

Queensland Water  
Commission

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**South East Queensland  
Regional Desalination  
Siting Study - Phase 2**

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Phase 2 Siting Study

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FINAL D

Queensland Water  
Commission

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**South East Queensland  
Regional Desalination  
Siting Study - Phase 2**

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Phase 2 Siting Study

June 2009

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Appendix B	Engineering	Final A	20 February, 2009
Appendix C	Costing	Final A	17 April, 2009
Appendix D	Financial Analysis	Final B	19 April, 2009
Appendix E	Approvals Advice	Final A	12 February, 2009
Appendix F	Multi Criterial Analysis	Final A	21 April, 2009
Appendix G	Risk Analysis	Final A	17 April, 2009
Appendix H	Phase 3 Scoping	Final A	10 March, 2009
Appendix I	Supplementary Reports	Final A	17 April, 2009
Appendix J	Greenhouse Gas Abatement	Final A	10 March, 2009
Appendix K	Glossary	Final A	21 April, 2009

# 1 Executive Summary

The Queensland Water Commission released the draft South East Queensland (SEQ) Water Strategy for consultation in March 2008. The Strategy is a plan for meeting water supply requirements for the next 50 years, and includes significant measures to ensure the region is well prepared to respond to extreme drought.

The Strategy proposes to preserve the best supply options, to ensure that:

- any future desalination facilities or Purified Recycled Water (PRW) schemes will be located on the best possible sites, minimising the environmental, social and economic impacts;
- corridors for connecting infrastructure can be identified and preserved;
- town plans (and other master planning documents such as airport master plans) can be amended to ensure that any future development around the sites is complementary;
- the sites can be taken into account in the design of the bulk networks for water and electricity; and
- focussed planning can be undertaken for sites that may be required as part of a Drought Response Plan, including obtaining environmental approvals.

Desalination plants are recommended by the Strategy as a climate resilient water supply to meet the long-term needs of SEQ. With limited supplies available via alternative measures, it is considered prudent that sufficient sites are identified and preserved such that the total foreseeable supply gap for the region could be met with desalinated seawater.

The draft Strategy identified six potential sites for future desalination facilities in SEQ, and recommended further investigations be undertaken in relation to these sites. Two additional sites in the vicinity of the Brisbane River Mouth were identified in discussion with Brisbane Airport Corporation (BAC) and the Port of Brisbane Corporation (PoBC), following the extensive public consultation process after release of the draft Strategy. The potential to expand the Gold Coast Desalination Facility at Tugun was highlighted by SureSmart Water during Phase 2 consultation.

This report summarises the findings of the Phase 2 Studies, in relation to all of the sites considered. Recommendations are made for categorisation of sites as Priority, Reserved or Excluded (Table 1)

**Table 1 Site Categorisation**

Category	Site	Property description	Owner
"Priority"	Lytton	Lot 49 SP193294	Minister for Industrial Development
	Marcoola	Lot 753 CG3375	Sunshine Coast Regional Council
	Tugun	Lot 30 and Part of Lot 31 SP197355	Gold Coast City Council / State of Queensland
"Reserve"	North Stradbroke Island	Part of Lot 1 USL32114	State of Queensland
	Port of Brisbane and/or	Part of Lot 83 SP108337 and/or	Port of Brisbane Corporation Limited
	Brisbane Airport	Part of Lot 1 RP844114	Commonwealth of Australia
	Bribie Island	Part of Lot 64 SP104224	State of Queensland
	South Stradbroke Island	Lot 17 WD2688 and Lot 18 WD1474	State of Queensland
"Excluded"	Kawana	Lot 9 SP174900 and Lot 12 SP174900	Sunshine Coast Regional Council

The recommendations are made in accordance with a framework set out in the report, and on the basis of the Phase 2 investigations. As outlined in the Phase 2 Terms of Reference, these investigations have included:

- a desktop analysis of environmental and social site aspects, including cultural heritage status, significant flora and fauna species, geological and bathymetry data, water quality data, local and regional planning schemes and social impacts on local communities;
- preliminary engineering (based in part on the outcomes of the site analysis) for a production capacity of 100 ML/d and 400 ML/d at each site, both for the plant itself and for its ancillary infrastructure such as feed water delivery, concentrate disposal and product water pipe networks, and electricity supplies;
- development of capital and operating cost estimates for each plant capacity at each location, and of a net present cost of those estimates with sensitivity analyses;
- advice on the likely approval mechanisms necessary for construction of a desalination project centred around each site based on current legislation; and
- a risk assessment, and development and application of a framework and mechanisms for site scoring and ranking.

The projected regional requirement for additional climate resilient water supply by 2056 may be as high as 308,000 ML per annum or 856 ML per day (on the basis of climate change

adjusted yields from committed water supply sources and the region experiencing high series estimates for population growth).

QWC envisage that several separate plants may be required to service this supply gap (Refer Section 2.3). Although the technology may emerge over time to increase the potential output from any one of the sites, there are strategic benefits to dispersed sources:

- risks to supply from desalination plants (such as catastrophic failure of the process or serious feed water quality events) are far less likely to impact on multiple plants at distributed sites. Diversification of supplies both type and location is a key principle of the strategy, increasing the overall resilience of the system for a range of risks, and
- not only is security of supply increased but also efficiency, through the minimisation of long distance pumping of water.

It is also the case that while the SEQ water grid provides the capacity to move water across the region to where it is needed most, generally the SEQ water supply system will essentially be operated as three major supply areas:

- the North Coast, generally comprising the Sunshine Coast and Moreton Bay local government areas;
- central area, generally comprising the Brisbane and Ipswich local government areas and towns in the Somerset, Lockyer Valley and Toowoomba local government areas that are supplied from the Brisbane River system; and
- the South Coast, generally comprising the connected areas of the Redlands, Logan, Scenic Rim and Gold Coast local government areas.

Distributed desalination capacity would also help achieve some level of independence for each of the areas, alongside other measures.

The framework set out and explained in Section 7.1 combines regional and sub-regional drivers for categorisation of the sites. The primary driver at a regional scale is identification of priority sites to be adopted within the drought response plan, each in a different sub-region, for flexibility. Given this underlying motivation, it is recommended that the two priority sites be identified in the North and Central sub-regions, as the South sub-region is already served by a climate resilient supply in the form of the Gold Coast Desalination Facility at Tugun.

The Lytton site is recommended as one Priority site. Although all sites in the Brisbane River Mouth have merit, at this point in time only the Lytton site can pragmatically be recommended as a Priority site. The other sites are not available immediately and would require commercial and infrastructure agreements to be in place before certainty over the availability of the site at short notice could be gained.

The Marcoola and Bribie Island sites are the other candidates for categorisation as a Priority site. Each site has advantages and disadvantages. Bribie Island has some strategic advantage through proximity to the forecast drought mode and longer term supply gaps, and some reduced risk to timelines in a drought scenario given a potentially short network connection, but conversely its island location presents some heightened risks in a fast-tracked construction program.

Arup recommends that Marcoola presents the best option at this time, but highlights that this preference could change once more detailed investigations are undertaken and the issues involved in delivering the Bribie island facility are better understood.

The study investigations revealed no fatal flaws for any site (given time to plan for implementation), however two sites have been recommended for exclusion.

The balance between the incremental benefit of additional redundancy and the wider benefits to be gained by excluding the sites was a significant factor, especially in the case of South Stradbroke Island which has very significant environmental and societal value. The plant site itself sits within a broader contiguous nature conservation area and acquisition of the site for those purposes is intended by other local and state government bodies. There is some suggestion that areas of aboriginal cultural heritage may exist on the site despite not being recorded in the heritage registers at this time. From a technical perspective, access and power supply would both be significant issues to address on this site.

Numerous factors have led to the exclusion of Kawana. Compared to other northern sites, the Kawana site itself is considered more environmentally valuable due to the presence of endangered remnant vegetation which would require clearing for a 400 ML/d scenario. Clearing of endangered remnant vegetation would require the establishment of vegetation offsets. From a planning perspective, the site would require occupation of land identified as Open Space- Recreation Preferred Land Use providing recreational opportunities for residents and visitors to the area. As all of the sites in the North sub-region were considered broadly equivalent on the basis of the value for money analysis, the Kawana site was recommended for Excluded status. This was also considered to provide a benefit to the community, given interest in the site as a sport and recreational area.

The remaining sites have been recommended for Reserved categorisation, totaling at least two Reserved or Priority sites in each sub-regional area. This is consistent with the guidance provided by the categorisation framework, and warranted in particular due to the early stages of investigation and the ongoing potential that hitherto unidentified issues might be discovered with more detailed assessment at any particular site.

## 2 Planning Context

The Queensland Water Commission (QWC) released the draft South East Queensland (SEQ) Water Strategy for consultation in March 2008. The Strategy is due to be finalised by mid 2009.

The Strategy is a plan for meeting water supply requirements for the next 50 years. It is designed to deliver a new standard of water security by implementing a range of demand management measures and, being ready to take proactive action to invest in new infrastructure in a timely way. Importantly, it includes significant measures to ensure the region is well prepared to respond to extreme drought.

### 2.1 SEQ Water Grid

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The draft Strategy builds on the program of current and committed projects, including Traveston Crossing Dam Stage 1. With these projects the region will transition from a water supply system comprising eight independent water supply zones to a connected SEQ Water Grid.

The SEQ Water Grid provides the capacity to move water to where it is needed most maximising the yield of the system as a whole. As stated in the draft Strategy, the construction of interconnections will increase the yield of existing supplies, as at 2006, by about 14%. This increase will be achieved through the coordinated management of dams, minimising evaporation and the likelihood of spills, and by managing risk at a regional level, rather than on an individual water storage or water supply system basis.

### 2.2 Sub-regional Supply Areas

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Within this grid framework, excluding the circumstance of a severe drought, the SEQ water supply system will essentially be operated as a series of large supply areas. Once the SEQ Water Grid is completed, each of the supply areas will feature:

- one or more major dams;
- increased diversity of supply, due to the construction of desalination and purified recycled water facilities and interconnecting pipelines;
- increased supply from rainwater tanks and other local alternatives; and,
- a surplus of supply over demand until between 2026 and 2042 ML per annum, depending on consumption trends, the rate of population growth, and the impact of climate change.

The SEQ Water Grid will also be operated such that a drought storage reserve is retained in each area.

The major supply areas are:

- the North Coast, generally comprising the Sunshine Coast and Moreton Bay local government areas;
- Central area, generally comprising the Brisbane and Ipswich local government areas and towns in the Somerset, Lockyer Valley and Toowoomba local government areas that are supplied from the Brisbane River system; and,
- the South Coast, generally comprising the connected areas of the Redlands, Logan, Scenic Rim and Gold Coast local government areas.

The boundaries between these supply areas will vary over time based on the local and regional water balance, and opportunities to minimise operating costs. For instance, Logan may be supplied from sources on the Gold Coast or Brisbane, depending on dam levels and the level of operation of the South East Queensland (Gold Coast) Desalination Facility.

Similarly, the northern areas of the Moreton Bay local government area may be supplied from the Sunshine Coast or from Brisbane.

The System Operating Plan establishes a framework for the operation of the SEQ Water Grid based on the principles outlined in Section 3.3 of the draft South East Queensland Water Strategy.

Planning for future upgrades to the SEQ Water Grid should seek to maintain and enhance the capacity of each of these supply areas. A key element of this is to identify and preserve sites for desalination or purified recycled water facilities in each supply area. These sites should be suitable for development as part of the regional Drought Response Plan or, beyond 2026, in normal conditions.

### 2.3 Supply Gap

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The demand management program which underpins the Strategy is forecast to reduce the supply gap by about half by 2056. Still, demand is forecast to increase to about 580,000 ML per annum by 2026 and 795,000 ML per annum by 2056 based on medium series population growth and the ongoing effectiveness of demand management initiatives. This highlights both the potential contribution of demand management measures, and also the need to closely monitor demand outcomes over time. With this demand, the supply gap (that is, the demand for additional supplies over and above supply provided by existing and committed infrastructure ) would reach 97,000 ML per annum by 2056.

QWC advise that the supply gap would increase significantly depending on the scale of climate change and its effect on surface water yields and population growth. The most pronounced supply gap is observed under a scenario which considers the committed infrastructure under a climate scenario where surface water storage yields are reduced by 10%, and high series population growth eventuates across the region. Without additional supplies by 2056, the gap between supply and demand could be up to 350,000 ML per annum, which is more than 7 times the rated capacity of the recently completed Gold Coast Desalination Facility. The purpose of the Strategy is to identify and bring on supplies at appropriate times to prevent this gap from developing.

