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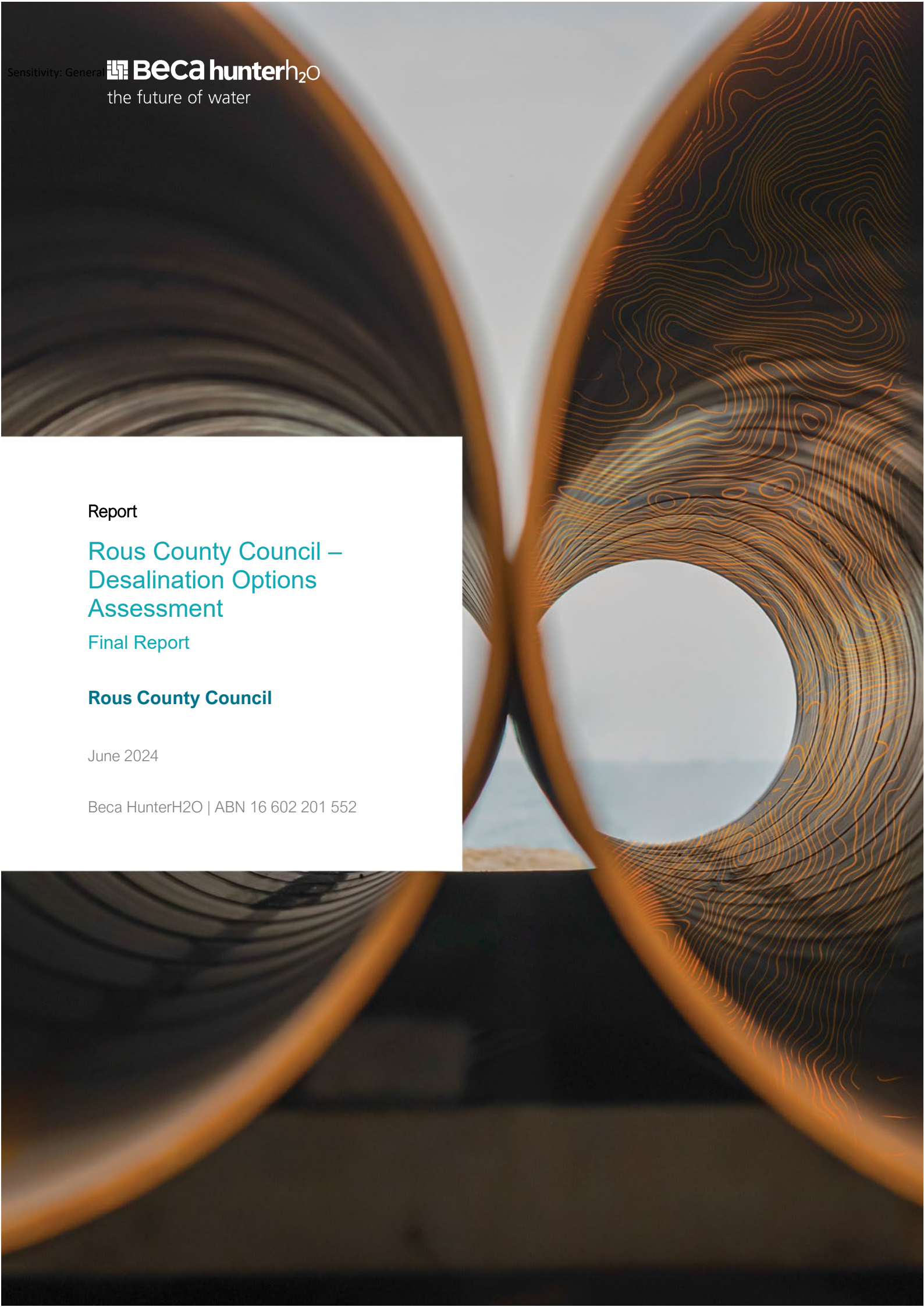

Report

Rous County Council – Desalination Options Assessment

Final Report

Rous County Council

June 2024

Beca HunterH2O | ABN 16 602 201 552

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Executive Summary

Rous County Council ('Council') are responsible for bulk water supply to Lismore City Council, Byron Shire Council, Ballina Shire Council, and Richmond Valley Council. The Council service area is within the Far North Coast region and the Regional Water Strategy (RWS) for this area was finalised in June 2023. The plan, led by the Department of Planning and Environment, identifies RCC as having a "very high" water security risk due to the projected reduction in yields and high population growth, particularly in the Byron and Ballina Shire Council Areas. This risk is enhanced given the reliance on surface water supplies which are dependent on climate. As such, Council is keen to understand the options for climate independent supply such as seawater desalination alongside works to investigate and implement groundwater supplies at Alstonville and Woodburn.

This work is to understand the practicalities of implementing seawater desalination, which will be used to compare with alternate water security strategies, and to complement work on dam depletions scenarios. The work is a critical input into Councils drought response and upfront bulk supply investment planning and provides a realistic and risk appropriate solution to maintaining water supply in a severe and ongoing drought.

This report documents the assessment of desalination as a potential solution, with preliminary feasibility investigations undertaken for permanent (two locations) and emergency (six locations) facilities selected previously through a shortlisting process. Critically, to understand the practicalities of pursuing seawater desalination at scale, the strategic delivery program and comparative costs of permanent and drought response plants has been documented. Together these elements were then utilised to rank the locations from most to least preferred for either type of facility.

At high level, a permanent desalination plant appears to be technically feasible option, however the site selection process has identified significant challenges even at the preferred site locations, notably the impact of the Cape Byron Marine Park on intake and outfall locations. These sites exhibit some risks that are more material than the similar sized Belmont desalination plant currently being delivered by Hunter Water in Newcastle, and therefore the expected cost are likely to be on the higher side when considered against industry benchmarks.

In the case that Council were to progress a drought response desalination plant approach as opposed to other drought response options (such as emergency groundwater supplies, dead storage in Rocky Creek Dam or Purified Recycled water (PRW)), a key outcome from the investigation is that the 'Severe Drought Scenario' delivery period, of up to 12 months, is reliant on 27 months, and $1.1 to $3.2 million dollars, of option development works being successfully completed. Even with the option development work completed, the 12 months delivery relies on favorable outcomes of a number of investigations, including geotechnical, and makes a number of assumptions on the availability of desalination equipment, which are at risk. As such, the only way to achieve certainty in a desalination plant being available to provide supply when required in a severe and ongoing drought, is to construct the plant, or significant components of the plant, upfront in preparation. However, reliance on the available drought response desalination options to maintain supply in a severe and ongoing drought is an approach with heightened risk that the supply is not available in time to meet demand and prevent, or delay, a "day zero" event.

In the case that a drought response desalination plant is preferred, the maximum deliverable volume has been found to be 10 ML/d even in a high risk program due to the availability of containerized desalination units, or a 5 ML/d plant in a moderate delivery program. As such, it is not possible to deliver a drought response desalination plant of sufficient capacity to provide Level 5 Emergeny restricted supply (estimated to be 22.7 ML/d at 2025).Therefore, the option may only meet the project objectives in combination with another drought reponse option.

In the shortlisting process a key determinant of shortlisted sites was the avoidance of the Cape Byron Marine Park, and this has had a large impact on the preferred site decision for the permanent facility, as well as for some of the drought response sites which have longer intake and outfalls to avoid coastal or estuary areas of the Marine Park. It has resulted in the shortlisted sites presented being mostly differentiated on the cost of the intake and outfall structures.

A second key consideration has been the impact on the community. Approvals are assumed to be required upfront for the plants, which may be acceptable to the community in an extreme drought but less acceptable when water storages are full. This will be a key consideration in the exhibition period for the Environmental

Impact Statement (EIS). An EIS is expected to be required for all sites given the value of the investment, and this will need to be delivered as part of the upfront works to put Council in a position to respond when required.

A summary of the key project outcomes are included below.

Table ES-1: Project Delivery – Severe Drought Scenario

Component	Value
Total Project Duration	39 months (27 prep + 12 delivery)
Minimum Preparation Period (*upfront works*)	27 months
Drought Response Mobilisation Trigger	70% Storage Level
Drought Response Delivery Trigger	50% Storage Level
Drought Response Delivery Period	Up to 12 months
Commissioning	0-20% Storage Level
Supply Capacity	5 ML/d (Moderate Risk Program) 10 ML/d (High Risk Program)
Emergency Demand (at 2025)	22.7 ML/d
Supply Shortfall (at 2025)	12.7 to 17.7 ML/d

Table ES-2: Preferred site rankings

Type	Capacity	Site Ranking
Permanent Plants	10, 15 or 25 ML/d	1. Newrybar/Ross Lane
		2. Suffolk Park
Drought Response	2, 5 or 10 ML/d	1. Lighthouse Pde, Ballina
		2. Skennars Head Sports Fields, Ballina
		3. New Brighton Sports Fields, Ocean Shores
		4. Brunswick Head Boat Harbour, Brunswick Heads

Before Council considers any strategic investment into either temporary or permanent desalination options, Council will need to undertake a comparative business case against its preferred long term water supply augmentation strategy. The business case will need to deliberate on the risk appetite and the potential for other emergency water supply options being implemented concurrently.

1 Background

Rous County Council ('Council') are responsible for bulk water supply to Lismore City Council, Byron Shire Council, Ballina Shire Council, and Richmond Valley Council. This supply network services approximately 46,000 connections and a population of about 100,000 people in the Far North Coast region of NSW. The Council also provides drinking water to approximately 2,000 retail customers who are directly connected to the bulk distribution network, including residential (70%), farms (22%), commercial and industrial customers.

The Council service area is within the Far North Coast region and the Regional Water Strategy (RWS) for this area was finalised in June 2023. The plan, led by the Department of Planning and Environment, identifies RCC as having a "very high" water security risk due to the projected reduction in yields and high population growth, particularly in the Byron and Ballina Shire Council Areas. This risk is enhanced given the reliance on surface water supplies which are dependent on climate. As such, Council is keen to understand the options for climate independent supply.

This report is the final deliverable of the Rous County Council Temporary Desalination Options Assessment project being undertaken by Beca HunterH2O with Council. The intent of this project is to determine a preferred site for an emergency desalination plant, to understand the practicalities in delivering that option type, and how it may integrate with the existing system.

As one of the options being considered in Council's Future Water program, this work will be a critical input to Council's decision making.

1.1 Work to date

Stage 1 of the project was to provide Council with a Strategic Consideration Memo, which outlined upfront assumptions and lessons learnt from other similar projects, as well as outlining the approach to determining the preferred site, and to shortlist sites for progression to more detailed feasibility study, which included a workshop with Council stakeholders in December 2023.

The Strategic Considerations Memo is provided as Appendix A.

The Site Shortlisting Summary Memo is included as Appendix B.

Stage 2 of the project (summarised in this report) was to determine site feasibility for shortlisted sites, develop comparative costs, and undertake an MCA with Council to determine a preferred site or sites.

2 Site Feasibility

Following the shortlisting process six sites were progressed to more detailed feasibility investigations, including:

- Permanent Sites:
  - Suffolk Park/Tallow's Beach
  - Newrybar/Ross Lane
- Emergency Sites:
  - New Brighton Sports Field
  - Brunswick Heads Boat Harbour (Boather Reserve)
  - Suffolk Park/Tallow's Beach
  - Newrybar/Ross Lane
  - Lighthouse Beach Area

Based on new information available, we have also included Skennars Head as an emergency option in this analysis. The site was ruled out in the shortlisting process based on the distance to power and water network connection points, however new information on the proximity of a Ballina Shire Council trunk main and the assumption that generators will be used for emergency options means the site should be reintroduced.

Common assumptions have been detailed in the Strategic Consideration Memo (BecaHH2O, September 2023), with key components included below:

- The assumed volumes are as per Table 2-1:

Table 2-1: Assumed volumes for drought response and permanent plants

Plant Type	Production (ML/d)	Intake Volume (ML/d)	Brine Volume (ML/d)
Drought Response	2	5	3
	5	12.5	7.5
	10	25	15
Permanent	10	25	15
	15	37.5	22.5
	25	62.5	37.5

- The required plant area is as per Table 2-2:

Table 2-2: Plant footprint assumptions Strategic Consideration Memo (BecaHH2O, September 2023)

ML/d	Plant footprint (ha)	With 50% Construction area (ha)	With 100% Construction area (ha)
5	0.5	0.7	0.9
10	0.9	1.4	1.8
15	1.4	2.0	2.7
20	1.8	2.7	3.6
25	2.3	3.4	4.5

- All options require brine disposal to ocean based on advice from EPA/DPE that estuary outfalls are unlikely to be approved.
- Infrastructure is sized to meet the design capacity, and no allowance has been made for larger infrastructure to enable future expansion. This should be considered through the design process.
- No specific allowance has been made for redundancy in the process train to allow for full supply capacity when process trains are offline.
- Any comments on the feasibility of options are based on available desktop data. Field investigations are required to validate the assumptions made in this report, including but not limited to geotechnical conditions and existing asset capacity and condition.

Generic plant layouts have been included as overlays onto site maps for the shortlisted locations to provide a visual representation of the likely area taken up by a facility. The layout utilised is based on the components included in other emergency and permanent desalination plants without being optimised for any particular site. The layouts are visual aids only to provide perspective, and the layout and final components will be required to be developed through design.

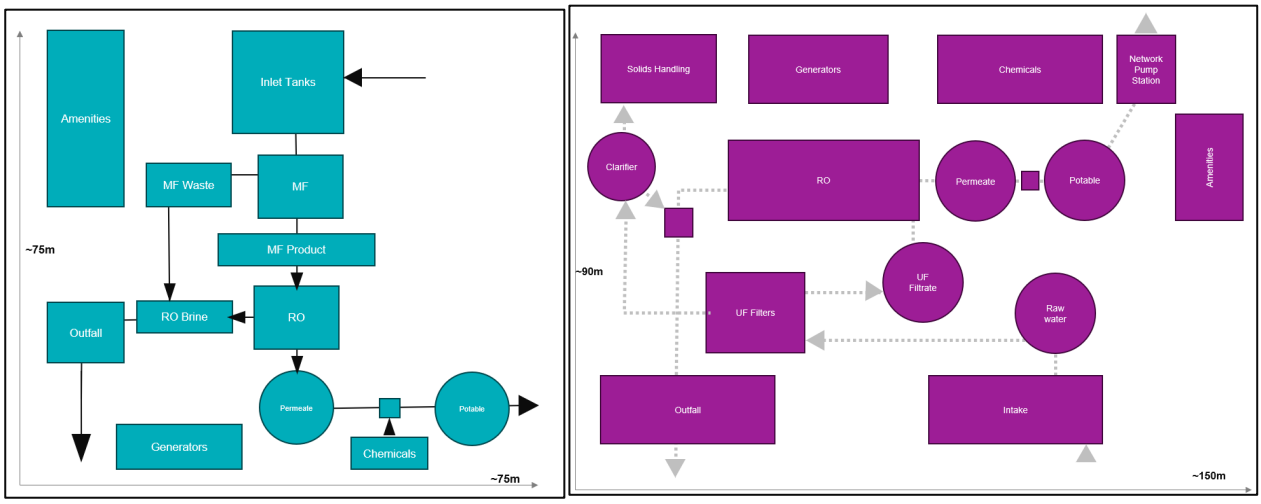

Figure 1: Generic plant layout for drought response desalination plant (left) and permanent (right). Note different scales

2.1 Common components

2.1.1 Raw Water Quality

For all sites, a desalination specific sampling regimen should be developed to provide a full picture of the chemical species of significance for pre-treatment and desalination across a broad spectrum of climatic conditions. Any raw water sampling regimen should include event monitoring and reference to rainfall and associated changes in salinity or water quality in offshore locations due to freshwater plumes and/or direct runoff.

For emergency schemes, the water quality analysis should consider the expected conditions during operation. For example, the plant is unlikely to be required following extended significant rainfall that may negatively impact raw water quality. Further, the short- and long-term efficiency impacts associated with variable raw water quality, within reason, are more acceptable under an emergency scenario given it is expected in an emergency situation that operation will be more hands on, being a trade-off to increase the speed of delivery of the system. Hence

there may be a greater appetite for a wider raw water quality envelope that would not be 'efficient' for a permanent system, due to increased membrane cleaning and possible decreased membrane life.

For permanent sites, there is a higher focus on good and stable water quality to maximise efficiencies, minimise process risk and minimise operating costs.

These requirements do not differentiate between sites unless a difference in water quality is determined.

2.1.2 Waste Management

2.1.2.1 Backwash Waste

For emergency schemes, it is assumed that the backwash waste from pre-treatment will be discharged with the brine stream. This is based on the assumption that coagulant dosing upstream of the UF system is not required. This simplifies the process and in particular waste management. The UF system may achieve better performance in terms of membrane cleaning intervals and organics removal with coagulant dosing but may preclude UF backwash waste discharge with the concentrate, and necessitate thickening/dewatering processes and off site solid waste disposal. This assumption should be reviewed at future stages and in conjunction with membrane suppliers.

For larger permanent plants, it is expected that coagulation will be used to manage backwash waste and a solids thickening and disposal process will be required.

2.1.2.2 Chemical Cleaning Waste

For emergency sites, Chemical Clean in Place (CIP) cleaning waste for the UF and RO systems is to be assumed to be collected, neutralised, and disposed to sewer.

This is assumed as a reasonable assumption at this stage of the project, given the limited volume (high level estimate of approx. 10-20 kL/d), and typical available capacity in sewer networks and at wastewater treatment plants. However, in future design phases the hydraulic, solids and biological capacity of the receiving wastewater plant should be checked to ensure it can handle this additional load.

Any discharge to sewer will require a liquid trade waste licence, the application for which would include an assessment of the network capacity to transfer the waste as well as the receiving plants capacity to treat the waste.

For larger permanent sites, dedicated waste handling may be required.

2.1.3 Emergency Storage tanks

The proposed storage tanks to be used for emergency sites are 50 kL PE tanks. These are preferred as they are generally the largest tanks that can be purchased off the shelf and deployed rapidly for emergency response.

Note that custom design of these tanks will be required to handle the flow rates required and difference in connection sizes which will add to the delivery lead time.

2.1.4 Chemical Dosing

Chemical addition includes:

- Intermittent raw water sodium hypochlorite dosing prior to the cartridge filters to manage bio-growth.
- Sodium bisulfite dosing as required to remove free chlorine from the feed to the RO membranes following pre-chlorination of the raw water.
- Antiscalant dosing to reduce scaling of the RO membranes.
- Carbon dioxide and lime dosing, or calcite contacting, to support re-stabilisation

    - Unless blending non-RO treated water at the given location can achieve the required treated water quality.
- Treated Water (RO permeate) sodium hypochlorite dosing for disinfection, as an initial mitigation measure for chlorine sensitive pathogens and to ensure a chlorine residual in the distribution network.

The requirement for the following chemicals needs to be confirmed at future design stages:

- Sodium hydroxide addition to 2nd Pass feed for improved boron rejection
- pH correction for SWRO scaling management
- UF and RO specific CIP chemical requirements
- Fluoridation as/if required.

Appropriate chemical storage and bunding will be required to minimise the risk of chemical spills to the environment and to minimise health and safety risks/incidents during delivery, storage and use.

2.1.5 Treated Water Storage

The reverse osmosis process cannot easily be ramped up and down, it operates at a fixed rate with step changes in flow based on units or 'trains' turning on or off. Hence designs require treated water buffering to allow the RO units to continue operating while there are different levels of demand. The site requirements for significant treated water storage for overall network balancing will not be fully resolved until future project stages. However, the preliminary analysis indicates that the receiving reservoirs or trunk mains for the emergency options under consideration are likely to be large enough to avoid significant site treated water storage requirements for emergency options.

For the larger permanent sites, a dedicated clear water tank may be required, particularly at Newrybar where there the receiving reservoir is more distant than at Suffolk Park.

Potable water pipelines have been sized assuming polyethylene pipe types, with velocity limited to 2 m/s and friction losses limited to less than 5 m/km to balance pumping costs to material costs at a high-level. It is noted that there may be a higher tolerance for elevated friction losses for drought response plants given the short period of operation, and this should be considered further in design phases.

2.1.6 Power

For emergency sites up to 10 ML/d, it has been assumed that generators will be used to provide the required power. Power requirements have been developed based on a high-level conservative estimate comprising of:

- An allowance for intake pumping (assumed as flow rate at 3 bar discharge head)
- An allowance for the UF/RO power requirement of 5 kWh/m^3 of treated water, and an additional 20% contingency applied. This is a conservative number and subject to design development would likely reduce. For emergency plants in particular, it is reasonable to assume a higher value given the lower focus on efficiencies in the reactive deployment and operation in an emergency situation.
- An allowance for treated water distribution. The actual power requirement will be dependent on the receiving location pressure, which would require an understanding of the hydraulic grade line of the asset being connected to. At this strategic level, a fixed allowance has been included which has been sense checked against the proposed water network pump heads developed in the pipe size selections for each option.

Table 2-3 outlines the assumed power requirements for each capacity option.

Table 2-3: Indicative power draw requirements for desalination options (kW)

Capacity (ML/d)	2	5	10	15	25
Power draw (kW)	600	1,400	2,800	4,200	7,000

Generators provide a critical benefit in avoiding potentially costly upgrades to the power supply network which may require both a significant lead time and delivery by the network owner and operator. However, the use of generators comes with the negative environmental impact of noise and vibration which will have an impact on direct and even possibly distant neighbours, depending on the topography and existing background noise levels. The impact of noise can be reduced, but not eliminated and needs to be considered for possible sites.

In regard to safely delivering fuel to the generator, the use of generators is common practice across the construction industry and ensuring human and environmental protection, through for example double walled fuel storages is considered business as usual.

2.1.6.1 Energy Network Connections

Essential Energy is the owner and operator of the electrical distribution networks in the study area and determines the requirements and costs for new connections to their high and low voltage system. Whilst a preliminary review of the network can be undertaken by Accredited Service Providers (ASPs), the existing and future planned capacity and demands of the network, and therefore the connection requirements, can only be provided by Essential Energy, and only for that point in time (that is, future demand loads may change the availability of power from connections points).

For the permanent sites, it is expected that a connection to the high voltage system will be required. A review of the existing Essential Energy network indicates that:

- For the Suffolk Park site there is a 132 kV power station adjacent to the site. If there is energy available at that location, there would be low connection costs.
- For the Newrybar site, the nearest substation for potential connection is the Lennox Head 132 kV substation approximately 3.5 km from the site. The existing 11 kV distribution lines along Ross Lane that are adjacent the Newrybar site is unlikely to have capacity for the proposed site. If Lennox Head substation has sufficient capacity, it is likely that upgrade to the distribution lines would be required to increase the feed from the substation (see Figure 2).

The above information is based on a high-level review of the available data. If Council plan to progress with a permanent site with connection to the HV network, or a connection to enable an emergency site, contemporary enquiries to Essential Energy should be made.

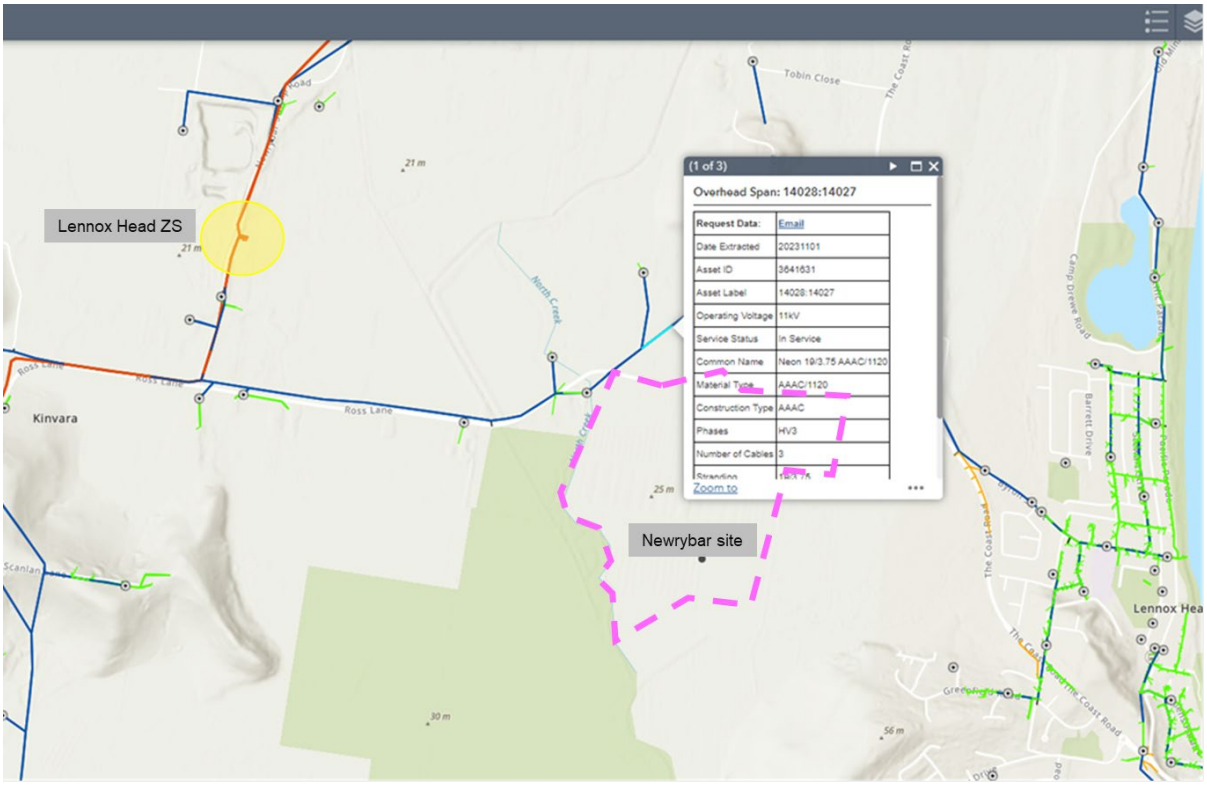

Figure 2: Extract from the Essential Energy portal of power network in the Lennox Head area.

2.2 Assessment of Shortlisted Sites

2.2.1 New Brighton Sports Field

Summary: Based on the information available the site is considered feasible and comparable to other options on technical grounds, however the impact to the community would require early engagement with Byron Shire Council and residences, and the construction of the 4 km potable water pipeline through narrow roadways and through sensitive environmental areas is a significant risk to delivery as a drought response.

Component	Relative Risk Rating
Plant Site	**Moderate** - Constrained site which is limited by community roads and houses on surrounding streets. Will require compact layout to achieve 5 ML/d capacity.
Intake/Outfall	**Moderate** - Relatively short distance to marine area which his expected to have stable water quality.
Community Impact	**Poor** - Use of the fields would be prevented during construction and operation. Neighbouring houses would be heavily impacted.
Water Network Connections	**Moderate** - Long (4 km) pipeline through road corridors and/or high value environmental areas. May need to be built upfront.
Capacity	**Poor** - Will require some compromise to achieve upper value of 5 ML/d.

The New Brighton Sports Field was not previously considered as a desalination option, and as a relatively small area and a sports field in use by the community, would only be suitable as a short-term drought response option.

The desalination plant would require the sports field and neighbouring carpark to be used by Council, which is only approximately 0.6 ha. As such, the maximum capacity would be limited to up to 5 ML/d and design and delivery would need to consider the constrained space. The site is surrounded by residential use, with relatively narrow residential access roads to the east and west. Impacts from noise, vibration and traffic would need to be considered. An approximate footprint for a 5 ML/d plant is shown in Figure 3.

