather than into Spencer Gulf. However, the dispersion that would be provided by the currents at Point Lowly is much greater than at any of the alternative sites evaluated. This is discussed in more detail below and in Chapter 17 of the Supplementary EIS.

The proposed Point Lowly pipeline would follow existing road and infrastructure corridors so, for the majority of its route, the required easement would be aligned in previously disturbed areas. This route would avoid conservation areas, major salt lakes and significant mountain ranges.

It would also be located adjacent to a suitable power supply, meaning a transmission line to power the pump stations would not be required along the length of the pipeline.

The proposed Point Lowly plant would be located on vacant land (see Figure 4.9) that is currently zoned for industrial use (DPLG 2010a), and would therefore not require a change of zoning or disturbance of an existing land use.

As described above, the proposed desalination plant needs access to an adequate electricity supply network, as it would require a 132 kV power supply. The Cultana electrical substation, 25 km from Point Lowly, is suitable for this purpose (see Figure 4.9).

Summary of assessment of alternative sites

General summary

Evaluation of the potential alternative sites against the assessment criteria is summarised in Tables 4.1–4.4.

The majority of the alternative locations would involve significantly longer pipelines and higher construction costs than Point Lowly, with the exceptions of Port Augusta, Fitzgerald Bay and Whyalla. As shown in Tables 4.1–4.4, the construction and operation of a pipeline to Olympic Dam from a desalination plant at other alternative locations (excluding the three listed above) would increase the impact of the pipeline (over and above the impacts of the proposed pipeline from Point Lowly) as follows:

- increased pipeline length – between 35 and 335 km
- increased vegetation clearance – between 109 and 1,040 ha
- increased energy use – between 17 and 161 GWhpa
- increased greenhouse gas emissions (CO_2 equivalent) – between 13 and 126 ktpa
- increased distance to deep water (20 m depth) of up to 10–15 km
- increased costs of between $70 million and $670 million for pipeline construction
- increased costs of up to $737 million for the additional electricity transmission line to supply the desalination plant and power the pump stations along the pipeline
- increased total construction costs of between $64 million and $1.25 billion.

Construction of a desalination plant at one of the alternative sites would also result in an increased area of ecological effect in the marine environment relative to that expected at Point Lowly. Average accessible current speeds would be between 47% and 95% slower (average 74%) than those measured off Point Lowly, which would provide significantly inferior mixing of the return water plume.

For comparison of the alternative sites, potential pipeline routes were chosen based on the shortest distance to Olympic Dam, while still optimising the provision of electricity supply and minimising vegetation clearance and disturbance to conservation areas.

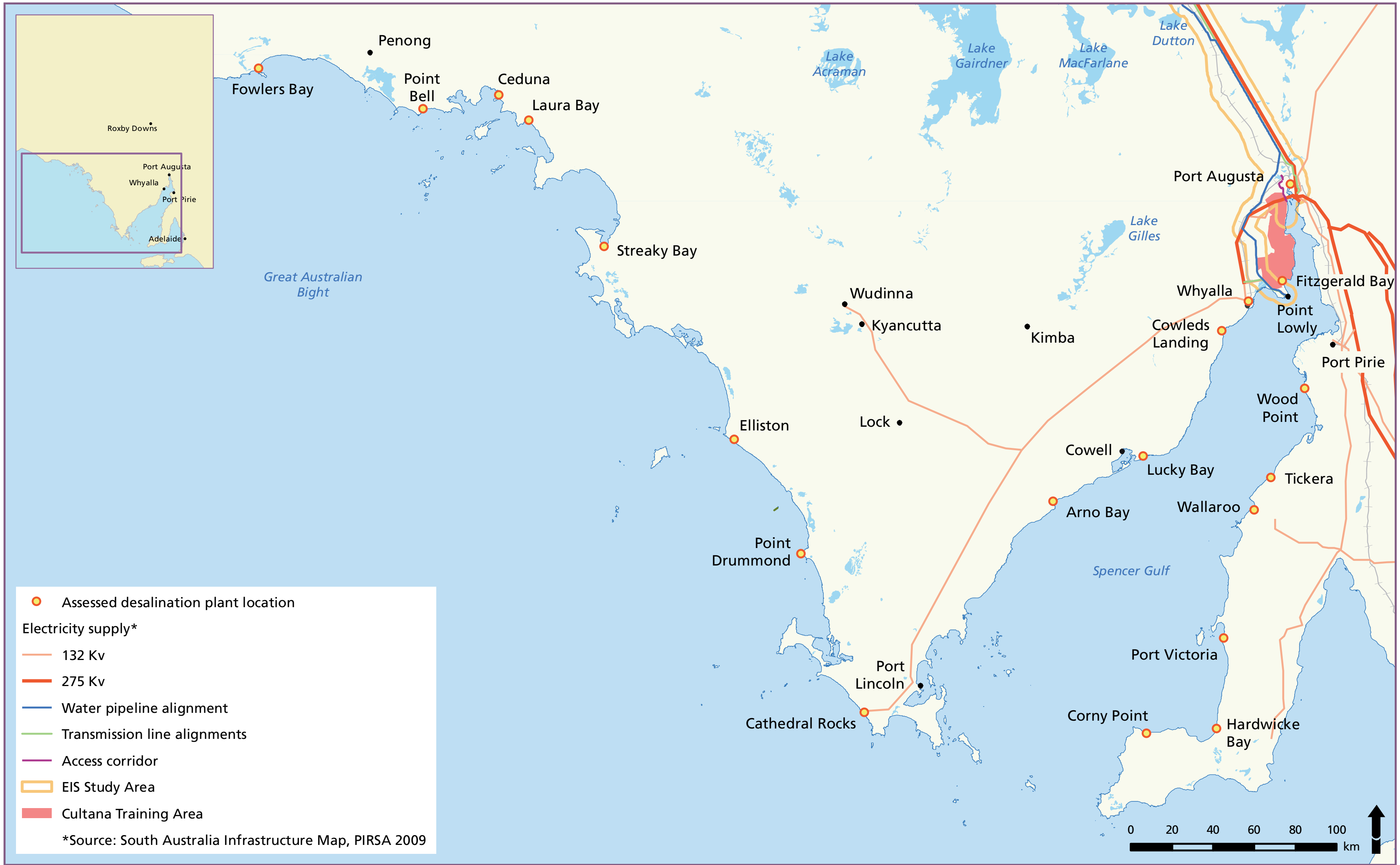


Figure 4.10 Eyre Peninsula electricity supply

Alternative pipeline routes have been aligned, where possible, to match existing road and infrastructure corridors and to avoid conservation areas and mountainous areas.

Vegetation clearance requirements, energy use and greenhouse gas emissions for the pump stations have been based on the estimated requirements for the Point Lowly plant and pro-rated for distance. Although some of the pipeline routes for the alternative sites pass through vegetated areas (including conservation reserves), the routes would be aligned through agricultural and pastoral areas for much of their length.

Several of the alternative sites, including Point Lowly, have significant environmental values, as shown in Table 4.4. Based on an assessment of the inherent environmental values at each site, and the consideration of mitigation measures to reduce impacts to these values, it can be concluded that many of the alternative sites would have a greater environmental footprint than Point Lowly. Although several of the alternative sites assessed would, potentially, be suitable for the location of a desalination plant, the sites that may be deemed suitable for environmental reasons have not been selected as the preferred site because they do not sufficiently satisfy the other selection criteria. This is discussed in further detail below.

As shown in Figure 4.6, all of the alternative locations assessed were chosen because they are on the coast. Although many have access to, or are only short distances from, suitable road networks, some (for example, those on the east coast of Spencer Gulf) may require upgrading of existing roads or construction of new roads to allow the safe movement of large trucks during the construction period. Many of the alternative sites would be located in areas that, depending on the exact site, would require a change of zoning to allow for industrial land use associated with the desalination plant.

As discussed above, the proposed desalination plant needs to be close to an adequate (132 kV) electricity supply. As illustrated in Figure 4.10, the alternative sites assessed in Upper Spencer Gulf are relatively close to a sufficient power supply. However, locating the plant at other locations on the west coast would require an extension of the existing 132 kV supply, which currently terminates at Wudinna, approximately 200 km east of Ceduna. The assessment of the alternative sites has assumed that the existing electricity transmission network on Eyre Peninsula has sufficient capacity to provide power to a desalination plant and the required pump stations.

In addition to the extra cost for pipeline construction, the extra cost of constructing a suitable electricity transmission line to power a desalination plant must be considered. Current estimates anticipate an installation cost for new electricity transmission lines of approximately $1 million per km. For several of the alternative sites assessed, construction of an electricity transmission line would not only be required to the site of the desalination plant, but would also be required along the length of the pipeline to power the pumps (see Table 4.2). Depending on the site, the estimated construction costs for the required electricity transmission lines (both to the site and along the pipeline alignment) could be up to $737 million more than the costs estimated for the Point Lowly site. Constructing an electricity transmission line would also require additional vegetation clearance.

Most of the alternative sites are located on generally level terrain. However, several of the west coast locations would most likely be in areas with high cliffs (including the areas around Elliston, Streaky Bay and Point Drummond). Apart from the visual impacts, this would make the construction of the intake pipelines expensive and potentially problematic, with no option but to tunnel both the intake and outfall pipelines, whereas it is proposed to tunnel only the outfall pipeline (see Section 1.4 of the Supplementary EIS). Current estimates of tunnelling costs are in the order of $18,000 per metre.

Assessment of sites in Spencer Gulf

Much of Spencer Gulf, particularly the Upper Spencer Gulf area, is typified by mangroves and shallow seabed slopes that provide seagrass habitats and associated communities. Because of these shallow slopes, water of sufficient depth to allow adequate dispersion of return water (>20 m) is typically two or more kilometres offshore at most of the alternative sites assessed in this area (see Table 4.1). This would necessitate construction of an extremely long outfall pipeline, leading to increased construction costs and environmental impact (including significant disturbance of seagrass beds). In addition, average current speeds at the alternative locations assessed in Spencer Gulf are between 47% and 87% slower than those recorded at Point Lowly (see Table 4.1), resulting a larger return water footprint with significantly inferior dispersion to that available at Point Lowly.

Port Augusta

Port Augusta, although located close to Olympic Dam with adequate provision of road and electricity infrastructure, was not selected as the preferred site because the gulf is narrow and shallow in this area. Port Augusta is more than 20 km away from water of sufficient depth to allow adequate dispersion of return water from a desalination plant.

As discussed in the Draft EIS (refer Section 16.5.2 and Appendix 011.3), due to the low current speeds and shallow water depths, an outfall at Port Augusta would have major impacts on the salinity regime and associated ecological values of the upper reaches of Spencer Gulf.

Sites south of Port Pirie

The eastern portion of Upper Spencer Gulf (approximately 90 km of coastline between Port Davis near Port Pirie and Point Riley near Wallaroo, as shown in Figure 4.6) consists either of mangroves, seagrass habitats or cliffs, with shallow seabed slopes and limited access to the coast via suitable sealed roads (see Tables 4.3 and 4.4).

Because of the shallow seabed slopes in this region, suitably deep water is up to 10 km offshore. This would require an extremely long outfall pipeline which, if tunnelled to avoid impacts to seagrass habitats, would cost in the order of $180 million.

Corny Point

Corny Point is located on the north-western tip of the 'boot' of Yorke Peninsula (see Figure 4.6). The distance to suitably deep water in this area (1 km) would require an outfall pipeline longer than that proposed for Point Lowly. Construction of a pipeline and associated electricity infrastructure would cost almost twice as much as that estimated for Point Lowly (see Table 4.2).

Whyalla

Whyalla is close to the coast, a similar distance from Olympic Dam as Point Lowly and has access to adequate road and electricity supply infrastructure. However, current speeds in the area are lower than those at Point Lowly, and the sea off Whyalla is not sufficiently deep to allow adequate dispersion of the return water plume; a 7 km-long outfall pipeline would be required to reach depths greater than 20 m, which would cost in the order of $126 million.

Additional constraints are the presence of intensive industrial facilities and the frequency of shipping movements into and out of Whyalla. Emissions from industrial facilities could have a detrimental impact on intake water quality for a desalination plant at Whyalla. Shipping traffic and dredging in the Whyalla harbour could result in the disturbance of sand and sediment and its suspension in the water column. This would have a detrimental effect on the intake water quality, and would require construction of a much longer intake pipeline. Although shipping in the Point Lowly area occurs at Port Bonython, and the desalination plant would be located next to an existing industrial site (the Santos hydrocarbon processing facility), the intake structure for the Point Lowly desalination plant would be located in Fitzgerald Bay to the north. Therefore, any industrial emissions and sediment suspension resulting from shipping movements at Port Bonython would not affect intake water quality for the proposed Point Lowly desalination plant.

Sites south of Whyalla

The sites assessed south of Whyalla (approximately 105 km of coastline between Whyalla and Cowell) offer limited access to the coastline.

This area of the gulf has significant areas of seagrass and mangroves, and a large aquatic reserve is located north of Cowleds Landing, making this area less suitable for a desalination plant.

The Munyaroo Conservation Park and Conservation Reserve are about 40 km south of Whyalla (see Figure 4.6), and adjoin several large, privately owned parcels of land under vegetation Heritage Agreements (DEH 2008). These areas form a significant area of contiguous remnant native vegetation of approximately 35,000 ha, covering about 25 km of coastline (see Figure 4.6). BHP Billiton would not construct the desalination plant or pipeline in the park, the reserve or the area of remnant bushland.