An analysis of the forecast demand growth in different sub regions indicates that by 2056, the supply gap is most significant in the southern and central regions. Depending on the level of transfers from other interconnected regions and other variables applying to supply and demand levels, the gap would be up to 219,000ML per annum in the central region and 119,000ML per annum in the south.

### 2.4 Drought Response Requirement

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Sustaining the levels of service commitments presented in the draft Strategy could depend on the provision of additional climate resilient water supplies over a short, defined implementation period in response to a severe drought. Seawater desalination is likely to be a key element of future drought response plans.

Once volume drops to a pre-determined level in our regional surface storages, (known as the trigger level) the drought response plan will be initiated. This is likely to entail a period of medium level water restrictions and an expedited preparation and construction period of around 36 months for new supply projects. In order to contain this period within the timelines required by the plan, some of the early works may need to be completed ahead of the triggering of the drought response plan. These preliminary works will be further scoped as part of Phase 3 desalination investigations.

Under a drought response scenario, low rainfall results in greatly reduced inflows to surface water storages. Supplies during such a period are limited to the available yields from climate resilient sources, plus the yields from climate dependent sources based on these reduced inflows (which have commonly been estimated through analysis of the historic rainfall

record). The requirement during this drought period would be the deficit between a restricted level of demand and the drought reduced yield from the existing infrastructure.

If we were to experience a severe drought which brought us to the trigger level in 2026 the drought mode supply gap could have reached 106,000ML per annum. This estimate takes into account committed infrastructure to that point and, forecast demand under restriction increased in line with high series population growth predictions. This drought mode supply gap could be met from a single large desalination site if required.

On a sub-regional scale, the drought mode supply gap at 2026 is most pronounced in the central supply region. This is largely due to the concentration of demand in this region and a relatively low proportion of climate resilient sources in this sub region. By 2056 however the supply gap in drought mode is more pronounced in the southern sub-region. This is the area where population growth is forecast to be highest.

## 2.5 Potential Future Water Sources

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It is important that the best supply options are preserved to prevent inappropriate development on or near the sites and to enable rapid response to any future drought. As stated in the SEQ Water Strategy, preserving the preferred sites now ensures that:

- any future desalination facilities or Purified Recycled Water (PRW) schemes will be located on the best possible sites minimising the environmental, social, and economic impacts;
- corridors for connecting infrastructure can be identified and preserved;
- town plans (and other master planning documents such as airport master plans) can be amended to ensure that any future development around the sites is complementary;
- the sites can be taken into account in the design of the bulk networks for water and electricity; and,
- focussed planning can be undertaken for sites that may be required as part of a Drought Response Plan, including obtaining environmental approvals.

A range of potential options for detailed investigation were identified based on initial screening. With the exception of desalination, the total capacity of each of these types of supply is less than the potential supply gap.

In relation to major new dams, the Strategy highlights that there are few sound opportunities beyond committed projects. This is due to the shortage of suitable sites in areas identified as having water available for development in Water Resource Plans. Following completion of the committed projects, the major catchments will be approaching their sustainable limits.

In relation to purified recycled water, the Strategy identified four potential purified recycled water schemes for detailed investigation, including two long-term options. In total, these schemes have the potential to increase the available supply by up to 100,000 ML per annum by 2056. Since the Strategy was released, the Government has announced that purified recycled water will be used an emergency source of supply only.

In relation to groundwater, resources are almost fully developed with the annual volume used for urban purposes over the next 50 years expected to remain largely static.

### 3 Potential Desalination Locations

The Strategy recommends that desalination plants, additional to the recently completed SEQ (Gold Coast) Desalination Facility, could be used as a climate resilient water supply to meet the long-term water supply needs of the region.

With limited opportunities existing for additional supply, it is prudent that sufficient sites are identified and preserved such that the total foreseeable supply gap for SEQ could be met with desalinated seawater.

Suitable desalination plant locations are generally in close proximity to the coast where considerable pressure on land availability exists due to competing uses such as residential, commercial and conservation. Given a scarcity of easily identifiable sites in this coastal strip there is a recognised need to preserve sites now, despite not being required immediately.

#### 3.1 Phase 1 Studies

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The Strategy identified six potential sites for future desalination facilities in SEQ, and recommended further investigations be undertaken on these sites. The six sites are:

- Marcoola (Finland Road) - Lot 753 CG3375
- Kawana (Milieu Place, Birtinya) - Lot 9 SP174900 & Lot12 SP174900
- Bribie Island - Lot 64 SP104224
- North Stradbroke Island - Lot 1 USL32114
- South Stradbroke Island - Lot 17 WD2688 & Lot 18 WD1474
- Lytton (37 Freight Street) - Lot 49 SP193294

The six sites were identified through the first phase of the SEQ Regional Desalination Plant Siting Studies, which were a suite of reports produced between 2006 and 2008. The Phase 1 studies were initiated by the Department of Natural Resources & Mines in 2003 who commissioned consultants GHD to carry out the study. A broad scale study of the SEQ region was undertaken to identify sites which met a set of general criteria relating to their suitability as a location for a desalination plant. Several iterations were made which focused on strategic zones throughout the region. This process resulted in six sites spread along the SEQ coastline being recommended for further investigation.

These six sites were included as a component of the draft SEQ Water Strategy and the Queensland Water Commission committed to the further investigation of these sites. This site categorisation study is the next phase of the investigations.

#### 3.2 Additional Sites

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During the extensive public consultation process that was undertaken following release of the draft SEQ Water Strategy, three additional potential sites were put forward.

Two sites in the vicinity of the Brisbane River Mouth were identified in discussion with Brisbane Airport Corporation (BAC) and the Port of Brisbane Corporation (PoBC) on land controlled by those entities. The site at Fisherman Islands underwent a preliminary evaluation to determine if the sites should be investigated further. A series of discussions were held with BAC to establish the optimal location amongst the available areas at the airport. The sites appeared to be suitable and were included in the Phase 2 investigations as potential alternatives to the Lytton site.

SureSmart Water was consulted during the Phase 2 Studies in order to incorporate learnings from the recently completed Gold Coast Desalination Facility at Tugun. Discussions highlighted that a business case had been developed for a 45 ML/d augmentation at Tugun and that increased capacities beyond this magnitude were potentially feasible at the site. SureSmart Water, now a wholly owned subsidiary of

WaterSecure, was requested to revisit their earlier work and look at the feasibility of a range of expansion scenarios to a total capacity of 400 ML/d at the site. The studies were undertaken by external consultants with the close cooperation of staff at the Tugun site. Findings from that study have been incorporated into this Phase 2 Siting Study.

## 4 Phase 2 Studies

In July 2008, QWC commissioned Phase 2 studies, which provide a more specific desktop comparison of the nine sites considered. Table 2 lists the sites that were considered as part of this investigation.

**Table 2: Phase 2 study sites**

Site ID	Site Name	Lot Number
A	Marcoola (Finland Road)	Lot 753 CG3375
B	Kawana (Milieu Place, Birtinya)	Lot 9 SP174900 & Lot 12 SP174900
C	Bribie Island	Lot 64 SP104224
D	Lytton (37 Freight Street)	Lot 49 SP193294
E	North Stradbroke Island	Lot 1 USL32114
F	South Stradbroke Island	Lot 17 WD2688 & Lot 18 WD1474
G	Brisbane Airport Corporation (BAC)	Lot 2 RP 844116
H	Fisherman Islands, PoBC	Lot 83 SP108337
I	Tugun	Lot 30 SP197355

### 4.1 Objectives

The key objective for this Phase 2 study is to conduct sufficient investigations and feasibility studies into the potential sites to allow QWC to provide advice to the Government regarding the categorisation of the potential sites.

As outlined in the Phase 2 Terms of Reference, works that will form the basis of that categorisation include:

- a desktop analysis of environmental and social site aspects, including cultural heritage status, significant flora and fauna species, geological and bathymetry data, water quality data, local and regional planning schemes, and social impacts on local communities;
- preliminary engineering (based in part on the outcomes of the site analysis) for production capacities of 100 ML/d and 400 ML/d at each site, both for the plant itself and for its ancillary infrastructure such as feed water delivery, concentrate disposal and product water pipe networks, and electricity supplies;
- development of capital and operating cost estimates for each plant capacity at each location, and of a net present cost of those estimates with sensitivity analyses;
- advice on the likely approval mechanisms necessary for construction of a desalination project centred around each site based on current legislation; and,
- a risk assessment, and development and application of a framework, and mechanisms for site scoring and ranking.

## 4.2 Reporting

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This report summarises the key aspects and conclusions of the Phase 2 studies.

For a full understanding of the Phase 2 methodology, analysis and conclusions it is necessary to refer to the Appendices listed below, in particular to gain an understanding of the basis for Phase 2 work and its limitations. Reliance on this report alone may result in misinterpretation and/or misapplication of its conclusions.

- Appendix A: Site Analysis
- Appendix B: Preliminary Engineering
- Appendix C: Costing
- Appendix D: Financial Analysis
- Appendix E: Approvals Advice
- Appendix F: Multi Criteria Analysis & Scoring (Non-Cost Aspects)
- Appendix G: Risk Assessment
- Appendix H: Phase 3 Scoping
- Appendix I: Supplementary Reports
- Appendix J: Greenhouse Gas Abatement
- Appendix K: Glossary of Terms

## 4.3 Approach & Limitations

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Background work and reports have used data current at the time of investigation, and have been developed on a consistent basis across the sites and remain suitable for the primary purpose of these Phase 2 studies – that is, categorising sites as Priority, Reserved or Excluded.

Note that Phase 2 has relied on desktop analyses, brief site visits and local government consultation, and a range of publically available datasets. All data collected has been compiled into a GIS database and has been licensed and made available to QWC.

The information summarised for the purposes of this study may not be suitable for decisions regarding corridor or site definition, or design, without further verification.

## 5 Site Summaries

The following section summarises the key findings for each of the potential desalination sites investigated. Table 3 and Table 4 set out general information of all sites relating to tenure, land use and general site characteristics such as lot size and slope. Sections 5.1 to 5.9 highlight each site's engineering and environmental issues associated with the development for desalination. Results of investigations into all sites excluding Tugun are contained within Appendix A- site analysis and Appendix B- Engineering. Tugun analysis is taken directly from the WaterSecure report, *Gold Coast Desalination Facility* report (found in Appendix I).

**Table 3 Site Information**

Site	Owner	Tenure	Current Use	Previous Use
Marcoola	Sunshine Coast Regional Council	Freehold	Vacant	Agriculture
Kawana	Sunshine Coast Regional Council	Freehold	Part of the Kawana Sports Grounds. Largely vegetated, partially cleared in centre.	Borrow Pit used as landfill – now capped.
Bribie Island	State Government	Unallocated State land	Forestry and is largely vegetated with pine plantation.	Plantation forests
Lytton	State Government	Freehold	Vacant and largely devoid of remnant vegetation.	Vacant
Brisbane Airport Corporation	Commonwealth of Australia (leased to Brisbane Airport Corporation)	Freehold	Vacant and devoid of remnant vegetation.	Vacant
Fisherman Islands	Port of Brisbane Corporation	Freehold	Vacant rail loop and devoid of remnant vegetation.	Vacant
North Stradbroke Island	Redland City Council	Unallocated State Land	Rehabilitated mine.	Sand mining
South Stradbroke Island	State Government	Unallocated State Land	Currently not in use.	Historically, the site has had several major land uses.
Tugun	Gold Coast City Council	Freehold (Lot 30 and 31)	Desalination Plant (Lot 30). Sports and Recreation, Sewerage Infrastructure and landfill (Lot 31).	Landfill (Lot 30 and 31)

**Table 4 Site Characteristics**

Site	Area		Maximum Slope	Maximum Elevation	Local Flood Levels
Marcoola	24 ha (footprint)	53 ha (lot)	< 1% (footprint)	2.3 mAHD (footprint)	3.22 mAHD (1 in 100 year fluvial flooding event)
Kawana	24 ha (footprint)	28 ha (lot)	< 1%	2.65 mAHD (footprint).	2.5 mAHD (1 in 100 year coastal flooding event).
Bribie Island	24 ha (footprint)	1,520 ha (lot)	< 1% (footprint)	1.5 mAHD (footprint).	2.25mAHD (1 in100 year event)
Lytton	6 ha (footprint)	8 ha (lot)	< 1% (footprint)	7.1 mAHD (footprint).	2.35 mAHD (1 in 100 year event)
Brisbane Airport Corporation	24 ha (footprint allocation)		< 1% (footprint)	<2 mAHD (footprint).	1.58 mAHD (Highest Astronomical Tide)
Fisherman Islands	12.1 ha (footprint)		< 1% (footprint)	2.6 mAHD (footprint).	1.58 mAHD (Highest Astronomical Tide)
North Stradbroke Island	24 ha (footprint)	1,970 ha (lot)	31%* (footprint)	51.3* mAHD (footprint).	1.3 mAHD (1 in 100 year event)
South Stradbroke Island	24 ha (footprint)	63 ha (lot)	< 1% (footprint)	1 mAHD (footprint).	1.3 mAHD (1 in 100 year coastal flooding event)
Tugun	Information not available				

\*This study has assumed the North Stradbroke Island site will be levelled to minimise slope and reduce maximum elevation to 51.3mAHD.