Figure 3: New Brighton Sports Field site.

2.2.1.1 Raw water intake and brine disposal

The local estuary is not expected to be suitable as a raw water source given the limited depth and the estuary being part of the Cape Byron Marine Park, with the reach of the estuary immediately south of the site considered as Sanctuary Zone. Beachwells are also not recommended given the high value biodiversity areas near the site, including mapped Endangered Ecological Ecosystems and a National Park, which would limit the capacity to drawdown groundwater in the area.

Open ocean intakes and outfalls are most common for seawater reverse osmosis due to the high confidence in delivering the required volumes and dispersion requirements and the industry experience in delivery, and it is expected that this is the most viable option for this site.

It is expected that an ocean intake and outfall can be achieved through two options:

- Option 1: From the plant site, a HDPE intake/outfall will be constructed to a location approximately 400 metres from the coast using Horizontal Directional Drilling method (as per Appendix C). The pipeline will be launched via a shallow pit on site, with the boring machine guided to a depth to avoid impact on surrounding residences and assets. The pipeline alignment is to the north of the site to avoid houses. The pipeline will be pushed out from the surface and an intake structure including a screen to prevent entrainment, or a diffuser cap for brine dispersion will be constructed and installed by divers, likely using a barge for deployment. The total length required would be approximately 800 metres, which would be reaching the limits of a midi-rig HDD machine (see Figure 4, and may require a maxi-rig HDD. Another potential option is to deploy the pipelines as a staged HDD, with stage one from the site to the coast and stage 2 from the coast to the intake/outfall location, using the midi-rid if the larger rig is unavailable.
- Option 2: From the site, a trenched HDPE pipeline would be constructed beside New Brighton Avenue and to the end of Ocean Avenue, from which a HDD would be launched to approximately 400 m offshore and an intake/outfall structure fitted as above. It is assumed that excavated material will be returned to the pit and no material would be imported. The option would be more cost effective than

Option 1 and there would be higher likelihood that a midi-rig could be used, but this would need to be balanced against increased impacts to the community between the site and the HDD launch site.

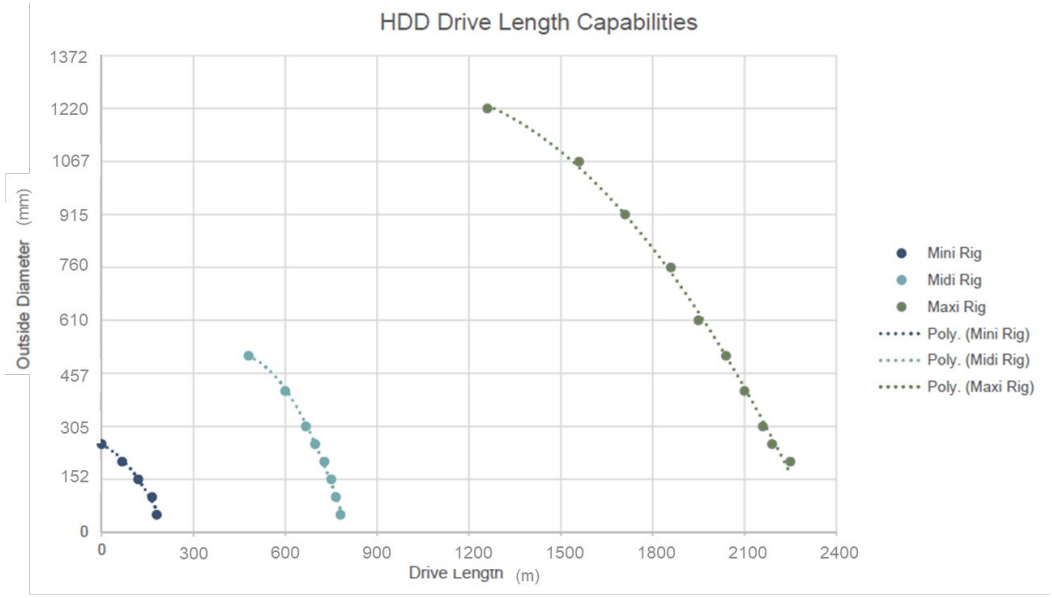

Figure 4: Indicative HDD ranges based on pipe diameter and rig type, from Farmer (2019) (adapted to metric by BecaHunterH2O)

An alternative option may be for a poly pipeline to be floated offshore and sunk in place using buoys and concrete stabilisers, creating a pipeline on the seabed. This may have the benefit of a shorter delivery time and less risk in contractor availability to undertake the HDD work, however the risk is that the ability to reach depth and distance offshore may be limited and there would be increased risk exposure to storm events in construction and operation. Where marine structures are in place to protect the pipeline, such as at Lighthouse Beach, this may be more viable option.

The type of intake and outfall structure and construction type will be heavily dependent on the wave energy, likely fauna species, hydrodynamic modelling, water quality testing and geotechnical conditions. As such, the proposed options are used for comparison purposes only.

2.2.1.2 Treated Water

For the 2 and 5 ML/d options, the potable water will be transferred to the Yamble Reservoir via new 4,000 m section of DN300, boosted from the desalination site to the reservoir pressure. For the 5 ML/d option, the local demand is too low to use up the full capacity, so the current 2,000 m section of DN200 between Yamble Reservoir and the Brunswick Reservoirs would also need to upgraded to a DN300 or DN375. Flows from the Brunswick Reservoirs would then need to be boosted to be able to supply St Helena reservoir.

The length of the pipeline and the construction area would make the delivery challenging and of a relatively high impact to the community. The roads are relatively narrow and the pipeline would need to cross through sensitive environmental areas. There is an existing pipeline which may be used to distribute some flows, but it is unlikely to have sufficient capacity for 5 ML/d.

As the flow is provided direct to the reservoir, there is expected to be limited water quality risks in the Ocean Shores/New Brighton areas. However, the interaction of flows between the northern reservoirs (Yamble and Brunswick) and St Helena would need to be managed to mitigate the risk of “dead zones” and water age.

2.2.2 Brunswick Heads Boat Harbour

Summary: Based on the information available the site is considered feasible and comparable to other options on technical grounds, however the impact to the community uses of the existing boat ramp and marina, would be required along with early engagement with Byron Shire Council and residences. Having an intake from the marina would require extensive engagement with NSW Health to ensure boat wastewater is not a potential contaminant to the raw water supply.

Component	Relative Risk Rating
Plant Site	**Moderate** - Constrained site which is limited by trees and surrounding uses. The shape of the site and the limited space will require a non-standard layout to achieve 5 ML/d capacity.
Intake/Outfall	**Moderate** – A pontoon intake presents an opportunity to save time and cost, however the brine outfall is relatively long.
Community Impact	**Moderate** - Use of the boat ramp and marina may be impacted, however it could be managed so that some access is maintained. Noise, vibration and lighting is unlikely to be a significant impact.
Water Network Connections	**Good** – Although the pipeline is relatively long, the majority of the construction would be through existing easements.
Capacity	**Moderate** - Limited to upper value of 5 ML/d.

The Brunswick Heads Boat Harbour site has not previously been considered as a drought response desalination site. The site is an operating boat and parking area, adjacent to the recreational and commercial marina.

The desalination plant would be constructed in the relatively open areas north of the boat sheds and would require the existing site uses and carpark access to be closed while construction and operation of the plant occurs. The site is relatively small at approximately 0.6 hectares, and constrained by established trees. As such, the maximum capacity of the site would be up to 5 ML/d. An example of the plant footprint and site boundary is shown in Figure 5.

Figure 5: Brunswick Heads Boat Harbour site and potential intake.

2.2.2.1 Raw water intake and Brine disposal

There are two options for raw water intakes, and one for the brine outfall.

As the per section 2.2.1.1, a HDD ocean intake/outfall pipeline could be constructed from the site to connect the ocean water source to the first treatment stage. The intake pipeline would be constructed using HDD, and an intake structure including a screen to prevent entrainment, would be constructed and/or installed by divers. The pipeline would be angled to the nearest coastline at the southern end of New Brighton Beach and then offshore to 10 metres depth, as per Appendix D. The pipelines would be outside of the Cape Byron Marine Park, however hydrodynamic modelling would be required to confirm that brine disposal or construction activities would not affect the Marine Park area. The brine disposal and intake locations would be separated by at least 500 metres to prevent re-circulation of brine. Given that the pipeline would be approximately 1,400 metres in length, a maxi-rig HDD would be required.

As an alternative to an ocean intake, the harbour area is considered a Special Purpose Zone of the Cape Byron Marine Park which may allow a reasonable argument that a pontoon intake structure within the harbour area is consistent with the Marine Park legislation. If this were the case, a floating pontoon intake could be constructed within the protected boat harbour for raw water supply (as per Figure 5). Further work would be required to ensure the area is not used for boats to dispose of ballast or septic waste, which may present health risks, but if feasible this would provide a much lower delivery cost and time option for raw water.

2.2.2.2 Treated Water

For the 2 ML/d options, the potable water will be transferred to the water main between Yamble reservoir and the Brunswick Reservoirs via new 500 m section of DN250, boosted from the desalination site to the reservoir zone pressure to feed both northern and southern zones.

For the 5 ML/d option, a direct connection to the Brunswick Reservoirs would be required via a 4,000 m DN300 pipeline. Flows from the Brunswick Reservoirs would then need to be boosted to be able to supply St Helena reservoir.

As per the New Brighton option, the interaction of flows between the northern reservoirs (Yamble and Brunswick) and St Helena would need to be managed to mitigate the risk of “dead zones” and water age.

2.2.3 Suffolk Park/Tallow's Beach

Summary: The option is not considered technically feasible as an emergency response option. The intake and outfall lengths and depths are not considered practical unless the pipelines can be placed on the seabed for at least half of the proposed distance, and even then, the costs are expected to be prohibitive. The Tallow's Beach is also a high visibility project for Byron Shire Council, and although the future site options are not public, it is expected that progress on the future site use will occur in the near future (i.e. before Council could complete design works) and that the future site use is unlikely to be consistent with use as a desalination plant.

Tallow's Beach

Component	Relative Risk Rating
Plant Site	**Poor** – the on-site ponds are to be reattained as an environmental asset, and the remainder of the site is undergoing an options assessment for future use. It is unlikely that the future use will be compatible with a desalination plant given the focus on the environmental value of the area.
Intake/Outfall	**Very Poor** – The requirement to avoid the Cape Byron Marine Park means the intake and outfall lengths are considered too long to be practical.
Community Impact	**Moderate** – Neighbouring holiday park users would likely be impacted by the noise, vibration and lighting from the plant. It will also affect beach access for tourists and the community.
Environmental Impact	**Moderate –** High value environmental areas border the site, which may be impacted by construction and operational noise, vibration and lighting.
Water Network Connections	**Good** – Connection to local reservoirs.
Capacity	**Good** - Can achieve 10 ML/d.

Suffolk Park

Component	Relative Risk Rating
Plant Site	**Good** – Sufficient capacity and numerous potential site footprints could be plausible to minimise impacts. The sub-station also provides precedent for large infrastructure.
Intake/Outfall	**Very Poor** – The requirement to avoid the Cape Byron Marine Park means the intake and outfall lengths are considered too long to be practical.
Community Impact	**Good** – Relatively low impact depending on the plant footprint.
Environmental Impact	**Good –** Relatively low impact, no high value biodiversity noted on site.
Water Network Connections	**Good** – Connection to nearby reservoir.
Capacity	**Good** - Can achieve 10 ML/d.

The Suffolk Park and/or Tallow's Beach sites have not previously been considered as desalination sites. The two sites could progress independently, with Suffolk Park being the more likely permanent larger plant and Tallow's Beach likely only an emergency site, or, they could progress in tandem with the intake and outfall launched from Tallow's Beach and the plant itself at Suffolk Park.

The Suffolk Park site is relatively open with some areas of high gradient to the south, and indications of marshy land to the north. Figure 6 shows indicative layouts for a temporary and permanent plant area, with the permanent option requiring additional tree clearing unless it can be moved to north of the road without impacting nearby properties. The neighbouring area includes a house to the immediate east, and a resort on the western boundary. Given the location of the sub-station at the site, it is assumed that impacts on these neighbours are manageable, but this would need to be investigated in more detail and may influence the capacity and layout of the plant.

The Tallow's Beach site is a former sewage treatment plant which has been demolished and partially remediated. The site included two lots, one of which is cleared and remediated but not yet developed or with an approved development application. The other area includes two former effluent storage ponds. The development of the remediated area is a subject of keen interest in the Byron Bay community, with options presented to Council in March 2023 but not yet available to the public. Further research following the shortlisting of sites found that the effluent ponds are now expected to be retained as habitat as per a Council decision in 2023, and will therefore not be remediated and become available for future use. As such, the site may be available in the short-term as an emergency site or as a location to construct an intake and outfall, but is not expected to be viable as a permanent option or as a long term emergency option.

Figure 6: Suffolk Park site (left) and Tallow's Beach site (right)

2.2.3.1 Raw water intake and Brine disposal

For both the sites, it is expected that an intake and outfall structure off Tallow's beach extending to beyond the General Purpose Zone of the Marine Park would be required (see Figure 7). If Tallow's Beach is unavailable, another location to launch the intake and outfall structures would need to be determined. The distance from the Tallow's Beach site to the edge of the General Purpose zone is approximately 2,200 metres, and the intake is assumed to be at least 500 metres away from the brine disposal outfall to prevent recirculation.

The pipeline distances are beyond what is generally considered typical for HDD and would likely require micro tunnelling or pipejacking (see Figure 4), both of which will also require a launch shaft at the beginning of the pipeline and at the end, and will be higher cost and delivery time than HDD.

Due to the depth of the intake and outfall of between 20 and 25 metres, depending on how far from the Habitat Zone the structures are required, diving to construct and maintain the intake and diffusers will also be more challenging and less cost-effective than options with shallower intakes and outfalls.

Alternative option could be to use HDD to avoid the wave energy zone and then float and sink long sections of pipeline to site on the seabed, and connect to the HDD section. This would require about 1,200 metres of HDD to reach approximately 10 metre depth, and 1,000 metres of additional pipeline weighted with concrete stabilisers. This would mean that a pipeline is on the surface within the Marine Park area, which may be unacceptable to stakeholders and so has not been assumed as the base case.

In order to successfully construct using these methods, particularly if confidence is required that the asset can be constructed within a constrained timeframe, a high level of geotechnical knowledge is critical. This would generally include offshore geophysical investigations followed by marine coring. Any cost estimates for these methods are highly speculative until the method and geotechnical conditions are confirmed.

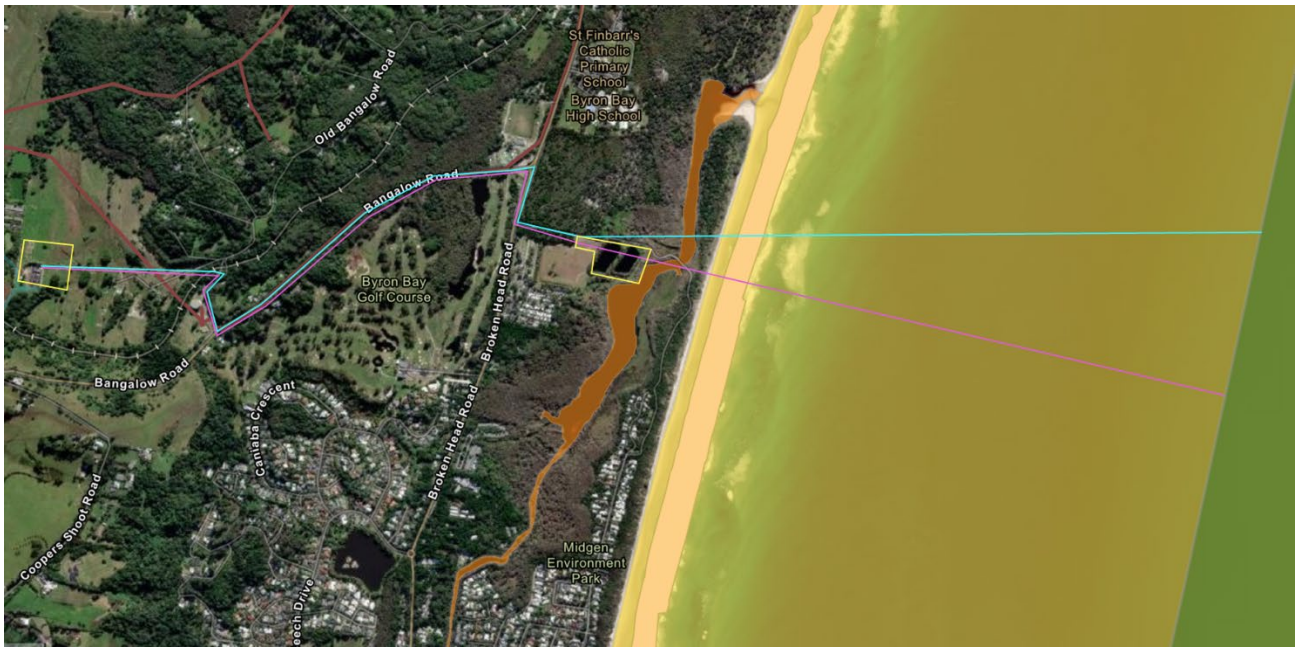

Figure 7: Suffolk Park/Tallow's Beach sites with Marine Park shown as shaded yellow area.

2.2.3.2 Treated Water

For options of 2 or 5 ML/d, a connection to the Coopers Shoot Reservoirs is required. From Suffolk Park, this would be a 700 m or 2,000 m section of DN225 or DN300, and from Suffolk Park or Tallow's Beach respectively. The condition of the asbestos cement pipeline from Coopers Shoot to St Helena would need to be confirmed.

For larger options (>10 ML/d), the connection between Cooper's Shoot and St Helena Reservoir would also need to be upgraded. This would require a DN375, DN450 or DN500 for 10, 15 or 25 ML/d respectively.

2.2.4 Newrybar/Ross Lane

Summary: The option is not considered technically feasible as an emergency response option if a direct intake and outfall is to be constructed. However, the site is likely to be viable as an emergency option if the intake and outfall pipelines are launched from a more southerly location. The pipeline to connect that location would need to consider the constrained roadway.

Component	Relative Risk Rating
Plant Site	**Good** – the site is large, open, flat and has been identified for future commercial/industrial development.
Intake/Outfall	**Moderate** – The option for a direct HDD intake and outfall from the site to ocean is not feasible given the Cape Byron Marine Park. The option to trench a pipeline and have shorter intake and outfalls is reasonable, however the corridor to construct the pipeline is constrained.

Community Impact	**Good** – The site is relatively distant form sensitive receptors and large enough to move to avoid unacceptable impacts.
Environmental Impact	**Good –** There are no high value biodiversity areas identified on the site, and it is likely that the site is large enough to avoid these areas, or archaeological areas of significance, if found.
Water Network Connections	**Good** – Connection to large pipeline near the site.
Capacity	**Good** - Can achieve 10 ML/d.

The Newrybar/Ross Lane sites are the collective name for an area of interest west of Byron Bay Road in the area of Lennox Head. There are a number of potential sites in the area which may be suitable, however the Ross Lane site as shown in Figure 8 has been previously flagged as a potential employment land in the Ballina Shire Growth Management Strategy (2012) and more recently as an investigation area for urban or employment land in the North Coast Regional Plan (2022). This site is also closest to the ocean. Given these factors, this is assumed as the site area.

The sites are outside of mapped flood prone areas, however the aerial imagery indicates the potential for localised high water tables and inundation during wet period which may require management during construction. The site is otherwise flat and open and generally unconstrained, with good road access and limited biodiversity values.

Figure 8: Newrybar/Ross Lane site and potential plant footprints for 5 ML/d and 25 ML/d plants

2.2.4.1 Raw water intake and Brine disposal

A connection between the site and the ocean is constrained by coastal wetlands, the northern residential area of Lennox Head, and by the presence of the Cape Byron Marine Park offshore. For options less than 10 ML/d, there are two options considered as reasonable for the site:

- Option 1 – The option would be for a 3,200 metre intake and outfall pipelines extending offshore to avoid the Marine Park area. As per section 2.2.3.1, this range would be in excess of the capability of HDD and pipe jacking or tunnelling would be required. The potential alignment is shown in Appendix F. As per section 2.2.3.1, an alternative is to HDD to beneath the area of wave energy and lay a pipeline on the seabed from that point is also possible, but as this is also in the Marine Park, it is unlikely to be consistent with the Marine Park requirements and outside of Council's stated requirement to be outside the Marine Park.
- Option 2 – In order to avoid the Marine Park and therefore have a shorter intake and outfall, an alternative proposal is to trench a pipeline from the site to a launch site near Lennox Point headland, as per Appendix F. As per previous sites, a HDD pipeline would extend to 10 metres depth which is approximately 400 metres offshore.

For Option 2, it is noted that this area is a rock reef and may therefore have high biodiversity value, and that the construction corridor along the Byron Bay Road corridor is constrained by the wetlands and an alternative route may be required. It is also noted that the Lennox Head sewage treatment plant outfall discharges wastewater to the south of the proposed intake locations, and the risk of treated effluent entering the intake will need to be addressed through the hydrodynamic modelling.

Options to connect to the Lennox Head outfall have been considered for the brine discharge outfall, however distance to the outfall pipeline and likely challenges of integrating with the existing outfall indicate that a new outfall is more robust as an option at this point in time.

2.2.4.2 Treated Water

It is expected that options up to 20 ML/d could be delivered from the site via a connection to the Ross Lane DN450 pipeline owned by Rous County Council, which can transfer 15 ML/d to Knockrow Reservoir, as well as a southerly supply of at least 5 ML/d south along the Ballina Shore Council trunk main to the Pines Road Reservoir (20 ML/d reservoir volume).

For options greater than 20 ML/d, a new direct connection to the Knockrow Reservoir and an upgrade of the connection between Knockrow and St Helena from 450 mm to 500 mm would be required.

Network capacities have been undertaken at a high level, and further investigations are required to confirm the capacity of the existing systems – particularly for constituent councils.

2.2.5 Skennars Head

Summary: Based on the information available the site is considered feasible and comparable to other options on technical grounds, however the impact to the community would require early engagement with Ballina Shire Council.

Component	Relative Risk Rating
Plant Site	**Good** – the site is large, open and flat.
Intake/Outfall	**Good** – the intake and outfall will need to be constructed direct to ocean through HDD. The presence of the wastewater outfall will need to be managed.
Community Impact	**Moderate** – The construction and operation will prevent usage of at least some of the sporting fields, however it is likely that others could be continued to be used.
Environmental Impact	**Good –** There are no high value biodiversity areas identified on the site, and it is likely that the site is large enough to avoid these areas, or archaeological areas of significance, if found.

Water Network Connections	**Good** – Connection to large pipeline near the site which supplies Ballina.
Capacity	**Good** - Can achieve 10 ML/d pending further water network investigation.

The Skennars Head site is an existing sporting field and as such will impact on the community use of the site during construction and operations. The site is large, which would allow some of the fields to continue to be used unlike New Brighton Sports Fields.

The site is flat, open, and contains low biodiversity value given the current use. The surrounded area is residential to the south, with vegetated areas to the east including Coastal Wetlands and open areas to the north and west. The site has good road access.

Figure 9: Skennars Head site and plant footprint for 5 ML/d

2.2.5.1 Raw water intake and Brine disposal

A connection between the site and the ocean is constrained by coastal wetlands on the eastern boundary and Littoral Rainforest to the east across The Coast Road. The area is also heavily vegetated between The Coast Road and the coastline, with the main point of access being Rocky Point Rd, which provides access to the beach and carpark.

It is assumed for this project that minimising interference with beach use and vegetated land will be a priority, and therefore the assumed intake and outfall is the same as described in Option 2 of the Newrybar/Ross Lane site (section 2.2.3.1), this being an intake/outfall constructed from the site to a location at 10 metres depth using the HDD.

The potential alignment is shown in Appendix G.

The alignment places the intake north of Iron Peg, away from the Lennox Head wastewater outfall which enters the water at the gravel beach south of Iron Peg, and at least 500 metres away from the brine disposal location to minimise recirculation. The brine outfall alignment could join the existing outfall, however the conditions and capacity of that pipeline would need to be investigated further to understand whether this is a reasonable option. Critical risks include the difference in wastewater and brine densities and therefore the different dispersant mechanisms required to minimise impact, as well as the risk to non-marine grade assets when adding hypersaline wastewater.

2.2.6 Lighthouse Beach Area

Summary: Based on the information available the site is considered feasible and comparable to other options on technical grounds, however the impact to the community would require early engagement with Ballina Shire Council.

Component	Relative Risk Rating
Plant Site	**Moderate** – the site is constrained by vegetation and exiting use, but there is sufficient area for a plant.
Intake/Outfall	**Good** – intake and outfalls to the ocean are relatively short, and the option to have estuary and breakwall pipelines would save considerable time and cost. The key risk is water quality fluctuations due to the river.
Community Impact	**Poor** – The construction and operation will prevent usage of at least some of the beachfront parkland, as well have a high impact on local residents. An alternative site at Pop Denison's Park could reduce the impact of neighbouring houses, but would require assumption of the park, which is planned for upgrade in the near future.[1]
Environmental Impact	**Good –** There are no high value biodiversity areas identified on the site, and it is likely that the site is large enough to avoid these areas, or archaeological areas of significance, if found.
Water Network Connections	**Good** – Connection to the East Ballina reservoir is relatively short and there is an existing unused pipeline which may be re-purposed for this project. The nearby 20 ML Pine Avenue Reservoir is a substantial storage and could also receive and distribute flows.
Capacity	**Moderate** - Will require some compromise to achieve 5 ML/d. 10ML/d may be achievable at Pop Denison Park.

The Lighthouse Beach Area provides access for recreational uses to Lighthouse Beach and the breakwall on the northern side of the Richmond River. The site would have significant community value, and therefore would only be considered as a temporary emergency desalination plant location. The area has three potential sites areas, as identified in Figure 10, which would limit tree clearing and have sufficient area for a 5 to 10 ML/d plant. The northern option provides an established hardstand area and more distance from residences, whilst the southern site would have less impact on beach users, but more impact on residents. The Pop Denison Park site has more area and the advantage of being screened from the road by existing trees and close proximity to Shaws Bay, if that is considered a feasible intake location. The site has existing use as a playground and is planned for further development, which would provide a significant constraint.

[1] 1513 Pop_Denison_Park_Masterplan_Report.indd (nsw.gov.au)

Figure 10: Lighthouse Beach Area desalination site options

2.2.6.1 Raw water intake and Brine disposal

The site is in close proximity to both the ocean and the mouth of the Richmond River, which provides opportunities and challenges depending on the operating philosophy of the plant. Two options for both the intake and brine discharge have been considered, with Option being a more traditional planned approach and Option 2 being an emergency response.

- Option 1 – an ocean intake and brine outfall are constructed using HDD as discussed in previous options. The intake and outfalls lengths would be approximately 1000 metres to reach 10 metres depth, and separated by at least 500 metres to prevent recirculation. The intake would be place further from the river to lessen the risk of fluctuations in water quality, however given the size of the Richmond River catchment this is unlikely to be enough distance to prevent water quality impacts in a significant event.
- Option 2 – In the case of an emergency, an intake from the river from either Shaws Bay or the river channel could be constructed at a low cost and delivery time. The intake could be a pontoon structure or fixed to the breakwall to provide stability. This intake would be heavily impacted by changes in water quality in the Richmond River and is therefore appropriate only as temporary drought option or, in low to medium freshwater events, possibly on incoming tides with the plant operating at a lower capacity.