Similar to the eastern side of the Upper Spencer Gulf, the shallow slopes of the seabed in this region mean that sufficiently deep water is several kilometres offshore, requiring a much longer outfall pipeline than that required for Point Lowly.

Assessment of sites on the west coast

Several west coast sites have been assessed against the criteria described above. In addition to the locations suggested in the submissions (Ceduna, Elliston, Point Drummond and Port Lincoln), locations around Fowlers Bay, Streaky Bay and Laura Bay were also assessed. Cathedral Rocks was selected to represent the area around Port Lincoln because Port Lincoln itself was considered to be too sheltered to provide adequate dispersion of the return water plume. The South Australian Government is also considering the Cathedral Rocks area as a possible location for a future desalination plant (SA Water 2008).

Selection of likely pipeline alignments involves balancing construction costs and environmental impact. A shorter route would, potentially, incur less cost to construct the pipeline but could involve greater environmental impact.

The alignment of pipelines from the majority of Eyre Peninsula and west coast sites would also have to pass through or around the Gawler Ranges and avoid the large salt lakes in the area. Avoiding these areas would add hundreds of kilometres to the alignments, while aligning the pipeline through the Gawler Ranges would add to the difficulty of construction because of the hard rock substrate and steep and highly variable terrain. The constant changes in elevation would also pose difficulties in terms of the number of pump stations required to pump the water up numerous inclines.

Reducing the length of pipeline routes from sites at Fowlers Bay, Ceduna and Laura Bay would require them to be aligned through the Pureba Conservation Park and the Woomera Prohibited Area (WPA). It is noted that the impacts of vegetation clearance through the Pureba Conservation Park would be of much greater significance than the majority of the eastern alignments, as the latter would follow road reserves or pass through agricultural or pastoral land, rather than significant areas of intact native vegetation. For Elliston and Streaky Bay, longer routes (40 km and 195 km extra, respectively) to the east have been assessed, as these routes avoid the conservation areas and WPA to the north, and would allow the pipelines to be aligned adjacent to an existing 132 kV power supply. Taking into account the construction costs for an electricity transmission line ($1 million per kilometre), the longer route to Elliston would cost $470 million less than the shorter route (see Table 4.5). For the sake of consistency, the alignments that would involve the cheapest construction costs have been assessed for all of the alternative west coast sites. As discussed above, it has been assumed that there is sufficient capacity in the existing electricity network to provide power to the desalination plant and pump stations for all of the alternative locations and pipeline routes.

Table 4.5 Comparison of alternative routes from selected west coast sites against Point Lowly

Site	Pipeline length (km)	Vegetation clearance (ha)[1]	Energy use (GWhpa)[2]	GHG emissions (ktpa)[2]	Length of electricity line (km)[3]		Construction cost ($m)
					To plant	Along pipeline	
Point Lowly	320	993	154	120	25	0	665
Northern route – through conservation parks and Woomera Prohibited Area							
Fowlers Bay	575	1,784	277	216	347	425	1,922
Ceduna	495	1,536	238	186	259	345	1,594
Laura Bay	425	1,319	205	159	191	275	1,316
Streaky Bay	460	1,427	221	173	148	460	1,528
Elliston	550	1,707	265	206	80	550	1,730
Eastern route – via Wudinna, Kimba and Port Augusta							
Fowlers Bay	857	2,659	412	321	347	40[4]	2,101
Ceduna	769	2,386	370	288	259	40[4]	1,837
Laura Bay	700	2,172	337	263	191	40[4]	1,631
Streaky Bay	655	2,033	315	246	148	40[4]	1,498
Elliston	590	1,831	284	221	100[3]	0	1,260

Notes
Selected alignments shown in bold.
1 Vegetation clearance assumes pro-rated based on the estimated vegetation clearance for Point Lowly (993 ha), as reported in Section 15.5.1, Table 15.4 of the Draft EIS.
2 Annual energy consumption and greenhouse gas (GHG) emissions for electric pumps based on projected consumption of 154 GWhpa for proposed Point Lowly plant and pro-rated for distance.
3 Electricity connections for all sites assumed at Wudinna except Elliston (Kyancutta).
4 Assumes connection to pipeline to pump station located at Kimba from existing 132 kV line to the south (See Figure 4.10).

As discussed above, many of the assessed West Coast locations would involve pipeline alignments that would either pass through conservation areas or through areas with intact native vegetation (see Figure 4.6). Construction of the pipelines and additional electricity transmission lines for all of the west coast sites would require vegetation clearance in excess of 1,300 ha; this is 33% more than the clearance area proposed for the Point Lowly water supply pipeline (see Table 4.1).

In addition, these longer pipelines would also require the construction of additional electricity transmission lines along their length to provide power for the required pump stations. This would need additional clearance of vegetation and, as stated above, would cost in the order of $1 million per kilometre. If a west coast location were selected, the extra length of pipeline and electricity infrastructure required would add between $595 million and $1.25 billion to the cost of establishing a desalination plant (see Table 4.2).

Ceduna and Fowlers Bay

Ceduna was assessed in the Draft EIS and the reasons for its rejection were stated. In addition to those reasons, while a straight pipeline from Ceduna to Olympic Dam would be 355 km long (35 km longer than the proposed pipeline from Point Lowly), a realistic pipeline alignment from Ceduna would need to be much longer to avoid large conservation areas such as the Yellabinna Regional Reserve, Yellabinna Wilderness Protection Area and the Yumbarra Conservation Park (see Figure 4.6). However, as discussed above, the pipeline alignment would pass through the Woomera Prohibited Area (WPA) and the Pureba Conservation Park. Although this route would follow an existing access track, a construction corridor of 30 m would need to be cleared, as well as a 1 ha laydown area every 100 km, necessitating the clearance of a significant area of undisturbed native vegetation. Conversely, aligning the pipeline along the eastern route via Wudinna would make a pipeline 275 km longer (see Table 4.5). As discussed above, the shorter, northerly route has been assessed for the Supplementary EIS.

As sufficiently deep water is several kilometres offshore, locating the desalination plant at Ceduna would also require the construction of an extremely long outfall pipeline. In order to reach sufficiently deep water, a site approximately 50 km west of Ceduna at or around Point Bell would be required, entailing further extension of pipeline and electricity infrastructure. A pipeline alignment to such a site would be approximately 495 km long, and an electricity transmission line of almost 260 km would be required to link the site with the existing 132 kV power supply that currently terminates at Wudinna.

Fowlers Bay is 455 km in a straight line from Olympic Dam. Land use around Fowlers Bay is a mixture of conservation and primary production, with little surrounding industrial land use and limited access to coastal sites on quality sealed roads. As listed in Table 4.1, average current speeds at Fowlers Bay are also quite low (20 times slower than those measured at Point Lowly – see Table 4.1), indicating this site would provide only limited potential for dispersion of the return water plume via secondary mixing.

Selection of a site at Fowlers Bay and a realistic pipeline alignment would require a pipeline 575 km long (via the Pureba Conservation Park and the WPA) and an electricity transmission line from Wudinna almost 350 km long. The construction of these two infrastructure components would require more than 1,780 ha of vegetation to be cleared (much of it in conservation areas, as shown in Figure 4.6) and would cost almost $2 billion.

Streaky Bay and Laura Bay

Sites further south along the west coast of Eyre Peninsula involve additional distance from Olympic Dam, and also involve potential clashes with conservation areas, both inland and on the coast (see Figure 4.6). Streaky Bay and Laura Bay are both close to conservation areas (onshore and offshore), and pipeline alignments for both sites would be required to avoid conservation areas in the interior of Eyre Peninsula (see Figure 4.6). New electricity supply lines of about 150 km (Streaky Bay) to 200 km (Laura Bay) would be required to power a desalination plant in either of these locations. In addition, suitably deep water is more than 2 km offshore at Streaky Bay and around 15 km offshore at Laura Bay, requiring a much longer outfall pipeline than that proposed for Point Lowly.

As discussed above, the pipeline route assessed for a Laura Bay site would be aligned through the Pureba Conservation Park and the WPA. Although this would decrease the length of the pipeline by approximately 275 km in comparison to the eastern route, it would involve clearance of a large extent of intact native vegetation in a conservation park.

The route for Streaky Bay was aligned to the east towards Wudinna, avoiding the conservation areas, the Gawler Ranges and the salt lakes. Although this route would be cheaper to construct than the northern route (see Table 4.5), this alignment resulted in the Streaky Bay route being the longest pipeline of all those assessed (655 km). A pipeline from a desalination plant at this site to Olympic Dam would involve twice the vegetation clearance, construction cost, power demand, GHG emissions and operating cost of a pipeline from the Point Lowly site.

Elliston

Elliston, although adjacent to the coast, has limited available industrial land in suitable locations. As shown in Figure 4.11, there is only a small area of suitably zoned land at the furthest extent of Waterloo Bay (DPLG 2010b). The majority of land in the Elliston area is zoned Primary Industry, Water Protection or Coastal, and there is an aquaculture zone just offshore to the north and east of the township. In addition, the Lake Newland Conservation Park is north of the township, limiting potential sites to the areas south of the township (further from Olympic Dam) along a stretch of coastline noted for its rocky cliffs.

Locating the desalination plant at Elliston would require the construction of a new electricity transmission line to Kyancutta to provide the necessary 132 kV power supply, at a cost of around $80 million. The total cost of constructing a 590 km pipeline and the required electricity infrastructure would be over half a billion dollars more than the cost for the proposed Point Lowly plant (see Table 4.5).

Further to these logistical and financial considerations, studies have shown that the secondary mixing (provided by currents and wave energy) off Elliston is also significantly lower than in the ocean off Point Lowly (BMT WBM 2010, see Appendix B1 of the Supplementary EIS). Measured current speeds in the Elliston area are up to six times slower than the median speeds measured at Point Lowly (see Tables 4.1 and 4.6 and Appendix B1), indicating that the return water would be dispersed much less effectively at a site in this area. Figure 4.12 shows the measured current speeds at Point Lowly, Elliston and at the site of the Adelaide Desalination Plant at Port Stanvac. This figure demonstrates that the percentile current speeds measured at Point Lowly (even those measured during a dodge tide) are significantly higher than those recorded at Elliston (see Figure 4.12, Table 4.4 and Appendix B1). Therefore, the currents at Point Lowly would provide superior dispersion of the return water and a smaller environmental impact footprint than would be experienced at Elliston.

Table 4.6 Current velocities between 2.6 m and 3.7 m from the seabed (BMT WBM 2010)

Location		Point Lowly		Elliston		Port Stanvac
		Dodge tide	All conditions	Site 1	Site 2	
Current velocity (cm/s)	Median	14	38	6	5	11
	Maximum	42	131	30	24	39