## 5.1 Marcoola

Site A (described as Lot 753 on CG3375) is situated at 393 Finland Road, Marcoola. The site is situated to the north-west of the Sunshine Coast Airport and east of the Sunshine Motorway. The Mt Coolum National Park is located to the east and north of the site. There is also an area of National Park approximately 0.5 km to the south.

The intake and outfall pipes will travel east from the subject site to the coast line and either tunnelled or trench and sea bed laid construction are possible. The assumed route for the pipes connecting the desalination plant to the water supply network at North Pine Water Treatment Plant is approximately 102 km. The length of network connection required between the site and QWC nominated connection point is both a risk and opportunity. A 100 km corridor creates both significant risks (tenure, approvals, cost) and opportunity (route options assessment and optimisation).

### 5.1.1 Flora & Fauna Summary

Aspect	Feature
Vegetation	Intake/outfall – may require some clearing within Mt Coolum National Park (use of fire trail may help minimise).
Wetlands	The site is a referable wetland and is identified in the 'Map of referable wetlands' – a buffer is required (likely 100 m). Intake/outfall – potential impact on wetlands in Mt Coolum National Park and Maroochy River & Wetlands Conservation Area must be mitigated.
Terrestrial and aquatic fauna	Essential habitat – Mt Coolum National Park and areas exist within the Maroochy Wetlands Conservation Park (Bli Bli) and Ferntree Creek National Park (Parklands), which may be impacted by the pipelines.
Wildlife corridors	Pipelines – would potentially impact core habitat to the local biodiversity network in conservation areas to east and west of the site (Mt Coolum National Park, Maroochy Wetlands Conservation Park (Bli Bli) and Ferntree Creek National Park (Parklands)).

### 5.1.2 Legislative & Planning Summary

Aspect	Feature
Planning context	<p>Sunshine Coast Airport is a significant constraint – the proposed use of the site for a desalination plant conflicts with the <i>Maroochy Plan 2000</i>, as it:</p> <ul style="list-style-type: none"> <li>Conflicts with the intent of the Strategic Plan (the site is identified for Agricultural Protection and Special Purposes – Airport).</li> <li>Is not a “preferred and acceptable use” in the Marcoola Conservation (Special Purpose) Precinct and Sunshine Coast Airport (Special Purpose) Precinct and conflicts with the intent of the precincts.</li> <li>Conflicts with the intent of the North Shore Planning Area which is to provide for residential communities, the significant tourist resorts of Twin Waters and Surfair, and the regional Sunshine Coast Airport.</li> <li>Is beneath the airport’s Obstacle Limitation Surface (OLS) area and any structures on the site have the potential to protrude into the OLS (particularly towards the South of the site).</li> </ul>

## 5.1.3 Preliminary Engineering Summary

Aspect	Feature
Geotechnics	According to published mapping, Acid Sulfate Soils are likely to be present on site. Fill required to obtain ground level above 1 in 100 year flooding event.
RO Plant	Plant location on lot constrained by Sunshine Coast Airport's obstacle limitation surface area Consultation is required regarding intended use of the site for vegetation offset for new runway; navigational instrument locations
Intake / outfall	Site is located within popular beach areas Pipe trenched on land and laid on sea bed, and tunnelling, considered feasible design options.
Network connection	Long (106 km) network connection pipeline (to North Pine WTP) is largely co-located with Northern Pipeline Interconnector; long connection and associated pumping is significant in outcomes.

## 5.2 Kawana

Site B (described as Lot 9 and Lot 12 on RP174900) is situated at Milieu Place, Birtinya. The land is currently indicated as part of the Kawana Sports Grounds and has been indicated for urban development within the SEQ Regional Plan and a development application restricts land use to sport and recreation. The site is partially cleared and the remainder of the site remains vegetated. The 400/MLd option would require clearing of 'endangered' Remnant vegetation, which is also mapped as 'essential habitat' which will require a referral to Department of Environment and Resource Management (DERM) and offsets obtained.

The site is known to have a historical use as a 'borrow pit' and was remediated to a depth of approximately 1m below ground level. The potential for ground contamination and/or ground stability should be confirmed with geotechnical ground investigations to better establish ground conditions and implications for any mitigation measures.

The intake and outfall pipes will travel to the east of the site and may only be tunnelled due to the built up nature of the coastline. The assumed route taken by the pipes connecting the desalination plant to the water supply network at North Pine Water Treatment Plant is approximately 82 km. Of this distance, 80 km is assumed to be within the same easement as the Caloundra City Council pipeline connecting the water reservoir at Kawana to surrounding suburbs and the Northern Pipeline Interconnector (NPI).

### 5.2.1 Flora and Fauna Summary

Aspect	Feature
Vegetation	<p>Plant site – Remnant Vegetation on site comprising Regional Ecosystems (RE) with endangered and not of concern status. Significant flora is possible on site and records indicate a possible 12 flora species listed under Nature Conservation Act and three of these are also listed under EPBC. Clearing of the essential habitat will be required for the 400 ML/d scenario.</p> <p>Vegetation on site has 'essential habitat' status (referrable to –DERM).</p>
Wetlands	<p>The area affected by remnant vegetation is designated as a 'referable wetland' – a buffer is required (likely 100 m).</p> <p>Network connection – potential wetland crossings associated with Mooloolah River, impacts of which must be mitigated.</p>
Wildlife corridors	<p>The site is recognised for its value as a core habitat. Linkage between Currimundi Lake and the Mooloolah River National Park forms part of a large core habitat area with the Mooloolah River National Park to the west which connects to Palmview Conservation Park and Beerwah Forest Reserve.</p> <p>EPA's Biodiversity Planning Assessment (BPA) mapping indicates the vegetation on/around site to be 'of State significance'.</p>

## 5.2.2 Planning and Legislative Summary

Aspect	Feature
Planning context	SEQ Regional Plan – lot indicated for urban development.
	Caloundra City Plan 2004 (Update 2) – lot recognised for its conservation value.
	Birtinya Floodplain (Area C13) – lot recognised as part of this floodplain and considered as having significant vegetation.
	Vegetation Management Act – likely that clearing of remnant vegetation will need to be assessed at the point of application, and clearing will need to be offset due to its status as ‘essential habitat’, ‘wetland’ and ‘endangered RE’.
	A development agreement further restricts the use of the site to sport and recreation purposes only.
	Constrained by issues relating to the previous use of the site as a landfill.

## 5.2.3 Preliminary Engineering Summary

Aspect	Feature
Geotechnics	Site is the location of a former ‘borrow pit’, which was remediated in 2003.
Access	Most likely via local roads entering to the north east of the site and onto Milieu Place, and onto Main Drive. Some disruption to local road users and safety risks will need to be managed.
	The DMR multi modal transport corridor traverses the south eastern tip of the site, meaning access to and from the south east corner directly onto Kawana Way will not be possible.
RO Plant	400ML/d option requires clearing of significant vegetation.
Intake/outfall	Tunnelling considered only feasible design option due to density of foreshore development.
Network connection	Long (83k) pipeline connection to North Pine WTP Clearwater Reservoir.
	Assumed co-location with Northern Pipeline Interconnector from near the corner of Old Gympie Road and Upper Tolson Road.

### 5.3 Bribie Island

Site C a 24ha portion situated in the south eastern corner of a 1,520ha lot (described as Lot 64 SP104224) and is situated in the suburb of Welsby on Bribie Island. Pumicestone Passage is located to the west of the subject site, between Bribie Island and the mainland. Bribie Island National Park surrounds the subject site. Site access and ability to transfer material to the island site are considered to be issues which may pose risks for construction timeframes

The intake and outfall pipes would travel east from the site to the coastline. Either tunnelled or trenched and sea bed laid construction are possible. The assumed corridor for the pipes runs across the Bribie Island National Park and Ramsar wetlands.

The assumed route for the network pipes connecting with the water grid at North Pine Water Treatment Plant is approximately 60 km. Ramsar wetlands areas will be affected by construction of the network pipeline further complicating the approvals processes which could be costly or time-consuming. Further investigations, including design, would help determine the extent of the risk and appropriate mitigation measures. The connection from the island to the mainland crosses Pumicestone passage, conservation zone of the Marine Park (Moreton bay) Zoning Plan, 2008.

#### 5.3.1 Flora and Fauna Summary

Aspect	Feature
Vegetation	Pipelines likely to necessitate clearing within Bribie Island National Park to the east and south of site.
Wetlands	The remnant vegetation surrounding the site is a 'referable wetland'. Ramsar wetlands impacted by intake and outfall, and network connection pipeline.
Terrestrial and aquatic fauna	The Bribie Island National Park is 'essential habitat' for four species. Brief site inspections confirmed presence of the threatened Wallum Froglet in the National Park directly adjacent to the east of the subject site, which may be impacted by the intake and outfall pipelines.
Marine ecosystems	The beach and vegetation to the east of the site has been indicated as Fish Habitat Area. This will be affected by intake/outfall pipes. The assumed network connection alignment crosses a 'Conservation Park Zone' (under the <i>Marine Park (Moreton Bay) Zoning Plan, 2008</i> ) through Pumicestone Passage.

#### 5.3.2 Legislative and Planning Summary

Aspect	Feature
Planning context	Wetland Protection Area – bounds site to the west, south and east. Planning and development: <ul style="list-style-type: none"> <li>site currently pending gazettal to become State Forest under the <i>Forestry Act 1959</i>;</li> <li>site use for a desalination plant conflicts with the purpose of the <i>Recreation Areas Management Act 2006</i>;</li> <li>Crossing Pumicestone Passage impacts the Conservation Park Zone of the <i>Marine Park (Moreton Bay) Zoning Plan, 2008</i>.</li> </ul>

## 5.3.3 Cultural Heritage and Native Title Summary

Aspect	Feature
Cultural heritage	Aboriginal Cultural Heritage Register – 10 items of Aboriginal significance recorded on the Aboriginal Cultural Heritage Register on Lot 64 and site development could potentially affect numerous items. However the assumed footprint does not interfere with any registered item of Aboriginal significance.

## 5.3.4 Preliminary Engineering Summary

Aspect	Feature
Access	Two lane bridge constructed in 1963 with unknown weight restrictions (DMR unable to advise) connects Bribie Island to the mainland.  Construction and possibly operational access requirements mean either a bridge or jetty is needed. Existing bridge considered likely to be insufficient. Existing bridge is expected to have capacity for some construction transport movement. This will need to be supplemented by an alternate access to site including the need to set up a temporary jetty on the island for transportation of heavy equipment delivered by sea.
Intake/outfall	Pipe trenched on land and laid on sea bed, and tunnelling, considered feasible design options.
Network connection	Connection to North Pine WTP Clearwater Reservoir, 55 km from the desalination plant site. The assumed method of construction for the marine crossing at Pumicestone Passage is sea bed laid pipe.
Power	Energex has identified the upgraded connections to Bribie Island as potentially complex and the most costly of any of the sites investigated.

## 5.4 Lytton

Site D is described as Lot 44 SP193294 and is situated at Freight Street, Lytton to the south-west of the Port of Brisbane and close to the Brisbane River. The lot has an available area of 8ha and adjoining land would be required for a plant size greater than 100ML/d.

The intake for both options are situated in Moreton Bay, west of Mud Island. For a 100ML/d plant the assumed outfall would be into the Brisbane River while an outfall for the 400ML/d plant would extend to west of Mud Island within Moreton Bay. While the intake location will provide appropriate intake water quality on the basis of available monitoring data, the risk of unpredictable changes in water quality (contamination from oil spills) exists, increasing operational costs and plant down time. Both trenched and sea bed laid options are considered for this site, however the length of the connections to Moreton Bay is significant for the site.

The 100ML/d plant would result in approximately 11 km of connecting pipeline, crossing the Brisbane River once at Morningside. A larger 400ML/d plant would connect to a reservoir at Stapylton approximately 52 km in length.