  The brine outfall could be constructed by sinking sections of pipeline along the northern edge of the breakwall to protect the structure from storm conditions from the predominantly south easterly swell. The pipeline would be fitted with diffusers to increase dilution, but the shallower depth and proximity to a hard structure which generally has high concentration of marine fauna would likely mean higher biodiversity impacts, albeit temporarily. The structure would also be vulnerable to north westerly swell conditions, typically associated with tropical storms/cyclones.

Options 2 is considered feasible in a situation where the community and stakeholders are accepting of the emergency situation and are tolerant of higher levels of impact to their use of this community space, and would need to be progressed with significant engagement with constituent Councils and government departments.

2.2.6.2 Treated Water

For options of 2 or 5 ML/d, a connection to the East Ballina Reservoir owned by Ballina Shire Council has been assumed. The reservoir is of 10 ML capacity and is linked to the larger Pine Avenue Reservoir, which has sizeable trunk mains both north and south which would likely enable distribution of at least 5 ML/d to Ballina customers. The operating mode and pump heads for the reservoir would need to be confirmed with Ballina Shire Council to understand whether further network augmentations would be required to service customers at specific desalination plant capacities.

Figure 11: Ballina Shire Council water network infrastructure based on GHD (2015)

3 Strategic Program

The information gained from other desalination projects regarding lead times for planning, design, procurement, and construction have been used to inform high-level delivery programs for permanent and drought response plants.

3.1 Permanent Plants

The program for delivery of a permanent plant has been divided into the components detailed in Table 3-1.

Table 3-1: Tasks and descriptions for baseline program

Component		Description
Planning	Initial Planning Works	Project Inception, stakeholder briefings, project description
	Environmental, Social and Regulatory risks	Preparation of scoping report and receiving SEARs.
		Approval through the State Significant Infrastructure (SSI) process (i.e. EIS process).
		Required licenses/approvals such as Section 60 & Environmental Protection License (EPL) processes.
Feasibility & Design	Feasibility / investigations	Survey, geotechnical and water quality data.
	Design	Development of desalination design including process engineering, mechanical engineering, civil/structural engineering, electrical engineering, safety engineering and relevant design deliverables culminating in Issued for Construction (IFC) designs and construction management plans (MPs).
Procurement	Procurement Planning	Development of Procurement Strategies and preparation of contract. Completion of Financial Approvals and appropriates governance, including delegations for drought decision making.
Procurement	Procurement Implementation	Tender and lead times for key equipment including the desalination unit, bulk pipes, tanks and electrical items
Construction & Commissioning	Construction	Key construction items including laying slabs for treatment plant area, construction of WTP equipment, mechanical & electrical installations, and major pipelines.
	Commissioning	Includes testing and commissioning of equipment period, when finished water be available to the network.

Permanent plants are assumed to be wholly delivered in non-drought periods under standard procurement, design and delivery timeframes. Options to defer some assets until the appropriate drought trigger is reached have been considered, which would generally require that the intake and outfalls, power connection and some

site civil assets to be delivered prior to the drought, allowing some process units to be deferred. However, the long lead time of high-pressure pumps for the scale of plants being considered, and the uncertainty that containerised desalination units will be available, particularly for larger plants, means that a drought response delivery is not practical.

The assumption for permanent plants is that there is a much higher focus on delivering long-life assets and optimising the plant to reduce power and labour resources over the operating life of the plant, than would be necessary for a temporary drought response plant. A standard non-drought program for Rous is provided in Table 3-2, which assumes that normal development and delivery processes would be followed, and that subsequent tasks will not progress until approvals are received. Therefore, this represents the lower risk approach which will result in maximised delivery and operational efficiencies.

An alternative high-risk approach has also been included, which may be achievable for a 10 ML/d plant. This approach would require procurement and construction activities to begin prior to the approval being received, and for some design and construct activities to be running in parallel. This is a high-risk approach which will likely incur additional costs to parallel tasks and constructors pricing for additional risk and is not a recommended approach.

Both programs begin from the approval of the preferred site and a decision to progress though the required delegated authorities. For projects which include funding contributions above $10m from the NSW state Government, this may include financial approval through the Infrastructure Investor Assurance Framework administered by Infrastructure NSW.

The sequencing and overlap of tasks is shown in Appendix I.

Table 3-2: Delivery Program for Permanent Desalination Facility from site selection and option approval

Tasks	Standard		High Risk	
	Duration	Cumulative Duration	Duration	Cumulative Duration
Project Inception, stakeholder briefings, project description	8 weeks	8 weeks	8 weeks	8 weeks
Preparation of scoping report and receiving SEARs.	14 weeks	22 weeks	14 weeks	22 weeks
Feasibility / investigations	12 weeks	34 weeks	12 weeks	34 weeks
Concept Design	40 weeks	74 weeks	40 weeks	74 weeks
Planning Approval (EIS)	80 weeks	102 weeks	80 weeks	102 weeks
Procurement Planning, Governance and Finance Approvals	36 weeks	128 weeks	10 weeks	102 weeks
Design and Construct	144 weeks	272 weeks	52 weeks	152 weeks
Power Augmentation	78 weeks	206 weeks	12 weeks	152 weeks
Commissioning	16 weeks	280 weeks	8 weeks	155 weeks

3.2 Drought Response Plants

A summary of the key component of the Drought Response delivery approach is included as Table 3-3.

Table 3-3: Summary of drought delivery project components.

Component	Value
Minimum Preparation Period (upfront works)	27 months
Drought Response Mobilisation Trigger	70% Storage Level
Drought Response Delivery Trigger	50% Storage Level
Drought Response Delivery Period	Up to 12 months
Commissioning	0-20% Storage Level
Supply Capacity	5 ML/d (Moderate Risk Program) 10 ML/d (High Risk Program)
Emergency Demand (at 2025)	22.7 ML/d
Supply Shortfall (at 2025)	12.7 to 17.7 ML/d

The available time to deliver a drought response desalination plant, or to finalise delivery of a permanent desalination facility, is determined by the time between an appropriate storage level to implement responsive works and the point where that supply is required. Whilst the basis of this approach is theoretically sound, there have been mixed results in implementation. For example:

- Sydney Water, Melbourne Water and Gold Coast City Council delivered desalination plants in response to drought conditions during the Millenium Drought. The projects had delivery periods of greater than 48 months, incurred significant costs, and the Gold Coast and Melbourne plants may not have been able to provide supply when required if the drought had not broken prior to reaching that point due to construction delays or material failures.
- In the 2019/20 drought period, Hunter Water began implementation of a 30 ML/d drought response desalination plant at Belmont following storages dropping to the response trigger of 70%. By time the drought broke, storages had reached 52% and the delivery program for Belmont was unlikely to be achieved if the drought continued with similarly low inflows to the 12 months prior.
- In the same drought, Mid Coast Council began delivery of an 8 ML/d desalination plant at Nabiac with some elements being constructed before the drought broke in February 2020. The availability of containerised desalination units meant that the supply would be initially limited to 3.5 ML/d and 5.5 ML/d, before reaching the full capacity required.

The programs developed attempt to balance the aims of deferring expenditure and meeting the target delivery date. However, given that the proposed approach relies on the availability of desalination units, third party constructors, and specialised material and labour resource, it is not possible to have certainty that this will be achieved, particularly in a scenario where drought is widespread and competition for desalination units and/or specialised labour and materials is high. If drought response desalination is preferred over alternative options, what upfront works are implemented will be a risk decision for Council, and should be reviewed as additional information becomes available, particularly from on-site investigations and discussion with delivery contractors.

Key assumptions include:

- Tasks are progressed in parallel, meaning that normal review and approval processes at critical control points, for example between development or delivery stages, are not occurring. This significantly increases the risk that omissions or errors in design lead to issues in delivery and/or operation.
- Efficiencies in plant operation, particularly in terms of labour and energy use, are not prioritised and normal processes to optimise design, delivery or operation are not undertaken to the same extent.

- The program assumes generators will be used for power supply and no augmentation to the power network is proposed.

3.2.1 Potential Trigger Point

An appropriate drought trigger is a storage level which is reached at a low enough frequency that the likelihood of investment each year is low (for example, 1 in 50-year or 1 in a 100-year likelihood) but also that allows enough time to enable a material portion of the investment to be deferred. For this project we have assumed that a reasonable storage level for a drought response would be 50% or lower given that this level has only be reached once in the previous 100 years (see Figure 12) and may allow enough time to defer much of the desalination plant investment.

The frequency of reaching this storage level will increase over time due to growth, and potentially due to changes in the underlying climate, and should therefore be monitored and adapted over time. The benefits in further decreasing the likelihood of reaching the trigger through demand management optimisation of existing supplies is outside of the scope of this work but should also be considered.

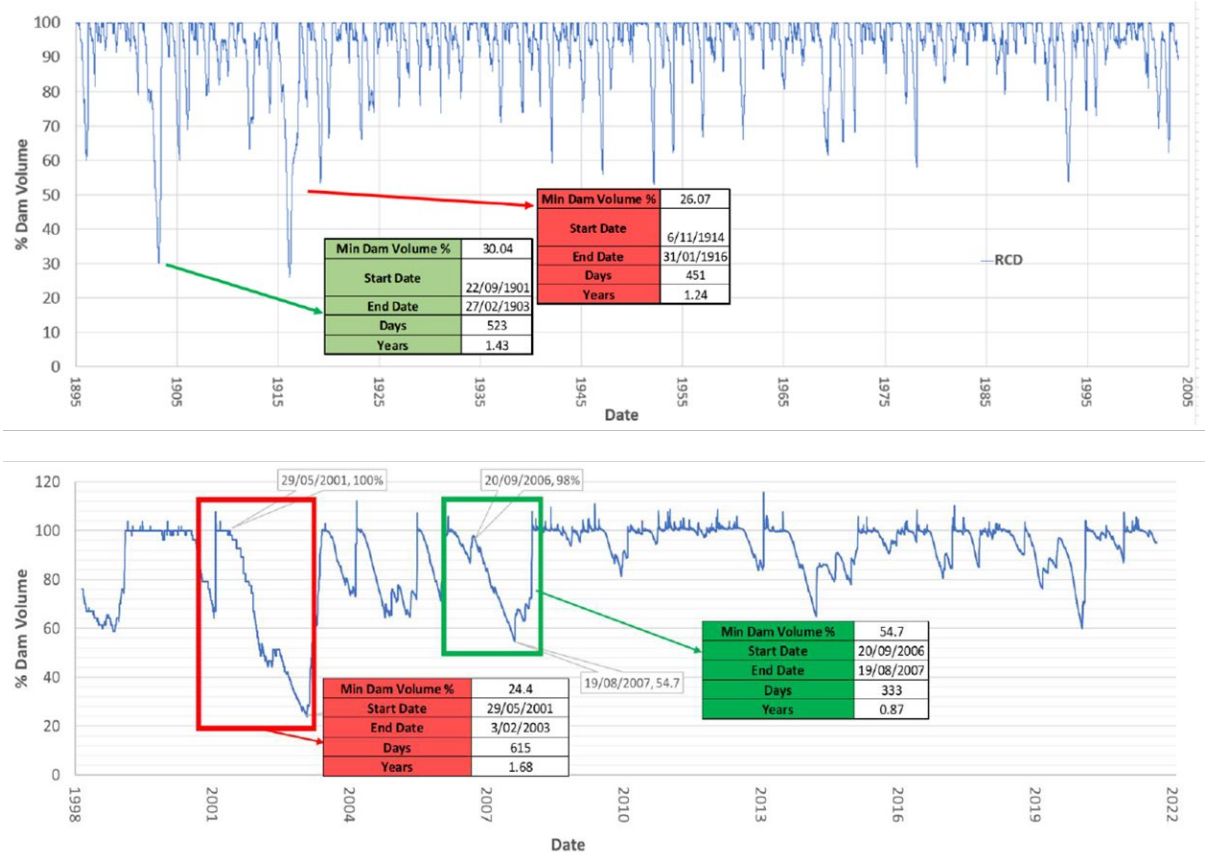

Figure 12: Extract from Engeny (2023) showing dam storage levels over time.

3.2.2 Drawdown Period

Data provided by Council shows drawdown periods for the current system in two scenarios:

- A severe drought, defined as the repetition of the worse historical year for inflows into existing sources (1915).
- A catastrophic drought, defined as a severe drought with rainfall capped at 5 mm/d and inflows to sources capped at 1 percentile of historic inflow data.

The data indicates that a 'Severe' drought event can lead to dam levels dropping from 100% to 30% in about 13 months, and Rocky Creek Dam potentially becoming empty after 20 months. In a 'Catastrophic' drought, the time between 100% and empty for Rocky Creek Dam falls to 15 months.

Based on these drawdown scenarios, Council have provided the trigger levels and response periods which would lead to commissioning of a desalination plant at a range of storage levels (0%, 20% or 40%) in Table 3-4, with additional detail included in Appendix J.

Table 3-4: Dam depletion time in months provided by Rous County Council, based on internal Council modelling for a 'Severe' and 'Catastrophic' drought scenario.

Target Implementation	Severe Drought Scenario				
Dam Level	6 months	9 months	12 months	15 months	18 months
0%	25%	35%	50%	70%	85%
20%	45%	60%	80%	95%	>100%
40%	75%	90%	>100%	>100%	>100%

Target Implementation	Catastrophic Scenario				
Dam Level	6 months	9 months	12 months	15 months	18 months
0%	35%	60%	80%	>100%	>100%
20%	60%	85%	>100%	>100%	>100%
40%	>100%	>100%	>100%	>100%	>100%

Assuming the adoption of a 50% storage trigger from section 3.2.1, the following can be derived:

- For a severe drought scenario, up to 12 months may be available for response actions if the plant is commissioned at 0% storage levels.
- For a severe drought scenario, a lead time of 7 months may be available for response actions if the plant is commissioned at 20% storage levels.
- For a catastrophic drought scenario, a lead time of 8 months may be available for response actions if the plant is commissioned at 0% storage levels.

A preferred target level for commissioning the plant (which determines whether the supply acts to slow the depletion of the existing system, provides potable supply once all over sources have been depleted, or both) has not been determined by Council. The estimated emergency demand at 2025 is 22.7 ML/d, which his higher than achievable through a drought response plant. As such, additional sources will be required to supplement emergency supplies.

The preferred risk scenario, 'Severe' or 'Catastrophic', has also not been determined by Council and the true likelihood of either scenario is unable to be determined given the short instrumental record for climate in the region, the uncertainty created through natural climate variability, and the additional variability possible through anthropogenic climate change.

As such, multiple delivery programs are discussed to cover the potential delivery periods to be assumed, which will be subject to risk-based decisions by Council.

3.2.3 Drought Response Delivery Programs

The delivery programs have been developed by comparing:

- the scope of works and durations as shown in Table 3-8, which includes the works to be undertaken, duration and timing for the three drought scenarios,
- the time available, as determined by the appropriate trigger point and drawdown period in sections 3.2.1 and 3.2.2, and
- the time required as shown in Table 3-8.

In these table, the following definitions apply:

- Simple intake and outfall – no marine directional drilling or tunnelling. Intakes and Outfalls are either attached to pontoons, existing marine infrastructure or laid on the seabed in an area with some protection from wave energy.
- Complex intake and outfall – Any intake or outfall which requires directional drilling, pipe jacking, tunnelling or similar.

It is assumed for these delivery programs that the project would progress through standard approvals. It is possible that Council could adopt the approach that little or no pre-work is done, and that in the emergency drought situation environmental approvals would be set aside by the State government. Council could mobilise in that scenario to deliver a plant in a similar way to other emergency scenarios, such as earthquakes, cyclones, flood events etc.. This would be in some ways similar to the position Mid Coast Council were in when they progressed their drought response plant in 2019/20, which was enabled by the Water Supply (Critical Needs) Act 2019. However, in the Mid Coast Council scenario the proposed plant used a river intake and brine disposal, and Council already owned the site, which was an operating water treatment plant with existing chemical dosing and potable network connections. The delivery timeframe for 3.5 ML/d was still approximately four months, and in the case of Rous County Council they do not own any of the potential sites, the sites are not currently operating water facilities, and more complex intake and outfall structures are required. It is not recommended that Council adopt a fully reactive approach.

3.2.3.1 Scope of works

The scope of works in Table 3-5 is based on readiness activities which are required prior to the drought to enable a drought response plant to be delivered, preparation within the organisation as the trigger level approaches, and the execution/implementation of the delivery works.

Readiness Activities

Based on the scope of works, it is expected that a minimum of 27 months for readiness activities assuming that no infrastructure is required to be delivered upfront. These steps will provide planning approval for delivery of a plant and all required financial approvals, including State Government IIAF approval if required, and agreements with constituent Councils and landholders to connect to third party infrastructure and utilise third party land as required.

It should be noted that the conditions of approval for an EIS for State Significant Infrastructure lapse after 5 years, meaning that the design and approval will need to be re-submitted every five years to maintain currency unless a longer period can be negotiated with the State government. An overview of the potential scope of works for an EIS is included as Appendix K as a guide.

In the case of a 'Catastrophic' drought scenario where the response period is six months, the intake and outfall will need to be constructed upfront as readiness activity 3, and for some options the potable water connections may also be required upfront depending on the complexity and scale of the construction.

Drought mobilisation

It is expected that the drought response project will essentially be 'shelved' until required, meaning that resources, internal approvals and external agreements will need to be refreshed/reviewed as the drought response trigger approaches. This period is essentially required to ensure that Council are ready to execute contracts and mobilise internal and external resources at the trigger point. As with the delivery trigger level, the frequency of reaching the drought mobilisation trigger needs to be low enough to be practical, whilst enabling enough time to respond.

Execution and Implementation

The implementation stage has been separated into two phases to account for the different cash flows for the complex intake and outfall and the balance of plant expenditure. Construction of a complex intake and outfall is considered high risk given the impact that geotechnical and weather conditions can have on the delivery timeframe, so the full 12 months is allowed for mobilisation, construction and connection to the desalination plant.

The highest risk for the balance of plant is the availability of the containerised process units and the high-pressure pumps. It has been Council's experience that lead times are very long and supply contracts are required to be executed with payment on delivery. Given the compressed delivery timeframe, it is more likely that the terms of those contracts are unlikely to be favourable for Council with significant costs to break the contract.

At any point in time, if a termination of a contract at Councils direction is to occur, then Council may still incur costs for material not required and works not undertaken.

Initial orders to confirm availability can be undertaken at the execution of the contract, but delivery and installation of the unit and remainder of the plant could be deferred until the final six months. The key benefit of separating these delivery packages is the potential to defer costs of lower risk items if the drought breaks.However, it is importnat to note that there may be signifciant costs which may be incurred to exit delivery contracts where works do not progress. These costs would be negotiated during the procurement phase and are likely to be significant. As such, Coucnil will need to be willing to approve funding releases on the understanding that the funding may be committed even if the drought breaks. A breakdown of potential committed costs using the Lighthouse Pde sites as an example is provided in Table 3-6.

Table 3-5: Delivery phases for drought response desalination plants

Phases	Key Activities	Duration	Severe, Simple Intake	Severe, Complex Intake/Outfall	Catastrophic
Preferred Option Decision					
Readiness actions 1	Strategic Execution Plan Planning Approval (Environmental Impact Assessment), Concept Reference Design, Community Engagement and Exhibition Procurement and Governance Strategy	18-24 months	Upfront	Upfront	Upfront
Readiness actions 2	Concept and Detailed Design Completion of Financial Approvals (Council/State) Completion of third-party agreements (e.g. MOUs with landholders)	9 months			
Readiness actions 3 (if required)	Delivery of critical upfront infrastructure (potable water connection and/or intake and outfall structures)	12 months	Deferred	Deferred	
Mobilisation	Mobilisation of project team Preparation of contracts Critical stakeholder engagement Design and site access review	3 months	3 months prior to 50%		
Execution	Execution of contracts	Milestone	50% Storage Level		
Implementation Package 1	Site establishment Construction of intakes/outfalls and potable water connections (if required) Confirmation of order for desalination units, pumps, tanks and valves.	See Table 3-8	25-50% Storage Level	50% Storage Level	50% Storage Level
Implementation Package 2	Receipt of desalination units and construction of Balance of Plant		25-50% Storage Level	25-50% Storage Level	50% Storage Level
Operation at 0% or 20% Storage Level					

Table 3-6:Example commited costs at project stages.

			Lighthouse Pde (no HDD)		Lighthouse Pde (HDD)	
Phases	Key Activities	Trigger	Approval	Cumulative Total	Approval	Cumulative Total
Mobilisation	Mobilisation of project team	70%	Internal costs to reallocate resources to contract and procurement review, approval documetns, regulator, community and stakeholder engagement, design review and market engagement.			
	Preparation of contracts					
	Critical stakeholder engagement					
	Design and site access review					
Execution (Desal Plant)	Containterised desal (100% supply fee at execution, 75% of total contract costs committed prior to delivery to site in case of cancellation)	50%	$1,722,667	$4,095,963	$1,722,667	$4,608,864
Execution (Civil)	Civil contract - 3 months committed costs		$2,373,296		$2,886,197	
9 months remaining	Intake/Outfall drilling starts (if required), 75% payment Civl contract - incurred plus 50% assumption above base	40%	$1,186,648	$5,282,611	$6,188,041	$10,796,904
6 months remaining	Exectution of contract for Balance of Plant (electrical, tanks, pumps, etc.) 100% of intake outfall committed cost 100% of desalination plant costs committed, less operator labour	25%	$5,302,998	$10,585,609	$5,608,962	$16,405,866
3 months remaining	100% of delivery costs committed	12%	$4,203,758	$14,789,367	$4,523,706	$20,929,572
0 months remaining	100% operational costs committed	0%	$2,252,850	$17,042,217	$2,252,850	$23,182,422

3.2.3.2 Time Required

Estimated delivery timeframes for drought response options are outlined in Table 3-8. The timelines are driven by the likelihood of containerised desalination units being available and/or the expected delivery timeframe for intake and outfall structures, which is discussed in more detail in Appendix A. A critical input to the delivery timeframes is the expected availability of desaliantnatiin units as per

Table 3-7: Containerised desalination availbility based on advice from Osmoflo

Capacity (ML/d)	3 months	6 months	12 months	18 months	24 months
<1	Likely	Highly Likely	Highly Likely	Highly Likely	Highly likely*
1 to 4	Possible	Likely	Highly Likely	Highly Likely	Highly likely*
4 to 10	Unlikely	Possible	Likely	Highly likely	Highly likely*
10 to 20	Rare	Rare	Possible	Highly likely	Highly likely*
>20	Rare	Rare	Unlikely	Likely*	Highly likely*

The timeframes apply only to the implementation phases, and therefore assume that all readiness activities are complete, and the organisation is prepared to execute contracts and release funding. Experience from other drought response programs has shown that the delivery organisation needs to be in an emergency mindset, and authority to release funds and procure services needs to be appropriately delegated once the drought trigger has been reached. The supplier stressed that although these timeframes and risks are based on consideration of drought scenarios, there is no way to anticipate the broader demand at that point in time, and local or international market demand may mean units are unavailable for supply.

Table 3-8: Delivery periods for 5 and 10 ML/d drought response desalination plants.

5 ML/d Capacity	High Risk	Moderate Risk
Rous - Emergency – Simple Intake and Outfall	6 Months†	9 Months^
Rous - Emergency – Complex Intake and Outfall	9 Months^	12 Months^
10 ML/d Capacity	**High Risk**	**Moderate Risk**
Rous - Emergency – Simple Intake and Outfall	12 Months†	15 Months†
Rous - Emergency – Complex Intake and Outfall	12 Months†	15 Months†

^ Timeframe determined by desalination unit availability† Timeframe determined by intake/outfall construction

3.2.3.3 Practical Delivery Timeframes

Based on the scope of works, an assumed delivery timeframe of 12 months based on a 50% storage level trigger, and the required delivery timeframes, the following can be derived:

- Only a 5 ML/d plant can be delivered in a severe drought scenario under a moderate risk program.
- A 10 ML/d plant can be delivered in a severe drought scenario under a high-risk program. The drought mobilisation trigger would be 65%.
- For a 10 ML/d plant, drought mobilisation would be required 18 months from 0% storages in a moderate risk program (i.e. 3 months before the trigger), which would be at a 85% storage level (Table 3-4). This is not considered practical, meaning that only the high-risk program in a severe drought scenario is possible for a 10 ML/d plant.

- Only a 5 ML/d plant with a simple intake under a high-risk program could be delivered in a catastrophic drought scenario. Drought mobilisation would need to begin between the 70% and 75% storage level.

These outputs are summarised in Table 3-9.

Table 3-9: Deliverability confidence for drought response options under drought scenarios, assuming 50% drought response trigger.

Deliverability	5 ML/d		10 ML/d	
	High Risk	Moderate Risk	High Risk	Moderate Risk
Severe Drought				
Simple Intake and Outfall	✔	✔	✔	x
Complex Intake and Outfall	✔	✔	✔	x
Catastrophic Drought				
Simple Intake and Outfall	✔	x	x	x
Complex Intake and Outfall	x	x	x	x

4 Comparative Costs

Comparative costs were developed for emergency and permanent options. The preliminary order of magnitude costs presented have been developed solely for the purpose of comparing and evaluating competing options. They are sufficiently accurate to serve this purpose. They cannot be used for budget-setting purposes as common elements between options may have been omitted and/or the works not fully scoped. A functional design should be undertaken if a budget estimate is required.

In discussion with the Council project manager, it was determined that the 5 ML/d option for the emergency sites should be developed for comparison purposes. Where an increase in the capacity to 10 ML/d would significantly change the ranking of options on cost, this has been noted.

The costs include:

- Survey, Investigation, Design and Project Management costs; the SID component can vary from 5% to 20% depending on the complexity of the project. An allowance of 15% of the project cost was applied for emergency sites, and 11% for permanent sites.
- Construction management costs was assumed to be 10% of the contract award sum for both internal and external parties for emergency sites, given the high complexity and likely increased rates required to meet short timeframes. For the permanent sites, this was lowered to 5% for both internal and external parties given the efficiency of scale and lower time pressure.
- An inherent risk contingency of 15% to allow for uncertainty in the scope of work, uncertainty in the costs to be applied and uncertainty in site conditions.
- A strategic risk contingency of 15% to account for factors beyond the control of the designers or constructors, such as industrial issues, adverse weather, availability of labour and materials and extensions of time due to unforeseen circumstances.

4.1 Permanent Plant Costs

A summary of the option costs are included in Appendix M and Figure 13.