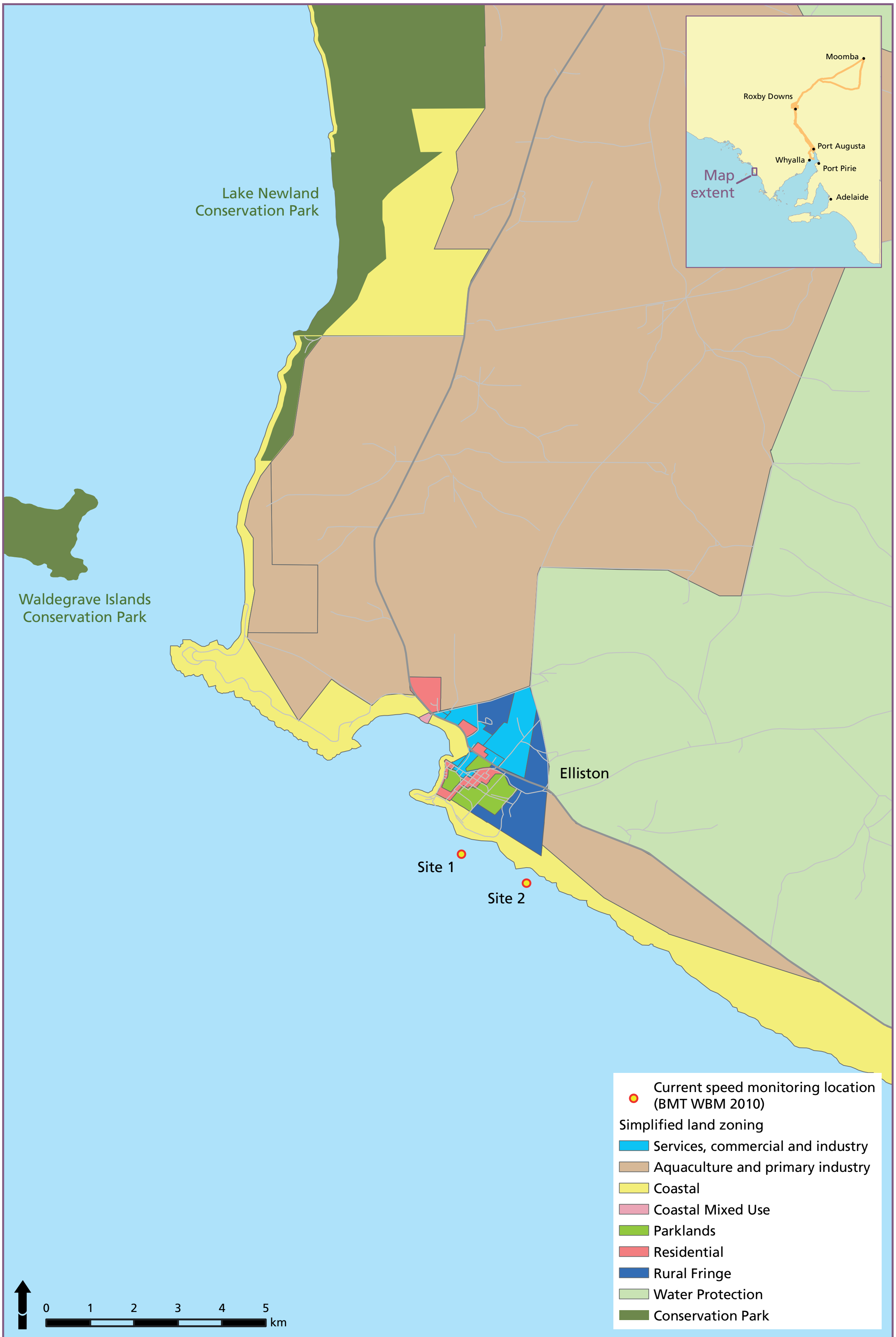


Figure 4.11 Current speed monitoring locations and land zoning around Elliston

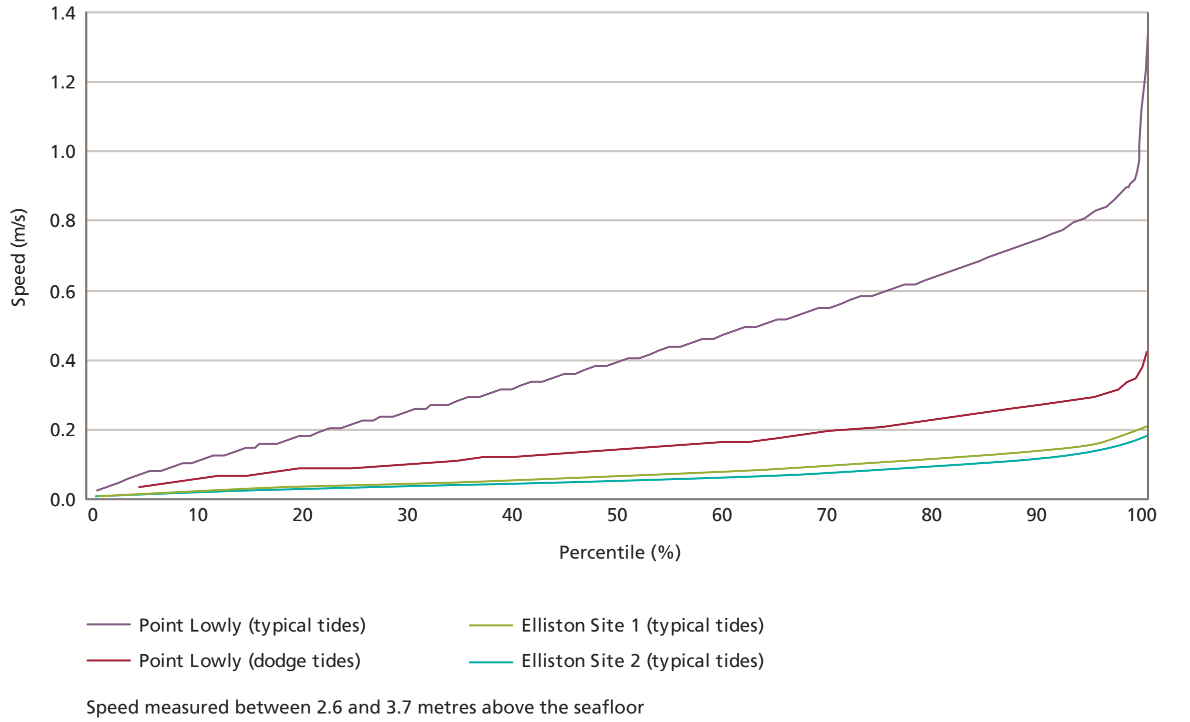


Figure 4.12 Comparison of current speeds off Point Lowly and Elliston

Point Drummond

The main factors against locating the desalination plant at Point Drummond are:

- distance (a 600 km water pipeline would be required)
- the lack of infrastructure (a 100 km electricity transmission line would be required)
- total construction costs of $1.3 billion
- lack of suitably zoned land and suitable roads
- limited access to the coast due to rocky cliffs.

In addition, the alignment of a pipeline from Point Drummond would need to divert around several conservation areas and the Gawler Ranges.

Cathedral Rocks

Cathedral Rocks, near the southern tip of Eyre Peninsula, is rejected primarily on the basis of distance. It was the furthest assessed straight-line location from Olympic Dam (500 km) with the second longest pipeline alignment (630 km), almost double the length of the proposed Point Lowly pipeline. A pipeline from a desalination plant at a Cathedral Rocks site to Olympic Dam would involve almost twice the environmental impacts and costs of a pipeline from the Point Lowly site.

The coastline and surrounding areas in the vicinity of Cathedral Rocks are largely undisturbed, and have significant areas of dense native vegetation. A pipeline from a desalination plant in this location would have to avoid several gazetted conservation areas, as well as heavily vegetated areas, particularly around Uley, that are zoned Water Protection (DPLG 2010c). In addition, the coastline in this area provides limited access to the coast due to rocky cliffs, and has few adequate roads to facilitate construction.

Potable water supply to Eyre Peninsula west coast communities

During the initial planning phase for the desalination plant site, it was considered desirable to locate the plant close to an existing SA Water supply network to facilitate a cost-effective connection to supply water to local communities. Several responses to the Draft EIS have suggested that locating the plant on the west coast of Eyre Peninsula, in particular at Elliston, would enable the supply of potable water to this region to be supplemented. This aspect is discussed in Section 4.3.2 below.

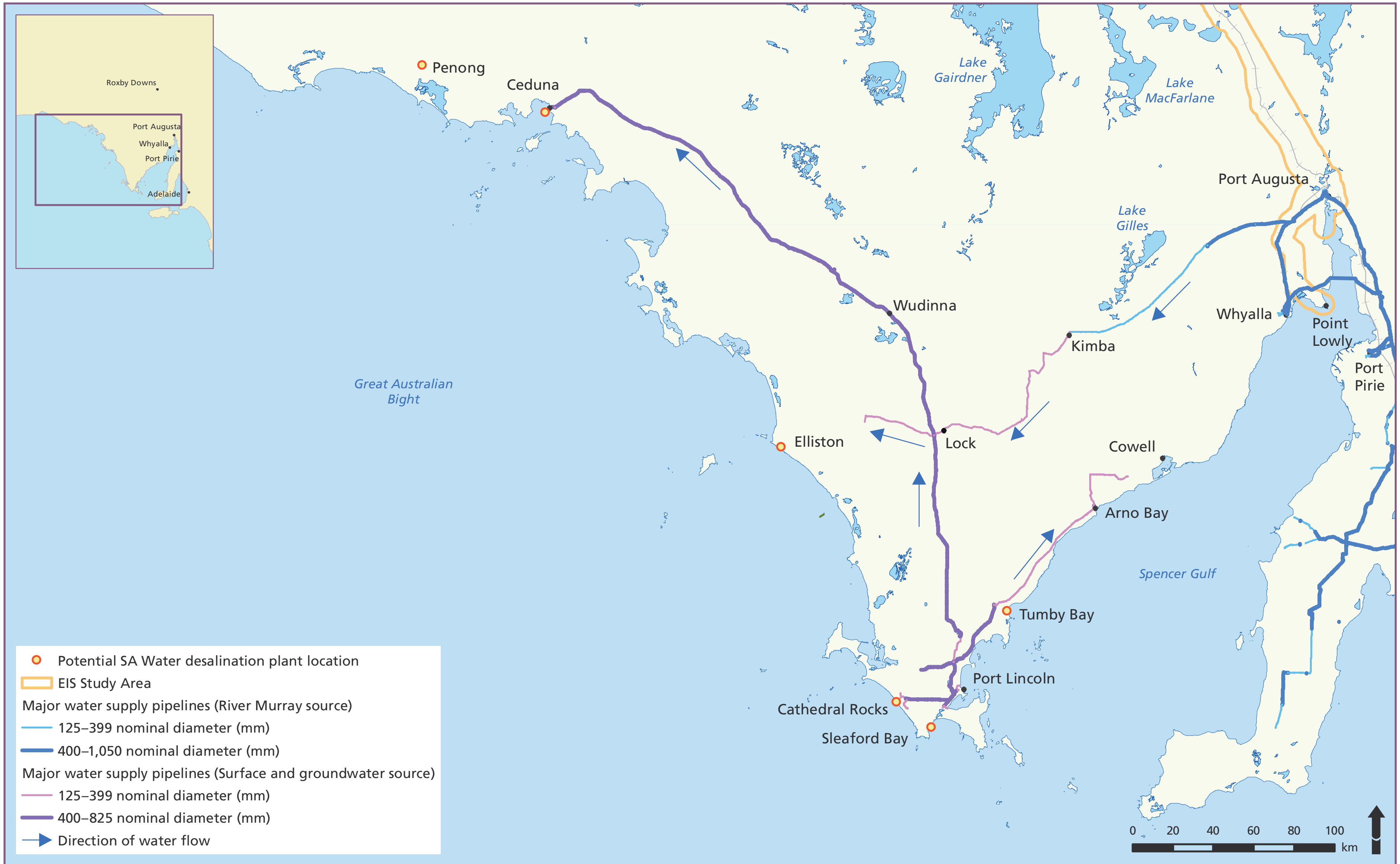


Figure 4.13 SA Water infrastructure on Eyre Peninsula

4.3.2 THE POINT LOWLY DESALINATION PLANT

Issue:

Submissions requested water from the desalination plant to be provided to local communities.

Submissions: 90, 109, 128, 227, 290 and 376

Response:

The South Australian Government, through SA Water, is responsible for providing water to communities across South Australia.

The existing SA Water network (see Figure 4.13) supplies River Murray water to Eyre Peninsula through pipelines via Port Augusta (underground) and Port Broughton (undersea), which continue via Iron Knob to Kimba and Lock (SA Water 2010a). The majority of Eyre Peninsula is supplied by a network of pipelines that originate in Port Lincoln and pump groundwater north towards Lock and north-east towards Cleve; and from Lock north-west towards Ceduna (SA Water 2008; see Figure 4.13).

Shortly after BHP Billiton's consideration of a desalination plant at Point Lowly began in 2004, the South Australian Government asked BHP Billiton whether its planning for the project could include the option of water being available from the plant to supply areas of northern South Australia currently receiving water from the River Murray. The Government proposed this because of the need to reduce pressure on environmental flows in the Murray. As a result, BHP Billiton completed its assessment of a desalination plant based on a maximum daily supply of 280 ML/d, with 80 ML/d to be available for government purposes. In 2009, after the completion of the Draft EIS, the Government advised BHP Billiton that because of its decision to construct a desalination plant in the Adelaide metropolitan area which would significantly reduce the draw on River Murray supplies, it no longer wished to pursue the option of involvement in a desalination plant at Point Lowly.

The bulk of water demand in the region is from the major population and industrial centres of Upper Spencer Gulf, including Port Pirie, Port Augusta and Whyalla. The population around these three centres is about 1.5 times greater than the rest of Eyre Peninsula combined (ABS 2010). Recent population growth in this area attributed to increased resource sector activity (ABS 2008) is expected to continue, with some projections estimating the population of Port Augusta could increase by up to 16% by 2016 (Port Augusta City Council 2009).

Point Lowly is well located to provide water to supplement existing SA Water supplies, as it is close to the SA Water network and complements the flow direction of the existing system. Locating the plant at Ceduna or another location on the west coast of Eyre Peninsula would require either a reversal of the current flow direction in the north-western portion of the SA Water network, or the construction of an additional pipeline to supply areas south-east of Ceduna (SA Water 2008). In addition, the capacity of the existing SA Water network to pump in this direction may be insufficient for the volumes of water required due to the small (825 mm or less) pipeline diameters in this area (see Figure 4.13).

In June 2009, the government released its 'Water for Good' plan to ensure South Australia's future water security to 2050 (Office for Water Security 2009). Water for Good outlines over 90 actions to diversify the water sources, improve water conservation and efficiency, and reduce the reliance on the River Murray and other rain-dependent water sources in South Australia. Among the proposed actions was the construction of the Adelaide desalination plant at Port Stanvac. The plan also recommended investigations into additional water sources, including desalinated seawater, for Eyre Peninsula. SA Water's assessments (SA Water 2008; SA Water 2009) found the most favourable sites were in the south of Eyre Peninsula, near Sleaford Bay and Cathedral Rocks, south of Port Lincoln (see Figure 4.13).

Issue:

Justification was requested for the decision to cut and cover the intake and outfall pipelines rather than the use of a tunnelling installation method.