### 5.4.1.1 Flora and Fauna Summary

Aspect	Feature
Marine ecosystems	<p>Intake and outfall pipes will be located within the habitat zones or general use zones of the Moreton Bay Marine Park. The outfall site adjacent to Mud Island has been designated as a 'Material Disposal Area' in Map 2 – Moreton Bay Marine Park Designated Areas.</p> <p>Marine park zoning may become more restrictive on discharges into Moreton bay, which could impact the allowable discharges from the desalination plant.</p>

### 5.4.1.2 Planning and Legislative Summary

Aspect	Feature
Planning context	<p>In regards to planning and development -of all sites it is the least constrained by the State Coastal Management Plan and the SEQ Regional Coastal Management Plan. The site is within general industry area of the Australia Trade Coast Local Plan area and Brisbane City Council have expressed a desire for the site to be available for activities which are employment generating / value adding.</p>

## 5.4.1.3 Preliminary Engineering Summary

Aspect	Feature
Dispersion	<p>An outfall for a 100 ML/d capacity plant discharging into the Brisbane River has a negligible environmental impact based on a brine dispersion study.</p> <p>An outfall for a 200ML/d capacity plant discharging into Moreton Bay has negligible environmental risks based on the South East Queensland Healthy Waterways Partnership brine dispersion study (Appendix I).</p>
Network connection	<p>100 ML/d option requires a total of 11 km to nominated connection nodes on Lytton Rd and Schneider Rd.</p> <p>The 400ML/d option will utilise the above connection and an additional main to Staphylton Break tank, at a distance of approximately 52km.</p>
Intake/outfall	<p>Both sea bed laid and tunnelled installations are considered feasible.</p> <p>The length of outfall necessary to ensure the discharge does not affect sensitive receivers is significant exposing this site to greater potential geotechnical issues, if tunnelled.</p>

## 5.5 Brisbane Airport Corporation

Site G (described as Lot 2 RP844116) is situated at Airport Road, Brisbane Airport. It is a parcel of land leased from the Commonwealth by Brisbane Airport Corporation (BAC) within the local government area of Brisbane with an area of up to 24 ha investigated for the purposes of this study. The land is currently vacant, although it is not available for desalination development. The availability of this site is reliant on the developments of the parallel runway, following which the land could be released for development.

The site is situated to the east of the airport and adjacent to the Moreton Bay Marine Park. Bramble Bay is just north of the site. From a planning perspective the site is located within the Brisbane Airport precinct, which is associated with its own development planning and legislation further described in Appendix A.

The intake and outfall for both 100ML/d and 400ML/d options is assumed to be west of Mud Island, in Moreton Bay. This requires lengthy (10km) tunnelling to avoid impacts to the Marine Park (Moreton Bay) Zoning and the environmentally sensitive Bramble Bay, just north of the site.

The 100ML/d plant's network connection pipeline would be to reservoirs at Murrarie and Eagle Farm, crossing the Brisbane River once at Morningside. A larger 400ML/d would follow the same corridor as for Lytton.

### 5.5.1.1 Flora and Fauna Summary

Aspect	Feature
Wetlands	Intake/outfall – Tunnelled construction is recommended to avoid the Moreton Bay Marine Park Habitat protection zone in Bramble Bay, which is also a mapped Ramsar wetland.
Marine plants	There is a narrow band of mangroves associated with the drain in the west of the subject site. There is also an area affected by Saltwater Couch ( <i>Sporobolus virginicus</i> ).
Terrestrial and aquatic fauna	The site contains Casuarina wetland and a mangrove lined channel that may harbour some native or migratory species.
Wildlife corridors	Part of the foreshore to Moreton Bay.
Marine ecosystems	The intake and outfall site adjacent to Mud Island has been designated as a 'Material Disposal Area' in Map 2 – Moreton Bay Marine Park Designated Areas.

## 5.5.1.2 Planning and Legislative Summary

Aspect	Feature
	<p>The 2003 Brisbane Airport Master Plan identifies the site as being within the Special Uses (Airport) area. Land within this designation is identified as airport land that will be needed in the long-term for runways, taxiways, aprons, aircraft services, and terminal support including car parking, taxi ranks and holding areas, bus and coach pick up and set down. The use of land for a desalination plant within this designation conflicts with the intent of the Special Uses (Airport) area.</p> <p>The site is within the Obstacle Limitation Surface (OLS) area and the Procedures for Air Navigation Services – Aircraft Operational Surfaces (PANS-OPS) area;</p>
Planning context	<p>BAC have stated that it is their intention to decommission Runway 14/32 in the future following the construction of the new parallel runway.</p> <p>In regards to planning and development:</p> <ul style="list-style-type: none"> <li>the site is owned by the Commonwealth Government, and is not subject to the provisions of the Brisbane City Plan 2000;</li> <li>the proposed use of desalination plant is incompatible with the 2003 Brisbane Airport Master Plan, as the land is designated as Special Uses (Airport) area;</li> <li>BAC's intention to decommission Runway 14/32 means that a desalination plant on the site is unlikely to compromise the functioning of the Brisbane Airport.</li> </ul>

## 5.5.1.3 Preliminary Engineering Summary

Aspect	Feature
Dispersion	Dispersion impacts for the outfall locations (West of Mud Island).are the same as for Lytton in the same location.
Geotechnics	ASS are likely to be present.
Access	Access via perimeter road through BAC land and to Pinkenba. This will require changes to 'air side' boundaries to exclude the plant site and access route from 'air side' restrictions.
Network connection	<p>100MLd option 12 km connection to Schneider Rd, a further 5km across Brisbane River to nominated connection node on Lytton Rd.</p> <p>The 400ML/d option will utilise the above connection route From Lytton Rd the same connection rote will apply as the Lytton 400ML/d option.</p>
Intake/outfall	Intake and outfall will be tunnelled to a point west of Mud Island to avoid impacts on Bramble and Moreton Bay.

## 5.6 Fisherman Islands –Port of Brisbane Corporation (PoBC)

Site H (described as Lot 83 SP108337) is situated within the rail loop off Bingera Road, Fisherman Islands. It is currently approximately 4.3 ha, however, after expansion the land available in the centre will be approximately 12.1 ha. This expansion would be sufficient for a 100ML/d option, but would need to occur prior to development of the site as the current space available is too small. For a 400ML/d option, additional space requirements for ancillary facilities can be met either on land close to the bridge crossing to the island and sections of the reclamation underway now or at the Lytton site which has been assessed in this study. Access to the site would be inherently difficult with ongoing train movements on the rail loop.

The intake for the 100ML/d and 400ML/d options, and the outfall for the 400ML/d option are assumed to be located directly within Moreton Bay to the west of Mud Island. For the 100ML/d option, the outfall is to be located on the quayside, west of site. Both trenched and sea bed laid options are considered for this site. The 100ML/d network connection pipeline would connect to reservoirs at Murrarie and Eagle Farm, crossing the Brisbane River once at Morningside. A larger 400ML/d would follow the same corridors as for Site D – Lytton.

### 5.6.1.1 Flora and Fauna Summary

Aspect	Feature
Marine ecosystems	The pipes will be located within the general use zones of the Moreton Bay Marine Park. The outfall site adjacent to Mud Island has been designated as a 'Material Disposal Area' in Map 2 – Moreton Bay Marine Park Designated Areas.

### 5.6.1.2 Planning and Legislative Summary

Aspect	Feature
Planning context	The site is under the jurisdiction of the Port of Brisbane Land Use Plan 2007 (LUP2007). The LUP2007 identifies the site as being an Investigation Area. Various areas within the port precincts are designated as 'Investigation Areas'. The proposed use of the site for a desalination plant is generally in accordance with the principles of the Investigation Area Precinct.

### 5.6.1.3 Preliminary Engineering Summary

Aspect	Feature
Dispersion	Dispersion impacts for the outfall locations (West of Mud Island and into the Brisbane River on the quayside of Fisherman Islands).are the same as for Lytton.
Geotechnics	Reclamation material composed of sand underlain by clays. This site may require significant preparation works prior to construction.
Access	Access across the rail lines into site may be difficult and will require coordination with Queensland Rail.
Network connection	100ML/d network connection via 21km pipeline to Lytton Rd and Schneider Rd, crossing the Brisbane River at Morningside. The 400ML/d option will utilise same connection as the Lytton 400ML/d option.
Intake/outfall	Tunnelled or sea bed construction is applicable to this site. All intakes are located west of Mud Island. 100ML/d outfall is to be on the quayside of Fisherman Island, west of the desalination site. 400ML/d outfall also to be west of Mud Island.

## 5.7 North Stradbroke Island

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Site E is a 24ha portion situated in the centre of a 1,970ha lot (described as Lot 1 on USL32114) situated in the middle of North Stradbroke Island. The lot is currently used for sand mining purposes, although the sand mining is restricted to a small area of the lot at any one time. The majority of land on North Stradbroke Island is under a mining lease. It is understood there is significant community interest in returning the land to its natural state to add to the state's conservation estate post-mining.

The assumed pipeline corridors associated with Site E are influenced by the topography of the site. Intake and outfall pipes are assumed to head south from the desalination plant to avoid the escarpment that separates the sand dunes and Ramsar wetlands (18 Mile Swamp) of North Stradbroke Island, and then east to the ocean. These must be tunnelled to avoid the environmentally sensitive 18 Mile Swamp. The intake and outfall structures are located within the Marine Park National Park Zone which restricts coastal development.

The network connection corridor has been assumed to reach Russell Island along the same infrastructure corridor as that used by Redland City Council to extract water from 18 Mile Swamp, and then travel south to cross the Broadwater at the narrowest point, continuing on the mainland to the reservoir at Stapylton, a distance of approximately 37 km. For a 400 ML/d desalination plant, the assumed corridor continues from Stapylton along the Southern Regional Water Pipeline to Cameron's Hill, an additional 95 km of pipe. Ramsar wetlands areas will be affected by construction of network pipeline further complicating the approvals processes which could be costly or time-consuming.

Corridors for connecting infrastructure, particularly those on Russell Island which are occupied by existing utilities, are known to be highly constrained and it is acknowledged that further detailed planning would be required to address those issues.

## 5.7.1 Flora and Fauna Summary

Aspect	Feature
Vegetation	<p>Vegetation in the vicinity of the site has 'essential habitat' status which will require a referral to DERM should clearing be required.</p> <p>Site – The site has been mined in recent history and contains regrowth native vegetation that has been planted as part of the mine's rehabilitation program. The regrowth vegetation on the subject site is approximately five years old. Potential that vegetation may be near remnant when construction is required.</p> <p>Pipeline – may necessitate clearing areas of remnant vegetation, requiring assessment under the Vegetation Management Act.</p>
Wetlands	<p>Wetlands represented on North Stradbroke Island include intertidal, lagoon, swamp, lake and streamline systems, the most significant being 18 Mile Swamp on the east coast.</p> <p>The area of remnant vegetation surrounding the site has been indicated as a referable wetland under Integrated Planning Act (IPA) 1997. The siting of the plant is likely to require a 100m buffer. The majority of North Stradbroke Island and Moreton Bay is also mapped as Ramsar wetlands.</p> <p>Pipelines – may traverse Ramsar wetlands to the east and west of site. Any interference would require referral to Commonwealth under the EPBC Act.</p>
Terrestrial and aquatic fauna	<p>Area surrounding the subject site is mapped as essential habitat as is Russell Island. These areas will be affected by pipelines.</p>
Marine ecosystems	<p>The ocean off the east coast of North Stradbroke Island has been indicated as 'Habitat Protection Zone' and 'Marine national park zone' within the Moreton Bay Marine Park Zoning Plan.</p> <p>The assumed network connection alignment crosses 'Conservation Zone' and 'Habitat Protection Zone' (under the <i>Marine Park (Moreton Bay) Zoning Plan, 2008</i>) on the waterway crossing to the mainland.</p>

## 5.7.2 Legislative and Planning Summary

Aspect	Feature
Planning context	<p>Planning and development issues:</p> <ul style="list-style-type: none"> <li>• conflict with the planning scheme, as the intent for the area is for conservation purposes;</li> <li>• can only occur with the approval of the mining lease holder;</li> <li>• conflict with the Marine Park (Moreton Bay) Zoning Plan, 2008 as <ul style="list-style-type: none"> <li>○ the intake/outfall likely to traverse the Marine National Park Zone in which coastal development is not permitted, and</li> <li>○ the network connection is likely to traverse the Conservation Park Zone associated with Canaipa Passage to Russell Island. The recommended tunnelled construction will avoid impacts on this conservation zone.</li> </ul> </li> <li>• a desalination plant is code assessable in the Conservation Zone;</li> <li>• a Water Supply Catchment exists to the east of the site in 18 Mile Swamp.</li> </ul>

## 5.7.3 Cultural Heritage and Native Title Summary

Aspect	Feature
Cultural heritage	Aboriginal Cultural Heritage Register - plant footprint does not affect any items of aboriginal significance, but corridors for the inlet and outfall are in the vicinity of several items.
Native Title	Site – State owned land. A registered Native Title claim is relevant to the site. Pipelines – assumed corridor is subjected to four existing registered Native title claims.