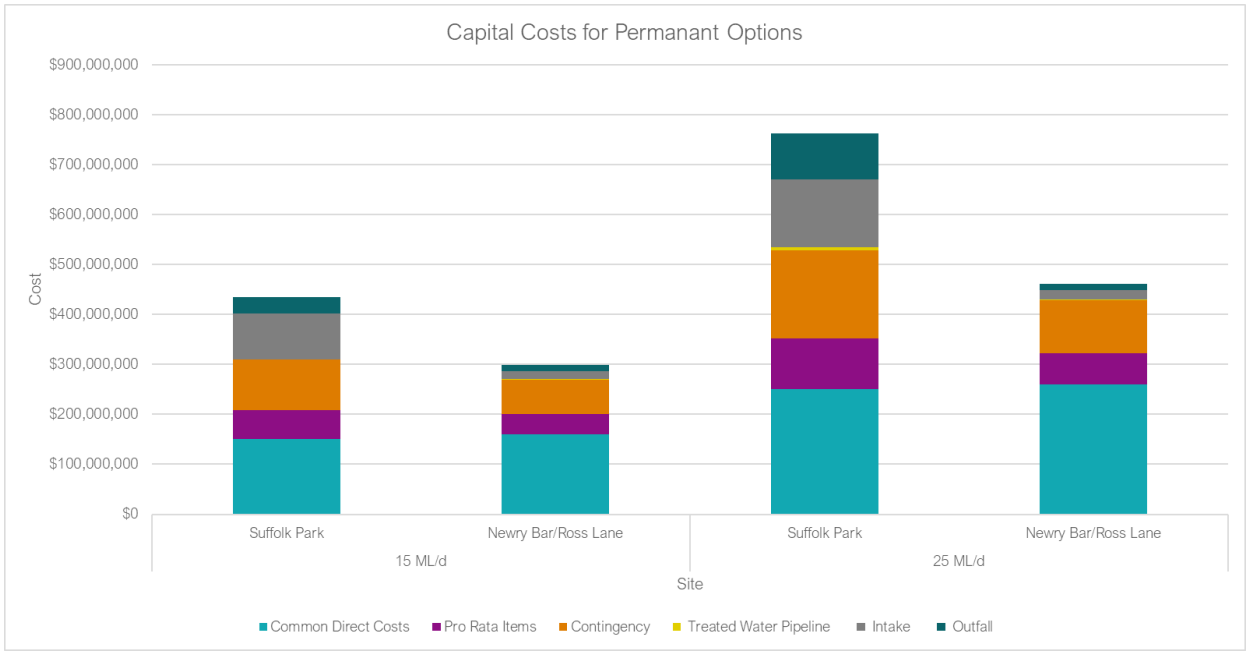

Figure 13: Comparative Costs for 15 ML/d and 25 ML/d options at Suffolk Park and Newrybar/Ross Lane

For permanent plants, the costs have been developed based on industry benchmark intake and outfall costs provided in Voutchkov 2019, and a unit rate of $10M/ML for the balance of plant. For the 15 ML/d plant, intake costs are assumed to be $40,000 per meter and outfall costs $14,000 per metre. For the 25 ML/d plant this is increased to $60,000 and $40,000 per metre respectively. The actual costs will be heavily dependent on the geotechnical conditions at each site, which are currently unknown. The assumed values are considered reasonable when benchmarked against similar projects which have difficult geotechnical conditions and similar capacities, but the costs should be considered indicative.

Net Present Values (NPV) for the options have been developed based on the following assumptions:

- a 5% discount rate, with 3% and 7% discount rate as sensitives.
- NPV was estimated over an 40-year period as per advice from Council, with the plant components and useful life estimates as per Table 4-1, and depreciation applied using the straight-line method.

Table 4-1: NPV asset assumptions

	Electrical	Mechanical	Civil
% of CAPEX	20%	30%	50%
Useful Life	30 years	50 years	100 years
Residual value	10%	10%	10%

- The operating and maintenance costs were developed from accepted percentage values applied to previous estimates for desalination plants and include annualised membrane and filter replacement costs.
- The capital costs are assumed to follow a three-year design and approvals phase and a four-year delivery phase, with delivery spending assumed to be 10% in the first year and 30% for each remaining year.

The results for Suffolk Park and the lower cost Newrybar/Ross Lane option are shown in **Error! Reference source not found.**, with a summary table for Newrybar total costs included as Table 4-2.

Table 4-2: Net Present Value comparative costs, assuming trench and HDD for Newrybar/Ross Lane.

Discount Rate	15 ML/d		25 ML/d	
	Suffolk Park	Newrybar/Ross Lane	Suffolk Park	Newrybar/Ross Lane
3%	-$371,773,029	-$358,251,620	-$809,040,766	-$566,926,672
5%	-$408,275,286	-$310,099,506	-$720,741,984	-$487,817,921
7%	-$360,620,177	-$267,394,698	-$633,659,907	-$418,906,728

Table 4-3: O&M and Capital/NPV Costs for Newrybar

O&M Cost Summary		
Plant Size	25 ML/d	15 ML/d
Variable O&M Costs		
Power	$5,948,276	$3,568,966
Chemicals	$905,172	$543,103
Replacement of membranes and filters (annualised)	$1,030,220	$618,132
Waste disposal	$646,552	$387,931
Subtotal variable	$8,530,220	$5,118,132
Fixed O&M		
Labor	$707,071	$424,242
Maintenance	$707,071	$424,242
Environmental and Performance Monitoring	$265,152	$159,091
Indirect O&M Costs	$1,237,374	$742,424
Subtotal, fixed O&M costs	$2,916,667	$1,750,000
Total O&M Costs (p.a.)	$11,446,887	$6,868,132
Newrybar Site (Trench+HDD)		
Captial Cost	$461,697,365	$299,509,739
NPV (40 years, 5%)		
Total O&M	-$130,454,473	-$78,272,684
Capital		
Initial Capital	-$362,661,413	-$235,263,689
Replacement Costs *(assume 90% replacement)*		
Electrical	-$18,776,492	-$12,180,581
Mechanical	$0	$0
Civil	$0	$0
Total Capital	-$381,437,904	-$247,444,270
Total Residual Asset Value	$24,074,459	$15,617,449
NPV40	-$487,817,918	-$310,099,505
Low -30%	-$341,472,543	-$217,069,653
High +50%	-$731,726,877	-$465,149,257

The primary driver of difference between the sites is the length of the intake and outfall structure. The other key differentiator will be the power connection requirements for each site, with Suffolk Park next to an existing substation and expected to be a low cost to connect, whilst Newrybar/Ross Lane may require upgrading or installation of a new 11 kV line from the site to Lennox Head Substation. An allowance of $10m direct cost has

been included in the Newrybar/Ross Lane estimate based on advice from Ausgrid on recent projects which included new 11 kV distribution lines of similar distances.

At $15-20M/ML for the lower cost options, the costs are significantly higher than those developed in the Ganden (2021) options report, which were in the order of $10/ML. This is consistent with the review undertaken in the Strategic Consideration Memo (Appendix A), which indicated that the Ganden cost estimates were not reflective of current delivery rates.

4.2 Drought Response Costs

A summary of the Drought Response option costs are included in Appendix L and Figure 14.

The costs have been developed from several sources, but are predominantly based on the costs from the Nabiac emergency desalination plant delivery undertaken by Beca HunterH2O with MidCoast Council in 2019, and available industry rates, including pipeline supply and installation rates for trenched and HDD pipelines. It should be noted that this cost build-up assumes a temporary plant with an assumed running period of 6 months, and that efficiencies in operation are a secondary consideration to the delivery timeframe and ability to reliably supply water. The assets are considered temporary, and a plant intended to operate for a longer period would not use the same components - therefore there is not a linear relationship between emergency and permanent plant costs.

The outcome of the costs is that the difference between sites is predominantly driven by the intake and outfall costs. In higher cost options, such as Suffolk Park, Tallows Beach and Newrybar/Ross Lane, the direct intake and outfall costs represent up to almost 50% of the total capital cost of the project. This flows through to higher pro-rata costs and contingencies, leading to a cost difference of up to double that of sites where the intake and outfalls are shorter. This is not a novel outcome, with the proximity to ocean general recognised as a key consideration to the preferred site for desalination site selection (as per Appendix A), however in this case it is primarily driven by the requirement to avoid the Cape Byron Marine Park rather than distance to the coast.

It should be noted that the intake and outfall costs for these options were developed based on HDD rates, but it is recognised that that construction methodology is unlikely to be feasible for some of these options (see section 2.2.3.1). As such, HDD rates should be considered for comparative purposes only.

An element not costed which may become a differentiator between sites is the land cost, which is difficult to quantify without engagement with the landholders. An allowance has been included for site rehabilitation, with sporting fields and public spaces assumed to have a higher requirement for Council to reinstate the grounds following the drought, but it has been assumed that land rental rates are common.

The costs are shown in Figure 14.

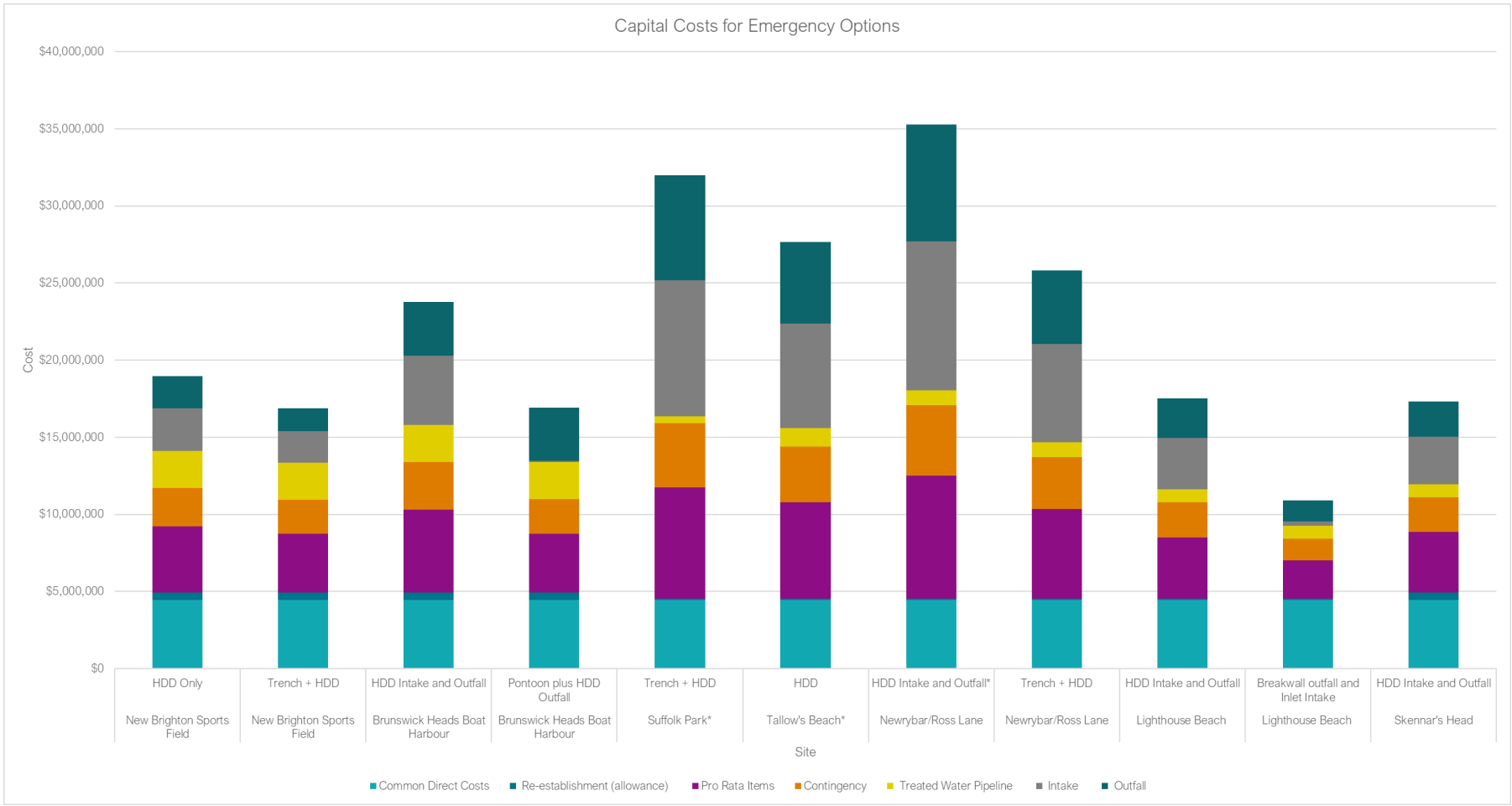

Figure 14: Capital Costs for the 5 ML/d plants at the shortlisted site options, noting that Suffolk Park, Tallow's Beach and the HDD Intake and Outfall option for Newrybar/Ross Lane is based on HDD rates.

4.2.1 Upfront Costs

A critical consideration for drought response plants is the cost of preparation works to enable the required response to be delivered in the available timeframe. As per Table 3-5, significant work is required to develop the EIS and design work to enable delivery of the plant. Assuming pro-rate costs of 3% and 6% for the EIS/Refence Design phase and Detailed Design phase respectively, the upfront costs for the shortlisted options ranges from $1.1 to $3.6m, as per *Figure 15*.

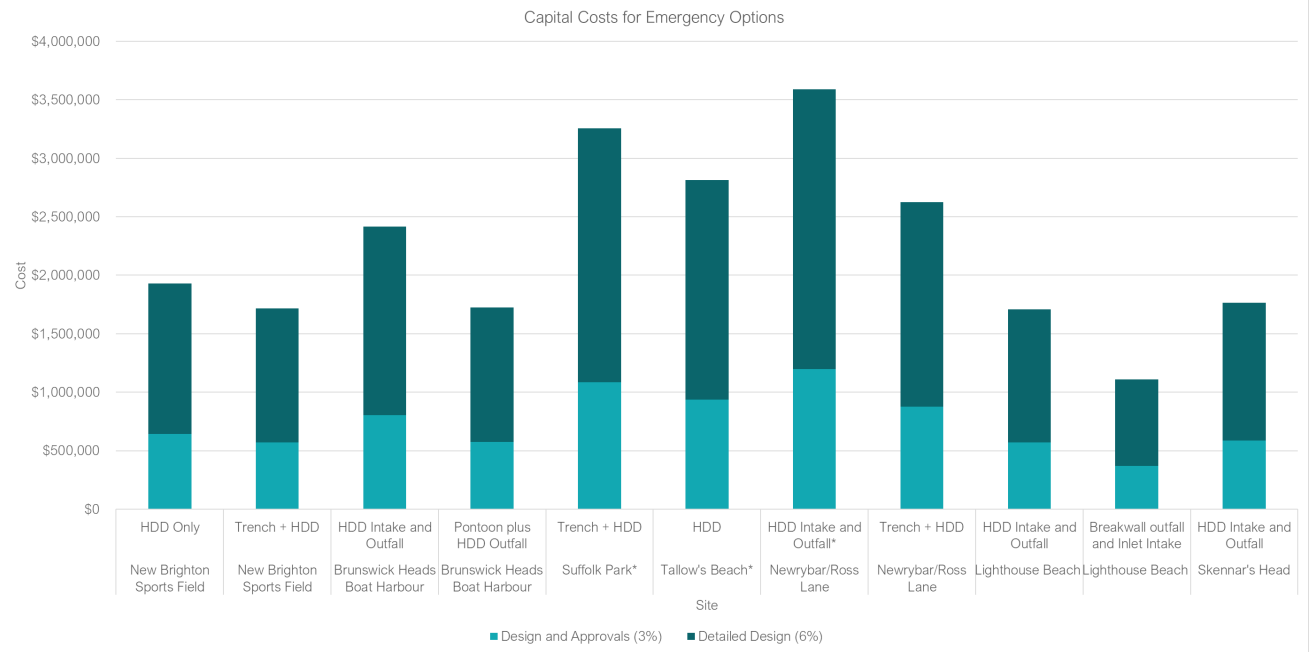

Figure 15: Summary of EIS/Reference Design and Detailed Design pro-rata costs for shortlisted options.

5 Multi-Criteria Assessment

A multi-criteria assessment (MCA) was undertaken with the Council project team to develop a ranking of sites in order of preference, based on the information available. The process began with a longlist of cost and non-cost criteria, which were reduced in stages to isolate the key factors which differentiated the shortlisted sites. Cost and non-cost criteria were then weighted based on the impact the criteria had on whether a site was or was not preferred. Scoring of options was undertaken and reviewed through the workshop, and a ranking of sites was endorsed by the workshop attendees.

The approach follows a general hierarchy of decision making as:

1. Removal of infeasible or practically infeasible options.
2. Removal of dominated or practically dominated options, which are defined as options which score worse against all criteria (dominated) or score better in only one criterion which is considered to be less valuable than the other criteria (practically dominated)
3. Assessment of options through weighted criteria, with weightings in this case created through a pairwise process.

5.1 Permanent Sites

Two permanent sites were shortlisted and progressed through site feasibility investigations and the MCA workshop, these being the Suffolk Park and Newrybar/Ross Lane sites.

To efficiently compare the sites, differentiating non-cost criteria were isolated from the longlist of criteria used in the shortlisting process Differentiating criteria were determined as those which differed in scoring for the shortlisted sites or were considered easily managed based on the site characteristics. For example, Koala Habitat was not considered to be present at Suffolk Park but present at the Ross Lane site, however the Ross Lane site is expected to be large enough to move the plant footprint to avoid any habitat impacts. For reference, the non-differentiating criteria are included as Appendix O .

The differentiating non-cost criteria are shown in Table 5-1 along with the comparative costs.

Given the significant difference in comparative costs, in line with dominant/practically dominant decision making, participants in the MCA workshop were asked whether the non-cost criteria were reasonably expected to overcome the significant difference in costs for the two options, which was predominantly driven by the longer intake and outfall structures. The workshop considered the non-cost criteria to be significantly less critical to the project success given that:

- Impacts to Cultural Heritage and Vegetation Communities are expected to the manageable given the long delivery timeframe, and the potentially more impacted sites being large enough alter the plant footprint to potentially avoid high impact areas.
- In both cases land will need to be purchased. Given the long lead time of the project it is expected that negotiations with different land holders would be manageable.
- Cost impacts Marine – this criterion further strengthens the case for Newrybar/Ross Lane over Suffolk Park.
- Cost impacts Power – An allowance of $10m has been included in the Newrybar/Ross Lane comparative costs. If a higher connection fee is required, it is not expected to be equivalent to the current cost difference given the location of the Lennox Head substation.

Given the above, Newrybar/Ross Lane was determined as the preferred site based predominantly on cost and the lack of significantly differentiating non-cost criteria.

Table 5-1: Differentiating criteria for permanent sites.

Crtieria	Description	Sites	
		Suffolk Park SubStation	Ross Lane
Cultural Heritage	Aboriginal or non-Aboriginal heritage sites may lead to sites being unsuitable.	None listed on site or in area	Council Heritage Site or AHIMS sites in neighbouring sites
Vegetation Communities / Land	Vegetated areas of high value outside of National Parks, for example, State Conservation Areas. Includes seagrass meadows for intake/outfall structures.	Construction area includes vegetation	Construction area has no vegetation
Land Ownership	Land already owned by Council will lead to cost and time savings, as well as reduce program risks.	Empty site of Council or State ownership	Private or Crown landholding with minimal current use
Cost Risk - Marine	Critical cost differentiator will be intakes and outfalls and power, with the final costs unable to be known priorir to further investigations and design		
Cost Risk - Power	Critical cost differentiator will be intakes and outfalls and power, with the final costs unable to be known priorir to further investigations and design		
Cost		**$844,316,709**	**$516,032,352**

5.2 Drought Response Sites

Six drought response options were progressed through site feasibility investigations and the MCA workshop, with three having two options for intake and outfall types as per Table 5-4. To determine the sites and criteria to progress to MCA scoring (i.e. assessment of sites by weighted criteria) the following steps were undertaken and endorsed through the MCA workshop.

	Step	Action
1	Identification of differentiating criteria from those used in the shortlisting process.	The non-differentiating criteria are included as Appendix O Differentiating criteria are included as Table 5-4.
2	Options which are considered infeasible were removed.	The Tallow's Beach site and the Newrybar/Ross Lane option with direct HDD from site were removed due to the feasibility concerns outlined in sections 2.2.3 and 2.2.4 respectively.
3	Remove options which are dominated/practically dominated.	The Brunswick Heads HDD intake and outfall option were removed given the likelihood that the pontoon option would be feasible and perform better on cost and non-cost criteria. The Newrybar/Ross Lane option was removed. The significant cost increase compared to Skennars Head was not seen as practical given the relatively low community impact of that option.
4	Identification of differentiating criteria once some options had been removed	Koala Habitat and Cultural Heritage were removed as no longer differentiating criteria. National Parks and Coastal Wetlands were considered of low relevance given that: • Remaining sites near wetlands are operating sports fields or a marina (not greenfield), and • It is assumed that run-off prevention etc will be undertaken as standard.

5.2.1 Criteria weighting

The remaining criteria and sites are shown in Table 5-5.

To weight criteria, an initial assessment was undertaken through a Pairwise comparison process. The outcome of this assessment indicated that the decision would be predominantly driven by the weighting of criteria related to community impact, or to financial cost. It was decided that a reasonable approach was to score the options based on three scenarios, these being community focussed weightings, cost focussed weightings and a balanced weighting. The balanced weighting is consistent with Council's standard weighting for financial criteria of 50%.

The weightings are shown in Table 5-2.

Table 5-2: Criteria weightings for MCA workshop

Category	Criteria	Cost Focussed	Balanced	Community Focussed
Social	Community Impact	20%	35%	50%
Deliverability	Estuary Mixing Plumes	10%	10%	10%
	Proximity to Point Source Pollutants	5%	5%	5%
Economic	Potential Upfront Expenditure	20%	15%	10%
	Cost Risk - Intake/Outfall	10%	10%	5%
	Total Cost	35%	25%	20%

5.2.2 Option Scoring

Scoring of options was presented at the workshop based on the qualitative scoring used in the shortlisting process, as well as the additional cost and non-cost date acquired during the site feasibility assessment, as shown in Table 5-4. The scoring was broadly endorsed, with the following key departures:

- The community impact score for Lighthouse Pde sites was considered overly negative given the potential to move the site away from the beachfront park to Pop Denison Park. This alternative location was considered less impactful on neighbouring houses and beach users, and allowed connection to an existing unused pipeline to the East Ballina Reservoir. The key risks with the site are the proposed Council uses and the potential for flooding, which require further investigation. It was noted however that the site is used to locate dredging equipment when Shaw's Bay is dredged, so there is some level of accepted impact to date.
- Community impact was also discussed in terms of the longevity of that impact and the context in which it occurs. Specifically, by that point in a drought the community may be more willing to accept impact given the water shortage and risk of no supply.
- Beca HunterH2O provided some information on potential integration of infrastructure. It was shown that the only site where the infrastructure (if delivered) may have ongoing benefit would be Skennars Head. The intake and outfalls for that site could be used for a future permanent plant at Newrybar/Ross Lane, and the outfall could be used by the Lennox Head WWTP to move wastewater discharges away from the shoreline. Council noted that they were unaware of any current plans to alter the current outfall location for Lennox Head WWTP.

Based on the above, the qualitative scores were revised and endorsed as per Table 5-5. These were converted to numerical scores using a conversion of Poor (0), Moderate (0.5) and Good (1) for non-qualitative criteria, and for quantitative criteria the scores were spread from 0 to 1 based on relative difference. The outcome of the scoring and weighting scenarios are shown in Table 5-3.

Table 5-3: Scoring and Ranking of sites for the three weighting scenarios

	New Brighton Sports		Brunswick Heads Boat Harbour	Skennars Head Road Sportsfields	Lighthouse Pde	
	Trench/HDD	HDD			HDD	Breakwall and Estuary
Cost Focussed	4.66	2.09	3.33	3.59	2.76	7.75
	2	6	4	3	5	1
Balanced	5.41	3.45	4.49	4.92	3.48	8.19
	2	6	4	3	5	1
Community Focussed	5.65	4.54	5.22	6.84	4.81	6.63
	3	6	4	1	5	2

The workshop participants agreed that Lighthouse Pde was the preferred site, consistent with the scoring in Table 5-3, and that New Brighton Sports Field was the preferred site in the Byron region – albeit with significant concerns raised regarding community impact. It was considered that Skennars Head would likely be preferred over New Brighton Sports Field, and if future works found a permanent desalination plant to be a preferred option for bulk supply, that it was likely that Skennars Head would become the preferred option given the integration potential.

Table 5-4: Shortlisted Drought Response Sites and criteria

Category	Criteria	Sites								
		New Brighton Sports	Brunswick Heads Boat Harbour		Former Trickling Filter Plant, Tallow Beach	Newrybar/Ross Lane		Skennars Head Road Sportsfields	Lighthouse Pde	
			Ocean Intake	Pontoon Intake		HDD	Trench/HDD		HDD	Breakwall and Estuary
Community Impact	Community Impact	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	200m of Popular Beach	200m of Popular Beach
	Proximity to Tourism Areas	No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity	Within 250m of dedicated tourist site	No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity	Within 250m of dedicated tourist site	Within 250m of dedicated tourist site
	Impact to existing use									
	Proximity to Residences	100m Houses	>250m from Houses	>250m from Houses	>250m from Houses	>250m from Houses	>250m from Houses	250m Houses	100m Houses	100m Houses
	Cultural Heritage	None listed on site or in area	None listed on site or in area	None listed on site or in area	Council Heritage Site or AHIMS sites in neighbouring sites	Council Heritage Site or AHIMS sites in neighbouring sites	Council Heritage Site or AHIMS sites in neighbouring sites	None listed on site or in area	None listed on site or in area	None listed on site or in area
Environmental	Proximity to National Parks	250m National Park	250m National Park	250m National Park	100m National Park	>250m from National Park	>250m from National Park	>250m from National Park	>250m from National Park	>250m from National Park
	Coastal Wetland	100m Coastal Wetland	100m Coastal Wetland	100m Coastal Wetland	250m Coastal Wetland	250m Coastal Wetland	250m Coastal Wetland	250m Coastal Wetland	>250m from Coastal Wetland	>250m from Coastal Wetland
	Koala Habitat	Possible	Possible	Possible	Sited	Possible	Possible	Possible	Possible	Possible
Water Salinity	Estuary mixing plumes	Within 3 km of minor river mouth	Within 3 km of minor river mouth	Within Estuary	> 5km or 3km from major/minor river mouth	> 5km or 3km from major/minor river mouth	> 5km or 3km from major/minor river mouth	> 5km or 3km from major/minor river mouth	Within 5 km of the Richmond River mouth	Within Estuary
Water Quality	Proximity to point source pollutants	5km	5km	500m	5km	3km	1km	1km	5km	1km

Table 5-5 :Shortlisted Drought Response Sites and Criteria for MCA scoring

Category	Criteria	Scoring				Sites					
		Impractical	Poor	Moderate	Good	New Brighton Sports		Brunswick Heads Boat Harbour	Skennars Head Road Sportsfields	Lighthouse Pde	
						Trench/HDD	HDD	Pontoon Intake		HDD	Breakwall and Estuary
Community Impact	Community Impact	100m of Popular Beach	200m of Popular Beach	500m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach
		Developed tourist site	Within 250m of dedicated tourist site	Visual impact to tourism site	No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity
			Worse	Moderate	Best	Worse	Worse	Moderate	Best	Moderate	Moderate
		Houses	100m Houses	250m Houses	>250m from Houses	100m Houses	100m Houses	>250m from Houses	>250m from Houses	100m Houses	100m Houses
Water Salinity	Estuary mixing plumes		Within Estuary	Within 3 km of minor river mouth	> 5km or 3km from major/minor river mouth	Within 3 km of minor river mouth	Within 3 km of minor river mouth	Within Estuary	> 5km or 3km from major/minor river mouth	Within 3 km of minor river mouth	Within Estuary
Water Quality	Proximity to point source pollutants	500m	1km	3km	5km	5km	5km	1km	1km	3km	1km
Financial	Potential Upfront Expenditure					$4,184,801	$7,868,033	$6,651,969	$8,715,979	$8,819,591	$370,183
	Cost Risk - Intake/Outfalls					800	1600	1400	1800	1800	0
	Comparative Cost - Single Delivery					$24,804,559	$27,162,577	$24,874,408	$25,323,337	$24,718,915	$18,067,026
	Comparative Cost - Staged Delivery					$26,930,959	$30,913,810	$28,063,377	$29,407,916	$28,827,339	$18,437,209

Appendix A. Strategic Considerations Memo

Beca hunterH2O
the future of water

Report

Temporary Desalination Options Assessment

Strategic Considerations Memo

Rous County Council

September 2023

Beca HunterH2O | ABN 16 602 201 552

Report Details

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1 Background

1.1 Rous County Council

Rous County Council ('Council') are a constituent council responsible for bulk water supply to Lismore City Council, Byron Shire Council, Ballina Shire Council, and Richmond Valley Council. This supply network services approximately 46,000 connections and a population of about 100,000 people in the Far North Coast region of NSW. The Council also provides drinking water to approximately 2,000 retail customers who are directly connected to the bulk distribution network, including residential (70%), farms (22%), commercial and industrial customers.