Submission: 2

Response:

Section 5.7.4 of the Draft EIS proposed that the intake and outfall pipelines associated with the proposed desalination plant would either be buried for their full length, or buried in the land-based sections and laid on the seabed in the deeper waters. The justification for this construction method, as detailed in the Draft EIS, was that potential environmental impacts could be adequately managed.

Since the publication of the Draft EIS, BHP Billiton has committed to tunnelling the outfall pipeline (see Section 1.4 and Appendix A6 of the Supplementary EIS for details). Tunnelling the outfall pipe would significantly reduce, if not avoid, the need for marine blasting.

It is proposed that the intake pipe, located in the sheltered Fitzgerald Bay, be installed via the trenching method, as assessed in the Draft EIS, because this could be undertaken with low residual impact. For example, the alignment of this pipe would require minimal, if any, marine blasting and the generation of sediment plumes from this area during trenching would be minimal due to low current speeds.

Issue:

BHP Billiton was asked to consider funding research into the desalination process to treat return water.

Submissions: 28, 288 and 350

Response:

BHP Billiton believes it has incorporated the best available technology into the design of the desalination plant but would continue to review developments that may enhance its application. The technology of the pre-treatment of return water discharge is an area of considerable potential development (Peters and Pinto 2008), and BHP Billiton would adopt new technologies if they were shown to increase the plant's efficiency or reduce its environmental impact.

Issue:

It was requested that the return water be disposed of on land rather than discharged back to Spencer Gulf. Suggested discharge sites included Olympic Dam and Lake Torrens. The potential for commercial use of the saline return water was also raised.

Submissions: 5, 34, 36, 80, 179, 182, 252, 264, 285, 312 and 378

Response:

Land-based discharge of the return water has been assessed as unfeasible due to the large volumes of water involved, and the large areas of land required. The anticipated 300 ML per day of return water would require over 12,000 ha (120 square kilometres) of flat, preferably coastal land to dispose of the return water through evaporation ponds. The use of the return water to produce salt for commercial purposes would require the construction of one of the largest salt production facilities in Australia; an area of more than 20,000 ha would be required to provide the necessary crystallisation ponds and infrastructure for the collection, storage and transport of salt. The environmental impacts of this additional land use would also be significant, as evidenced by the rejection (on environmental grounds) of a proposal to establish a 4.2 Mtpa salt production facility covering approximately 20,000 ha in Western Australia.

The option of discharging the return water to a specifically constructed facility on land has been investigated, and is discussed in Section 4.10.2 of the Draft EIS. In order to discharge the 300 ML/d (110 GL/year) of return water from the proposed Point Lowly plant to land, approximately 12,000 ha would need to be cleared to construct evaporation ponds (Department of Agriculture Western Australia 2004) in which to store the return water. It is likely that these ponds would have to be lined (with impermeable clay or an artificial liner) to prevent leakage and impact to local groundwater resources (Svensson 2005).

No acceptable site to accommodate this level of clearance and the required evaporation ponds was identified. If ponds were not used, a thermal evaporation method would be required (Chelme-Ayala et al. 2009; Tanaka et al. 2003), which would be highly energy-intensive.

It was suggested in submissions that such a site would be available at the Olympic Dam operation. However, transporting the return water to Olympic Dam would significantly increase power consumption for pumping and require the construction of a separate 320 km pipeline and pumping infrastructure. Both of these factors would increase greenhouse gas emissions and land disturbance significantly beyond that of the selected option. The option of discharging return water to land (regardless of location or proximity to the desalination plant) therefore has higher capital and operating costs than the selected option and no perceived environmental benefit, as the marine studies presented in the Draft EIS and confirmed in Chapter 17 of the Supplementary EIS have demonstrated clearly the sustainable nature of discharging return water to Upper Spencer Gulf.

The potential for discharge to a natural salt lake (e.g. Lake Torrens) was also discussed in Section 4.10.2 of the Draft EIS. The option of discharging the return water into Lake Torrens was rejected because Lake Torrens is a national park, and the discharge of return water would be inconsistent with the management principles of this conservation area.

With regard to the potential commercial use of the salt from the return water, existing desalination plants that produce commercial salt from their return water differ from the proposed Point Lowly plant in one or more of the following ways (Alberti et al. 2009; Ravizky and Nadav 2007; Svensson 2005; Ahmed et al. 2003; Turek 2002):

- they generally have much smaller production capacity
- they use brackish groundwater rather than seawater as a source (the greater the salinity of the return water, the lower the evaporation rate)
- they use either a thermal distillation process or a combination of methods to produce desalinated water
- they are adjacent to large expanses of inexpensive and unproductive desert land in which to construct large evaporation ponds.

The Dry Creek salt fields, operated by Cheetham Salt, cover approximately 4,000 ha (Hough 2008) and use approximately 50 GL/year of seawater at a salinity of around 35 g/L to produce 750 ktpa of salt (K. Taylor, Cheetham Salt, pers. comm., 28 June 2010). The proposed Point Lowly desalination plant would produce approximately 110 GL/y at a salinity of around 75 g/L. Based on the land use requirements at Dry Creek, it is estimated that the Point Lowly desalination plant would require the construction of approximately 9,000 ha of shallow concentration ponds (at an average 0.5 m depth) in order to concentrate the salts sufficiently to allow crystallisation.

It is noted that the crystallisation ponds at the Dry Creek facility are only operational from September to April, after which time the ponds are drained and harvested, and operations are postponed for the winter (K. Taylor, pers. comm., 28 June 2010). This practice would also be required at Point Lowly. This is important because salt production facilities utilising seawater as feed water (such as at Dry Creek) are able to prevent the inflow of additional water if the concentration and crystallisation ponds are full by switching off the pumps from the sea. However, return water from the proposed desalination plant would provide a constant supply that would require disposal. Therefore, if the concentration and crystallisation ponds were to become inundated by unseasonal rainfall, any excess return water would have to be disposed of by other means, namely by discharge to the ocean or to evaporation ponds on land.

Therefore, a salt production facility at Point Lowly would require an area of approximately 12,000 ha of flat land (Western Australian Department of Agriculture 2004) to construct evaporation ponds to store the return water produced by the desalination plant in the winter months, and as an emergency storage measure in case of inundation. This would be in addition to the 9,000 ha for the concentration ponds required for salt production, bringing the total land area for pond construction to about 21,000 ha. To put this area of land in perspective, the One Steel evaporation ponds north of Whyalla cover approximately 875 ha, and the Dry Creek salt fields north of Adelaide cover 4,000 ha. The area required for a salt production facility at Point Lowly would be more than twice as large as the biggest salt production facility in Australia, in Dampier, Western Australia. The Dampier facility produces 4.2 million tonnes of salt annually and covers 10,000 ha with its evaporation and crystallisation ponds (Dampier Salt 2010).

With an average salinity of 75 g/L (which is much more than double than that of the Dry Creek intake), the annual volume of return water from the proposed Point Lowly plant would include approximately eight million tonnes of contained salt. Assuming a salt recovery at Point Lowly the same as Dry Creek's recovery of 15 ktpa salt per GL of intake water, recovery at Point Lowly would be in the order of 1.7 Mtpa, which is triple the current South Australian output (Hough 2008). However, this estimate of recovery is highly conservative and, given the higher salinity of the return water and approximately 20% higher evaporation rates at Point Lowly for the months September to April when the ponds would be operational (Bureau of Meteorology 2010a; Bureau of Meteorology 2010b), it is anticipated that a salt production facility using return water from a Point Lowly desalination plant could recover in excess of 2 Mtpa, an amount equal to one fifth of current Australian production (Hough 2008).

Salt production would also require large quantities of fresh water. Based on an anticipated production rate of 2 Mtpa and comparing water demand with a Western Australian operation (Dampier Salt 2009), a Point Lowly salt facility would require more than 550 ML/y of fresh or bore water.

Commercial salt production at this scale at Point Lowly would not only require the clearance of 20,000 ha (over 200 square kilometres) for the construction of the ponds and significant additional water volumes. A significant amount of additional storage and handling infrastructure would also be required, including conveyors, stockpiles, washing areas and wharf loading facilities to convey and load the salt onto ships and/or trucks for transport. A proposal to establish a 4.2 Mtpa salt production facility covering approximately 20,000 ha at Yannarie in Western Australia was rejected by the WA EPA, primarily due to concerns about its environmental impact (WA EPA 2008).

Issue:

BHP Billiton's commitment to power the desalination plant with renewable energy was commended in several submissions. It was requested that contractual links be developed to tie the supply of this electricity to local providers. It was also suggested in the submissions that renewable energy generation sites co-located with the desalination plant would be the most favourable outcome for powering the plant.

Submissions: 2, 90, 107, 117, 129, 149, 199, 243, 288, 329 and 356

Response:

Providing renewable energy to power the desalination plant is not dependent on the location of a generation facility, and the requirements for locating power generation facilities are not always compatible with those for locating desalination plants. The proposed desalination plant would access renewable power via the National Electricity Market (NEM). This approach would maintain the reliability of supply for the desalination plant by providing stable baseload energy from the NEM while still ensuring the plant's energy supply was generated from renewable sources.

The desalination plant would require stable baseload power. If the plant relied entirely on a co-located solar or wind power generation facility, a consistent baseload power supply would not be available if there were calm conditions or insufficient solar radiation. Therefore, the desalination plant would purchase (renewable) power from the grid (NEM) to ensure a stable baseload supply.

If it were feasible to co-locate a renewable generation facility with the desalination plant, the plant would still have to be connected to the NEM so that excess power generated by the facility in favourable conditions could be sold into the grid, but when conditions were unfavourable, the plant could draw power from the grid. However, the location of a renewable power plant is not always complementary to the location of a desalination plant, as site requirements differ for each type of renewable energy, and many of these are incompatible with the requirements of a desalination plant, as discussed below.

Location of wind farms

Although many other factors are considered, wind farms are generally located in areas with the optimum combinations of the following factors: high wind speeds, minimal variation in wind speeds, proximity to suitable electricity transmission infrastructure, good road access, low population density and compatible surrounding land use (primarily grazing or cropping land use with minimal forested areas) (SEA 2004; Rehman et al. 2003; Baban and Parry 2001; Milligan and Artig 1998).

Although wind farms are often located in coastal areas to reduce interference or turbulence from topographical features (which slow down wind speeds), some coastal areas are unsuitable due to their minimal wind speeds. Wind farms are often on elevated or hilly sites, where they are best placed to exploit the increases in wind speeds observed in such areas (SEA 2004). As discussed in Section 4.3.1 of this chapter, one of the assessment criteria for the selection of a site for the desalination plant was the availability of flat, coastal land to reduce the length of intake and outfall pipelines and the energy required to pump water. Therefore, the preference for a low-lying site for a desalination plant is incompatible with the preference for elevated sites for the placement of wind turbines.

The majority of the existing wind farms in South Australia are located on elevated or hilly sites. This includes the wind farms at Starfish Hill (near Cape Jervis on Fleurieu Peninsula), Hallett (Mid North) and Mount Millar (between Cowell and Cleve on Eyre Peninsula), and the wind farms approved for construction at Clements Gap (south of Port Pirie) and Lincoln Gap (about 15 km south-west of Port Augusta). Many are located inland rather than immediately adjacent to the coast (such as Hallett, Lincoln Gap and Mount Millar). Unlike the compact layout of a desalination plant, most of these farms extend for several kilometres, with the individual turbines placed at significant intervals (for safety and performance reasons). For example, the Cathedral Rocks wind farm, which comprises 33 turbines, covers 11 km of coastline with a total site area of 2,900 ha (Clean Energy Council 2010).

Location of solar plants

Solar generation plants need to be in locations with high solar irradiation (high temperatures), minimal cloudy days, large areas of very flat terrain with low agricultural value to allow for the construction of the solar array and sufficient distance from heavily vegetated areas to avoid overshadowing (Carrion et al. 2008). In Australia, these criteria are best satisfied by areas well inland. As discussed above, desalination plants are preferably located on the coast to reduce the length of pipeline required, making the co-location of a desalination plant with a solar generation facility largely incompatible.

Figure 4.6 of the Draft EIS, reproduced here as Figure 4.14, provided an indication of the solar, wind and geothermal energy potential of sites based on just some of these factors.

From the discussion above, it can be concluded that obtaining renewable energy from the NEM rather than a co-located generation facility is the optimum method of ensuring a stable baseload energy supply for the desalination plant while still using a renewable energy source.