## 5.7.4 Preliminary Engineering Summary

Aspect	Feature
Geotechnics	Ground conditions on site are unstable and unconsolidated due to mining activities and will require significant ground stabilisation works prior to construction. The topology is undulating and will require levelling prior to construction. Ground investigations and access to good mining records would significantly assist in characterising and mitigating the risk associated with constructing on this site and creating a tunnel shaft and tunnelling under 18 Mile Swamp.
Access	Site – isolated from mainland making access difficult and is expected to result in additional costs for material, plant and labour transport and delays due to the water crossing. New purpose-built jetty structure considered likely to be required to receive, moor and launch barges for materials, plant and labour across to the site for construction, to remove sand excavation and spoil from the site and tunnels. Assumed that a receiver jetty would be built at the Port of Brisbane.
Intake/outfall	Tunnelling considered only feasible design option. Trenched and sea bed laid option not considered feasible due to environmental and construction barriers between site and beach.
Network connection	Stapylton Break Tank, 32 km from the desalination plant site nominated as connection node for 100ML/d. Cameron's Hill Reservoir, 66 km from Stapylton Break Tank nominated by QWC as connection node for 400ML/d option. Crossing of the broadwater to the mainland needs to be carefully managed.
Power	The connection of power from the feeder on Russell Island is problematic and will require detailed design which may increase the cost of this site significantly.

## 5.8 South Stradbroke Island

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Site F (described as Lot 17 on WD2688 and Lot 18 on WD1474) is situated in the middle of South Stradbroke Island. The site is covered in high quality remnant vegetation, essential habitat and Ramsar wetlands. The majority of land outside of the subject site is Conservation Park and there is significant community interest in adding the subject site to the existing Conservation Park. It would be extremely difficult to ameliorate the impact on some common and unique species, with significant populations on South Stradbroke Island. Offsets on the mainland are unlikely to satisfy the immediate needs of some of the less vagile significant species present on the island as they do not have the opportunity to migrate to other areas.

Access to the site is limited and consists of boat access to Couran Cove and informal sand tracks to the site.

The intake and outfall pipelines would need to cross areas of remnant vegetation and National Park to reach the coast, over a distance of 1 km. Both tunnelling and trenched with sea bed laid construction are considered feasible.

The product water alignment between the plant and water supply network for this study is approximately 21 km (100 ML/d option) or 85 km (400 ML/d option). The alignment must cross the Broadwater and Southern Moreton Bay Islands, and skirt or cross the Coomera wetlands. It is assumed to follow an existing pipeline to Stapylton.

## 5.8.1 Flora and Fauna Summary

Aspect	Feature
Vegetation	<p>The site has never been developed and as such is covered in high quality 'not of concern' remnant vegetation that can be described as coastal woodlands, wetlands and dunal complex.</p> <p>Site and Pipeline- will necessitate clearing remnant vegetation requiring assessment under Vegetation Management Act 1999.</p>
Wetlands	<p>Site- a referable wetland, surrounded by remnant vegetation indicated as conservation estate. A 100m buffer will be required. South Stradbroke Island and Moreton Bay are also within the Directory of Important Wetlands and recognised as Ramsar wetlands.</p> <p>Site and Pipeline- may necessitate removal of vegetation within Ramsar wetland areas. Any interference will to require a referral to Commonwealth under EPBC Act.</p>
Marine plants	Mangroves are likely on or near the site and are considered to be protected marine plants.
Terrestrial and aquatic fauna	<p>The two major habitat types provided by the subject site are palustrine wetlands and coastal forest. Estuarine wetlands are present immediately west of the subject site. These habitats are connected to contiguous remnant vegetation and support significant fauna species.</p> <p>The subject site is recognised as essential habitat for three threatened species of frog.</p> <p>17 migratory wetland species are considered to utilise site. There is a significant roosting site on the island.</p>
Wildlife corridors	South Stradbroke Island is part of a large core habitat area that serves endemic species and migratory species. The habitat of South Stradbroke Island is connected to the mainland through the Southern Moreton Bay Islands.
Marine ecosystems	<p>The ocean off the east coast of South Stradbroke Island has been indicated as 'Marine National Park Zone' within the Marine Park (Moreton Bay) Zoning Plan, 2008.</p> <p>Fauna surveys conducted in 2006 noted that the southern beaches of South Stradbroke Island were utilised as nesting sites for the Loggerhead Turtle and the Green Turtle.</p>

5.8.2 Legislative and Planning Summary

Aspect	Feature
Planning context	<ul style="list-style-type: none"> <li>• Within the conservation precinct on the South Stradbroke Island Local Area Plan.</li> </ul> <p>Conflicts with the planning scheme, as the intent for the area is for conservation purposes;</p> <p>Conflicts with Council/EPA's intention to acquire sites for nature conservation purposes. Site F is identified within the South Stradbroke Island Management Area, parts of which have been amalgamated into the South Stradbroke Island Conservation Park as identified by Schedule 3 of the <i>Nature Conservation (Protected Areas) Regulation 1994</i>; and,</p> <p>Conflicts with the <i>Marine Park (Moreton Bay) Zoning Plan, 2008</i> as the intake/outfall infrastructure traverses the Marine National Park Zone in which coastal development is not permitted.</p>

5.8.3 Cultural Heritage and Native Title Summary

Aspect	Feature
Cultural heritage	Items of Aboriginal cultural heritage significance have been located in the region. Items were observed during the site inspection.
Native Title	Constrained by two existing registered Native Title claims.

## 5.8.4 Preliminary Engineering Summary

Aspect	Feature
Geotechnics	Site- unconsolidated sands which would be susceptible to settlement upon loading. (degree apparent only with geotechnical testing).
Access	<p>Site – isolated from mainland with similar access issues as North Stradbroke Island. Island site expected to experience additional costs for material and labour transport and delays due to the water crossing. Logistics of maintenance and operation throughout the design life of the structure will be subject to similar issues. Emergency access also via the water crossing.</p> <p>New purpose-built jetty structure considered likely to be required to receive, moor and launch barges for materials, plant and labour across to the site for construction, to remove sand excavation and spoil from the site and tunnels. Assumed that a purpose built jetty would be built on the Island.</p>
Power	<p>No power supply exists on South Stradbroke Island and any connection carries high cost risk.</p> <p>New connection into and upgrade to Coomera substation identified by Energex for 100ML/d option, connection and upgrade to Yatala substation required for 400ML/d option.</p>
Intake/outfall	<p>Tunnelling or Sea Bed Laid.</p> <p>Intake and Outfall conflicts with <i>Marine Park (Moreton Bay) Zoning Plan, 2008</i>.</p>
Network connection	<p>Stapylton Break Tank, 23 km from the desalination plant site nominated by as connection node for 100ML/d. Cameron's Hill Reservoir, 66 km from Stapylton Break Tank nominated as connection node for supply for 400ML/d option.</p>

## 5.9 Tugun

The existing desalination plant at Tugun near the Gold Coast (described as Lot 30 on SP197355) is situated immediately west of the northern end of the Gold Coast Airport runway 14-32 and is bounded by Gold Coast City Council (GCCC) owned property. The desalination plant has a rated capacity of 135ML/d.

The opportunity exists to expand this to meet future demand requirements by augmenting an additional 45ML/d, by duplication (135ML/d augmentation- to a total of 270ML/d) or triplication (270ML/d augmentation- to a total of 405ML/d) of the existing desalination facility. The WaterSecure report *Gold Coast Desalination Facility- 45, 135 and 270 ML/d expansion study*, 19 February 2009, forms the basis of assessment of these expansion opportunities. The information in sections 5.9.1 to 5.9.2 has been taken directly from the WaterSecure multi criteria analysis, contained within the *Gold Coast Desalination Facility* report. Unless otherwise stated, the impacts are relevant to both duplication and triplication.

Expansion is expected to require use of part of Lot 31 on SP 197355, adjacent to the existing desalination plant site. Lot 30 was previously used as a landfill which has been remediated. Lot 31 is an operational landfill for some time into the future. The land required for desalination expansion is currently included in the GCCC masterplan for use as regional sporting complex. Alternative land will be required for its relocation.

For both augmentation options, the following apply:

- extensive new marine works (both on intake and outfall pipelines);
- extensive network integration works; and,
- two new potable water storage tanks are required to be constructed on site or remote from site.,

Impacts on flora and fauna are reported to be minimal and all expansion options avoid sensitive areas. There are some minor impacts on the local community reported.

### 5.9.1 Flora and Fauna Summary

Aspect	Feature
Terrestrial and Intertidal Environment	Both augmentation options will result in a very low impact on: <ul style="list-style-type: none"> <li>• protected areas; and</li> <li>• essential Habitat.</li> </ul>

## 5.9.1 Legislative and Planning Summary

Aspect	Feature
Tenure	<p>Land related issues that have potential to affect securing the site for use as a desalination plant include:</p> <ul style="list-style-type: none"> <li>Queensland Rail has identified the need for a rail corridor on part of Lot 31;</li> <li>GCCC has identified the need for some of the land for a regional sporting complex; and,</li> <li>Energex has identified the need for development of a high voltage power easement in Lot 30 and/or Lot 31.</li> </ul> <p>Land required for desalination expansion is currently included in the GCCC masterplan for use as regional sporting complex. Alternative land will be required for its relocation. Local community resistance to an expanded regional facility may arise. GCCC have indicated in consultation that significant changes to local planning initiatives will result and have expressed concern about the ability to meet long term sport and recreation requirements for the area if the triplication proceeds. Council have requested that future masterplanning involve a range of State agencies with coordination by QWC.</p>
Planning context	<p>The Gold Coast Airport may impact expansion potential as Lot 31 is beneath the OLS. The existing desalination facility complies with the OLS.</p> <p>The Gold Coast Airport Master Plan<sup>1</sup> is reported to have no increased constraints on Lots 30 and 31.</p>

## 5.9.2 Preliminary Engineering Summary

Aspect	Feature
Geotechnics	There is an unknown quantity of landfill on Lot 31. A suitable engineering solution will be required if the land is to be used for the desalination expansion.
RO Plant	The 400ML/d plant will be closer to residents than the existing plant, with visual and noise impacts.
Intake Water Quality	Current operations indicated that feed water is of suitable quality for the desalination process.
Intake/outfall	<p>The existing intake tunnel is incapable of the increased duty requirement without modification.</p> <p>For both options, a new intake tunnel of approximately nominal 4m diameter is required. This would allow the existing inlet tunnel to be reverse directed to discharge. Brine discharge would be via both of the existing inlet/outfall pipelines.</p>
Network connection	<p>Two additional reservoirs (on, or close to, site), and bulk water storage reservoirs within the reticulation network would be required for both options.</p> <p>Duplication of the Southern Regional Water Pipeline would be required to deliver treated water to the grid in the medium term, as the current network connection does not have sufficient additional capacity to do so.</p>

<sup>1</sup> [www.goldcoastairport.com.au/pd/Master\\_Plan\\_2006.pdf](http://www.goldcoastairport.com.au/pd/Master_Plan_2006.pdf)

## 6 Site Scoring

The Phase 2 studies investigated the proposed sites in sufficient detail to enable multi-criteria analysis (MCA) of non-cost aspects, as well as costing and financial analysis for each site (the basis for calculations of estimates and non-cost scores is provided in the appendices).

MCA is a method to enable comparison of sites. In practice, reference to the MCA results is not required where the categorisation framework (refer Section 7.1) identifies clear differentiation between the sites. However this process can be used to separate sites within a sub-region between which there is no clear differentiation under the framework.

The methodology underpinning the scores used to compare sites in such instances is outlined below. The scores themselves are presented within the overall categorisation where relevant (refer Section 7).

### 6.1 Scoring Methodology

A methodology was developed which was designed to incorporate investigations of the options under investigation which could be used to directly compare sites.

The Value for Money (VfM) approach was adopted. The approach is beneficial in any situation, but only practical when reasonably reliable estimates of the total cost and an assessment of the non-cost impacts can be made.