The RCC water supply system services the area from Evans Head to Ocean Shores along the NSW coast, and inland to Lismore. The majority of the potable water supply is sourced from Rocky Creek Dam and treated at Nightcap Water Treatment Plant (WTP) before distribution to reservoirs through three trunk mains owned and operated by RCC. When storages fall below 95%, supply to Nightcap WTP is supplemented by run of river extraction from the Wilsons River, and supply to Ballina Shire Council is supplemented by Emigrant Creek Dam via the Emigrant Creek WTP. Additional minor raw water sources include groundwater supply to Alstonville and Wollongbar, and to Woodburn, Evans Head and Broadwater (see Figure 2).

The current average annual demand for the region is approximately 12.3 GL, which equates to an average daily demand of 33.7 ML/d. Approximately two-thirds of the demand is for supply to Ballina (25%), Byron Bay (20%) and Lismore (22%), with the next largest demand being for Non-Revenue Water (NRW) (12%). Significant growth is projected for the region with a 20% increase expected in system demand projected by 2040, much of which will be driven by growth in Ballina which is expected to increase to 32% of total demand.

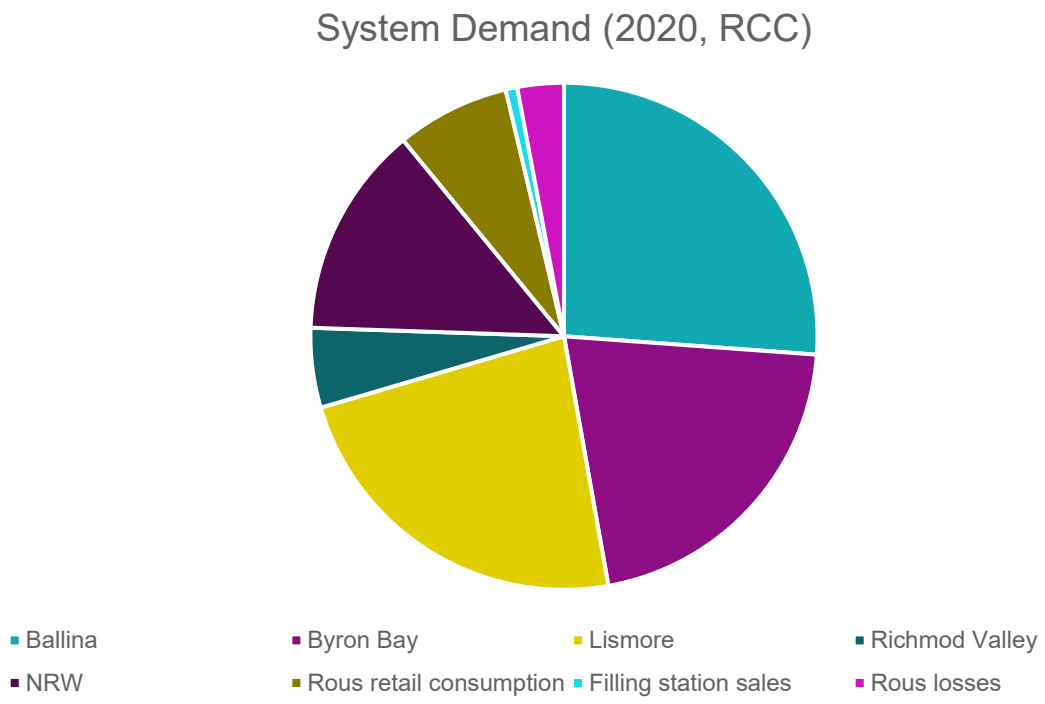


Figure 1: Demand sources as a percentage of total system demand in average conditions.

The Council service is within the Far North Coast region and the Regional Water Strategy (RWS) for this area is currently in draft. The plan, being led by the Department of Planning and Environment, identifies that RCC as having a "very high" water security risk due to the projected reduction in yields and high population growth, particularly in the Byron and Ballina Shire Council Areas. This risk is enhanced given the reliance on surface

water supplies which are reliant on climate. As such, Council is keen to understand the options for climate independent supply.

1.2 Drought Response Plan

The Department of Planning and Environment (DPE) requires that local water utilities consider options to respond to or prepare for extreme events, including drought. These options are developed through strategic plans and operationalised through Drought Response or Drought Management Plans (DMPs). The primary objective of the DMP is to ensure continued water supply during drought conditions to meet water user, public health and firefighting needs.

The most recent DMP for RCC was prepared by Hydrosphere Consulting in 2016, with updates to restricted demands currently under development. The plan includes a summary of the water sources, restriction levels, triggers and target reductions in demand, which have been amended following discussion with Council in August 2023 and consolidated in Table 1-1.

Table 1-1 2023 Draft RCC Water Restriction Triggers (source: pers. comms RCC)

RCD Supply Level (% of full supply volume)	Restrictions	Target Reduction in Demand	Average daily Target Demand	Operational Status	Source Usage
100%	Everyday Water Saving Measures	0%	36.3	Normal Operation	Rocky Creek Dam only
95%					Start Wilsons River Source and Emigrant Creek Dam
60%	Level 1 Moderate	7.5%	33.6	Dry Period Operation	Start Woodburn bores, Converys Lane bore
45%	Level 2 High	15%	30.9		
30%	Level 3 Very High	22.5%	28.2		Start Ballina Shire Councils plateau bores
20%	Level 4 Severe	30%	25.4	Emergency Operation	Start emergency supply source
10%	Emergency	37.5%	22.7		

In the case that drought progresses, the plan also includes measures to be undertaken to slow down the depletion of the primary source (Rocky Creek Dam) and/or provide a base supply that could be implemented within relatively short lead time in emergency conditions. The plan included guidance on activation activities required to enable these supplies to be available once storage levels with RCD reached 10% (Table 1-2).

Table 1-2 Activation Requirements for Potential Emergency Sources (2016 DMP)

Potential Emergency Source	Activation Requirements	Timing
Increased extraction from the Wilsons River Source	• Seek permission from DPI-Water to operate outside normal licensing rules	2 weeks
Activation of Plateau and Woodburn bores	• Prepare bores for pumping • Complete test pumping for quantity and quality • Determine expected supply contribution and treatment requirements	>1 month

	• Commence pumping and treatment	
Groundwater extraction (new bores)	• Determine suitable site/s • Approval requirements • Technical and environmental investigations. • Complete test pumping for quantity and quality • Determine expected supply contribution and treatment requirements • Commence pumping and treatment	>3 months
Temporary desalination plant	• Determine suitable site/s • Source package treatment plants • Establish power supplies • Determine brine disposal procedures	>3 months
Indirect potable reuse	• Technical and environmental investigations • Community consultation • Approvals • Infrastructure design and construction	>2 years

1.3 Project Understanding

This Strategic Consideration Memo is the first deliverable of the Temporary Desalination Options Assessment project being undertaken by Beca HunterH2O for Council. The intent of this project is to provide Council with an understanding of the practicalities of implementing a Temporary Desalination Plant as an emergency response measure to a severe and ongoing drought. The work will address the activation requirements as detailed in Table 1-2 from the 2016 DMP, specifically, what and how much time is required to enable a desalination plant to be able to meet emergency supply requirements. The work will also consider whether a temporary desalination plant is the best approach, or whether an upfront investment would provide more benefit.

The work will be a critical input to Council's future drought response planning, as well as for bulk supply investment planning. It is noted that desalination is not the only investment being considered to address drought risk in the region, for example interregional connections and investments in neighbouring council areas, but this work will be focussed on the Rous CC bulk supply system.

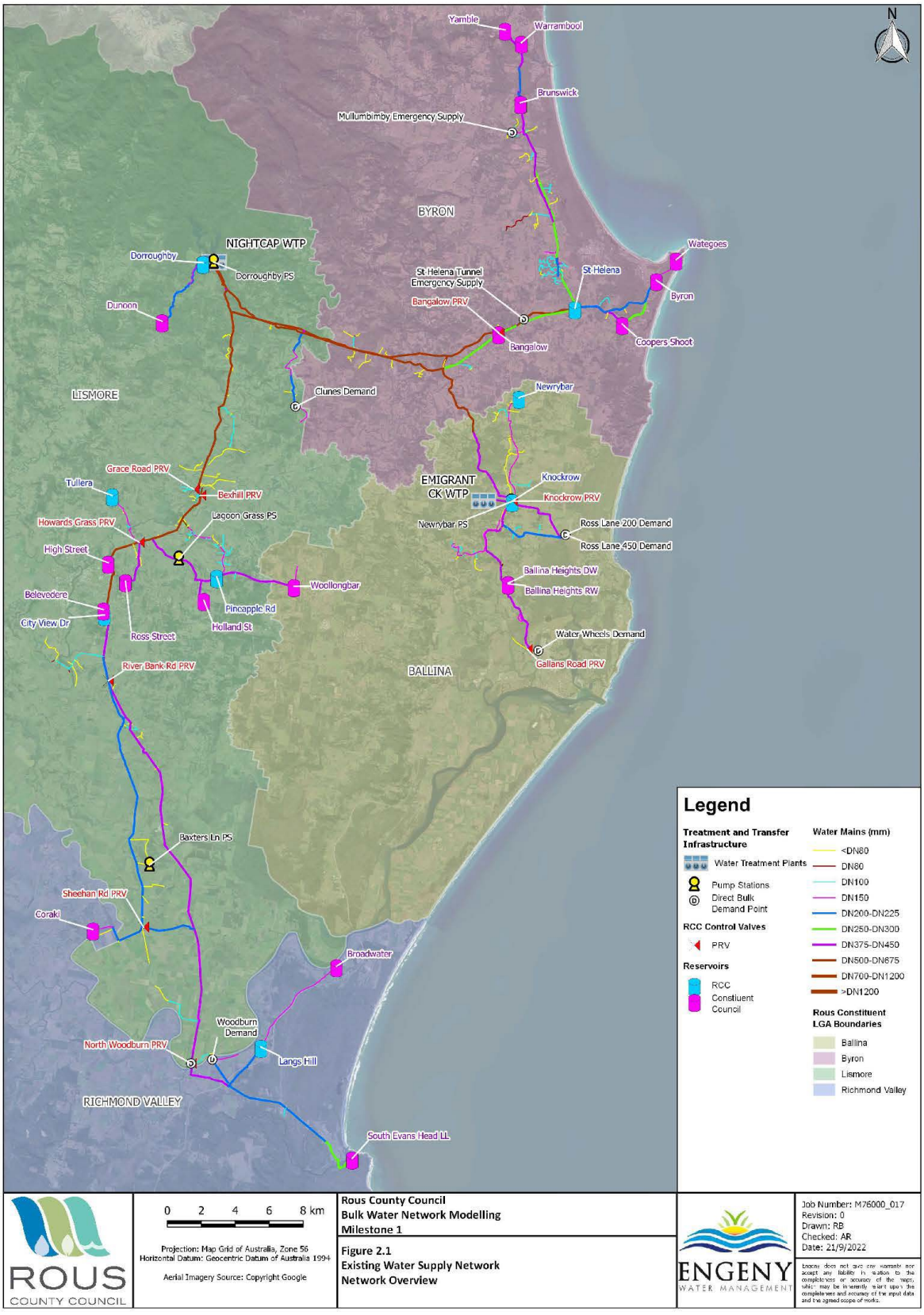


Figure 2: Rous County Council System Supply Map

2 Planning Pathways

An assessment of the relevant planning requirements and a preliminary environmental, social and regulatory risk assessment was undertaken by Ramboll Australia Pty Ltd to inform the site selection criteria, and potential approval, cost and program impacts. This information is included in full as Appendix A.

A summary of the key outcomes for this project are included below.

This advice is not legal in nature and therefore legal advice should be considered. Clarification should also be sought from relevant government agencies and potentially legal counsel regarding their interpretation of, and agreement with this advice before proceeding.

2.1 Planning Pathway Considerations

The primary consideration for the planning approval pathway is whether the proposal will be considered as Development without Consent, Designated Development or State Significant Infrastructure, and the associated requirements. The relationship between the level of environmental assessment and approval type is included as a matrix below, with the specific triggers detailed in Appendix A.

Whilst all proposal criteria are equally relevant in terms of determining the approval required, the Capital Investment Value (CIV) and processing capacity offer particularly relevant guidance, such that given the number of customers serviced by Council it is reasonable to state at this early stage that at least one Environmental Impact Statement would be required if a desalination plant was proposed. There may be opportunities for smaller plants to be delivered through an REF process, however, these would likely only be relevant for small communities or large industrial customers (e.g. Broadwater, South Evans Head).

Approval type	Development without Consent		Designated Development	State Significant Infrastructure
Environmental assessment	Review of Environmental Factors (REF)	REF + Public Exhibition	Environmental Impact Statements	

Figure 3: Proposal classification and approval matrix.

2.2 Environmental, Social and Regulatory Risks

The preliminary Environmental, Social and Regulatory risk assessment considered a range of environmental aspects potentially relevant to a desalination proposal, and the risk of these aspects regarding project time, cost and approvals. The key risks identified in Appendix A include:

- The studies required to demonstrate the acceptability of the impacts of brine disposal and any terrestrial biodiversity impacts are considered the highest risks to project time.
- The studies required to demonstrate the acceptability of brine discharges, terrestrial biodiversity impacts and potential flood management are considered the highest risk to cost.
- The acceptability of brine discharges and terrestrial biodiversity impacts are considered the highest risk to gaining project approvals.
- Community acceptance, particularly for brine discharges, terrestrial biodiversity and energy use are considered a high risk to the project.

3 Reference Studies

3.1 Rous CC

There have been a number of studies relevant to desalination plants in the Far North Coast region over the previous decade. These studies are reviewed below, with commentary on material gaps.

3.1.1 Northern River Regional Bulk Walk Supply Study – Hydrosphere 2013

The Northern Rivers Regional Bulk Water Supply Study was undertaken by Hydrosphere consulting for the Northern Rivers Regional Organisation of Councils (NOROC) and was finalised in 2013. The Report considered desalination as a preferred option to meet the regions increasing water demands. The study noted that desalination is an attractive water source as it is easily scalable to match demands and is independent of climate, providing a high secure source. The Report included a short list of preferred sites for the plant, based on a study area extending north into Tweed Shire Council and west to Kyogle Council (i.e. larger than the Council are being considered in this study).

The report identified general localities rather than specific land parcels, it notes that the approach was not exhaustive and that a comprehensive site selection process would be required as part of further investigations.

Key site considerations for the site selection included:

- Less than 2 km to the ocean
- Land parcels greater than 24 ha, based on the Tugun (Gold Coast Desal) site and allowing a 100 metre buffer (i.e. not scaled for different capacities)
- Adequate buffers to sensitive areas
- Central to current and projected demand points
- Close to existing water supply infrastructure
- Proximity to electrical supply
- Major primary works requirements, such as river crossings
- Topography (to minimise pumping energy)

Based on the above considerations a shortlist of four sites was developed as shown in Table 3-1. The Wooyung site located south of Pottsville in the Tweed shire was considered as the preferred option based on "it's position being central to the major water demand centres, suitable land with appropriate distances from sensitive land uses and environmental protection area, and proximity to the planned regional interconnection."

Table 3-1 Northern Rivers Regional Bulk Water Supply Study - Desalination Sites Shortlist

Location	Assessment Summary
Wooyung, Tweed Shire Council	Preferred location based on assessment criteria
Tyagarah, Byron Shire Council	Not considered viable due to environmental constraints associated with the Byron Bay Marine Park.
Seven Mile Beach Lennox Head, Ballina Shire Council	Not considered viable due to environmental constraints associated with the Byron Bay Marine Park.
South Ballina, Ballina Shire Council	Not considered viable due to distance from the main urban centres, and the requirement for a major river crossing of the Richmond River.

The site criteria used in the study was generally reasonable, although the required site area criteria is considered excessive given that Tugun is a large desalination site with a capacity of 125 ML/d, which would exceed the needs of Council (see Section 3.1.2.6.4. The other key challenge with this site for this study will be the reliance

on the Tweed Shire to Rous CC pipeline, which is not in place, meaning that connection to the Council system from the preferred sites would be more costly than assumed.

3.1.2 Rous County Council Desalination Investigations – Ganden, 2020

Ganden was engaged by Council to undertake a feasibility level, proof of concept assessment for the provision of a desalination plant as a future water source.

3.1.2.1 Document review

The work included the review of the Preliminary Feasibility Assessment of desalination as a water supply option (Geolink, 2011) which identified three shortlisted sites:

- Tyagarah (groundwater feed water).
- Lennox Head (ocean feed water).
- South Ballina (estuarine feed water).

The review noted that the report considered only a single plant in proximity to large demand areas. The report indicated that there are three locations of low level groundwater salinity available in the Council area (South Ballina, Lennox Heads and Tyagarah), however this coastal sand aquifer is understood to have limited capacity and has not been further considered as a sustainable source of raw water for the production of drinking water. Estuarine sources in the Richmond River were also assessed, but the report determined that there were no significant advantages over ocean water sources suitable locations.

The Ganden report also reviewed the Future Water Strategy Integrated Water Planning Process (MWH 2014), which recommended two sites to be shortlisted:

- Tyagarah – the design included a beach well intake through a horizontal collector system with an ocean outfall off Tyagarah Beach. The option was considered to be in flood prone land, and the construction of the pipeline though a nature reserve, an outfall in the Byron Bay Marine Park, and offshore construction impacts on tourism were seen as significant constraints.
- South Ballina – a beach well intake plant with a river or ocean outfall. The option was considered to have risks with water quality and requirements for additional treatment, and to potentially impact threatened species in the areas (Pied Oystercatcher).

There are no capacities for these plants provided in the Geolink (2011) report, but the costs are $103m and $107m capex and $9.2m opex were considered high by Ganden.

3.1.2.2 Ganden Investigations

The design basis for the Preliminary Concept Design and site selection included the following significant assumptions:

- There would be a single plant location
- Boron removal was assumed to be sufficient through a single pass process
- 10 ML/d was provided as the required capacity.
- There was no raw water quality data available, so feed quality water is assumed to be suitable (although there is significant commentary on this risk).

The review undertakes a comprehensive review of desalination technologies, which covers a broad range of intake and outfall, and treatment options. The following gaps were noted:

- The comment that the selection of an outfall location can only be completed once an EIS is complete is an oversimplification. It would be expected that a general location for the intake/outfall and accompanying water quality, sediment and benthic fauna/infauna investigations around that area would be included in the EIS. Once the EIS is approved, more detailed/higher resolution environmental and marine geotechnical investigations would assist in refining that location within the proposed area.

- As noted, pre-treatment of MF/UF is increasingly common for small to medium scale desalination plants and would be the baseline assumption for a proposed plant. MF/UF generally requires less civil infrastructure, occupies a smaller footprint than conventional media filtration, provides a more consistent RO feed water quality and is easier to mobilise at short notice.
- As noted, pre-treatment is critical for effective operation of desal membranes, however, for emergency plants which are expected to operate for short periods (i.e. months), there may be more tolerance to run the plant with sub-optimal water for some periods. This would not be the case for larger baseload plants with a long asset life expectancy, and would likely incur additional opex costs.
- As noted, rainfall plumes are a considerable risk to plant intake quality and the higher turbidity can challenge the pre-treatment process. However, it should be noted that turbidity risks can be addressed though pre-treatment (at a cost) whereas salinity variations can be more difficult to deal with for larger plants.

As noted, the community engagement process will be critical to a successful desalination proposal, and desalination has been a polarising option in other communities. It is worth adding to this statement that the most recent studies on option preferences in the Hunter, Central and Mid Coast regions have indicated that desalination has a lower level of support than inter-regional transfers or surface water storage options. The main concerns are the cost, energy consumption and impacts of brine disposal. There is also a significant portion of the community who consider desalination plants as 'white elephant' investments, largely based on the experiences in Melbourne and Sydney, which is indicative of the difficulty in explaining drought response investments to the community.

3.1.2.3 Site selection

The site selection process is not included in the report in detail, with reference to stakeholder workshops as the mechanism for determining the shortlisted and preferred site decisions. The criteria that are included in the report and commentary on the shortlisted sites is included below.

- Cultural heritage – it is noted that brownfield sites would have lower risks of encountering aboriginal cultural sites or artefacts, which could be a significant risk to the project approval. We agree with this statement and would recommend that a review of cultural site data and the involvement of qualified archaeologists early in the project is beneficial.
- Coastal Geological and Sediment Conditions – costal erosion risks are weighted heavily in this assessment. A marine intake and outfall structure for a larger plant would generally be offshore at a depth of at least ten metres, and at a distance where the impacts of coastal erosion processes are limited. The intake and outfall pipeline would similarly be at a depth where surface processes are not of importance.

The preferred site from the study is the land adjacent to the Byron Bay WWTP. The site does not appear in the previous reports, and was selected due to proximity to St Helena reservoir, and the lack of expected development next to WWTP. The concept is for the plant to supply Suffolk Park, Byron Bay, Ocean Shores, Brunswick Heads and Bangalow, but the report doesn't consider the option or requirements to supply water from St Helena reservoir to the broader system.

Alternative sites are also considered in the Ballina region, at South Ballina or near Lennox Head. The South Ballina site is significantly constrained as it requires a 5.6 km intake and outfall structure, and would require power and water network connections across the Richmond River. The report notes the risk of freshwater plumes from the Richmond River on the intake water quality, and whilst we agree that this is a significant concern, it should be noted that this could be acceptable depending on the operational philosophy for the plant. For example, if the plant is not required to provide supply at all times, then downrating the plant production at these times may be acceptable.

The Lennox Head site is situated adjacent to the wastewater treatment plant which has an existing ocean outfall. This is considered a significant benefit.

3.1.2.4 System Integration

The Rous County Council Desalination Investigation prepared for Council by Ganden Pty Ltd identifies the Average Daily Demand across the Rous supply area as shown in Table 3-2.

Table 3-2 Demands by Location- Byron Shire (Ganden, 2020)

Location	2020 ADD (ML/d)	2036 ADD (ML/d)
Byron Bay (City only, no Tourists)	1.5	2.0
Byron Bay (City only, with Tourists)	2.6	3.2
Byron Bay LGA (including Byron Bay, Bangalow, Ocean Shores, Suffolk Park and Brunswick Head, no Tourists)	8.4	11.0
Byron Bay LGA (including Byron Bay, Bangalow, Ocean Shores, Suffolk Park and Brunswick Head, with Tourists)	9.6	13.2
Ballina City	4.5	4.5
Ballina City, Lennox Head and Skennar Head	6.5	7.2

The Average Day Demands for the Byron Shire exceed the proposed plant capacity of 10 ML/d, however further consideration should be given to determining minimum seasonal demands. The decrease in demands during water restrictions, combined with diurnal variation of demands, may mean that total plant production rates are not achievable due to insufficient consumption. High level water restrictions can potentially reduce consumption to 60% of average demands, and minimum diurnal flows can be as low as 20% of average daily demand. Based on this broad assumption there may be a need to transfer over 2 ML/d from a 10 ML/d desalination plant beyond the Byron shire.

Similarly, there may not be enough demand under high level water restrictions to consume 5 ML/d within the Ballina Shire. The deficit here is less than 1 ML/d, however this flow would need to be transferred beyond the Ballina network.

It was proposed in the Rous County Council Desalination Investigation that a Byron Bay desalination plant connects to the St Helena Reservoir; this reservoir can distribute flows further north within the Byron Shire, and options should be investigated to transfer any consumption deficit via Bangalow into Ballina Shire via Knockrow. If the plant is staged (5 + 5 ML/d), the additional infrastructure required for any transfers may be compared with building the second stage at an alternate location.

Capacity and pipe class verification should be undertaken for transfer pipework between the proposed Byron Desalination Plant site and St Helena Reservoir, noting that the hydraulic grade line will be reversed in comparison to the current distribution network.

Back-feeding from Ballina/ Lennox Head should be considered separately if desalination plant capacity is split across two locations. A single 10 ML/d plant at Ballina / Lennox would be underutilised for significant durations. It may be preferable to consider a 6 ML/d Byron plant, with a 4 ML/d Lennox plant, as the lower production at each site is more likely to be fully utilised across all demand scenarios, including restricted demands, noting that this would need to be balanced against the need for multiple planning approval, design and delivery phases.

3.1.2.5 Cost Estimates

The cost estimates used in the report are not reflective of current market rates. The table shown as Figure 3 provides a summary of constructed or planned desalination plants in Australia, and a per ML cost.

Project Name	Location	Capacity	Project Value (including intake/outfall)	CAPEX per MLD	Construction Year	CPI Adjusted Value[8]	CPI Adjusted CAPEX per MLD
Belmont Drought Response Desalination Plant	Lake Macquarie City, NSW	15 MLD	$90MM	$6MM (estimated)	Still in design development	$90MM	$6MM (estimated)
Agnes Waters Desalination Plant (1770)	Agnes Waters, QLD	1.5 MLD, 7.5 MLD Future	$29MM	$19.3MM /3.8MM	2010	$35MM	23.3MM/ 4.67MM
Adelaide Desalination	Port Stanvac, SA	300 MLD	$1,830MM	$6.1MM	2012	$2,085MM	6.95MM
Gold Coast Desalination Plant	Tugun, QLD	125 MLD	$1,200MM	$9.6MM	2009	$1,480MM	11.84MM
Sydney Desalination Plant	Kurnell, NSW	250 MLD	$1,803MM	$7.212MM	2010	$2,260MM	9.04MM
Melbourne Desalination Plant	Wonthaggi, VIC	410 MLD	$5,700MM	$13.9MM	2012	$6,496MM	15.84MM
Perth (Southern) Desalination Plant	Binningup, WA	270 MLD	$955MM	$3.537MM	2012	$1,090MM	4.04MM
Kwinana Desalination Plant	Kwinana, WA	130 MLD	$389MM	$3MM	2006	$522MM	4.02MM

Figure 3: Australian desalination plants and costs (Ganden, 2020)

Changes in the cost estimate for Belmont are detailed in Section 3.2.3. For the other plants listed, there are material differences in the design and delivery of these plants which significantly affect the cost. For example:

- The Gold Coast plant was delivered in drought, and incurred significant expense to meet the delivery timeframe in a resource constrained market. The cost of the desalination plant also excludes the significant costs of the SEQ Water Grid, which enabled the water to get from the Gold Coast to the broader supply system.
- The Sydney Desalination Plant is a 250 ML/d capacity plant which is expandable to 500 ML/d. Some components of the plant, such as the intake and outfall structures, were built to meet the 500 ML/d capacity.
- The Perth plants were constructed outside of drought periods and therefore avoided the increased costs in meeting short delivery timeframes and/or delivering in a resource constrained market. The Kwinana plant also saved significant costs due to the intake and outfall being in an embayment, resulting in very short pipelines (intake of less than 400m, outfall less than 700 m).