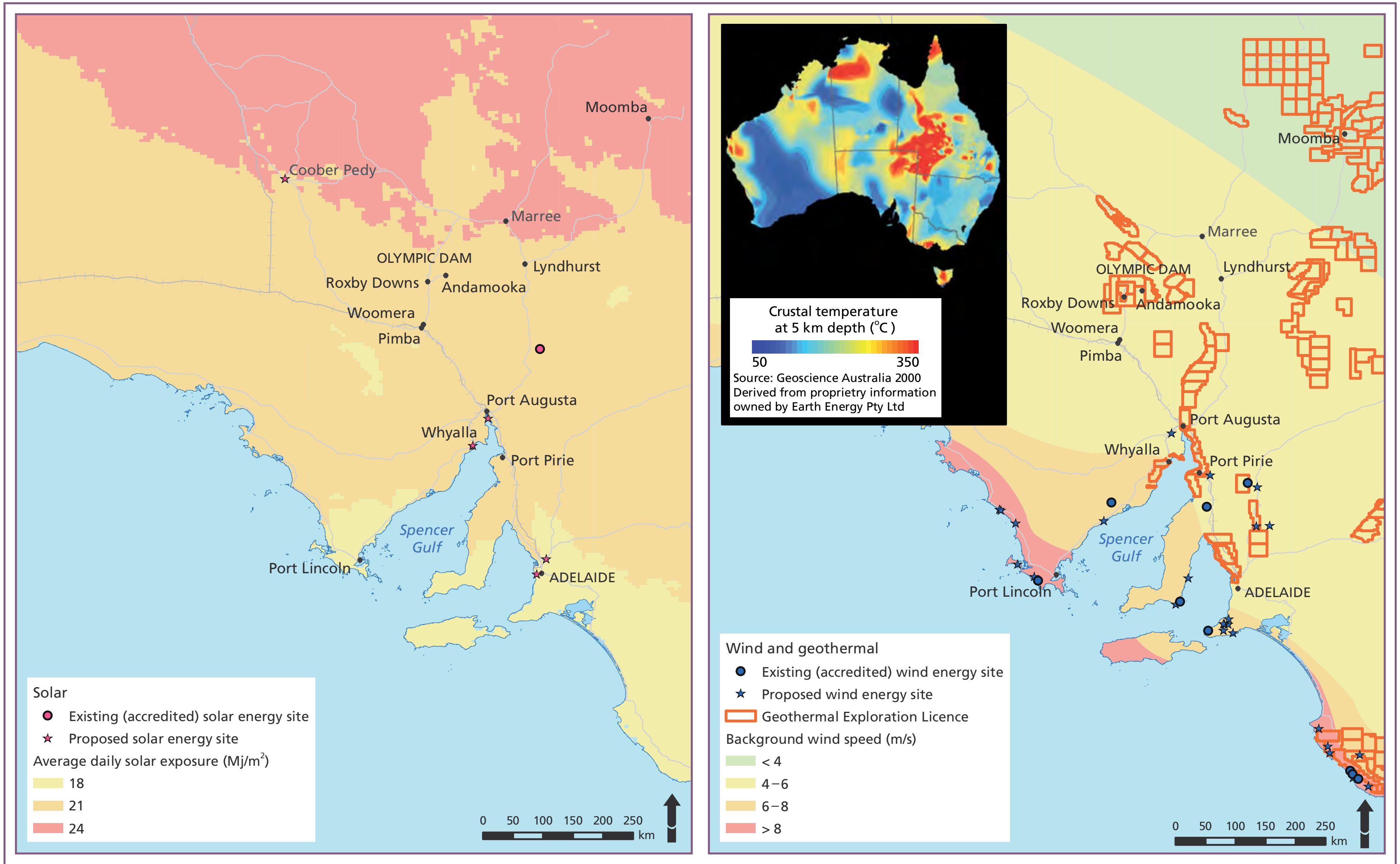


Figure 4.14 Alternative energy resources in South Australia

Issue:

Reverse osmosis (RO) desalination has been selected as the preferred method of desalination. Other methods, such as mechanical vapour compression (MVC), have been suggested. In particular, it was suggested that the RO process would require more pre-treatment than MVC to ensure that the source water was of high quality, and would also require considerable maintenance of the membranes, including cleaning and backwashing.

Submission: 288

Response:

The method of desalination for the proposed Point Lowly facility was selected following a detailed assessment process. Reverse Osmosis (RO) was selected as it is the most reliable, energy-efficient process available, and is considered the best practice method for South Australia.

As detailed in Section 5.7.4 of the Draft EIS, reverse osmosis involves forcing seawater under pressure through membranes which have a network of tiny pores. These pores allow fresh water to pass through, leaving the majority of salts behind in a high-salinity solution. RO is one of the most widely used methods of desalination; it is estimated that around 44% of global capacity is provided by such plants, while MVC provides 5% or less and is predominantly used for smaller plants producing less than 3 ML/d (Wittholz et al. 2008; Darwish and Al-Najem 2005). Although desalination plants that use thermal distillation (boiling) of sea water to produce fresh water (including MVC) have previously been more widespread, developments in RO technology over the past few decades have seen its use increase rapidly; RO is used in almost three quarters of Europe's desalination plants (Fritzmann et al. 2007).

The main reason RO desalination is proving more popular is that it has considerably lower energy costs than other methods (Mabrouk et al. 2008; Kennedy et al. 2002). Modern RO desalination plants can produce 1,000 L of product water using only around 2 kWh of electrical energy (Busch and Mickols 2004; Shannon et al. 2008). Energy is the largest factor in the cost of seawater desalination, and can make up between 20 and 44% of the total cost of desalinated water (Wittholz et al. 2008; Busch and Mickols 2004). Therefore, methods that consume less energy will be favoured over those that are more energy-intensive.

Distillation methods (including MVC) require large amounts of energy to boil the seawater, and can consume five to six times as much energy as a similar-sized RO plant (Fritzmann et al. 2007; Raluy et al. 2004). Consequently, RO plants can produce water at approximately one-third the cost of vapour compression plants (Karagiannis and Soldatos 2008). In the Middle East, where most of the world's desalination capacity has been installed, the low cost of fossil fuels has historically seen thermal methods preferred over RO (Fritzmann et al. 2007). However, RO plants are now increasingly favoured over distillation methods, primarily due to the high-energy costs associated with the latter (Darwish and Al-Najem 2005).

The reverse osmosis method has other positives, such as better production efficiency (i.e. 30–50% of the intake water recovered as desalinated product water) when compared with distillation type plants (10–30% recovery) (Tularam and Ilahee 2007). RO plants are also much cheaper and quicker to install (Kennedy et al. 2002). In addition, because RO plants are modular, it is very easy to expand their capacity should demand for water increase.

The proposed desalination plant would require high-quality source water to minimise fouling of the membranes. Pre-treatment would include chemical dosing and mechanical filtration to remove fine particles and sediment and to prevent marine growth on the intake infrastructure. Although the RO membranes would require regular backwashing, the membranes themselves have an anticipated lifespan of three to seven years, after which they would be replaced.

The MVC process requires specialised and frequent maintenance of the mechanical compressor, which is the major component in this process (Mandani et al. 2000).

A recent study investigating the suitability of a number of desalination methods for the Adelaide area found that RO desalination is 'optimal technology for desalination at all capacities' (Wittholz et al. 2008). The SA Water desalination plant currently being constructed at Port Stanvac, south of Adelaide, will also produce desalinated water by reverse osmosis. Generally, international consensus has found RO desalination to be the 'state-of-the-art desalination technology' (Shannon et al. 2008) as well as 'the desalination technology that causes the lowest environmental load' (Raluy et al. 2004).

Accordingly, for the reasons outlined above, BHP Billiton has selected reverse osmosis as the preferred method of desalination for the proposed plant at Point Lowly.

4.3.3 ALTERNATIVE SUPPLY SOURCES

Issue:

It was suggested that BHP Billiton should source its additional water requirement from the River Murray.

Submission: 25

Response:

The option of using the River Murray as the primary water source for Olympic Dam was rejected as the Murray is already seriously under threat through over-allocation, drought, and rising salinity, all of which have significant effects on river ecology, irrigators and other water users. In addition to these factors, there are concerted and co-operative efforts by numerous agencies, governments and other groups to reduce demands on the River Murray system. BHP Billiton would not seek to add additional pressure on commercial or environmental water allocations.

Inflows into the River Murray have been in decline, and the Murray-Darling Basin has recently experienced the worst drought since records began in 1891 (DEH 2009). In the 117 years between 1891 and 1997, average inflows to the Murray were 11,600 GL, while in the years 1998 to 2008, this more than halved to 5,400 GL (MDBA 2009). Inflows in 2009 were only 2,075 GL, a 30% decrease on the previous year (MDBA 2009, MDBC 2008).

The ramifications of this decrease in inflows combined with historical overuse are well publicised, including a decline in the overall river health throughout the Murray-Darling Basin, increasing salinity and turbidity, drying out of wetlands, damage to riparian vegetation, weed invasion, decreasing biodiversity and impacts to irrigators and graziers (MDBA 2010; Gehrke et al. 2003; RMUUC 2003).

Declining river health also affects wetlands, forests and floodplains, and local systems such as the Lower Lakes and the Coorong (MDBA 2010) that, along with other wetlands along the Murray, is listed as a wetland of international importance under the Ramsar convention. The threat of acidification exposed soils due to declining water levels in the Lower Lakes was so great that the South Australian Government recently implemented emergency response measures (including a temporary weir) to maintain water levels, and also considered allowing seawater into Lake Alexandrina (DENR 2010; DEH 2009).

Due to the reduced flows into the River Murray, water allocations to irrigators have been significantly reduced in recent years. In July 2008, South Australian irrigators' allocations were set at only 2% of their licensed entitlements (Department of Water, Land and Biodiversity Conservation 2008). Although allocations rose to 21% by July 2010 (ABC News 2010) and 63% in September 2010 (Caica 2010) with the prospect of further increases due to good winter rains, the long-term security of allocations is uncertain, with irrigator allocations varying year by year (and month by month) depending on the amount of rainfall in the Murray-Darling Basin and extraction rates in the eastern states.

Furthermore, the policies of both the Australian and South Australian governments focus on reducing demand on the River Murray. Many of the authorities charged with the management of the Murray are introducing proposals or making efforts to reduce the extraction of water and increase the amount available for environmental flows, including:

- the South Australian Government's Strategic Plan has identified the condition of the Murray as a critical environmental issue for the state, and has set a target to increase river flows by 1500 GL/a by 2018 (DPC 2007)
- the Living Murray initiative of the South Australian and Australian governments provides for 500 GL/a to be returned to the river as environmental flows (MDBC 2009)
- the South Australian Government's Lower Lakes Environmental Reserve dedicated 170 GL to the Coorong and Lower Lakes over summer 2009–2010 for environmental purposes (Rann and Weatherill 2009)
- the Australian Government has allocated over $3 billion for the purchase of water entitlements to return water to the system (DEWHA 2009)
- the South Australian Government issued a High Court challenge to the Victorian Government's cap on licence trading, in an attempt to allow the purchase of water licences for environmental purposes (Rann et al. 2009).

With such concerted efforts to improve the amount of water available for environmental purposes rather than human consumption, the security of entitlements from the Murray is uncertain. BHP Billiton would not wish to add to the demand for water from the Murray (and, thereby, exacerbate the existing effects of water shortages on the river system) when there are such intensive nation-wide efforts to reduce it.

Issue:

Further justification was sought for rejecting the option of sourcing additional water from SA Water's sewage treatment plants.

Submissions: 2, 25, 199, 209, 284 and 302

Response:

The option of using recycled sewage from SA Water's Adelaide wastewater treatment plants was rejected as the quantity of this water was less than one-third of the quantity required at Olympic Dam, and is already subject to high demand in the metropolitan area. In addition, the quality of this water was not consistently high enough for use in the metallurgical processing plant. It would also require a new, 600 km pipeline from Adelaide to Olympic Dam.

Section 4.8 of the Draft EIS provided the following reasons for rejecting the option of using recycled effluent from SA Water's wastewater treatment plants for the proposed water supply source:

- the short-term security of supply becomes uncertain during the drier summer months, when the local use of this treated wastewater may be high
- the long-term security of supply is uncertain, with increased local competition expected for this water in the future
- if these competing demands grow (as seems likely) then the cost of this water would also rise
- the potentially variable quality of the water could jeopardise the efficiency of the Olympic Dam metallurgical plant.

There are also other reasons that justify this choice.

SA Water collects and treats approximately 95 GL of wastewater per year in Adelaide (SA Water 2010b), and provides non-potable recycled water from its wastewater treatment plants at Glenelg, Christies Beach and Bolivar through the following major schemes (SA Water 2010b):

- Southern Urban Reuse Project – 0.4 GL/a
- Glenelg to Adelaide Park Lands Recycled Water Project – 3.8 GL/a
- Virginia Reuse Scheme – 18 GL/a
- Mawson Lakes Recycled Water System – 0.8 GL/a.

The total amount of water produced by these schemes is 23 GL/a, or an average of 63 ML/d. The water produced is currently accessed by several customer groups, including agricultural (Virginia market gardens and Southern Vales vineyards), local government (Holdfast Bay and Adelaide City Councils) and residential (Mawson Lakes and Seaford Meadows).

SA Water recycles 31.3% (approximately 30 GL) of its effluent per year, including the output from the metropolitan schemes outlined above as well as from other, smaller, regional schemes (SA Water 2009). Approximately 70 GL of treated effluent is discharged to Gulf St Vincent each year (Water Proofing Adelaide 2005).

As detailed in Section 5.7 of the Draft EIS, the proposed expansion at Olympic Dam would require an additional 186 ML of water per day (around 68 GL/a), indicating that it would require all of the water already provided to the current recycling schemes mentioned above, plus more than two-thirds of the effluent currently discharged to the ocean (assuming this water was available and treated to an appropriate standard for use at Olympic Dam), which would significantly restrict any further expansion of water recycling schemes in the Adelaide metropolitan area.