Key aspects of the methodology developed are:

- a multi-criteria approach to assess non-cost (environment/social) advantages and disadvantages of each site (Discussed in full detail in Appendix F);
- cost estimates expressed as a present value of all capital and operating costs, as the best measure of the technical advantages and disadvantages of each site. Qualitative scoring for technical aspects was considered, but would have been a regressive step applying less rigour in balancing technical aspects against each other than is achieved with a well-founded cost estimate (Discussed in full detail in Appendix D); and,
- combining these two aspects into a single metric that assesses value for money and provides a basis for comparing trade-offs in cost and non-cost aspects at each site. A simple VfM approach is to divide each option's non-cost score by its cost, and select the option with the highest score per dollar of cost. This is referred to as a cost-effectiveness ratio.

### 6.2 Scoring Assessments

#### 6.2.1 Intake / Outfall Type

The intake/outfall construction methodology is a key factor which affects both cost and non cost scores. For some sites the only practical option is to tunnel the intake and/or outfall pipelines e.g. Site B – Kawana, where there is a dense residential strip between the site and ocean; and Site E – North Stradbroke, where a wetland poses a construction and environmental barrier between the site and beach. For all other sites, where approving authorities will need to be satisfied that environmental impacts are acceptable and manageable, a trenched and sea bed laid pipe option is technically reasonable which offers a lower cost alternative than tunnelling.

Site summaries indicate where trenching methods are considered viable. In such cases, for the purposes of comparison, both trenching and tunnelling options are considered.

#### 6.2.2 Network Connection

The assumed network connection details have a significant impact on the scores calculated, and have the potential to differ very significantly, depending on the final details of both the design as well as the scenario in which the plant is required.

The most extreme variation in scoring results from exclusion of the network connection. This conservatively approximates, for example, where the required supply is local to the plant site, or where the future development of the Water Grid and implementation scenario means that there is an existing ability to transfer water from the desalination plant to the demand with only minimal connection works.

To make the implication of this variable clear, both scenarios have been included in calculation of all scores. Almost all network planning, design and optimisation variants should fall within the envelope of these two scenarios.

It is not anticipated that the network could be largely avoided when crossing from the mainland to island sites, and so the scores calculated for the island sites include the cost and non-cost impacts of the network required to connect from the mainland to the islands and network within the islands themselves.

#### 6.2.3 Cost Estimate

The costs generated are based on assumptions listed in Section 5 and have an expected accuracy of +30%, which could be considered equivalent to the P90 risk adjusted estimate (i.e. Risk adjusted estimate with 90% probability of occurring) that is typically used for budget purposes. Costs are detailed in Appendix C, and have been combined with MCA scores to result in ranked sites used in recommendations, Section 7.

## 7 Recommendations for Site Categorisation

### 7.1 Categorisation Framework

The framework advised by QWC for the categorisation of sites as Priority, Reserved or Excluded is outlined in Figure 1. Key elements of this framework are explained in Section 7.2.

#### Reserve sites

- Recommend sites to be reserved with a combined capacity in excess of 1000 ML/d.

The reservation of sites should take into account the full range of issues considered as part of the Phase 2 investigations, including environmental impacts, consistency with adjoining land uses, technical feasibility and cost.

- Recommend at least two sites to be reserved in each of the North, Central and South sub-regions.

#### Priority sites

- Recommend two priority sites for detailed investigation. The sites should be:
  - located in different sub-regions;
  - suitable for development as part of the response to a drought occurring anytime within the next 10 years; and,
  - practical for the construction of a 100 ML/d facility within a three year period, having completed an appropriate amount of preparatory work.
- The identification of the preferred sites should take into account the cost of constructing and operating the connecting pipelines during the drought and in normal conditions, as well as the cost of constructing the plant.
- The assessment of priority sites should be based on current technologies and the current and committed scope of the SEQ Water Grid.

#### Excluded sites

- In each region, those sites additional to the requirements (listed above) maybe excluded from further consideration. This decision should be made on the basis of an assessment of the costs and benefits of reserving the site.

Costs include the alternative existing or potential use of the site, taking into account community impacts such as loss of public open space.

Benefits include the additional redundancy provided by the reservation of the site, given potential capacity of other sites in that sub-region and the feasibility of the constructing a desalination facility on the site.

This analysis should be carried out on the basis of the site analysis and cost estimates, as well as sub-regional water balance projections.

**Figure 1: Site Categorisation Framework**

## 7.2 Rationale for the Categorisation Framework

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As described in Section 2.3, the regional requirement is for additional climate resilient water supply.

### 7.2.1 Spare sites

Given that work so far has been of a preliminary nature, and approvals are yet to be sought for any further desalination plants, it is prudent to retain options. An example could be if a current preferred site is less favourable in light of new information or as the region grows and changes shape. All sites would be subject to a detailed assessment to the level of an environmental impact statement. It is possible that while a site is preferred based on the Phase 2 Studies, it may be discounted on this more detailed level of assessment meaning it is important to maintain alternatives.

Further differentiation between multiple sites within a sub-region could be provided as additional, detailed investigations are undertaken, i.e. geotechnical studies on the routes for seawater tunnels. Further, changes over time such as available technology, may change preferences between sites.

Beyond the approval and preliminary engineering phases, QWC expects that there will be a point at which sites are proven to be viable. At this point, other reserved sites which are above and beyond the regional requirement may be released for alternative uses.

Whilst there is a potential to reserve more than a single alternative site in each sub-region, there are implications to consider if this were to be pursued. In some cases the costs of preservation in terms of lost opportunities for other development and community uncertainty as to the future of the area will override the benefit of preserving a site. This balance must be considered when determining whether any site is reserved, if it is not a preferred alternative.

### 7.2.2 Priority versus Reserved Sites

Priority sites are a subset of the reserved sites. The priority sites are intended to be available for a drought response to be delivered within a three year period. Two sites, each in different sub-regions, should be nominated as priority sites for further detailed investigation. Retaining two priority sites provides redundancy in the options available. Given that the implementation of a drought response plan relies on certainty of a climate resilient supply being brought on line in a given timeframe, there is a significant risk in committing to a single site at a desktop stage of investigation, despite recommendations that the site appears to be the most suitable at this stage. Knowledge gaps around each site could result in significant constraints that might affect or prevent successful (especially timely) implementation of the drought response plan. Nomination of priority sites in different sub-regions helps to reduce the risk that two sites will be subject to the same major constraint (for example, a limitation on discharge into Moreton Bay).

In determining priority sites to be incorporated into the drought response plan, different drivers will come into play.

The priority site will likely need to contribute to meeting demand in the greater Brisbane region, as the Wivenhoe Somerset system provides most of the contingency volume for the region and it is expected that this will be significantly depleted if the response plan is triggered. Selection of the priority site will therefore take into consideration the potential for the network to transport this new source to the major demand nodes in Brisbane. The cost of these network components will then be a consideration in nominating the priority site.

Costs associated with developing the plant at a given site based on the current state of knowledge on available technology and the sites features, should also be taken into consideration. Based on a range of issues, outlined below, costs will be refined significantly as part of Phase 3 -

- the location of inlet and outlet pipes;

- the preferred route of the connection to the SEQ Water Grid, including environment issues and costs;
- required upgrades to existing network infrastructure; and,
- emerging technology.

It is also acknowledged that expected costs will change over time, with changes to technology, the development the SEQ Water Grid, and demographic and demand changes in the region.

### 7.3 Recommended Categorisation

The framework set out and explained in the preceding sections combines regional and sub-regional drivers for categorisation of the sites.

The primary driver at a regional scale is identification of two priority sites to be adopted within the drought response plan, each in a different sub-region for flexibility.

Given this underlying motivation, it is recommended that the two priority sites be identified in the North and Central sub-regions, as the South sub-region is already served by a climate resilient supply in the form of the Gold Coast Desalination Facility at Tugun.

Table 5 and Table 6 show the cost effectiveness build up from MCA and NPV for all options excluding contingency which does not impact the sites' rankings. Sites are arranged from north to south, by sub-region.

**Table 5 Cost Effectiveness 100ML/d**

		MCA		NPV (without contingency) (\$billion)		Scores (cost effectiveness)	
		With network	Without network	With network	Without network	With network connection	Without network connection
Northern	A. Marcoola Sea Bed	3.58	4.11	\$1.76	\$1.15	2.03	3.58
	A2. Marcoola Tunnelled	4.27	4.65	\$2.07	\$1.46	2.06	3.13
	B. Kawana Tunnelled	4.42	4.55	\$1.99	\$1.48	2.22	3.08
	C. Bribie Island Sea Bed	3.28	3.99	\$1.79	\$1.52	1.83	2.62
	C2. Bribie Island Tunnelled	4.13	4.41	\$2.08	\$1.81	1.99	2.44
Central	D. Lytton Sea Bed	4.83	4.87	\$1.31	\$1.20	3.69	4.06
	D. Lytton Tunnelled	4.83	4.87	\$1.69	\$1.58	2.86	3.09
	G. BAC Tunnelled	4.78	4.78	\$1.99	\$1.83	2.40	2.60
	H. Fisherman Islands Sea Bed	4.90	4.94	\$1.31	\$1.14	3.74	4.33
	H. Fisherman Islands Tunnelled	4.90	4.94	\$1.61	\$1.44	3.04	3.42
Southern	E. North Stradbroke Tunnelled	3.41	4.26	\$2.16	\$1.99	1.58	2.14
	F. South Stradbroke Sea Bed	2.47	3.01	\$1.65	\$1.47	1.50	2.04
	F2. South Stradbroke Tunnelled	3.29	4.13	\$1.88	\$1.71	1.74	2.41
	I. Tugun Tunnelled		4.64		\$1.31		3.55

**Table 6 Cost Effectiveness 400ML/d**

	MCA		NPV (without contingency) (\$billion)		Scores (cost effectiveness)		
	With network	Without network	With network	Without network	With network connection,	Without network connection,	
Northern	A. Marcoola Sea Bed	3.54	4.08	\$5.69	\$4.12	0.62	0.99
	A2. Marcoola Tunnelled	4.23	4.62	\$6.02	\$4.45	0.70	1.04
	B. Kawana Tunnelled	4.09	4.37	\$5.79	\$4.56	0.71	0.96
	C. Bribie Island Sea Bed	3.25	3.95	\$5.71	\$5.07	0.57	0.78
	C2. Bribie Island Tunnelled	4.10	4.38	\$6.02	\$5.38	0.68	0.81
Central	D. Lytton Sea Bed	4.73	4.87	\$5.67	\$4.77	0.83	1.02
	D. Lytton Tunnelled	4.73	4.87	\$6.16	\$5.25	0.77	0.93
	G. BAC Tunnelled	4.64	4.78	\$5.98	\$4.95	0.78	0.97
	H. Fisherman Islands Sea Bed	4.80	4.94	\$5.34	\$4.29	0.90	1.15
	H. Fisherman Islands Tunnelled	4.80	4.94	\$5.80	\$4.75	0.83	1.04
Southern	E. North Stradbroke Tunnelled	2.98	4.26	\$6.92	\$5.74	0.43	0.74
	F. South Stradbroke Sea Bed	1.62	2.40	\$6.22	\$5.03	0.26	0.48
	F2. South Stradbroke Tunnelled	2.86	3.49	\$6.47	\$5.29	0.44	0.66
	I. Tugun Tunnelled		4.49		\$4.27		1.05

### 7.3.1 North Sub-region

For the North sub-region, the recommendations should therefore:

- identify at least two sites to be preserved (i.e. categorised as “priority” or “reserved”);
- identify a “priority” site; and,
- exclude a site, unless the incremental benefit of the additional redundancy provided by the reservation of the site can be justified on a holistic assessment of the benefits and costs.

The North sub-region contains the Marcoola, Kawana and Bribie Island sites. The study investigations and subsequent consultation with Councils revealed no fatal flaws for the development of each of the sites from a technical perspective, given time to plan for implementation.

The study investigations revealed key constraints for the Kawana site as essential habitat on site and three separate documents directing use of the site for sport and recreation. Environmentally the site contains endangered Regional Ecosystems, 17.4 ha of which would require clearing with the 400ML/d option. Any clearing of such vegetation will need to be offset by vegetation of equal quality. Furthermore, the site is constrained by a development agreement attached to the site restricting its use to sport and recreation.

The Kawana site scores as well as the other sites without the inclusion of network connection, but worse than all other sites with the network connection. Beyond the scores and the water supply considerations outlined above, the existing development agreement on the site and potential risks with construction on former landfills are noted, and would be

frustrated if the site were to be preserved. On balance therefore, as long as sufficient total capacity potential is able to be preserved on sites across the region, the site will be recommended for 'Excluded' categorisation.