3.1.2.6 Additional Notes

In addition to the above, the following are general comments which are not covered in the Ganden report, but are considered noteworthy.

3.1.2.6.1 Intakes and Outfalls

- For saltwater reverse osmosis plants, it is worth noting that the intake capacity is required to be at least 250% of the freshwater supply capacity, given the generally accepted recovery rate of about 40% (ranges of 37-42% have been seen in large desalination designs). For ocean intakes, it is also standard to increase the diameter of the intake to allow for bioaccumulation, this removes the requirement to flush the intake with chlorine to remove growth and avoids operational environmental costs.
- Ocean intake structures need to be deep enough to avoid the keel depths of vessels, and it is preferable if the depth of the structure avoids wave energy. A general minimum of 10 metres is industry standard, and a maximum value of 20 metres is also preferred as construction and maintenance of the asset becomes operationally challenging due to dive depth limitations.
- For beachwells, interaction with groundwater dependant ecosystems are critical when considering environmental impacts, and can be difficult to measure without long-term data which covers natural wetting and drying periods. In general, a high level of understanding of the hydrogeology of the site is required to have confidence in the design being viable, which can only be achieved through upfront drilling and pump testing.

- For estuarine intakes, there is a significant benefit to constructing intakes in a slack water area. The construction risks are significantly reduced when compared to an ocean intake, as well as operational costs for ongoing monitoring and maintenance programs.
- As noted, if the desalination plant is not required during periods of rainfall, the plant may be turned off during these periods. However, given that rainfall in the catchment which changes the estuary salinity does not necessarily mean rainfall in the dam catchments, and/or, first flush rainfall can lead to high turbidity water in dams, the desalination plant may still be required. This impact may also apply to marine intakes which are located within the freshwater mixing zones from an estuary.
- The viability of outfalls to estuarine environments is heavily dependent on the flushing rate of that estuary, and the risk that the salinity increases above the naturally occurring maximum. That is, an estuary has a naturally variable salinity range, so increasing salinity within the normal range is unlikely to have a major impact, however a lack of flushing may lead to a higher-than-normal maximum salinity in dry periods which may stress local ecosystems.
- Co-location of desalination plants with wastewater plants with existing wastewater outfalls can provide significant cost reductions, although the ability of the existing pumps and pipelines to transfer higher salinity water needs to be considered. There are also potential benefits to adding brine to wastewater discharges to estuarine or marine environments given the increased salinity better matches the receiving water conditions.

3.1.2.6.2 Water Network Connections

- Where water is added to the system, the interface point between the two sources may create 'dead-zones' which can create water age risks for consumers. Water quality may also be of concern, particularly regarding taste issues at the interface between the traditional source water and desalinated water where comparison is more readily possible.
- Other changes in water characteristics can also have implications for operating and maintenance, which would need to be considered in delivery. For example, changes in temperature on chlorine decay or changes in fluoridation for non-fluoridated supply areas.

3.1.2.6.3 Operating Considerations

In general, desalination is a high-cost source when compared to surface or groundwater sources. As such, utilities will generally prioritise surface water or groundwater sources. There are a range of operating modes for desalination plants which seek to maximise benefit and limit costs, and these can impact the design of the process plant, the preferred intake and outfall type, the preferred connection points, and the level of service provided.

The four main operating modes are:

- Fully operational – full production to provide baseload supply at all times (e.g. Kwinana Desalination Plant).
- Hot standby – ready to move to full scale production within a number of days (e.g. Adelaide Desalination Plant). Usually achieved by operating at a lower production value to keep membranes fresh and have confidence that the asset is working, for example, this can be achieved by operating one day a week at full capacity or operating every day at 25%. There are potentially significant potential benefits in providing a standby source as a response to asset failures or water quality issues with existing sources (emerging contaminants, bushfires, etc.)
- Cold standby – ready to move to full production in a matter of days to weeks. This is usually achieved by having all required equipment in place, and a start-up process required restart and validate before moving to full production.
- Mothballing – ready to move to full production in 6 months or more (e.g. Sydney Desalination Plant). This would usually mean that some critical items are not on-site, or are in a long-term storage, and need to be purchased and/or re-installed. The approach would suit a drought response facility where there is sufficient notice for operation to be required and no scenario where the plant is expected to be operated reactively at short notice. It is noted that significant operating costs remain during mothballing.

Although there are generally high costs incurred to move between modes, for example to move from operation to mothballing or vice versa requires significant investment, there may also be opportunities to use a combination of the above. For example, moving a plant from hot or cold standby to fully operational to meet seasonal peak demand periods. It is critical in the above to understand how changes in production volumes are managed through the water network.

3.1.2.6.4 Site Area

The required site area for a desalination plant is dependent on the process capacity required, the intake and outfall type and location, onsite power requirements, buffers, and the required construction area.

A high-level review of existing potable supply desalination plants in Australia shows a large range in site area compared to capacity (see Figure 4), with an average of about 20 ML/ha. This dataset is heavily influenced by larger plants which would include some efficiency of scale and be beyond the requirements of Council. The most relevant plants for the size likely to be progressed by Council are Nabiac, Agnes Waters and Belmont, which are at a lower ratio of about 12 ML/ha. The Ganden preliminary concept design for the Byron Bay plant was a 10 ML/d capacity plant in an area of 0.2 ha (50 ML/ha), which would put it in the same range as the Marina East plant in Singapore (49 ML/ha) and whilst achievable, is not consistent with Australian developments given the area of land usually available.

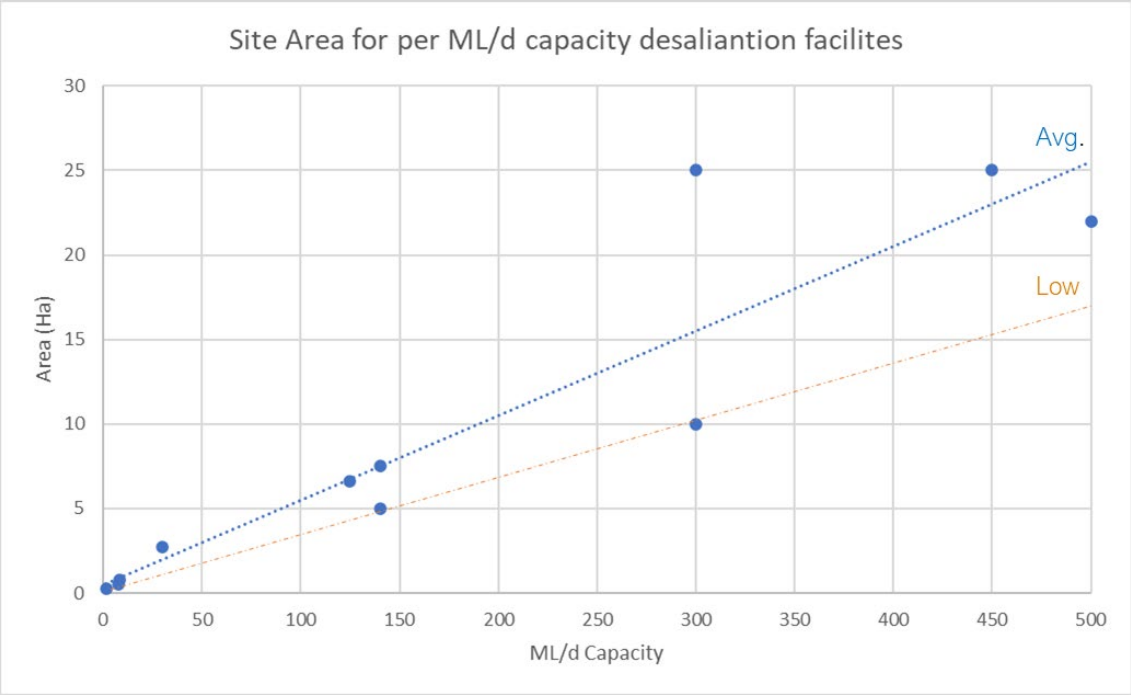


Figure 4: Capacity and area of desalination plants for potable water supply in Australia, with average and low extrapolations.

There is no set rule which would determine an amount of space per ML/d capacity, and the space used is often subject to the space available – that is, it is generally cheaper and easier to construct and operate facilities on larger sites, so larger area plants may simply be a product of a larger amount of land being available at a cost-effective rate. As such, it is reasonable that a 20 ML/d plant could have a footprint of less than 1 ha, however there would be a cost incurred (for example in operation challenges or building heights) that needs to be considered.

The other main consideration for plant areas which is often overlooked is the space required for construction. If the area available for construction is constrained, there will be a cost penalty in delivery. Based on a review of the construction areas used for plants where aerial photos are available, a general ratio of 50-100% of the plant footprint will be required for the construction area.

Table 3: Indicative plant areas with construction allowances (50 or 100% of plant footprint)

ML/d	Plant footprint (ha)	With 50% Const. (ha)	With 100% Constr. (ha)
5	0.5	0.7	0.9
10	0.9	1.4	1.8
15	1.4	2.0	2.7
20	1.8	2.7	3.6
25	2.3	3.4	4.5
30	2.7	4.1	5.5

In the case that plants can be co-located with existing water treatment plants (such as the Nabiac case study), the required footprint can be much smaller, as per Figure 3-5 and Figure 3-6. These examples consider the package plant provided by a supplier lie Osmoflo, and assume there is sufficient area on the existing site for construction.

Figure 3-5: Semirara plant as built, 1,925 m^2 for 7 MLD (~418 m^2/ML)

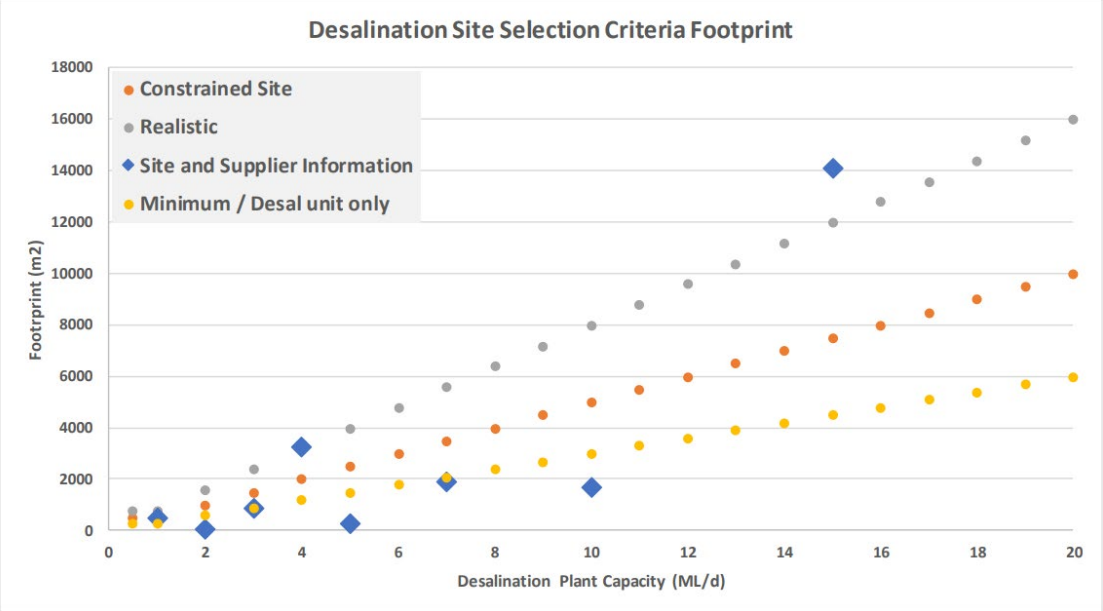


Figure 3-6: Feasibility guidance on plant footprint

3.2 Hunter Water

Hunter Water are currently progressing the design and approvals for a 30 ML/d seawater desalination plant. The plant will be co-located with the Belmont Wastewater Treatment Plant approximately 20 km south on the Newcastle. The project comprises:

- New seawater intake structure and tunnel (constructed by tunnel boring machine),
- MF/RO plant with four parallel process trains,
- Upgrades to the wastewater hydraulic control structure and outfall pumps to allow for brine disposal,
- Power connection via new 33 MVA transformer and transmission line upgrades, and
- Water network connections including new pipelines to existing reservoirs.

The determination to construct the plant as an upfront rather than drought response investment came through the 2022 Lower Hunter Water Security Plan. Prior to this, the preferred option was for a smaller drought response facility.

3.2.1 2014 LHWP

The 2014 Lower Hunter Water Plan determined that temporary desalination, a rainfall independent source to be deployed as late as possible in drought if needed, would provide a flexible contingency measure to reduce the risk of running out of water with minimal upfront expenditure. The plan committed Hunter Water to undertaking further site selection, planning and feasibility assessments to provide a state of readiness to implement a temporary desalination drought response if required. The delivery at the time of 2014 LWSP was for three 3 ML/d capacity plants, although the final sites and capacities were subject to further planning. The triggers to deploy the solution were based on the following surface water storage levels:

- 65% - Begin work on design and planning approvals
- 35% - Installation of plants
- At or below 30% - Begin operation (the modelling assumed 20%)
- Units would be decommissioned once storages returned to greater than 50%

Based on the above along with the drawdown estimates provided in the LHWP document, the plan allows 12-15 months for design and approvals and 6-8 months to install the plants prior to operation. The plan was considered achievable based on the concept of containerised plants being delivered to coastal open space areas or beaches and intake/outfalls being constructed by poly-pipe laid through the surf zone (similar to that later seen in Cape Town during the 2017/18 drought) or anchored to a coastal structure.

Critical work was undertaken following the publishing of the plan and the beginning of the 2019/20 drought, which changed the approach from three separate 3 ML/d containerised plants to a single 15 ML/d capacity plant at Belmont. The main reasons of the consolidation to one site and the larger capacity were:

- Advice was provided that an individual EIS for all three sites would likely be required, rather than a single EIS or the avoidance of an EIS by having three lower capital cost projects. A key consideration in this was the State Environmental Planning Policy (State and Regional Development) 2011 trigger for desalination projects to be considered State Significant Infrastructure once the capital value exceeded $10m. This advice increased the upfront costs and risks of the decentralised approach.
- Site selection investigations found that the level of infrastructure required to deliver the options would have material impacts in those areas and may cause community pushback. For example, diesel generators and hardstand areas near popular beaches. Outside of an emergency situation, it was expected that it would be difficult for these works to gain approval.
- The capacity of the plants was considered to provide a relatively low benefit in terms of delaying the time until the community would run out of water or providing a baseline supply once surface storages were depleted. For example, assuming base demand was still at an average of 138 ML/d, a 9 ML/d desalination plant would add up to 15 days to the depletion period before surface storages are exhausted and would supply a very small proportion of the community.
- The Belmont site was considered preferable given that Hunter Water owned the land, and that the existing wastewater outfall could be used for brine disposal. This approach, coupled with beach wells as the intake, would mean that no tunnelling or construction in the marine area would be required, significantly reducing costs and time risks.

In addition, the storage triggers were determined to be too low to allow enough time to deliver EIS rather than an REF, and it was decided that the EIS and Concept Design should be delivered prior to drought.

3.2.2 Belmont Desalination Design and EIS

In 2017 Hunter Water began development of the 15 ML/d Belmont Temporary Desalination Plant design and EIS. The work was being delivered as storages in the Hunter Water system depleted through drought, with storages dipping below 70% in March 2018 and eventually to 53% before the drought broke in February 2020. These were the lowest storage levels in the Hunter Water system since the 1980/81 drought.

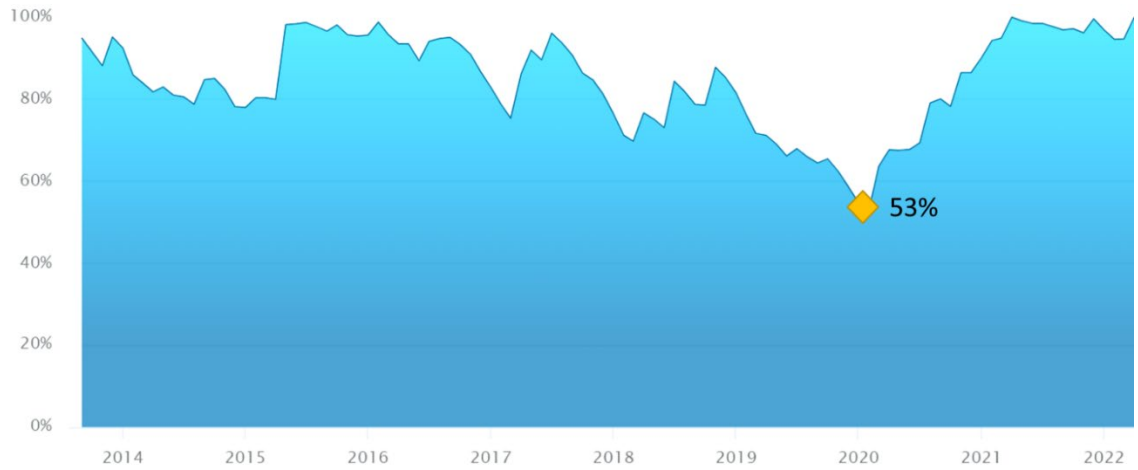


Figure 3-7: Hunter Water storage levels 2014 to 2022, with lowest level in February 2020.

Key outcomes from this period were:

- The initial concept of using beachwell intake structures was discarded following the installation of a Test Bore and pump testing to determine the productivity of the aquifer and inferred impacts on local sensitive areas. The key reasons to move to the marine intake option were the combination of the low productivity aquifer (fine sands), water quality risks, constructability risks of the proposed caisson and horizontal well structure, and impacts on surrounding land-holders/ecosystems. In addition, given the natural heterogeneity in groundwater systems and the movement of salinity interfaces, some risks would not be well understood until construction occurred or large-scale pumping began, which would put the delivery timeframe and viability of a drought response plant at risk.
- Offshore water quality data was a critical input to the process design and intake location. Early monitoring to develop a long-term dataset would have been beneficial.
- The time required to deliver the EIS was significantly longer than expected, in part due to change in the intake design and then further increase in capacity, but also due to the complexity of the project.
- A lack of marine geotechnical data was found to be a key knowledge gap in progressing beyond a preliminary concept design. Procurement of this data is high cost.
- Procurement and internal approvals to progress the design contract were lengthy (6-12 months), and external approvals through the Infrastructure NSW process also added material resourcing and time requirements.
- The delivery contractor included significant risk-based costs to deliver the plant in the timeframe required, particularly due to the risks of storm events delaying geotechnical data acquisition or intake construction.
- Commissioning of the plant, particularly process validation and NSW Health approval, added several months to the program.
- Power connections were found to be a critical path item if a large system upgrade was required. (Hunter Water were able to share the existing power supply to the Belmont Wastewater Treatment Plant as a back-up option)

3.2.3 2022 Lower Hunter Water Security Plan

Also in 2017, Hunter Water began work on the 2022 LHWSP which took a “clean-slate” approach to the question of how best to incorporate desalination into the broader supply strategy, including whether upfront or drought response approaches were preferable, and what site/s should be used. This program progressed in parallel to the design and approvals for the Belmont desalination plant, however the two programs worked together to share learnings and approaches as required. This included increasing the Belmont capacity to 30 ML/d as the LHWSP recommended a shift towards an enduring supply approach to yield, rather than accepting a probability of running out of water.

A key outcome from that program relevant to this project was that Hunter Water used spatial data to review all parcels of land within the area of operations, and applied a phased screening process to identify preferred sites. The outcome of the work was that the Belmont site was shortlisted as an upfront 30 ML/d site, and Walsh Point was identified as the preferred drought response site. The critical factors for shortlisting these sites were:

Belmont:

- Existing ocean outfall.
- Site owned by Hunter Water and zoned appropriately.
- Work progressed on the option meant that this site had the highest confidence in viability. This was important given that the LHWSP found that the existing system was at an unacceptable risk of not meeting the required level of service in drought.

Walsh Point

- Proximity to large power and water network infrastructure.
- Industrial zoning and surrounded by heavy industry (low social and environmental impacts)
- Large sites available which allowed for a large desalination plant.
- Relatively close to the Pacific Ocean (1.5-2 km ocean outfalls required)

Following the approval of the 2022 LHWSP, work began on delivering the 30 ML/d Belmont Desalination Plant and developing the EIS and Concept Design for the Walsh Point site. The key issue since that point has been the rising costs of water infrastructure, including desalination. Compared to the $6/ML rate referenced by Ganden based on the initial Belmont cost estimates, the rate now would be closer to double that.

The amount of space to construct the plants has also been challenging, given that any site would require an additional area between 50%-100% of the plant footprint as lay down area for construction. For example, the construction area for the Belmont plant is between 5 and 6 ha, whereas the plant area is less than 3 ha. Where the land isn't owned by the utility, it means a larger site than required would need to be purchased, or risk taken that neighbouring blocks will be available for lease when needed.

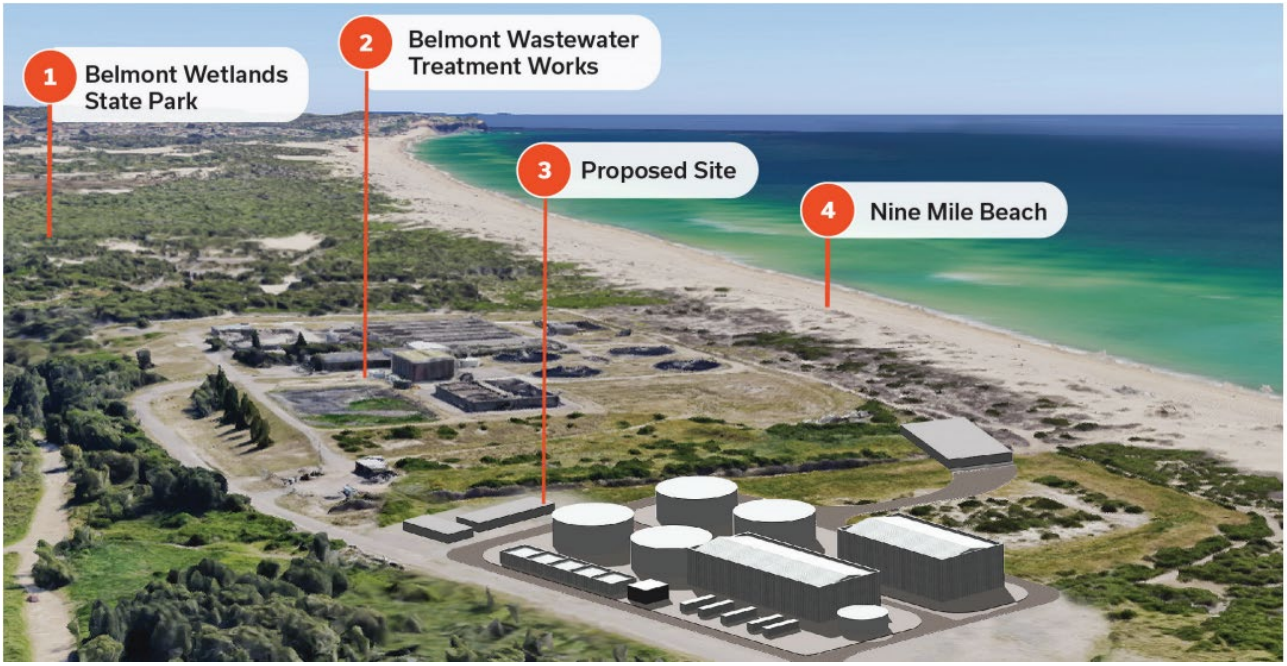


Figure 3-8: Belmont Desalination Plant layout

3.3 MidCoast Council – Nabiac Desalination Plant

During November 2019, following a period of bushfires and unprecedented drought conditions, MidCoast Council (MCC) commenced a number of emergency measures to urgently supplement water supplies. One of these was the fast-tracked design, procurement and construction of infrastructure to desalinate seawater to augment potable water supplies to the Manning Scheme. Beca HunterH2O was engaged by MCC to assist with the design and project management of the project, which was delivered to an accelerated program with multiple construction contracts.

During February 2020, the drought broke and emergency augmentation of supply was no longer required. The project was suspended and then subsequently terminated at milestones in design and construction that minimised expenditure whilst enabling MCC to maximise value for completion of the scheme if required for a future drought.

The project infrastructure broadly would have comprised of:

- a river intake and raw water pumping infrastructure on the Wallamba River
- a raw water pipeline to a temporary treatment plant within the existing Nabiac Water Treatment Plant grounds
- a network of tanks for attenuation of raw water flow situated on hardstand or in-ground with connecting pipework
- temporarily hired microfiltration (MF) units for pre-treatment and seawater reverse osmosis (SWRO) units situated in shipping containers
- a generator to provide emergency power supply, reflecting the criticality of the system
- permeate lines to Nabiac Water Treatment Plant
- a RO reject pumping system and discharge line to the Wallamaba River, a number of kilometres downstream of the intake location

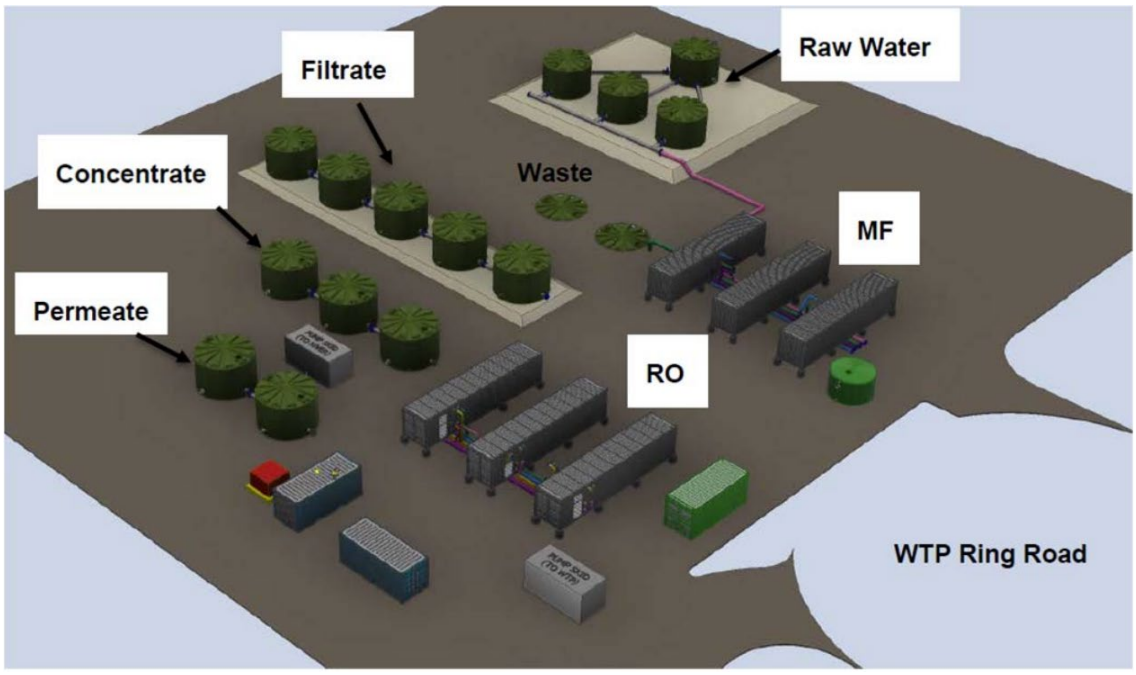


Figure 3-9: Proposed plant civil layout

At the time of planning the project, the harvesting and disposal infrastructure were designed to enable staged introduction of MF & SWRO units to yield initially 3ML/d, then 5.5ML/d and up to 8ML/d subject to the availability of these units in the market.