Another factor constraining the use of recycled effluent from SA Water treatment plants is water quality. Although the water provided would be treated to class A standard, the quality of the treated wastewater is variable, and it is not treated to drinking water standard (SA Water 2010b). The levels of chlorides, nitrates and organic compounds in the recycled water stream would adversely affect the solvent extraction, uranium recovery and flotation processes at Olympic Dam. Even if sufficient volumes could be guaranteed, the potential variability in water quality would jeopardise the efficiency of the Olympic Dam metallurgical plant.

In addition, treated water would have to be pumped from the SA Water treatment plants in metropolitan Adelaide to Olympic Dam, requiring a pipeline over 600 km long, virtually double the length of the proposed 320 km pipeline from Point Lowly. A doubling in the length of the pipeline would result in the doubling of the associated construction costs, land clearance, energy requirements for pumping and operational greenhouse gas emissions. It is also likely that a pipeline alignment from the Adelaide treatment plants would traverse significant urban areas, which would involve considerable logistical and financial implications beyond that proposed for the selected alignment.

Given the uncertainties surrounding the quality and quantity of water available from this source and the additional environmental impacts involved, this capital and operational expenditure would not be a practical investment; therefore, the reasons provided in the Draft EIS remain valid.

Issue:

It was suggested that BHP Billiton construct multiple, smaller desalination plants spread around South Australia rather than one large plant as this would reduce potential environmental impacts.

Submissions: 28 and 154

Response:

The construction of a number of smaller desalination plants would not be economically feasible. In addition to the land area required for the numerous small plants themselves, it would be necessary to construct individual inlet and outfall structures at each location, as well as an additional network of roads, electricity transmission lines and water pipelines.

In addition to the increased capital and operating expenditure required for multiple plants, the environmental impact of these construction works would also be significantly greater than for a single plant, and the affected area would be greater.

Selection of a sufficient number of appropriate sites would also be problematic, because they would have to be close to each other to minimise the length of pipeline required, yet also satisfy the other assessment criteria identified in Section 4.9 of the Draft EIS and discussed in Section 4.3.1 of this Supplementary EIS.

The establishment of a single plant provides the required quantity of water while centralising the infrastructure requirements and reducing the potential construction and operational impacts on the marine and land environments.

Issue:

It was suggested that BHP Billiton construct a water pipeline from the Ord River in Western Australia and from overflowing dams in northern Australia because this would provide sufficient water for BHP Billiton and South Australia to the extent that it would alleviate pressure on the River Murray.

Submission: 298

Response:

The option of using water from the Ord River was rejected as the construction of a pipeline 2,500 km long was not considered feasible in economic, environmental or operational terms.

The Ord River Irrigation Area (ORIA) is south of Kununurra in the far north-east of Western Australia, about 30 km from the Northern Territory border and about 127 km south-west of Australia's northern coast, adjacent to the Timor Sea (see Figure 4.15). The Ord River Irrigation Scheme began in the early 1960s and, under the recently commenced Stage 2 expansion, will provide water to 24,330 ha of irrigated agricultural land (Ord Irrigation Cooperative 2010). Lake Argyle, the main storage for the irrigation area, is Australia's largest inland reservoir, with a capacity of around 11,000 GL (Ord Irrigation Cooperative 2010), which is equivalent to five years of mains water consumption in South Australia (i.e. 218 GL per year) (SA Water 2009).

Olympic Dam is about 1,820 km in a direct line from Lake Argyle and it is not considered feasible to construct a pipeline between them as it would cross almost the entire continent. Apart from the significant logistical considerations and environmental impacts associated with traversing several deserts, mountain ranges and other habitats and landscapes, the estimated length of the pipeline required is in the order of 2,425 km (assuming no deviation from the optimum alignment due to environmental, heritage or topographical considerations). Current estimates of construction costs are $2 million per kilometre, indicating that such a pipeline would cost in the order of $5 billion to construct.

Operating a pipeline from the Ord River would require considerable amounts of energy to power the 20 or so pump stations required to transport the water to Olympic Dam. It is estimated that the pumps would require over 300 million litres of diesel per year, which would generate greenhouse gas emissions of over 870 kt CO_2-e per year (about 2,400 tonnes per day) (DCC 2009). If electric pumps were used, annual power consumption is estimated at 866 GWh, with associated emissions of over 667 kt CO_2-e per year (about 1,830 tonnes per day) (DCC 2009).

Based on the analysis above, this suggestion is not considered a feasible alternative, either in an economic or environmental sense.

Figure 4.15 Lake Argyle to Olympic Dam pipeline

Figure 4.16 Large salt lakes near Olympic Dam suggested in submissions for run-off storage

Issue:

As an alternative source of water for Olympic Dam, it was suggested that BHP Billiton collect 30 GL of rainfall and run-off by lining several large salt lakes south of Olympic Dam (Island Lagoon, Pernatty Lagoon and Lake MacFarlane), and use these lakes as reservoirs.

Submission: 31

Response:

Island Lagoon, Pernatty Lagoon and Lake MacFarlane are three large salt lakes collectively covering over 1,440 km^2 in the Far North of South Australia, and are located just under 100 km south of Olympic Dam (see Figure 4.16). These salt lakes, like most of the lakes in the Far North of South Australia, are usually dry, and only fill for short periods after heavy and prolonged rainfall.

The Far North experiences highly irregular rainfall events, low annual rainfall (162.8 mm at Woomera aerodrome, Bureau of Meteorology 2010c; and 132.8 mm at Olympic Dam aerodrome, Bureau of Meteorology 2010d) and high net evaporation rates (the annual average is 3100 mm, Bureau of Meteorology 2010c).

These climatic conditions, coupled with the enormous storages that would be required to hold the volumes needed to maintain an adequate supply over an entire year (or several years, in the event of extended drought periods), highlight the questionable feasibility of this proposal. The logistical ramifications of lining natural salt lakes and the requirements for maintaining a liner over such a large area (including ensuring that storage in these low-lying areas can be maintained deep enough to compensate for evaporation) also severely limit its application.

It is estimated that in order to collect the 30 GL/a suggested, approximately 180 square kilometres of lake would need to be lined. In order to collect the peak 200 ML/d of additional water sought for the expansion, about 500 square kilometres would need to be lined. This assumes that all rainfall is collected and none evaporates.

This would involve stripping the salt crust from the surface of the lake and installing an impermeable clay base and high-density plastic liner. In addition to this, the surface of the lake basin and the run-off channels leading into the reservoir area would have to be prepared so the liner and base would not lift or leak. Measures to prevent the contamination of the water storage areas with salt from the underlying lake surface would also have to be implemented, as an increase in chloride concentrations would render the water unsuitable for use in the metallurgical plant, and the water would require desalination before use.

At current estimates, the cost of lining 180 square kilometres of salt lake would be approximately $18 billion. The entire expanse of these reservoirs would also have to be covered to prevent evaporation from the shallow collection areas, and pumping and filtration infrastructure would have to be installed, increasing the disturbance footprint, energy use and associated costs.

The environmental impacts on the salt lakes and surrounding areas would also be significant. Salt lakes in northern South Australia are sensitive ecosystems that are specialised and highly diverse (De Dekker 1983; DEH 2008). Many of the vegetation communities associated with the salt lake systems, and the vertebrate and invertebrate fauna that use them as habitat, have restricted distributions (Williams 2002). Several are threatened or endangered, and many are endemic to the salt lake systems in which they are found, relying on them entirely for their survival (DEH 2008; Newton 2008; Hudson 1997; De Dekker 1983).

In addition, several species of migratory birds use the lakes as feeding grounds when they fill (DEH 2010; Jellison 2005). While the salt lakes mentioned in the submission cover almost 1,500 square kilometres, the construction and maintenance of the required reservoirs over even a portion of this large area would cause a considerable disturbance to the environment, including significant impacts on surface water drainage, hydrological regimes and the region's ecology and biodiversity as a whole. Taking these considerations into account, this proposal would not be acceptable to BHP Billiton.

Issue:

It was suggested that no desalination plant should be constructed; rather, water demand should be reduced.

Submissions: 7, 199, 277 and 337

Response:

BHP Billiton has established and supported a number of initiatives to reduce water demand in and around Olympic Dam, and plans to implement additional measures to increase water efficiency for the proposed expansion. BHP Billiton has established a water use monitoring and management system at Olympic Dam to record usage and ensure that it is sustainable, and to identify opportunities for increased efficiencies. Water use efficiency has increased by 50% over the past decade despite a significant increase in mine output, and the measures associated with the proposed expansion would provide a further increase in efficiency.

Water is critical to the operation of Olympic Dam; without water there can be no processing of ore. However, obtaining a stable supply of quality water in such an arid environment is complex and expensive. Therefore, BHP Billiton makes every effort to minimise the amount of water used at Olympic Dam, both in order to reduce the cost of its supply and to maintain the sustainability of the source.

Outside the mining operation itself, BHP Billiton has directly funded, project-managed or contributed to programs for the capping of free-flowing bores, the installation of closed-pipe reticulation systems to replace open drains, closure of bore drains and bore remediation programs within the Great Artesian Basin (GAB). BHP Billiton funding for such projects has provided a total reduction in GAB extraction of 37 ML/d over the past decade (Torrisi and Trotta 2010). This amount is greater than the annual average GAB usage over the same period, and is also more than the amount of water currently extracted from the GAB for use at Olympic Dam and Roxby Downs (currently 33 ML/d).

BHP Billiton has established intensive water use monitoring and management programs, and undertakes ongoing modelling (based on data from the monitoring programs and management practices) and analysis (including independent expert review) to ensure that its water use from the GAB continues to be sustainable.

This approach has resulted in the implementation of several initiatives that have resulted in reductions in water demand at Olympic Dam. Monitoring data (Torrisi and Trotta 2010; see Figure 4.3) shows that the implementation of these and other initiatives have resulted in a 50% improvement in water use efficiency at Olympic Dam since the year 2000 (after the previous expansion). In this period, GAB abstraction has remained relatively constant, while mine output has more than doubled. It is anticipated that as monitoring continues and technologies improve, water use efficiency at Olympic Dam will continue to improve. As discussed in Section 25.5 of the Draft EIS, examples of water use efficiencies at Olympic Dam are the reduction in water demand resulting from the increase in flotation tailings solids concentration from 65% to 70%, which saved 9.5 ML per day, and the increase in total water use efficiency at the site from 1.2 kL per tonne of ore milled for the existing operation to 0.98 kL for the proposed expansion, representing an 18% increase in efficiency.

As outlined in Section 4.8 of the Draft EIS, the construction of a desalination plant has been identified as the preferred water supply for the expanded operation. The reasons for this choice are that it:

- meets the water demand of the proposed expansion
- does not compete with existing supplies
- is comparable in cost to its alternatives.

Issue:

It was suggested that BHP Billiton undertake a cost/benefit analysis of each alternative water source identified as a possible option in the Draft EIS, including who bears the costs and who receives the benefits in relation to each option and the respective environmental impacts of each option.

Submission: 67

Response:

It is noted that the reasons for selecting the preferred water supply system, and rejecting others, were provided in Section 4.8 of the Draft EIS; also, that the primary motive in identifying and assessing potential water sources is to supply water to an expanded Olympic Dam operation. As such, the financial cost of water supply is borne by BHP Billiton, with the resulting benefit being the opportunity to expand the existing mining and processing operation. The predicted environmental impacts of the proposed desalination plant were assessed and provided in detail in the Draft EIS and associated appendices.

4.3.4 GREAT ARTESIAN BASIN

Issue:

It was requested that BHP Billiton phase out extraction of water from the Great Artesian Basin (GAB) rather than increase it from the current average of 33 ML/d to the proposed 42 ML/d.

Submissions: 1, 2, 8, 10, 11, 13, 24, 35, 37, 42, 44, 46, 55, 57, 62, 65, 77, 85, 88, 92, 95, 97, 99, 102, 105, 114, 116, 125, 138, 147, 159, 161, 180, 185, 196, 204, 206, 216, 217, 224, 233, 241, 244, 247, 248, 254, 255, 258, 287, 288, 289, 292, 297, 299, 304, 306, 309, 313, 315, 328, 331, 335, 343, 345, 351, 352, 353, 363, 388 and 389

Response:

BHP Billiton's use of water from the GAB is sustainable and is subject to stringent licensing and reporting requirements of the South Australian Government. BHP Billiton plans to continue the sustainable operation of its GAB wellfields for the proposed expansion within the terms of its existing licence.

The existing Olympic Dam operation currently extracts approximately 33 ML/d from the GAB within the terms of its existing approved Special Water Licence. This existing and continued extraction from the GAB is dependent on BHP Billiton meeting strict groundwater pressure drawdown criteria designed to manage the impact of extraction on local groundwater-dependent springs. Information about current extraction rates, drawdown pressures and spring flows is presented annually in the BHP Billiton Olympic Dam Wellfields Annual Reports. As outlined in Sections 4.1.3 and 4.3.3 above, the efficient and sustainable use of GAB water has long been a priority of BHP Billiton, with significant improvements in water use efficiency achieved over the decade since the previous expansion at Olympic Dam.

As detailed in Section 5.7.6 of the Draft EIS, extraction from the GAB for the proposed expansion would be limited to specific activities and be in accordance with the requirements of the existing Special Water Licence. *The Roxby Downs (Indenture Ratification) Act 1982* requires BHP Billiton to submit, on an annual basis, a 10-year forecast of GAB water extraction to the South Australian Government. Progress against this forecast is presented in the BHP Billiton Olympic Dam Wellfields Annual Report.