Both the Marcoola and Bribie Island sites should be preserved. Both are feasible and have advantages and disadvantages when considered in a drought response context. The Bribie Island site is not on the mainland and some program and construction risks are therefore heightened, which is a disadvantage for certainty of rapid deployment in a drought. Conversely, the Bribie Island site is much closer to Brisbane, and the drought mode supply gap is expected to be most pronounced in the central sub-region at 2026, moving to the south sub-region by 2056 due to projected population growth (refer Section 2.4). Not only does that suggest some efficiency in cost and other terms, but it also reduces the risks associated with a long network connection.

The categorisation of sites in this region is therefore usefully informed by the site scoring for the sites which are not excluded (refer Section 5 for details of the methodology).

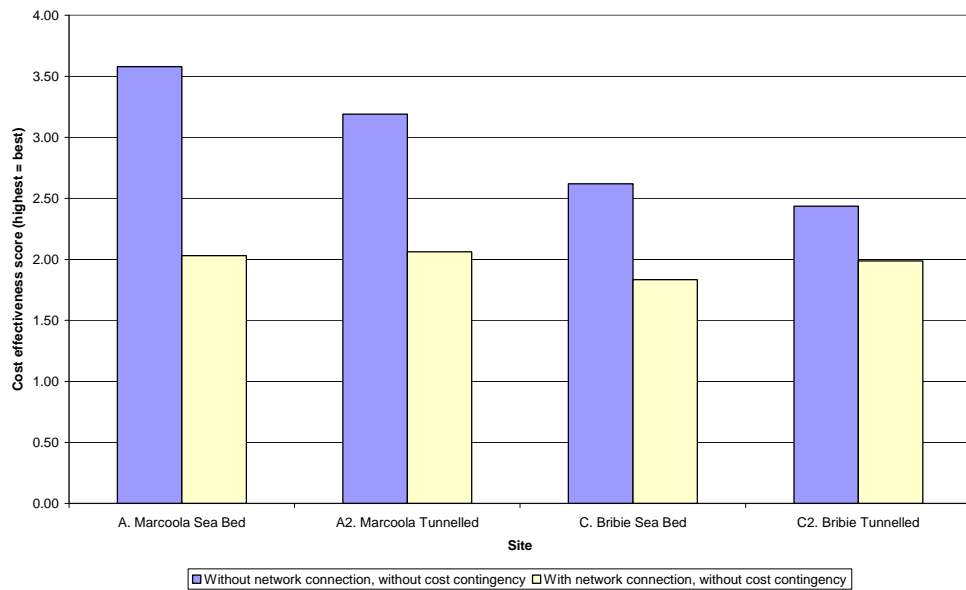


Figure 2 Site cost effectiveness – North sub-region, 100 ML/d production capacity

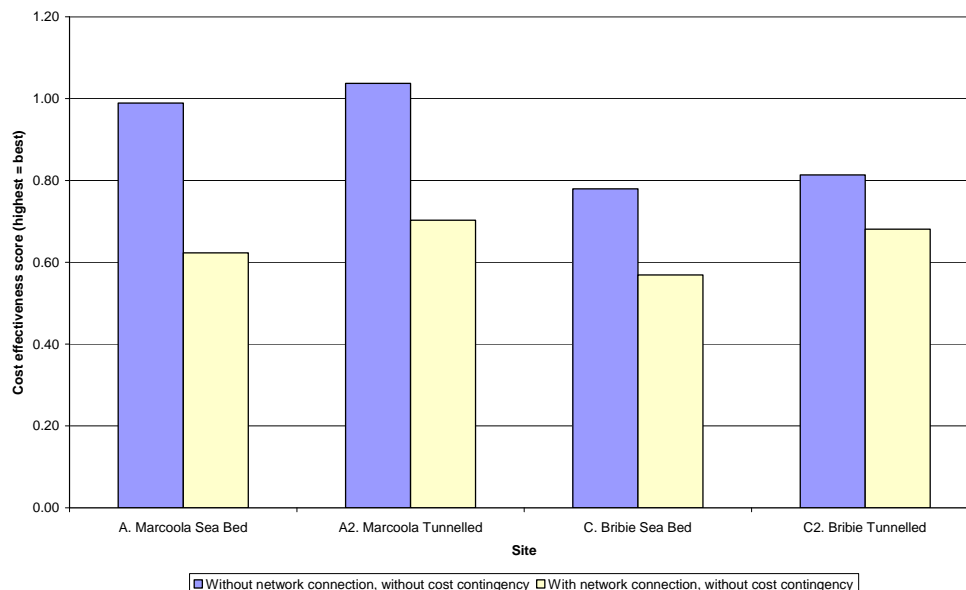


Figure 3: Site cost effectiveness – North sub-region, 400 ML/d production capacity

Figure 2 shows the site cost effectiveness scores for a number of different input parameters, for production of 100 ML/d desalinated supply at the North sub-region sites. As per Section 6, the assumed intake/outfall construction technique and the network connection have significant effect on the calculations of cost and non-cost impact, and therefore on the site scores). Figure 3 shows the site cost effectiveness scores for production of 400 ML/d. In all figures, higher scores indicate greater cost effectiveness (better value for money).

The figures show scores for the Marcoola and Bribie Island sites that are broadly similar (in the context of the range of scores across all sites).

The cost effectiveness scores for the Marcoola and Bribie Island sites are almost identical when the network connections required to deliver water to the QWC-nominated nodes near Brisbane are included, for both 100 ML/d and 400 ML/d scenarios. However, the cost effectiveness scores for Marcoola are significantly better than for Bribie Island if the network connections are excluded (i.e. when the scores are limited to the inherent merits of the sites themselves). There are a range of reasons for this, but the marine context for the Bribie Island site is an important factor. Whilst the scores including the network connection are expected to be most relevant in a drought response scenario, the reality will be subject to the particular circumstances that arise and evolve over time, and might be significantly affected by a wide range of factors including the future possibility that the NPI might have spare capacity to transfer water (e.g. depending on the particular drought scenario, future development of the Water Grid, variations from the projected demography).

According to the MCA scores (refer to Appendix F), Marcoola scores marginally better than Bribie Island for both supply options and both construction methods (tunnelling and sea bed laid). Both Bribie Island and Marcoola require crossing of environmentally sensitive national parks with the network connection pipeline, which would need to be either tunnelled or managed in accordance with the Nature Conservation Act 1992 or as stated under any management plan for the areas in question. Both sites have nearby mapped Fish habitats which will require permits from the Department of Primary Industry and Fisheries. Note that the environmental impact of pumping over long distances was not incorporated into the MCA but that assumed costs of carbon were incorporated in the financial analysis (commencing 2012, refer Appendix D).

The waterway to the south of the Marcoola site is considered a 'referable wetland', while the Bribie Island site is surrounded by Ramsar wetlands which would be impacted by both intake and outfall pipelines (if trenching) and network integration pipeline, requiring referral to the Department of Environment, Water, Heritage and the Arts (DEWHA). Bribie Island's network connection corridor must also traverse Pumicestone Passage to the mainland which impacts conservation zone under the Marine Parks (Moreton Bay) Zoning Plan, 2008, within which development is highly restricted. Bribie Island's outfall is within Moreton Bay as opposed to Marcoola's and while it is not impacted by the current zoning, future revisions of the plan may indicate the area is more sensitive than is currently mapped.

At the current level of knowledge and assessment, the recommendation in favour of Marcoola or Bribie Island is not clear cut.

Insurmountable obstacles have not been established for either site. Bribie Island's geographic position, in particular its proximity to the forecast supply gaps suggest that it may be the best long-term strategic and lowest cost choice. However, suitability as a drought response is a major factor for site categorisation and this consideration has determined the following recommendation.

A specific definition of QWC's required characteristics and performance for a drought response project has not yet been defined, but the ability to deliver within a 3 year program provides a broad characterisation of the requirement. Risks associated with the Bribie Island site include approvals (including the level of investigation, scrutiny and challenge), increased marine works requirements, and access and weather-related delays. There are

significant risks for the Marcoola site as well, including the increased length of pipeline that may need to be constructed within the drought response period. However, unless QWC is able to obtain and hold valid all State and Commonwealth approvals in advance of the occurrence of any drought, the combination of the risks for Bribie Island make that site significantly less desirable than Marcoola as a Priority site, on our current level of knowledge and assessment.

It is therefore recommended that the Marcoola is categorised as Priority (and Bribie Island categorised as Reserved), based in particular on the current understanding of their relative risks in a drought response scenario.

Noting that this recommendation may not align with the best long-term strategic or lowest cost choice, it is recommended that this categorisation be taken forward with the provision that QWC undertake a more detailed assessment of the risks and risk-costs due to environmental approval and construction issues for development of the Bribie Island site, and that this could potentially lead to a reassessment of the categorisation.

### 7.3.2 Central Sub-region

For the Central sub-region, the recommendations should:

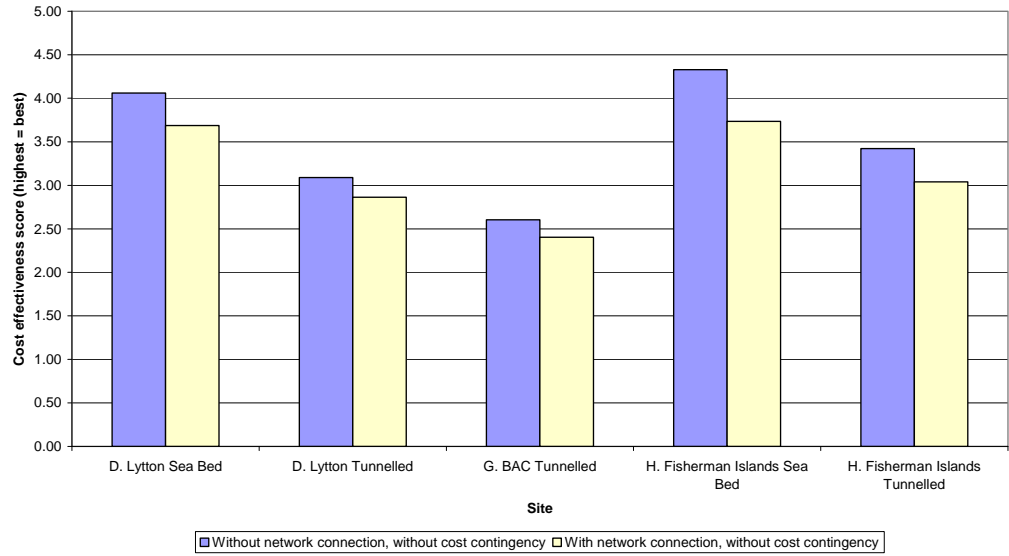
- identify at least two sites to be preserved (i.e. categorised as priority or reserved);
- identify a priority site; and,
- exclude a site, unless the incremental benefit of the additional redundancy provided by the reservation of the site can be justified on a holistic assessment of the benefits and costs.

The Central sub-region contains the Lytton, BAC and Fisherman Islands (PoBC) sites. The study investigations revealed no fatal flaws for the development of each of the sites from a technical perspective, given time to plan for implementation.

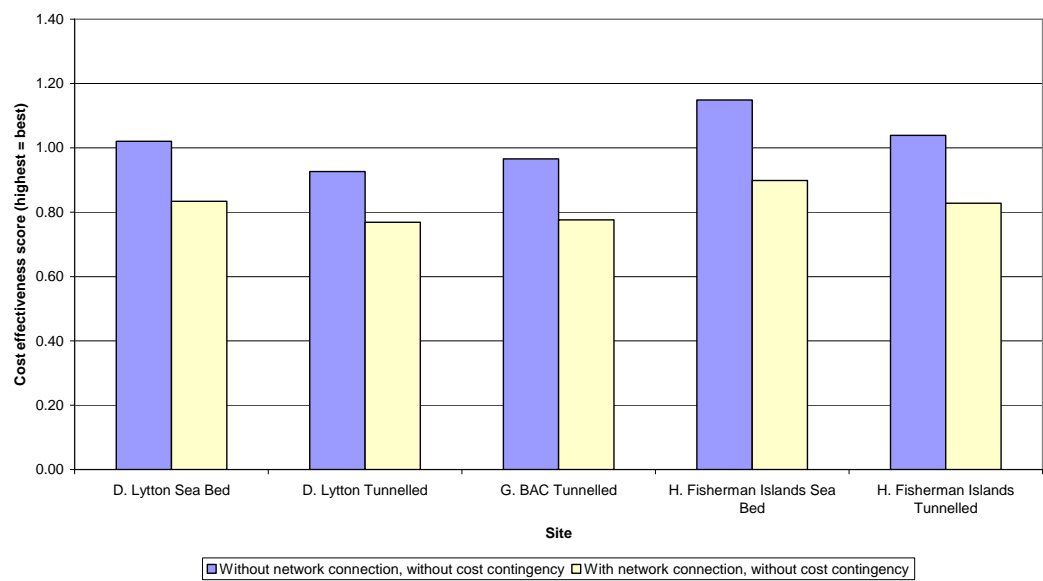
Whilst the BAC and Fisherman Islands sites have potential as alternatives to Lytton, this will depend in part on the nature of the agreements reached with the site's owners and availability of land. Currently the sites are not available for development, as well, deals would need to be negotiated and agreed for the land, and are contingent (in one case) on infrastructure modifications by third parties, neither site presents an immediately viable option should it be required. As such, the Lytton site is the only site that could meaningfully be categorised as Priority.