At the close of the project, Beca HunterH2O conducted a detailed lessons learnt process to capture what went well and what could be improved if the same situation were to arise.

Risk	Mitigation/Outcome
Community consultation	Invest in community consultation early
Availability of seawater desalination hire units	There are very few seawater desalination hire units / packages available in Australia at any time and even less during an extended drought. Any plan should consider the time, and cost, required to have seawater desalination units built from scratch for a specific project. The chance that units are ready and available for hire when required is next to zero.

	If the project is small (< 1 MLD) and hire units are identified as available, any plan should consider the costs associated with paying a retainer to the system provider to lock in the unit.
Not enough focus on the "Balance of Plant"	There can be a tendency for a design team to focus in on the reverse osmosis system design. However, this is only a relatively small component of the entire system design and delivery, and it is likely that getting water to and from the facility will be a much larger challenge.
Small production capacity step changes can have big implications	The capacity of a system needs to be locked in early to avoid time and cost blow outs. The capacity can always be revisited but it needs to be done with a view of the full system. The individual process units may not increase much but the balance of plant may step up to a size that has a significant time or cost impact.
When there is limited supply and high demand, you have no negotiating power	For hire units, there may only be one provider and as such they hold all the power in conducting negotiations. This cost premium needs to be built into any evaluation between hire and purchase. A mitigation measure, to retain some level of competitive tension, is not to rely on hire units and instead consider purchasing units, which would be mothballed following use and available for future events. Time penalties are encouraged but, given the power of negotiation is with the provider, these may not be accepted.

3.4 Tweed Shire Council

3.4.1 Background

Following an extended dry spell during 2019 – 2020, Tweed Shire Council (TSC) initiated a project to develop the planning for preliminary options to introduce temporary seawater desalination to the Tweed district water supply as an emergency drought response.

This early work involved establishing site feasibility criteria with TSC (including process, civil, network and electrical with TSC considering community aspects), developing a long list of location options and then working with TSC to consider a shortlist of sites that were feasible for seawater desalination of various capacities.

Several shortlisted sites were identified.

Following review and using a qualitative risk based approach, two of the shortlisted sites were recommended for further consideration based on being the most favourable.

Following the site selection study TSC requested Beca HunterH2O to develop a strategic program and feasibility study to implement up to a 10 ML/d desalination plant at a specific reference site that had been selected based on the outcomes of the site selection study

Given the relatively short period over which the surface water storage can be depleted during periods of reduced rainfall and the lack of alternative supply sources, TSC had a requirement to better understand the approximate duration of activities that would be required for the planning and implementation of a sea water desalination treatment facility at this location.

The approach to the overall strategic program was to develop a relatively aggressive "just in time" program for the purpose of highlighting the sensitivity of the different project phases and to support decision making about future works requirements and how to approach this project. A strategic level program was developed that describes the key activities and durations that would be required for a 10 ML/d emergency desalination plant to supplement the TSC drinking water supply during drought conditions.

The rate of Clarrie Hall Dam depletion during the 2001/02 drought was included in the program to provide context and to inform TSC how the duration of desal implementation activities compares to the rate of potential dam depletion during future drought conditions. The intention of this comparison was that it could be used by TSC to develop dam level triggers to commence elements of the work on the desalination facility to enable timely completion that is aligned with the TSC water security risk appetite.

In parallel with the preparation of the strategic program, a 'Site Feasibility Report' was prepared for the reference site. The site feasibility report was developed to complement the strategic program and allow clear identification of risks and to facilitate a better understanding of the requirements for future technical investigations.

3.4.2 Lessons Learned

The key lessons learned with regards to the strategic program and site feasibility report include:

- A 10 ML/d sea water desalination facility is a significant and complex infrastructure project and the time and resources required to implement should not be underestimated.
- Outside of emergency planning laws, it was concluded that the proposed plant was likely to be a State Significant Infrastructure project requiring preparation of an environmental impact statement (EIS), which would require a significant period of time, likely to be 18 to 24 months, to complete and seek necessary approvals.
- The supply of core desalination components from established suppliers was expected to take up to 12 months to be designed, manufactured and delivered to site. Noting that this study was completed following the COVID-19 pandemic in 2022.
- A significant portion of the planning, design, procurement and construction would need to commence while dam storage levels were at 100%. This is due to the rapid possible rate of Clarrie Hall Dam storage decline during a severe drought, which could result in the level dropping from 100% to near empty in a 12-month period under severe drought conditions. Therefore, meaningful dam storage triggers could not be developed.
- The site interfaces for power, brine discharge, waste handling and treated water distribution are significant contributors to the project timeline and complexity.
- At the conclusion of the site feasibility report there remains significant planning, technical and community barriers to implementation. The key knowledge gaps related to:
    - Formal geomorphological study and assessment of the intake site.
    - Dispersion modelling for brine outfall.
    - The most viable approach to sea water intake.
    - Raw water sampling and detailed understanding of raw water quality during drought conditions.
    - Detailed network modelling for treated water distribution.
    - Community consultation and customer sentiment.

As a summary, it was confirmed that the implementation of a desalination plant with a capacity of ~ 5 to 10 ML/d during drought conditions would likely take a significant period of time and be an expensive and complex project, with a relatively high degree of implementation and ongoing operational risk, that should not be underestimated. The approach of relying on an emergency desalination plant for TSC is questionable. TSC is strongly considering alternative approaches to emergency desalination as a drought response.

The conclusion of this and similar studies has been recognised in the Far North Coast Regional Water Strategy (June 2023), which states that for emergency supplies such as temporary desalination plants 'the lead times for these supplies can be long (12-24 months), which means that they need to be implemented very early on in a drought'.

3.5 Osmoflo

As a specialist membrane integration company, Osmoflo are a significant supplier of containerised desalination plants throughout the world, with approximately 60 containerised Rental assets in Australia. They also offer the design, fabrication, and commissioning of their custom-made systems constructed for specific projects. They have previously been engaged to provide Desalination Plant solutions for the Nabiac and Belmont drought response projects, as well as numerous other projects in Australia and internationally. In general, the Osmoflo scope includes the processing equipment, such as pre-treatment, reverse osmosis, cleaning and dosing systems, and remote monitoring, and excludes the intake/outfalls, network connections, power connections, approvals etc.

Rental assets availability

Osmoflo are unable to guarantee that appropriate Desalination Rental units will be available when required in a drought scenario, as they are typically rented on the "first come first served" basis and therefore they are always subject to availability and demand. In periods of drought it is expected that demand would be high, and, given that the company provides desalination plants globally, droughts in other countries could equally have a significant impact on unit availability.

The longer the notice period for the plant being required improves the likely availability of the plant, and the opportunities to perform any modifications required to best meet the site conditions. The relationship between notice period and the likelihood of units being available is detailed in Table 1-1.

In terms of improving the likelihood of availability and reducing the costs of executing a Rental asset as part of a drought response, options include:

- Delivering through a collaborative and/or pre-established contract with the supplier (i.e. ECI style of a contract)
- Allowing more time for deployment will decrease the overall costs of the project
- Allowing more time will allow better optimisation of the process and minimise compromises in performance. For example, providing second pass RO may be required to meet the ADWG specific requirements such as low boron concentrations.
- Long lead items can be ordered earlier in the process, which staggers investment and lowers the exposure of the end user if the drought breaks.
- Preliminary engineering and site-specific integration of Rental assets will enable identification of important Balance of Plant components (i.e. tanks, power supply, interconnecting piping, transfer pumps, re-mineralisation systems etc).

Intake water quality – salinity and turbidity

For seawater intakes of varying salinity, the plant would need to be designed to treat the highest salinity water (seawater), and augmentations to the plant design used to manage lower salinity periods.

Brackish plants are generally designed to treat inflows with salinity up to 5,000 TDS, after which high pressure brackish desalination plants are required to treat up to 10,000 TDS and higher. They generally would not be suitable to treat typical seawater salinities as brackish water RO systems by design have limited driving pressure and will struggle to overcome the osmotic pressure of seawater required to produce permeate at a reasonable recovery.

For example, the Leewood, Santos project would be a good example where TDS ranged from a low brackish to a high brackish water. It runs on a variable brackish water supplied from Coal Seam Gas produce water (stored in three different ponds with different salinities). The Primary Reverse Osmosis units were designed to Seawater specifications to meet variances in feed salinity while maintaining a name plate permeate capacity. During the design the following considerations were made:

- Different ponds were mixed to achieve the target salinity concentrations (also to manage algal loads on the pre-treatment units)
- Recovery is limited either by the scaling potential of feedwater or by the system design pressure

- A multi-stage Reverse Osmosis design allowed flexibility to operate at different recoveries. Consequently, plant production may vary depending on the feed water quality (higher TDS feed may result in lower recovery and ultimately in a lower permeate production)
- During the design we looked into the sizing of reject control valves, the high pressure pump, optimal array design and so forth

In some instances and for smaller RO plants brine recirculation strategy may be considered where the RO brine is recirculated back to the RO feedwater. It is common for a small industrial RO system to recycle a portion of its concentrate back to the feed of the high-pressure pump. This enables a system containing only a few elements to operate with a more practical recovery than that dictated by its minimum concentrate flow rate. This same method can be applied to a larger RO system to increase its recovery. For example, by recycling half of the concentrate back to the feed, a 75% recovery RO can be converted to an 87.5% recovery RO, resulting in a 12.5% water saving.

Significant disadvantages of this method are that the permeate quality will decrease and the potential for scaling will increase, depending on how much high-TDS concentrate water is being recycled back to the feed stream. That is to say the likelihood of forming scale seed crystals will increase because of the higher feed-brine concentration and these scale seed crystals may reside in the system longer than the antiscalant inhibition times.

In addition to variable TDS, it should be noted that for estuary supplies, TSS variability should also be considered as typically the Turbidity is higher after the significant rainfall event (which coincides with reduced salinity).

Table 1-4: Period to deliver a Rental asset

Capacity (ML/d)	3 months	6 months	12 months	18 months	24 months
<1	Likely	Highly Likely	Highly Likely	Highly Likely	Highly likely*
1 to 4	Possible	Likely	Highly Likely	Highly Likely	Highly likely*
4 to 10	Unlikely	Possible	Likely	Highly likely	Highly likely*
10 to 20	Rare	Rare	Possible	Highly likely	Highly likely*
>20	Rare	Rare	Unlikely	Likely*	Highly likely*

*Note 1: Ability to deliver an asset that is not in the current Rental Fleet will also depend on the commercial commitment – rental duration. We could potentially build a new plant but this would be subject to "normal" supply chain conditions (i.e. pre-COVID19), excluding Tendering Period and Contract discussion.

4 Flow Requirements

Estimated flow requirements for average day and restricted supply periods have been developed from the following documents provided by Council, as well as communications with Council staff.

- Hydrosphere 2022, Peak Day Demand Forecast – Review and Update, Technical Report prepared for Rous County Council
- Engeny Water Management 2022, Rous County Council Bulk Water Network – Milestone 1 – Model Update and Existing System Performance Assessment, Technical Report prepared for Rous County Council
- Hydrosphere 2020, Rous County Council Bulk Water Supply – Demand Forecast: 2020-2060, Technical Report prepared for Rous County Council
- Hydrosphere 2016, Rous County Council Regional Water Supply Drought Management Plan, Technical Report prepared for Rous County Council

The data presented in these reports was developed for different purposes at different times, and therefore provided varying levels of detail for demand sources, how these were broken down across the Local Government Areas, and the demand volumes. As such, some level of extrapolation between data sets was required to develop a consolidated dataset.

The intent of this rationalisation of the data was to:

- understand the demand at each reservoir or supply point in drought and non-drought conditions,
- understand the demand types in drought and non-drought conditions,
- use this knowledge to understand risks and opportunities for desalination supply.

4.1 Demand by location

To determine the demand volume at each service point, the average day demand (ADD) summary data from Table 4.8 of Engeny (2022) was used as a basis. The total ADD from this table was compared against the total volumes in the Hydrosphere (2022) report, and it was found the Hydrosphere data was higher. Given that the this data was based on observed SCADA operational data, it was considered more accurate and the Engeny (2022) volumes were uniformly increased pro-rata to match the higher ADD values in Hydrosphere (2022).

The ADD data was then reduced for restriction periods based on the draft demand reduction targets provided by Council, as per Table 4. The volumes for each supply point are included as Appendix B.

Table 5: DRAFT revised drought demand estimates (pers. comm from Council August 2023)

Restriction Level	2016 RCD Trigger	2025 target demand reduction	2025 target demand (ML/d)
0	-	-	36.3
1 – moderate	60%	7.5%	33.6
2 – high	45%	15%	30.9
3 – very high	30%	22.5%	28.2
4 – severe	20%	30%	25.4
5 - emergency	10%	37.5%	22.7

4.2 Demand by type

The more recent Engeny and Hydrosphere reports did not break down the demand by type, so the following data was adopted from the historic reports to determine the type of demand in each area:

- Residential and non-residential connection numbers from Hydrosphere 2020 for Ballina, Byron Bay, Lismore and Richmond Valley LGAs.
- The difference between the 2020 and 2022 Total Connections was then applied to residential and non-residential connections from 2020 pro-rata uniformly.
- Demand volumes at the extreme restriction demand were then calculated using:
    - 95 L/p/d for residential connections based on advice from Council, assuming 2.4 persons per connection as per the 2016 DMP.
    - 50% reduction in non-residential demand as per the 2016 DMP.
- Demand values by type for filling stations, Non-Revenue Water, council losses and retail customers are taken from Hydrosphere 2020
- Target monthly multipliers and assumptions for non-residential restricted demand from Hydrosphere 2016

The breakdown of demand per connection type and area is included as Appendix B.

It should be noted that a revision of the restricted demand supply volumes was underway at the time of this project, however given the strategic level of this assessment, the volumes developed are considered fit for purpose.

4.3 System Connections

The preferred network connection for product water from the desalination plant is to an existing storage or reservoir, which minimises complex hydraulics associated with discharging into existing pressurised sections of the network. Suitable storages will need to be sufficiently sized and part of large water supply zone to ensure sufficient customer demands. If a network connection point is required via an existing section of trunk pipeline, consideration of the condition & pressure limitations of the receiving trunk network is critical. It is preferable to stay within existing pressure envelope as going above or below the existing network pressures will impact customers and may increase the risk of leaks and breaks.

A key consideration for this project is that the large demand points in the system are separated by significant distances relative to the supply volumes. For example, two thirds of the drought supply would be consumed within the Ballina and Byron Bay area, with the remaining to go to Lismore, approximately 35 to 40km from St Helena reservoir, and to the Richmond Valley, a further 30 to 40 km south of Lismore. The fact that the existing network is already connected between all demand points provides an opportunity to provide supply from one point, however it also introduces significant risks of water quality degradation within the distribution system at low demands, a high proportion of leakage relative to supply, and high pumping costs.

If a desalination plant is constructed at Byron Bay and is proposed to distribute to the other LGAs, the condition of the existing pipelines would also need to be considered. If flows are required to be boosted to reverse the supply direction from the current configuration (i.e. pump through the existing pipes into St Helena Reservoir), it would be likely that some of the older pipelines will suffer breakages. Our experience from other projects has shown that the challenge of reversing the flow direction in the network is a significant cost, time and reliability risk, and if possible it would be preferable to test the network incrementally with the new configuration prior to a drought occurring to allow enough time to address any unsuitable assets/connections.

Based on the pipeline sizes included as Figure 4.4 of Engeny (2022), it is expected that the existing network would have pipe class and flowrate capacity to transfer the required emergency level restricted supply volumes from a desalination plant in Byron Bay or Ballina. However, a plant in the Richmond Valley would likely require an upsizing of the DN200-225 connection from South Evans Head to Woodburn.

Current operations maintain a hydraulic grade of at least 170 m in the trunkmains between NightCap Clear Water Storage and St Helena. It is likely that pressures required to reverse the transfer direction would be within the current operational pressure envelope. Maintaining network pressures when transfers are not active will require consideration.

Transfers will be contingent on being able to pump over high points in the trunkmains near Dorroughby where the network splits between the eastern (Byron / Ballina) and southern (Lismore / Richmond Valley) legs of the trunk network. Gravity supply from St Helena Reservoir to Knockrow / Ballina may also be problematic due to trunk main elevations.

A new pumping station would be required between St Helena Reservoir and Ballina / Lismore branches of the network. Alternatively, water may be able to be "batched" with a single pumping station at a Byron desalination plant, alternating supply between Byron (St Helena Reservoir) and the remainder of the network.

Supply to Dorroughby is likely to be problematic due to suction requirements for the Dorroughby Pumps. Due to low demands, this area may be better serviced by reserving storage at Rocky Creek Dam and supplying from NightCap WTP (potentially batching production if demands are too low).

5 Site Selection Criteria

Site selection criteria have been collated based on the information presented in this report, and categorised as relevant for the plant site and/or intake/outfall location (see Table 5).

The selection criteria have also been categorised as exclusion criteria and/or scored criteria:

- exclusion criteria are non-contestable criteria which would practically exclude that site from consideration. For example, the steepness of the site would made construction impractical. For some exclusion criteria, guidance from Council and/or Stakeholders will be used to determine a conservative assumed value.
- Scored criteria will be applied to short-list sites from the long-list, using weights and scores through a multi-criteria assessment.

Table 6: Site Selection Criteria

Criteria	Description	Plant	Intake/Outfall	Type	GIS Layer
Contaminated land	Significant cost and time risks if contaminated spoil is required to be disposed off-site, or treated on-site.	✔	✘	Exclude landfill sites, otherwise Scored	
Flooding	Significant risk to medium to long-term assets, and/or cost increases to build up sites.	✔	✔	Exclude to agreed value (1in20?), otherwise Scored	EPI_Flood
Sea Level Rise	Increases the risk of flooding and erosion through storm surge. Can lead to sites becoming unviable in the medium to long term, or increased costs to armour sites.	✔	✔	Exclude to agreed value, otherwise Scored	EPI_Flood
Site gradient	High grade sites can require significant earthworks as part of the construction process.	✔	✘	Exclude to agreed value (30%), otherwise Scored	5m_DEM.tif
Site elevation	Pumping costs to elevated sites need to be included, noting that elevated sites will have a lower pumping cost to provide potable to the network.	✔	✘	Exclude to agreed value (100m), otherwise Scored	5m_DEM.tif
Geotechnical conditions	Presence of rock beneficial for tunnelling and to create stable foundation conditions. Silt or in-filled areas can require pylons to bedrock for site stability.	✔	✔	Scored	
Cultural Heritage	Aboriginal or non-Aboriginal heritage sites may lead to	✔	✔	Exclude	EPI_Heritage, BSC_2012_LEP_HER

	sites being unsuitable.				
Proximity to Power	Critical to costs and timeframe for delivery. May need to be an upfront if a significant upgrade to transformers or transmission wires is required. Delivery may be dependent on third party (Essential Energy in this case)	✔	✘	Scored	Essential Energy
Coastal Erosion	Erosion of coastal plant sites or coastal intake/offtake structures or wells could reduce the longevity of the asset.	✔	✔	Scored	
Proximity to National Parks	Community expectations may be for a buffer zone around National Parks.	✔	✔	Exclude National, Parks, Scored buffer zone (100m)	NPWS_Estate
Vegetation Communities	Vegetated areas of high value outside of National Parks, for example, State Conservation Areas. Includes seagrass meadows for intake/outfall structures.	✔	✔	Exclude on advice from Council, Scored	EPI_Native_Veg_Protection
Proximity to Residences	Visual and noise/vibration impacts on residents may be unacceptable and introduce challenges to gaining planning approval.	✔	✔	Exclude Residential (R1-5, E1, SP3) and 250 m buffer (EP&A)	NPWS_EstateInternalBoundaries
Coastal Wetland	Proximity to coastal wetlands would require significant investigations to demonstrate acceptable impacts.	✔	✔	Exclude within wetland, Scored for buffer area (within 100m) (EP&A)	EPI_Wetlands

Littoral Rainforest	Proximity to littoral rainforests would require significant investigations to demonstrate acceptable impacts.	✔	✔	Exclude	
Koala Habitat	Clearing of Koala habitat will prevent a significant barrier to planning approvals.	✔	✔	Score	CoreKoalaHabitat, PreferredKoalaHabitat, ImpPopBoundary, WildifeCorridors
Land Parcel Size	The available land area will directly impact the potential capacity of the plant, or, lead to higher delivery costs.	✔	✘	Score (See Section 3.1.2.6.4)	LEP_Zoning, Lot, EPI_Urban_Release_Area
Terrestrial Biodiversity	Impacts on high value biodiversity will lead to significant investigations to prove the acceptability of the impact and/or risk planning approval.	✔	✔	Exclude CEECs, EECs. Score TECs	EPI_Terrestrial_Biodiversity
Proximity to Tourism Areas	Visual and noise impacts to tourism sites will lead to planning approval challenges.	✔	✔	Score	
Council owned land	Land already owned by Council will lead to cost and time savings, as well as reduce program risks.	✔	✔	Score	
Land Zoning	The land zoning will directly impact whether the proposal is permissible, noting that Council can re-zone land if required.	✔	✘	Exclude … Score …	LEP_Zoning
Drinking Water Catchments	Construction within a drinking water catchment will add to the approvals	✔	✔	Score	EPI_Drinking_Water_Catchments

	and costs of the proposal.				
Coastal Vulnerability Area		✔	✔	Score	PUBLIC/Marine_Protected_Areas
Coastal Environment Area		✔	✔	Score	PUBLIC/Marine_Protected_Areas
Coastal Use Area		✔	✔	Score	PUBLIC/Marine_Protected_Areas
Bushfire Prone Land	Site longevity is at risk for sites which are prone to bushfire impacts, particularly with projected climate change impacts.	✔	✘	Score	Bushfire_prone_land20230713
Proximity to Wastewater network	For smaller plants, use of the wastewater network to dispose of brine is a potential option.	✔	✘	Score	WastewaterSCs_V_polyline WastewaterPipes_V_polyline
Proximity to Water Connections	A critical aspect of the project cost is the connection to water network	✔	✘	Score	Ballina water Pipes Drinking_polyline
Water network hydraulic grade	Supplying water against the hydraulic grade of the system increases the complexity and cost of the proposal	✔	✘	Score	5m_DEM.tif
Estuary mixing plumes	Stable intake quality is a critical input to the RO process.	✘	✔	Exclude/Score?	Estuaries
Offshore reefs/outcrops	Exposed rock allows for desalination intakes to be anchored and provides an easier construction method.	✘	✔	Score	5m_DEM.tif
Off-shore slope	Need to avoid keel depths for vessels. (need at least 10 metres, preferable 15 metres) About 800-1000 metres off-shore based on maps available). Alternative is to set	✘	✔	Score	

	up exclusion zones for temporary			
Proximity to diffuse pollutants	Pesticides, pathogens and increased turbidity can create water treatment risks and lead to more difficult process requirements and/or approvals processes with NSW Health.	✗	✔	Score
Proximity to point source pollutants	Wastewater or industrial outfalls can contain chemicals which create treatment and/or brine disposal challenges.	✗	✔	Exclude within Xm, Score

Appendix A. Planning Pathway Considerations

ENVIRONMENT
& HEALTH

Rous County Council Temporary Desalination Options Study

Preliminary Environmental and Planning Advice

Project name	**Rous County Council Temporary Desalination Options Study**
Project no.	**318001817**
Recipient	**Beca Hunter H2O c/o Rous County Council**
Document type	**Report**
Version	**V1.0**
Date	**17/07/2024**
Prepared by	**Charyssa Lawrence**
Checked by	**Clare Butterfield**
Approved by	**Shaun Taylor**
Description	**Ramboll Australia (Ramboll) have been engaged by Beca Hunter H2O Pty Ltd (Beca Hunter H2O) on behalf of Rous County Council to provide preliminary environmental and planning advice for temporary desalination options assessment for the Northern Rivers coastal region.**

Ramboll Australia Pty Ltd.
ACN 095 437 442
ABN 49 095 437 442

1. Introduction

It is understood that Rous County Council (the Council) has commissioned Beca Hunter H2O to investigate the development of one or more emergency temporary desalination plants to service the larger population centres on the Northern Rivers Coast, New South Wales (NSW) (the Proposal). The townships of Ballina, Byron Bay, Lismore and Richmond Valley are being considered in the site selection planning stage of the Proposal.

Ramboll Australia Pty (Ramboll) has been engaged by Beca Hunter H2O to provide the preliminary environmental and planning advice to assist in the strategic planning decision making processes. This advice is not legal in nature and therefore legal advice should be considered. Clarification should also be sought from relevant government agencies and potentially legal counsel regarding their interpretation of, and agreement with this advice before proceeding.

2. Statutory Framework

A summary of the major planning pathway considerations is provided in **Table 2-1,** and **Table 2-2** provides a comprehensive analysis of planning and approval considerations relevant to the Proposal based on a review of the following environmental planning instruments:

- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation)
- State environmental planning policies including:
  - *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP)
  - *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP)
  - *State Environmental Planning Policy (Resilience and Hazards) 2021* (Resilience and Hazards SEPP)
  - *State Environmental Planning Policy (Biodiversity and Conservation) 2021* (Biodiversity and Conservation SEPP)
- Local environmental plans including:
  - *Ballina Local Environmental Plan 2012* (Ballina LEP)
  - *Byron Local Environmental Plan 2014* (Byron Bay LEP)
  - *Lismore Local Environmental Plan 2012* (Lismore LEP)
  - *Richmond Valley Local Environmental Plan 2012* (Richmond Valley LEP)
- *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- *Water Management Act 2000* (WM Act)
- *Protection of the Environment Operations Act 1997* (POEO Act)
- *Biodiversity Conservation Act 2016* (BC Act)
- *Water Supply (Critical Needs) Act 2019*

Table 2-1: Summary of Planning Pathway Considerations

Proposal criteria	Development without Consent		Designated Development	State Significant Infrastructure (SSI)
	Review of Environmental Factors (REF)	REF + Public Exhibition	Environmental Impact Statement (EIS)	
Capital Investment Value (CIV)	≤ $5 million	> $5 million[1]	≥ $10 million[2]	
Processing capacity[3]	< 2,500 persons or < 750 KL/day		> 2,500 persons or > 750 KL/day	
Environmental features[3]	Located outside of: • floodplains • coastal dune fields • drinking water catchments • 100 metres of a natural water body or wetland • 250 metres of a non-associated dwelling • Coastal wetlands or littoral rainforests as defined in the Resilience and Hazards SEPP Note: regardless of the above, if the activity is likely to significantly affect the environment (except in relation to biodiversity), an environmental impact statement would need to be prepared [4].		Located within: • floodplains • coastal dune fields • drinking water catchments • 100 metres of a natural water body or wetland • 250 metres of a non-associated dwelling • Coastal wetlands and littoral rainforests as defined in the Resilience and Hazards SEPP	
Licencing triggers[1]		If the activity requires an approval or permit under *Fisheries Management Act 1994*, *Heritage Act 1977*, N*ational Parks and Wildlife Act 1974*, or *Protection of the Environment Operations Act 1997*		Authorisations not required for SSI: • *Fisheries Management Act 1994* (Section 201, 205 or 219) • *Heritage Act 1977* (Part 4 or Section 139) • *National Parks and Wildlife Act 1974* • *NSW Rural Fires Act 1997* (Section 100b) • *Water Management Act 2000* (Section 89, 90 or 91).