BHP Billiton has invested significant capital in the development of the GAB wellfields and associated pumping stations and pipelines, and would not look to phase out GAB extraction as long as the use of this water source remains sustainable and within licence conditions.

4.4 ENERGY SUPPLY AND USE

Issue:

In the context that the proposed expansion would increase the operation's greenhouse gas emissions from 1.2 to 5.9 Mt per annum, representing 14% of South Australia's total emissions and 1% of Australia's emissions, BHP Billiton was asked to justify why it could not obtain all of its electricity requirements from renewable energy sources, such as solar, wind and geothermal.

Submissions: 2, 9, 10, 11, 13, 24, 31, 42, 43, 53, 62, 65, 77, 102, 112, 114, 116, 124, 134, 136, 147, 149, 156, 157, 159, 177, 180, 185, 196, 217, 224, 241, 248, 258, 266, 269, 288, 289, 299, 306, 312, 330, 336, 337, 345, 354, 356 and 388

Response:

The predicted increases noted above are related to an unmitigated expansion of Olympic Dam, whereas the Draft EIS provided several commitments that would collectively reduce the electricity demand for the proposed operation from around 4,400 GWh per annum to approximately 2,450 GWh, a reduction of about 45% over a business-as-usual scenario (refer Section 13.2.5 of the Draft EIS for details). BHP Billiton also committed to developing and maintaining an Energy and Greenhouse Gas Management Plan to establish and report on the likely emissions reduction pathway from the commencement of the expanded operation to the achievement of the 2050 goal, being to reduce greenhouse gas emissions (reportable under the National Greenhouse Gas and Energy Reporting (Measurement) Determination 2008) from the expanded operation to an amount equivalent to at least a 60% reduction (to an amount equal to or less than 40%) of 1990 emissions (see Chapter 13 of the Supplementary EIS for details).

Section 4.11 of the Draft EIS outlined the reasons why solar, wind and geothermal electricity sources were rejected as the sole source of power for the proposed expansion, in particular:

- dedicated wind or solar generation at the scale required for the expansion are not currently available
- solar and wind energy technologies are at an early stage of market development and are unable to supply baseload power on a continuous and competitive basis
- geothermal energy is commercially unproven at the scale required.

Put simply, if baseload renewable energies were available in the volume required, and at a price that was competitive with existing supplies (even after a carbon tax was applied), BHP Billiton would seek to utilise this power.

To this end, BHP Billiton under a heads of agreement relationship with BP Alternative Energy invested two years to assess the feasibility of constructing and operating a 100 MW solar plant near Roxby Downs. BP Alternative Energy contracted Fitchner Pty Ltd from Germany (recognised leaders in the industry) to investigate site selection, plant layout, material selection, construction methods, logistics, electrical connections, construction labour requirements etcetera to determine the project feasibility and the final capital and operating costs. The key outcomes of the study were that constructing a 100 MW concentrated solar thermal power plant with 3.5 hours of storage capacity was technically feasible, however the estimated capital cost was in excess of $600 million and the estimated operating cost was $340 per MWh. To put this in context, the proposed expansion requires a stable baseload capacity of 650 MW and would consume up to 2,450 GWh per year. Extrapolating the costs from the 100 MW solar plant to 650 MW equates to a capital cost equivalent of $3.9 billion and an operating cost equivalent of $830 million per annum. Sourcing electricity from the National Electricity Market is currently more than three times cheaper than the estimated solar supply.

BHP Billiton will, however, continue to monitor the progress and suitability of renewable energy sources for use at the Olympic Dam operation.

Issue:
It was suggested that the proposed Hiltaba Village and the expansion of the Roxby Downs township should be seen as an ideal opportunity to build solar-passive, energy-efficient, environmentally friendly dwellings.

Submission: 2 and 114

Response:
For both the Hiltaba Village and expansion to Roxby Downs, the achievement of energy efficiency and environmentally friendly buildings were, and will continue to be, guiding principles.

BHP Billiton would be directly responsible for the design and construction of the proposed Hiltaba Village. The expansion of Roxby Downs would be guided by the Roxby Downs Master Plan, a draft of which was provided as Appendix F4 to the Draft EIS, and the finalisation of the Master Plan is the responsibility of the South Australian Government.

Sustainability measures discussed in Section 5.10.2 of the Draft EIS with relevance to these accommodation facilities included:

- the installation of water saving appliances and fittings would be mandatory in all new households
- retention basins would be established in parklands to enable harvesting and reclaiming of stormwater for non-potable applications
- the principles of water sensitive urban design would apply
- treated effluent would be reclaimed from the new wastewater treatment plant for beneficial reuse to reduce the demand on the potable water supply
- renewable energy sources for the town would be investigated in conjunction with state and local government, focusing on domestic photovoltaic cells and/or purchasing renewable energy from electricity generators connected to the National Electricity Market (NEM)
- solar water heating would be required for all new residential buildings and it would be mandatory for all new buildings to comply with the energy limits to be imposed by the Building Code of Australia 2008
- Department of Planning and Local Government's energy conservation measures would be incorporated into land and building layouts
- an understanding of shading and solar orientation would be incorporated into building design to minimise energy use, including the use of wide eaves on new buildings
- urban development would be targeted to those areas identified as having lower ecological significance (as defined through an ecological survey of the wider Roxby Downs area: refer Appendix F4 of the Draft EIS for details).

4.5 TRANSPORT

4.5.1 LANDING FACILITY AND ACCESS CORRIDOR

Issue:

Further justification was sought on the need for a landing facility, rather than transporting all materials by rail.

Submissions: 67, 183, 310 and 386

Response:

If it was practicable, BHP Billiton would prefer to transport all materials by rail. However, there are some materials that are too large to do so. The landing facility is the closest point to Olympic Dam to which these very large materials can be shipped before completing the journey by road.

The maximum dimension of materials safely transported by rail is 2.4 m wide by 5 m high (the centre of gravity of the item also influences the ability to safely transport materials by rail). Once expansion activities began, the initial focus would be the commencement of mining activities for the development of the proposed open pit. Some components of the mining equipment would not fit in this rail window (i.e. they would be too large for rail transport) and therefore would need to be transported by road to Olympic Dam. Also, some of the processing infrastructure required for the expansion would be too large to be transported by rail (e.g. metallurgical plant processing tanks). Some of these materials are up to 15 m wide by 15 m high.

Materials of this size cannot be transported by road from existing ports, such as Port Adelaide, because the size of the road 'window' (i.e. the available space on the sides and above the road surface) is too small. However, because materials this big were transported from the pre-assembly yard located on the western outskirts of Port Augusta for the 1997 expansion of Olympic Dam, such a window remains between Port Augusta and Olympic Dam to enable the safe transport of these large materials.

Issue:

Further justification was sought for locating the proposed landing facility 10 km south of Port Augusta, on the basis that the facility would result in environmental degradation and loss of amenity. Also, submissions suggest that the construction of a landing facility is the cheapest option, not the most environmentally or socially acceptable option.

Submissions: 41, 68, 84, 109, 121, 135, 158, 165, 173, 211, 212, 213, 228, 242, 261, 263, 285, 288, 291, 332, 364 and 386

Response:

Section 4.14 of the Draft EIS discussed the reasons for selecting the preferred location and rejecting others (refer in particular to Figure 4.9, which is reproduced here as Figure 4.17).

Section 16.6.12 of the Draft EIS categorised the potential environmental impact of constructing and operating the proposed landing facility at the selected location in marine waters about 10 km south of Port Augusta as being negligible. This level of environmental impact was a result of:

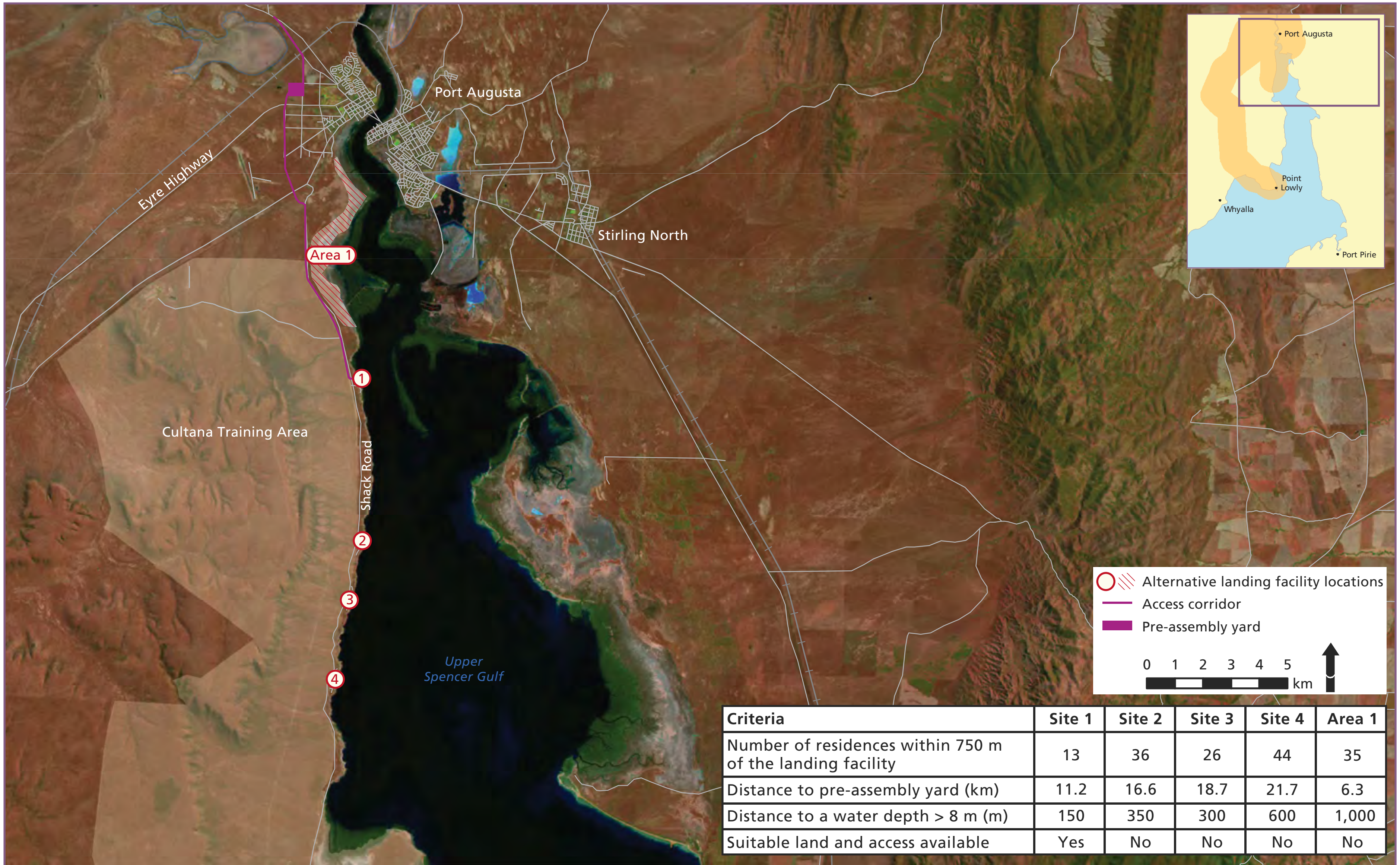
locating the facility close (within 200 m) of a deep water channel (>8 m) to avoid dredging a navigational channel

- selecting the design option that would result in minimal habitat disturbance. That is the proposed piered jetty structure rather than a land reclamation causeway structure
- selecting a location that significantly reduced the potential loss of marine flora; to three individual mangrove trees and less than 1 ha of seagrass (which is considered minimal given the extent of mangroves north of the proposed facility and the extensive area of seagrass meadows in the Upper Spencer Gulf).

BHP Billiton also aimed to minimise the impact on coastal home owners and residents by placing the access corridor associated with the landing facility in the Department of Defence's Cultana Training Area and undertook extensive discussions with the department on this location. The outcome of those discussions was support for the access corridor as shown in the Draft EIS. As shown on Figure 4.8 of the Draft EIS (reproduced in the Supplementary EIS as Figure 4.17), this would also result in potential impacts to additional coastal home owners (up to 44 homes compared with 13 for the chosen option).

Locating the facility further to the north of that chosen would require the dredging of a navigational channel about 1 km long (as per Area 1 in Figure 4.17). This option was considered to have a greater environmental impact than the chosen location.

With respect to amenity, the visual amenity impact assessment presented in Section 20.5.2 for the landing facility categorised the impact as 'slight'. This was based on a detailed assessment of the landscape absorption capacity (i.e. the visual change that would



Criteria	Site 1	Site 2	Site 3	Site 4	Area 1
Number of residences within 750 m of the landing facility	13	36	26	44	35
Distance to pre-assembly yard (km)	11.2	16.6	18.7	21.7	6.3
Distance to a water depth > 8 m (m)	150	350	300	600	1,000
Suitable land and access available	Yes	No	No	No	No

Figure 4.17 Landing facility location options

occur in the existing landscape because of the proposed development), the change that the development would have based on the horizontal and vertical field of vision of the human eye, and how the visual impact is affected by distance. The resulting photomontage that illustrated the visual impact based on the human eye field of view was provided as Plate 20.13 of the Draft EIS, reproduced here as Plate 4.1.