The BAC and Fisherman Islands sites are both on land in an industrial area, where the future terrestrial development would have a very low impact on the community at large. As such, although the general framework recommends that sites be considered for exclusion if they are beyond the requirements of prudent priority and spare site preservation, the benefits on balance outweigh the costs of categorising both sites as Reserved in this instance.

The cost effectiveness scores for the central sites are included in Figure 4 and Figure 5.



**Figure 4: Site cost effectiveness – Central sub-region, 100 ML/d production capacity**



**Figure 5: Site cost effectiveness – Central sub-region, 400 ML/d production capacity**

7.3.3 South Sub-region

For the South sub-region, the recommendations should:

- identify at least two sites to be preserved (i.e. categorised as priority or reserved);
- not identify a priority site (as the sub-region is already served by a climate resilient source); and,
- exclude a site, unless the incremental benefit of the additional redundancy provided by the reservation of the site can be justified on a holistic assessment of the benefits and costs.

The South sub-region contains the North Stradbroke Island, South Stradbroke Island and Tugun sites.

The study investigations did highlight that the South Stradbroke Island site, in particular, has very significant environmental and societal value. The plant site itself sits within a broader contiguous nature conservation area and acquisition of the site for those purposes is intended by other local and state government bodies. There is some suggestion that areas of aboriginal cultural heritage may exist on the site despite not being recorded in the heritage registers at this time. From a technical perspective, access and power supply would both be significant issues to address on this site.

The South Stradbroke Island site is therefore recommended for ‘Excluded’ status, subject to the relative merits of the other sites in the sub-region, and as long as sufficient total capacity potential is able to be preserved on sites across the region.

Figure 6 shows the site cost effectiveness scores for a number of different input parameters, for production of 100 ML/d at the South sub-region sites (as per Section 6, the assumed intake/outfall construction technique and the network connection have significant effect on the calculations of cost and non-cost impact, and therefore on the site scores). Figure 7 shows the site cost effectiveness scores for production of 400 ML/d. In all figures, higher scores indicate better cost effectiveness (better value for money).

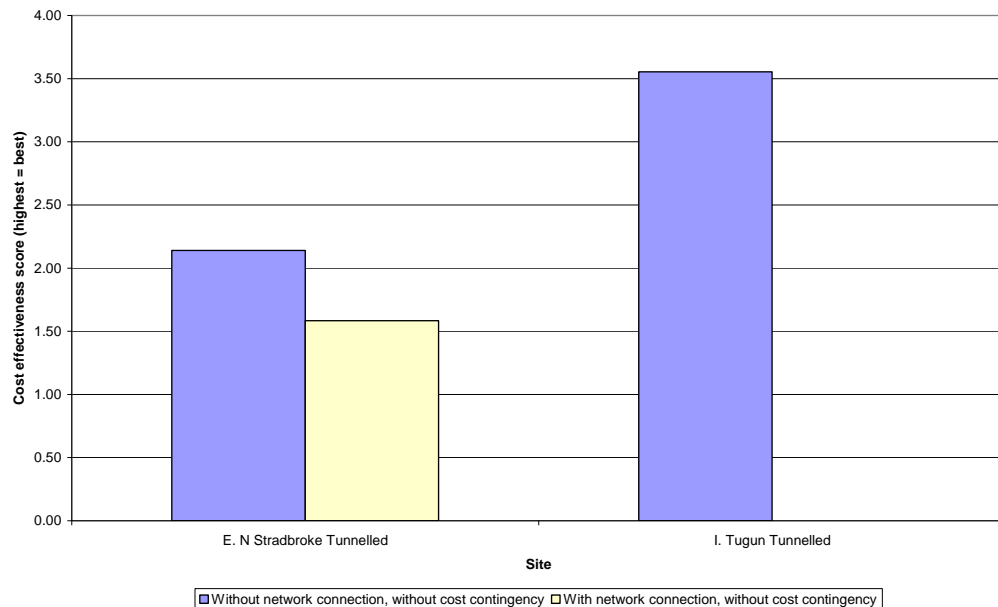
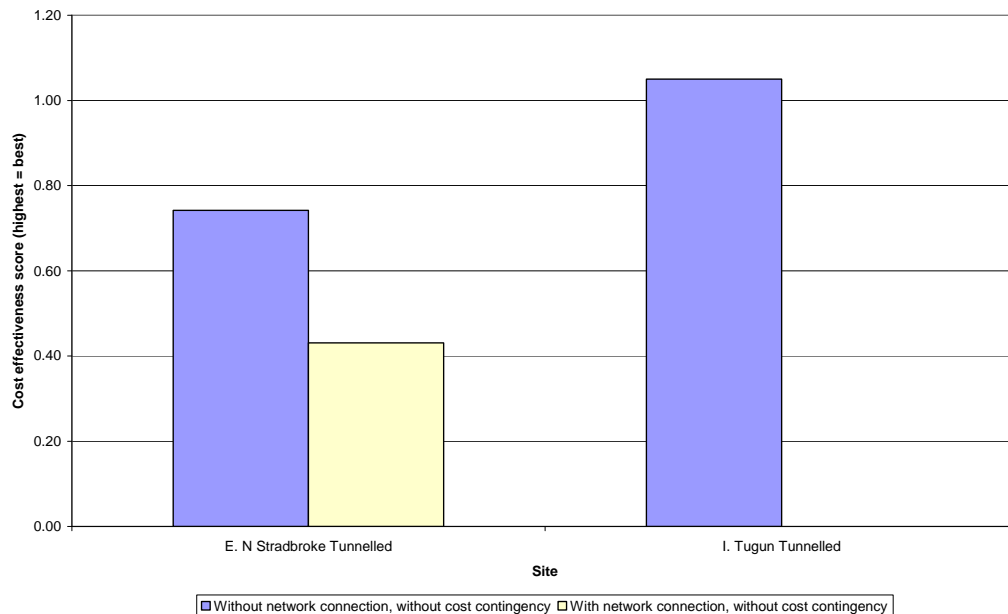


Figure 6: Site cost effectiveness – South sub-region, 100 ML/d production capacity



**Figure 7: Site cost effectiveness – South sub-region, 400 ML/d production capacity**

The North Stradbroke Island site has been preserved in keeping with the categorisation framework. Further work at this site will need to take account of the significant inherent risks of development on this site. The site and in particular the island has a high environmental value attached to it with many parts subject to current Native Title claims. Furthermore the engineering risks associated with construction on this remote and elevated site cannot be underestimated when further investigating this site.

The infrastructure already in place at the existing Tugun plant would indicate that further development of the site will be more streamlined, particularly in relation to access and power connection. Conversely, North Stradbroke Island’s power connection and access pose significant risk to construction and operations as it is remote and the power connection may be both technically difficult and costly due to the water crossing and the limited existing power infrastructure on the island. North Stradbroke Island is also more environmentally sensitive, with impacts on 18 Mile Swamp to the east of the site requiring close management, and necessitating tunnelling of the intake and outfall to avoid impacts. The site and network connection impacts Ramsar wetlands and the crossing to the mainland impacts conservation zoning under the *Marine Parks (Moreton Bay) Zoning plan, 2008*, within which development is highly restricted, hence tunnelling under the water crossing may be required, and further investigation of potential impacts highly recommended.

The Tugun site has been scored on the basis of information available from the WaterSecure report on expansion at the site. The comparison of this with the eight sites investigated by Arup is of general validity given it reflects an inherently different level of understanding of the site, and is based on information prepared by a separate party (in line with the overall methodology). It is subject to the assumptions made about non-cost impacts, and has necessarily adopted techniques for approximating the 100 ML/d and 400 ML/d data based on inputs for 135 ML/d and 270 ML/d expansions to the existing 135 ML/d plant. Based on this and the above discussion, it would appear that Tugun is a better value for money option than the North Stradbroke Island site.

#### 7.3.4 Summary Recommendations for Categorisation

The following categorisations are recommended:

- Site A (Marcoola): Priority
- Site B (Kawana): Excluded
- Site C (Bribie Island): Reserved
- Site D (Lytton): Priority
- Site E (North Stradbroke Island): Reserved
- Site F (South Stradbroke Island): Excluded
- Site G (BAC): Reserved
- Site H (Fisherman Islands): Reserved
- Site I (Tugun): Reserved

## 8 Phase Three Scope

The following summarises the recommendations from the Phase 3 scoping study that was undertaken at the end of Phase 2 and reported in Appendix H. Recommendations are provided for risk based cost estimation, engineering, environmental investigations, planning and approvals, social and community consultation and cultural heritage.

### 8.1 Scope

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Phase 3 work will:

- build on work undertaken in Phase 2 and further refining the project concepts;
- develop detailed planning and approvals pathways for procurement of sites and corridors;
- identify any early works required to ensure implementation can occur within the timelines required by the Drought Response Plan;
- complete any detailed investigations or design needed to underpin the necessary early works, including approvals; and,
- continue to review the feasibility, cost and impacts of development at the sites, and monitor any underlying changes in technology, market conditions, the environment, etc.

### 8.2 Review of categorisation

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Priority sites should be investigated in further detail as part of Phase 3 investigations. These investigations may cause the priority sites to be reviewed, especially in the case of the northern sub-region which may result in some knowledge gaps and uncertainty about the Bribie Island site being reduced to the point that it could be elevated to a priority site.

Priority nominations may also change over time due to factors such as sites becoming available, particularly for the categorisation of the three sites in the central sub-region.

### 8.3 Engineering

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The following investigations should be applied to Priority sites in Phase 3.

#### 8.3.1 Desalination Process

- establish water quality requirements and limitations for intake, outfall, and treated water will to determine the optimal desalination process;
- undertake raw water quality testing within vicinity of the intended intake location for each priority site and increase the understanding of the process and output quality risks for each site;
- develop concept process designs and consider deploying a pilot plant to one or more sites; and
- maintain a watching brief should on emerging desalination technologies and systems that may influence relative site suitability.

#### 8.3.2 Site investigations

Obtain detailed geotechnical testing, topographic survey, and undertake further assessment of access to inform detailed designs.

#### 8.3.3 Network connection

Optimise network integration point and pipeline corridor with consideration of environmental and planning implications

#### 8.3.4 Detailed network hydraulic analysis. Intake/Outfall

Determine the alignment of the intake and outfall and location of the point of intake and point of discharge and establish preferred construction technique.

#### 8.3.5 Energy and Power infrastructure

Undertake detailed consultation with Energex including further investigation into power options should address mechanisms for providing renewable energy.

### 8.4 Environmental Investigations

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The recommendations for ecological studies in Phase 3 for Priority sites include:

- detailed field investigations to determine the presence and extent of any significant flora and fauna species or vegetation communities under various state and federal legislation;
- obtain legislative approvals where appropriate and hold discussions with government bodies and local authorities regarding potential impacts on areas of interest;
- undertake further investigation into potential environmental mitigation measures and the potential impacts of brine discharge in Moreton Bay for the Lytton site.

### 8.5 Planning and Approvals

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Prior to Phase 3 it will be necessary to determine what major approvals pathway is to be followed. The level of complexity (and therefore time and costs) associated with site acquisition and development will vary from site to site. For Priority sites it is recommended that discussions are held with relevant State and local government authorities in regard to the planning and approval requirements for each Priority site. Where necessary, legal advice should be obtained and further investigation should be undertaken into the application and assessment requirements, costs and timeframes.

### 8.6 Social and Community Consultation

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A detailed community consultation plan should be developed and implemented early in Phase 3 to gain stakeholder acceptance and to ensure feedback can inform design.

### 8.7 Cultural Heritage

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The recommendations for cultural heritage studies in Phase 3 for Priority sites include

- carry out a full assessment of cultural heritage value of sites, including on-ground investigation; and
- consult relevant Aboriginal Party/ies and if required, prepare a cultural heritage management plan in accordance with the Aboriginal Cultural Heritage Act 2003.