With respect to the cheapest option being chosen, this assumption is incorrect. The cheapest option from a transport perspective for BHP Billiton would be to 'stick-build' (i.e. on-site assembly and construction of smaller components) as much of the expanded operation as possible. This option entails many smaller components being transported to site by either rail or road but requires a substantial increase in workforce, other supporting infrastructure, and it would extend the expansion schedule. Also, in the event that as many components as possible were transported on trucks for assembly at Olympic Dam, the increase in traffic volumes and the resulting safety risk and traffic delays experienced by the travelling public were considered to have a greater social effect than the proposed solution.

Plate 4.1 Viewpoint 36 showing the proposed landing facility jetty - *50 mm lens photomontage (human field of view)*

Issue:

It was suggested that the access corridor between the landing facility and pre-assembly yard be relocated further west of its proposed alignment.

Submissions: 49, 60, 67, 68, 102, 158 and 173

Response:

In response to submissions received, and in subsequent discussion with the South Australian Government and City of Port Augusta, BHP Billiton proposes to realign the access corridor further to the west of the alignment presented in the Draft EIS.

In particular, Figure 5.48 of the Draft EIS showed the original alignment of the access corridor. Figure 1.10 of the Supplementary EIS shows both the original and revised alignments, with the revised alignment closer to the Port Augusta airport between Caroona Road and the Eyre Highway (see Section 1.4 of the Supplementary EIS for further discussion).

Issue:

Eureka Industrial Estates Pty Ltd suggest that BHP Billiton has not properly assessed the environmental and traffic-related benefits of having an additional intermodal facility on the Eureka Industrial Estates Pty Ltd property located immediately north of the proposed pre-assembly facility in northern Port Augusta.

Submission: 23

Response:

For the proposed expansion, BHP Billiton does not require an intermodal facility at or near Port Augusta. Rather, and as described in Sections 5.9.4 and 22.6.9 of the Draft EIS, the proposed pre-assembly yard is planned as a support and coordination facility for the movement of pre-assembled modules from the landing facility to Olympic Dam. While some construction activities may take place at the pre-assembly yard, it is not planned to be an intermodal facility where cargo is staged (i.e. transferred between road/rail, stored and warehoused) as in the case of a conventional intermodal facility. The proposed Pimba facility is an example of a conventional intermodal facility appropriate to the proposed expansion of Olympic Dam.

It is understood that the Eureka Estate is planned to be an intermodal facility. However, at the time of writing the Draft EIS it was unclear what industries, services and activities would be established at the facility. While an intermodal facility at Port Augusta is not required for the proposed expansion, it would be a matter for potential suppliers to BHP Billiton to determine whether they could benefit from establishing a presence at the Eureka Industrial Estate.

4.5.2 ROAD AND RAIL TRANSPORT

Issue:

It was suggested that an opportunity exists to establish discussions between BHP Billiton, OZ Minerals, the South Australian Government and the Australian Government to duplicate the Stuart Highway through Roxby Downs and Prominent Hill to Coober Pedy. The submission notes that such a project would deliver benefits to both companies by offering transportation alternatives for products and or/supplies and increase the role of Roxby Downs as a major service centre in the Far North.

Submission: 63

Response:

BHP Billiton considered various options for the movement of project-related freight, including over-dimensional loads. The decision to select the Stuart Highway north of Port Augusta as the preferred transport option took into account existing traffic volumes, the impact on the environment and the cost of alternative options. This option was assessed in the Traffic Impact Assessment, with the findings presented in Chapter 19 and Appendix Q9 of the Draft EIS.

BHP Billiton does not propose to duplicate any section of the Stuart Highway as:

- the environmental and social impact would be greater than the proposed transport solution, as it would require substantial vegetation clearance, land acquisition for the duplicated roadway and delays to the travelling public resulting from significant roadworks over a long period
- existing and proposed traffic volumes do not justify its duplication as the level of service for the Stuart Highway would remain at level 'A' (free-flowing) irrespective of the additional volumes predicted for the expansion.

The Australian Government's Department of Infrastructure, Transport, Regional Development and Local Government identified in 2007 that the major challenges to maintaining South Australia's major road network between Adelaide and Darwin were to replace ageing assets, rectify narrow lane widths and undertake shoulder sealing (Auslink 2007 Adelaide – Darwin Corridor Strategy). BHP Billiton is prepared to work with the South Australian Department of Transport, Energy and Infrastructure (DTEI) to establish a baseline road condition for the Stuart Highway, and agree on a process by which an adverse impact resulting from the movement of over-dimensional loads attributed to the proposed Olympic Dam expansion could be determined. With an agreed baseline in place, both parties could accurately determine and attribute deterioration of the road pavement and shoulders. With this information,the cost of maintenance could be fairly and appropriately allocated between DTEI and BHP Billiton.

Issue:

It was suggested that because BHP Billiton exports important strategic commodities, and that diesel shortages should be expected in 2013 due to a period of social unrest in the Middle East as Iran approaches zero oil exports, BHP Billiton should construct its proposed rail spur earlier than currently scheduled. It also was suggested that the locomotives should be gas-powered.

Submission: 267

Response:

The BHP Billiton Group is a major user of diesel across its global activities and therefore adopts a strategic approach to ensure long-term supply and availability of diesel fuels to support ongoing operations. At the same time, BHP Billiton is closely monitoring progress in alternate materials such as bio-fuels, gas and electric power that could be used as a replacement for diesel. A number of trials are being undertaken in the use of alternate fuel sources across the BHP Billiton operations. The outcome of these investigations is still some time away and would need to prove commercial, operational viability and a favourable cost/benefit analysis to justify the use of such alternate fuels on an ongoing basis. Not only does BHP Billiton explore such initiatives for on-site activities, but similarly off-site opportunities such as rail locomotives.

BHP Billiton recognised that the use of rail is a more sustainable transport mode in terms of greenhouse gas emissions and diesel demand compared to road movements. The introduction of rail services via the proposed Pimba intermodal facility is planned as an early activity in the overall expansion schedule before construction of the rail spur. It is proposed that the rail spur be operational in time to support the movement of bulk sulphur to Olympic Dam and the export of copper concentrate from Olympic Dam. Once direct rail services to and from Olympic Dam began, the Pimba facility would be decommissioned.

Issue:

Respondents opposed the use of the Adelaide to Darwin rail line for the transport of uranium and concentrate on the basis of traffic delays and health risks from radiation exposure.

Submissions: 8, 10, 46, 65, 97,145,189, 215, 221, 256, 275, 305 and 338

Response:

The potential for traffic delays and health risks resulting from radiation exposure associated with the use of the Adelaide to Darwin rail line for the proposed expansion were assessed and presented in Sections 19.5.6 and 22.6.10 respectively, and collectively in Appendix E4 of the Draft EIS. In summary, the findings were:

- the proposed expansion would require two train movements per day between Pimba and the Port of Darwin, an increase in utilisation in the design usage levels of the existing rail corridor
- the calculated traffic delay at a rail/road crossing would be two minutes for a train travelling along the majority of the route (when the train would travel at 80 km/h), and up to seven minutes when a train was travelling at 20 km/h through Alice Springs
- existing rail operational procedures prevent trains stopping between Norris Bell Avenue (near the National Road Transport Hall of Fame) and the Alice Springs rail terminal, ensuring that trains would not block level crossings unnecessarily. Also, unlike most other rail services through Alice Springs, BHP Billiton has no planned requirements to stop at the Alice Springs rail terminal and would therefore seek semi-unimpeded train paths
- planned improvements to Berrimah Road as part of the Tiger Brennan Drive extension include a road-over-rail bridge to provide improved access to the Port of Darwin East Arm facility. This would avoid traffic delays as a result of rail movements at this intersection
- the proposed rail movements to the Port of Darwin for the export of concentrate would not start for approximately six years after the commencement of open pit mining at Olympic Dam. Prior to these rail movements, train times would be secured with the rail service provider and BHP Billiton would aim to transport its loads outside peak-hour traffic flows in built-up areas such as Alice Springs
- the rail wagons transporting the concentrate would be effectively sealed with air- and water-tight lids
- estimated radiation doses associated with the NT Transport Option were summarised in Table E4.18 of the Draft EIS (reproduced in the Supplementary EIS as Table 4.7). The table shows that all doses would be less than the recommended 1 millisievert (mSv) annual dose limit to members of the public and that the estimated doses are also less than the typical Australian natural background dose of about 2 mSv/y
- to provide some context to the radiation dose estimates, and as discussed further in Section 26.1.1 of the Supplementary EIS, in order to receive their member of the public dose limit of 1 mSv/y from gamma radiation alone from a train carrying Olympic Dam concentrate (which is 0.8 uSv/hr at 5 m) a bystander would have to remain within five metres of the train for 1,250 hours a year (the equivalent of 156 eight-hour days).

Table 4.7 Estimated total doses/annum

Dose Assessment	Gamma (mSv/a)	Dust (mSv/a)	Radon Decay Product (mSv/a)	Total (mSv) (limit is 1 mSv/a)
Public at edge of easement standing 5 m from a train	0.0008	0.000	0.000	0.0008
Public living within 20 m of rail line	0.0018	0.000	0.000	0.0018
Resident of Darwin (worst case)	0.000	0.120	0.020	0.160
Resident of Darwin (likely case)	0.000	0.000	0.040	0.040
Railway worker – train inspection[1]	0.200	0.000	0.040	0.200
Train crew[1]	0.500	0.000	0.000	0.500

[1] Note that rail workers and train crew would be monitored as part of routine operations.

Issue:

It was requested that BHP Billiton consider constructing a rail bypass around major population centres such as Alice Springs, Tennant Creek, Katherine and Darwin.

Submission: 317

Response:

Realignment of the existing rail line around population centres in the Northern Territory is a matter for the owners of the rail line, the local council and the NT Government to consider.

BHP Billiton proposes to utilise the existing rail line from Pimba to the Port of Darwin, and to construct a new rail spur that connects the Olympic Dam operation to the existing rail line at Pimba.

The construction of the standard-gauge rail line (1,435 mm) between Tarcoola and Alice Springs was covered by the *Tarcoola to Alice Springs Railway Act 1974*. The standard-gauge line was completed in 1980 and retained the existing alignment, which enters Alice Springs through Heavitree Gap to the south, then runs to the established Alice Springs rail station and intermodal terminal. In 2003, construction of the Alice to Darwin rail line was completed and this extended the rail services to the north of the Alice Springs rail station and intermodal terminal.

In the case of Katherine and Tennant Creek, the rail alignment has been located approximately 650 m and 550 m respectively from the nearest town receivers. In the case of Darwin, the rail line is located west of Palmerston North and does not enter Darwin proper.

The line between Darwin, Katherine, Tennant Creek and Alice Springs, which is part of and is connected to, the national rail system that traverses Australia, was designed to carry cargoes and passenger services between Darwin and the southern states. The passenger rail services are operated by GSR, and Freightlink handles all cargoes ranging from bulk materials such as iron ore, copper concentrate and bulk fuel through to containers of general and refrigerated goods. More recently, the Australian Army has moved its tanks between Darwin and Port Augusta along this rail system.

4.6 HILTABA VILLAGE

Issue:

It was suggested that due to dust and radiation issues, the proposed Hiltaba Village is too close to the mine site and should be relocated about 10 to 15 km from the nearest edge of the rock storage facility (RSF). Integrating the village with the township of Roxby Downs was also suggested.

Submissions: 72 and 238

Response:

As discussed in Section 4.12 of the Draft EIS, the preferred location of Hiltaba Village was selected following an impact assessment that took into consideration the potential effects from all relevant aspects of the expanded operation, including the dust and radiation issues questioned above.

In relation to dust, the total suspended particulates (TSP) annual ground-level concentration at the village would be 7.1 micrograms per cubic meter ($\mu g/m^3$), and therefore well below the applicable limit of 90 $\mu g/m^3$. For monthly deposition of total suspended particulates, 0.2 grams per square metre per month ($g/m^2/m$) was predicted, again well below the applicable limit of 4 $g/m^2/m$ (refer Section 13.3.5 of the Draft EIS). With regard to particulate matter of a 10-micron size (PM_{10}) over a 24-hour period, the air quality modelling predicted a maximum ground level concentration at Hiltaba Village of 65.9 $\mu g/m^3$, compared with the applicable limit of 50 $\mu g/m^3$. As such, unmitigated, this level marginally exceeds the applicable limit. However, as discussed in Sections 13.3.5 and 13.4.2 of the Draft EIS, operational control via a dust management system based on pre-emptive controls would be implemented to manage dust levels to within legislative limits. As such, the selected location of Hiltaba Village is suitable in terms of potential dust exposure.

In relation to radiation, the total estimated dose at Hiltaba Village would be 0.12 milliseiverts per year (mSv/y), well below the annual worker dose limit of 20 mSv/y and the member of the public limit of 1 mSv/y. As such, the selected location of Hiltaba Village is appropriate in terms of potential radiation exposure.

In relation to integrating the village with the township of Roxby Downs, this option was investigated and rejected on the basis of views expressed by residents in Roxby Downs and Andamooka that showed a strong preference for accommodating the construction workforce at a distance from the townships (refer Sections 4.12 and 7.3.1 of the Draft EIS).