Proposal criteria	Development without Consent		Designated Development	State Significant Infrastructure (SSI)
	Review of Environmental Factors (REF)	REF + Public Exhibition	Environmental Impact Statement (EIS)	
Land use zone	Permitted without consent in the prescribed land use zones[5]: • RU1 Primary Production • RU2 Rural Landscape • RU4 Primary Production Small Lots • E4 General Industrial • E5 Heavy Industrial • IN1 General Industrial • IN3 Heavy Industrial • SP1 Special Activities • SP2 Infrastructure.		Permitted with consent under the relevant LEP: • RU1 Primary Production (Ballina and Richmond Valley LEPs) • RU2 Rural Landscape (Ballina LEP) • E3 Productivity Support (Ballina LEP) • E4 General Industrial (Ballina, Lismore and Richmond Valley LEPs)	

Notes:

1. EP&A Regulation (Part 8 Division 1 Section 171)
2. Planning Systems SEPP (clause 21 of Schedule 1)
3. EP&A Regulation (Section 23 of Schedule 3) and Resilience and Hazards SEPP (Chapter 2 Part 2.2 Division 1 Section 2.7)
4. EP&A Act (Part 5 Division 5.1).
5. T&I SEPP (Chapter 2 Part 2.3 Division 24 Section 2.159)

Table 2-2: Planning Considerations Applicable to Proposal

Legislation, regulation, or policy	Planning Considerations		
	Development without Consent (REF)	**Designated Development (EIS)**	**State Significant (EIS)**
***Environmental Planning and Assessment Act 1979* (EP&A Act)**			
The EP&A Act establishes the framework for environmental planning and development approvals in NSW. The need for development consent under Part 4 or determination as an activity under Part 5 is regulated by environmental planning instruments (EPIs) such as State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs).	Division 5.1 of Part 5 of the Act provides for control and assessment of 'activities' undertaken by 'public authorities' that do not require development consent under Part 4 of the Act but require the determining authority to conduct a Review of Environmental Factors (REF) as to *"examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity".* If the activity is likely to significantly affect the environment, an EIS would need to be prepared instead of an REF (Section 5.7 of the EP&A Act). Rous County Council is considered a 'public authority' for the purposes of the EP&A Act.	Part 4 of the Act provides for the assessment and determination of development that requires development consent from a consent authority. Development consents are typically granted by a local council but may be granted by a regional planning panel or other government authority such as the Department of Planning and Environment (DPE). Development consent under Part 4 of the Act is required for development categorised as either designated development, State Significant Development (SSD) or State Significant Infrastructure (SSI). An Environmental Impact Statement (EIS) must accompany these developments and must comply with the industry-specific environmental assessment requirements (SEARs) for the Proposal. In the event that the majority of the Proposal is within a zone where it is permitted with consent under the LEP, but part is required to be in a zone where it is prohibited, the overall Proposal would be permissible under Section 4.38 of the EP&A Act. Those parts of the proposed plant that could normally be undertaken without development consent (such as water supply pipelines under the T&I SEPP) would be considered part of the overall Proposal and could only be constructed upon the overall Proposal receiving development consent. See further discussion in T&I SEPP section below. Under Section 5.23 of the EP&A Act, the following authorisations are not required for SSI: • a permit under Section 201, 205 or 219 of the *Fisheries Management Act 1994* • an approval under Part 4, or an excavation permit under Section 139, of the *Heritage Act 1977*	

Legislation, regulation, or policy	Planning Considerations		
	Development without Consent (REF)	**Designated Development (EIS)**	**State Significant (EIS)**
		• an Aboriginal heritage impact permit under Section 90 of the *National Parks and Wildlife Act 1974* • a bush fire safety authority under Section 100B of the *Rural Fires Act 1997* • a water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than an aquifer interference approval) under Section 91 of the *Water Management Act 2000*. It should be noted, however, that the information that would be required to attain these approvals will need to be provided in the EIS, and the conditions of consent would reflect the typical requirements of these approvals. Section 5.13 of the EP&A Act allows for a Proposal to be declared critical SSI "*if it is of a category that, in the opinion of the Minister, is essential for the State for economic, environmental or social reasons*".	
***Environmental Planning and Assessment Regulation 2021* (EP&A Regulation)**			
The EP&A Regulation contains key provisions for the operation of the NSW planning system and supports the EP&A Act. Part 8 sets out requirements for infrastructure and environmental impact assessment. The planning considerations for desalination plants are considered in Section 23 of Schedule 3 of the EP&A Regulation.	Part 8, Section 171 of the EP&A Regulation sets out the requirements to be considered by a REF. A REF must be published on the determining authority's website or the NSW planning portal if the activity has a capital investment value of more than $5 million or requires an approval or permit under: (i) *Fisheries Management Act 1994*, sections 144, 200, 205 or 219,	Desalination plants are considered designated development under Section 23 of Schedule 3 of the EP&A Regulation where they meet the following criteria: • The plant has an intended processing capacity of more than 2,500 persons equivalent capacity or 750 kilolitres per day, or • The plant has an intended processing capacity of more than 20 persons equivalent capacity or 6 kilolitres per day and is located: - on a floodplain - in a coastal dune field	

Legislation, regulation, or policy	Planning Considerations		
	Development without Consent (REF)	**Designated Development (EIS)**	**State Significant (EIS)**
	(ii) H*eritage Act 1977*, section 57, (iii) *National Parks and Wildlife Act 1974*, section 90, (iv) *Protection of the Environment Operations Act 1997*, sections 47–49 or 122, or the determining authority considers that it is in the public interest to publish the review.	- in a drinking water catchment - within 100 metres of a natural waterbody or wetland, or - within 250 metres of a dwelling not associated with the development	
***State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP)**			
The Planning Systems SEPP defines projects that are considered state significant development (SSD) and state significant infrastructure (SSI). Desalination plants are defined as 'water treatment facilities' under the Planning Systems SEPP.			Water treatment facilities (including desalination plants) are considered to be SSD or SSI where development has a CIV of > $10 million in accordance with both Section 21 of Schedule 1 (SSD) and Section 4 of Schedule 3 (SSI) of the Planning Systems SEPP. The Minister for Planning (or a delegate) is the consent authority for projects that are deemed SSD or SSI.
***State Environmental Planning Policy (Transport and Infrastructure) 2021* (Transport and Infrastructure SEPP)**			
The Transport and Infrastructure SEPP sets out the planning rules and controls for infrastructure in NSW. The Transport and Infrastructure SEPP simplifies the	Section 2.159 under Division 24 lists developments permitted without consent.	The Transport and Infrastructure SEPP does not declare any development types as designated development.	

Legislation, regulation, or policy	Planning Considerations		
	Development without Consent (REF)	Designated Development (EIS)	State Significant (EIS)
planning process for providing essential infrastructure like hospitals, roads, railways, emergency services, water supply and electricity delivery. Desalination plants are defined as 'water treatment facilities' under the Transport and Infrastructure SEPP. Division 24 of the Transport and Infrastructure SEPP relates to water supply systems including water treatment facilities.	Clause 1 states that development for the purpose of water reticulation systems may be carried out by or on behalf of a public authority without consent on any land. Clause 4 states *"development for the purpose of water treatment facilities may be carried out by or on behalf of a public authority without consent on land in a prescribed zone"*. As described earlier, Rous County Council is considered a public authority Prescribed zones that relate to 'Division 24 Water Supply Systems' include the following: • RU1 Primary Production • RU2 Rural Landscape • RU4 Primary Production Small Lots • E4 General Industrial • E5 Heavy Industrial • IN1 General Industrial • IN3 Heavy Industrial • SP1 Special Activities • SP2 Infrastructure.		

<table>
<tr><th rowspan="2">Legislation, regulation, or policy</th><th colspan="3">Planning Considerations</th></tr>
<tr><th>Development without Consent (REF)</th><th>Designated Development (EIS)</th><th>State Significant (EIS)</th></tr>
<tr><td colspan="4">State Environmental Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP)</td></tr>
<tr><td>The Resilience and Hazards SEPP includes provisions for development that is intended to be carried out on land within the coastal zone.

Chapter 2 of the SEPP outlines development controls for coastal management areas.

Chapter 3 of the SEPP outlines the requirements for hazardous and offensive development.

Chapter 4 of the SEPP outlines the requirements for remediation of land.</td><td colspan="3">Development on land identified as ‘proximity to coastal wetlands’, ‘proximity to littoral rainforest’, ‘coastal vulnerability area’, ‘coastal environment area’, or ‘coastal use area’ require consideration of differing ranges of development controls as shown in Table 2-3.

Table 2-3: Development controls as per the Resilience and Hazards SEPP
<table><tr><th>Land type</th><th>Summary of development controls</th></tr><tr><td>Proximity to coastal wetlands and littoral rainforest</td><td>The consent authority must be satisfied that the proposed development will not significantly impact on the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral forest, or the quantity and quality of surface and groundwater flows to and from the adjacent coastal wetland or littoral rainforest.</td></tr><tr><td>Coastal vulnerability area</td><td>The consent authority must be satisfied that the: proposed building or works are engineered to withstand current and projected coastal hazards for the design life of the building or works; the development is not likely to alter coastal processes to the detriment of the natural environment or other land; the development is not likely to reduce public amenity, access to and use of any beach, foreshore, rock platform or headland adjacent to the proposed development; and the development incorporates appropriate measures to manage risk to life and public safety from coastal hazards.</td></tr><tr><td>Coastal environment area</td><td>Development consent must not be granted unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on: the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment; coastal environmental values and natural coastal processes; the water quality of the marine estate, in particular the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1 of the SEPP; marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms; existing public pen space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability; Aboriginal cultural heritage, practices and places; and the use of the surf zone.

Development consent must not be granted unless the consent authority is satisfied that: the development is define the development is designed, sited and will be managed to avoid an adverse impact on those aspects described above; if that</td></tr></table></td></tr>
</table>

<table>
<tr><th rowspan="2">Legislation, regulation, or policy</th><th colspan="3">Planning Considerations</th></tr>
<tr><th>Development without Consent (REF)</th><th>Designated Development (EIS)</th><th>State Significant (EIS)</th></tr>
<tr><td rowspan="4"></td><td colspan="3"><table>
<tr><td></td><td>impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact; and if that impact cannot be minimised—the development will be managed to mitigate that impact.</td></tr>
<tr><td>Coastal use area</td><td>Development consent must not be granted unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on: existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability; overshadowing, wind funnelling and the loss of views from public places to foreshores; the visual amenity and scenic qualities of the coast, including coastal headlands; Aboriginal cultural heritage, practices and places; and cultural and built environment heritage.

Development consent must not be granted unless the consent authority is satisfied that: the development is define the development is designed, sited and will be managed to avoid an adverse impact on those aspects described above; if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact; and if that impact cannot be minimised—the development will be managed to mitigate that impact.</td></tr>
</table></td></tr>
<tr><td colspan="3">Controls relating to Chapter 3 of the SEPP may apply to the Proposal where the development is deemed as a type of hazardous or offensive development. The applicability of this Chapter of the SEPP to the Proposal may depend on final concept plans including the type and quantity of hazardous substances used and stored on site. Where this Chapter does apply to the Proposal, a preliminary hazard analysis is to be prepared by or on behalf of the applicant.
Controls relating to Chapter 4 of the SEPP relate to remediation of contaminated land and would only apply to the Proposal where remediation of contaminated land would be included in the Proposal which is considered unlikely.</td></tr>
<tr><td>Development within Coastal wetlands and littoral rainforests as defined in the Resilience and Hazards SEPP is not permitted without consent.</td><td>Section 2.7 of Division 1 of the SEPP refers to development on land within coastal wetlands and littoral rainforests area whereby development consent is required as designated development.

Coastal wetlands and littoral rainforests are defined in the State Environmental Planning Policy (Resilience and Hazards)</td><td>Where the Capital Investment Value (CIV) of a proposed desalination plant development is > $10 million, the Proposal can be considered state significant.

Refer to discussion on the Planning Systems SEPP</td></tr>
</table>

Legislation, regulation, or policy	Planning Considerations		
	Development without Consent (REF)	**Designated Development (EIS)**	**State Significant (EIS)**
		2021 Coastal Wetlands and Littoral Rainforests Area Map.	
***State Environmental Planning Policy (Biodiversity and Conservation) 2021* (Biodiversity and Conservation SEPP)**			
The Biodiversity and Conservation SEPP includes provisions for protection of koala habitat. The applicability of the SEPP in relation to koala habitat is based on LGA and land use zone.	Section 4.4 of the SEPP defines the land to which the koala habitat provisions apply as those LGAs listed in Schedule 2 of the SEPP. The Ballina, Byron Bay, Lismore and Richmond Valley LGAs are all included in Schedule 2 of the SEPP as pertaining to the North Coast Koala Management Area (KMA 1). Development within a KMA listed in Schedule 2 of the SEPP is subject to the Development Controls outlined in Part 4.2 of the SEPP. However, an exemption applies to the following land use zones listed under Clause 3(d) of Section 4.4: • Primary Production (RU1) • Rural Landscape (RU2) • Forestry (RU3) For all other land use zones within KMA 1 development is subject to the controls outlined in Part 4.2 of the SEPP depending on the availability of an approved koala plan of management (KPoM) applicable to the LGA. Ballina, Byron Bay and Lismore all have an approved KPoM. Development in these LGA's is to be consistent with the KPoM and Section 4.8. Richmond Valley does not have an approved KPoM. Section 4.9 of the SEPP requires development to be ecologically assessed by a suitably qualified specialist.		
Local Environmental Plans (LEPs)			
LEPs apply to a particular Local Government Area (LGA) and guide planning decisions for LGAs by allocating zones to different parcels of land with each zone possessing a number of objectives indicating the principal purpose of the land. Each zone lists which developments are permitted with		Water supply systems or water treatment facilities are deemed to be development permitted with consent in the following land use zones with reference to the relevant LEPs: • RU1 Primary Production (Ballina and Richmond Valley LEPs) • RU2 Rural Landscape (Ballina LEP) • RU5 Village (Lismore and Richmond Valley LEPs) • R3 Low Density Residential (Ballina LEP) • R3 Medium Density Residential (Ballina LEP) • E1 Local centre (Ballina LEP)	

<table>
<tr><th rowspan="2">Legislation, regulation, or policy</th><th colspan="3">Planning Considerations</th></tr>
<tr><th>Development without Consent (REF)</th><th>Designated Development (EIS)</th><th>State Significant (EIS)</th></tr>
<tr><td rowspan="2">consent, permitted without consent or prohibited.

Desalination plants are defined as water supply system or water treatment facilities in the LEPs reviewed.</td><td></td><td colspan="2">• E2 Commercial Centre (Ballina LEP)
• E3 Productivity Support (Ballina LEP)
• E4 General Industrial (Ballina, Lismore and Richmond Valley LEPs)
• RE1 Public Recreation (Ballina LEP)
• RE2 Private Recreation (Ballina LEP)
• W4 Working Waterfront (Richmond Valley LEP)
In the event that the majority of the Proposal is within a zone where it is permitted with consent under the LEP, but part is required to be in a zone where it is prohibited, the overall Proposal would be permissible.</td></tr>
<tr><td colspan="3">In the event of an inconsistency with the provisions of the T&I SEPP and the relevant LEP, the T&I SEPP prevails to the extent of the inconsistency, meaning that where the Proposal is on land in a prescribed zone (refer to zones listed in T&I Section of this table above), the Proposal would be permissible, regardless of the land use table in the relevant LEP.

If a site was found to be suitable for the Proposal, in a zone where it is not permitted under the LEP or the T&I SEPP, there may be an opportunity for a planning proposal to amend the LEP)and rezone the land) under Division 3.4 of the EP&A Act. The planning proposal would need to adequately justify the suitability of the particular site for the purpose of the proposal. The benchmark timeframes for assessment of a planning proposal is up to 320 days for a standard and 420 days for a complex planning proposal (from pre-lodgement to finalisation).

A complete breakdown of zoning permissibility for each LGA is provided in Table A-3-3 with reference to permissibility under the relevant LEP and the T&I SEPP.</td></tr>
</table>

Legislation, regulation, or policy	Planning Considerations		
	Development without Consent (REF)	Designated Development (EIS)	State Significant (EIS)
Other Approval Considerations			
Environmental Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) is the core piece of legislation protecting Matters of National Environmental Significance (MNES) and Commonwealth land.	There are nine MNES identified under the EPBC Act: • World Heritage Properties • National Heritage Places • Wetlands of international importance • Listed threatened species and ecological communities • Migratory species • Commonwealth marine areas • The Great Barrier Reef Marine Park • Nuclear actions • A water resource, in relation to coal seam gas development and large coal mining development. Under the EPBC Act, a referral is required to be submitted to the Department of Climate Change, Energy, Environment and Water (DCCEEW) for any 'action' that is considered likely to have a significant impact on any MNES. If DCCEEW determines the action to be a 'controlled activity' approval is required from the Minister of the Environment.		
Water Management Act 2000 (WM Act) aims to provide for the sustainable and integrated management of the state's water in accordance with ecologically sustainable development principles	Under section 91 of the WM Act, a controlled activity approval is required for certain types of activities which are carried out on waterfront land. 'Waterfront land' is defined in the WM Act as the bed of any river, lake or estuary, and the land within 40 m of the riverbanks, lake shore or estuary mean high water mark. However, a controlled activity approval exemption can apply under Section 41 of the *Water Management (General) Regulation 2018*, "*a public authority is exempt from section 91E(1) of the Act in relation to all controlled activities that it carries out in, on or under waterfront land*." Other approvals such as a water use approval and water management approval under sections 89 and 90 of the WM Act, respectively, can still apply.	Section 5.23 of the EP&A Act states that the following approvals are not required for SSI or SSD: • a water use approval under section 89 • a water management work approval under section 90 • an activity approval (other than an aquifer interference approval) under section 91 of the WM Act.	

<table>
<tr><th rowspan="2">Legislation, regulation, or policy</th><th colspan="3">Planning Considerations</th></tr>
<tr><th>Development without Consent (REF)</th><th>Designated Development (EIS)</th><th>State Significant (EIS)</th></tr>
<tr><td>Protection of the Environment Operations Act 1997 (POEO Act) aims to protect, restore and enhance the quality of the environment to maintain ecologically sustainable development and provides the key framework to regulate environmental pollution.</td><td colspan="3">An environment protection licence (EPL) is required for scheduled development work and scheduled activities under Chapter 3 of the POEO Act. Scheduled activities are listed under Schedule 1 of the POEO Act. Under Part 5.3 of the POEO Act it is an offence to pollute any waters.

The proposed desalination plant is not listed as a scheduled activity in Schedule 1 of the POEO Act, however, the Proposal may require a licence for a non-scheduled activity as a protection against prosecution under section 5.3 of the POEO Act for the pollution of waters. Pollution of waterways would not be expected to occur as a result of the desalination plant, with implementation of the management and mitigation measures, however an assessment would need to be included to support the proposed plant as part of any application for approval.</td></tr>
<tr><td rowspan="2">Biodiversity Conservation Act 2016 (BC Act) provides a framework for the assessment of a project's potential impacts on threated species, population and Endangered Ecological Communities.</td><td rowspan="2">Section 7.8 of the BC Act states an assessment under Part 5 of the EP&A Act needs a species impact statement or a biodiversity development assessment report (BDAR) where an activity is likely to significantly affect threatened species.</td><td colspan="2">Section 7.7 of the BC Act states an application for development consent (under Part 4 of the EP&A Act) is to be accompanied by a biodiversity development assessment report (BDAR) where an activity is likely to significantly affect threatened species.</td></tr>
<tr><td>-</td><td>Entry into the Biodiversity Offset Scheme (BOS) is automatically triggered for SSI projects.</td></tr>
<tr><td>Water Supply (Critical Needs) Act 2019 was a special-purpose, temporary legislation that gave the Minister for Water additional powers needed to secure regional town water supplies against drought.</td><td colspan="3">The Water Supply (Critical Needs) Act 2019 came into force on 21 November 2019 and was written to stop operating after two years (unless the Minister for Water extended it due to continuing risks to town water security). It could only be extended once.

From a review of the NSW Legislation web page there has been no regulation enacted to extend the application of the Act (which is the mechanism described in the act for extending it). As such it would appear that the Water Supply (Critical Needs) Act 2019 is no longer applicable (although it has not been repealed).</td></tr>
</table>

Legislation, regulation, or policy	Planning Considerations		
	Development without Consent (REF)	Designated Development (EIS)	State Significant (EIS)
Water Sharing Plans are the primary tool to define water-sharing arrangements in NSW.	The applicability of a water sharing plan (WSP) will depend on final site selection. Generally, the plan will set out the requirements for water extraction under access licences, limits the availability of water for extraction on long term basis and establishes the maximum volume of water that may be taken under an access licence. The following WSPs may apply to the water sources for the Proposal: • *Richmond River Area Unregulated, Regulated and Alluvial Water Sources 2023* • *Brunswick Unregulated and Alluvial Water Sources 2016* • *Tweed River Area Unregulated and Alluvial Water Sources 2023* The above plans generally apply to surface water and also groundwater contained in Cenozoic sediments, however, not surface water contained in the Richmond River Area Coastal Floodplain Alluvial Groundwater Source or the Richmond Regulated Alluvial Water Source or the Richmond Regulated Water Source. Richmond Regulated Water Source includes all water contained within rivers declared to be regulated rivers under the *Richmond Regulated River Order 2010*, Gazette No 135, 17 December 2010. This order does not regulate water sources contained in particular areas of land (such as below the mangrove limit) which would be regulated by the by Richmond River Area Unregulated, Regulated and Alluvial Water Sources 2023 listed above. The WSP for the *North Coast Coastal Sands Groundwater Sources 2016* applies to the groundwater sources shown on the map called Plan Map (WSP034_Version 3) and is generally land beyond the Water Sharing Plan alluvial application along the coast. The *North Coast Fractured and Porous Rock Groundwater Sources 2016* applies to groundwater sources shown on the Plan Map called Plan Map (WSP033_Version 1) Interpretation of application of the relevant plan would need to be confirmed following consultation with Water NSW. Where required, a Water Access Licence will need to be obtained for intake of water during operation of the Proposal from WaterNSW prior to any take of water occurring. This would relate to water take from groundwater or estuaries etc. If ground water was to be intercepted as part of the proposal, consideration would need to be given to the impact on groundwater dependant ecosystems and avoid drawing down on freshwater water sources.		

Legislation, regulation, or policy	Planning Considerations		
	Development without Consent (REF)	Designated Development (EIS)	State Significant (EIS)
Marine Estate Management Act 2014 and *Marine Estate Management Regulation 2017* provides for strategic and integrated management of marine waters, coasts and estuaries. The Act provides for the management of the marine estate consistent with the principles of ecologically sustainable development. *Marine Estate Management (Management Rules) Regulation 1999* sets out the rules for managing the marine estate and marine parks.	There are six marine parks in NSW. The Cape Byron Marine Park extends approximately 37 kilometres along the coastline from the Brunswick River northern training wall to Lennox Head. Part 5 of the *Marine Estate Management (Management Rules) Regulation 1999* provides the management rules for the Cape Byron Marine Park Section 56 of the *Marine Estate Management Act 2014* provides that a proposal within the locality of the Cape Byron Marine Park must be consistent with the Act and the approval must not be granted unless the proposal takes into consideration the purposes of marine parks or aquatic reserves, the effect of the development on the plants or animals within the marine park or aquatic reserve or their habitat, the regulations and any advice given to it by the relevant Ministers. Consultation with Minister for the Environment and the Minister for Agriculture and Western New South Wales would be necessary and if an EIS was to be prepared for the proposal, concurrence from the relevant ministers may be required as part of the determination.		
Other Approvals	The following approvals may be required for the Proposal depending on final plans and site selection: • a permit under section 201, 205 or 219 of the *Fisheries Management Act 1994* • an approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977* • an Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974* • bush fire safety authority under section 100B of the *Rural Fires Act 1997*		Section 5.23 of the EP&A Act states that the following are not required for SSI: • a permit under section 201, 205 or 219 of the *Fisheries Management Act 1994* • an approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977* • an Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974* • bush fire safety authority under section 100B of the *Rural Fires Act 1997*

3. Environmental, Social and Regulatory Risks

The preliminary environmental, social and regulatory risks associated with the Proposal have been assessed for environmental aspects potentially applicable to the Proposal. For each environmental aspect, three risk categories of 'time', 'cost' and 'approval' were assessed using the risk assessment matrix outlined in **Table 3-1**.

Table 3-1: Risk Matrix

Risk Matrix *(Risk = Likelihood x Severity)*		**Severity Level**				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood Level	Very Likely	Medium	High	Very High	Very High	Very High
	Likely	Low	High	High	Very High	Very High
	Possible	Low	Medium	Medium	High	Very High
	Unlikely	Low	Low	Medium	Medium	High
	Rare	Low	Low	Low	Low	Low

The risk matrix considers the likelihood and severity of risks associated with each risk category (time, cost or approval) to assign a risk rating for the environmental aspects applicable to the Proposal. Each risk category is interpreted as follows:

- Time: where a potential environmental issue could require extensive and long timeframe investigations
- Cost: where a potential environmental issue could require detailed and costly specialist investigations
- Approval: where a potential environmental issue could require additional works to be undertaken to obtain a development approval, or present a risk to approval being granted

The risk assessment was then applied on a 'worst case' scenario using the following Proposal assumptions:

- The Proposal will be located on a greenfield site (undeveloped land)
- The Proposal will be located within one kilometre of residential properties
- The Proposal will be located in proximity to the coastal region and as such impacted by potential acid sulphate soils and floodplain risks
- The Proposal will utilise a local road network for construction and operational access
- The Proposal will use existing energy sources to power the desalination plant
- The Proposal will utilise an existing wastewater treatment plant outfall for discharge

An overall weighted risk rating was then assigned to each environmental aspect based on the score derived for each individual risk categories, where a 'low' risk is weighted less compared to those risks identified as being 'high'. Mitigation is included to identify where areas of high risk can be reduced. The risk assessment is presented as **Table 3-2**. For those environmental aspects containing a low to medium weighted risk rating, standard assessments are likely required, whereas those containing a higher weighted risk rating may require more detailed assessments.

Table 3-2: Risk Assessment

Environmental Aspect	Risk Categories			Weighted Risk Rating	Comment
	Time	Cost	Approval		
Air quality and odour	Low	Low	Low	Low	• Given the nature of the desalination process it is not expected that air quality and odour impacts would be an issue. However, there is the potential that the community could raise concern.
Aquatic and marine ecology	Very High	High	Very High	Very High	• The potential impact of the plant outfall for discharge represents one of the key potential issues. Investigations into the estuarine environment at and surrounding the discharge location would need to be undertaken and the outcomes of the water quality modelling (discussed in the "Hydrology" section) considered to predict the potential impacts. • Government (NSW and federal) agencies and/ or the community may identify concerns about the potential impacts, particularly if the assessment identifies the potential for adverse impacts on threatened species, threatened ecological communities and/ or habitat for threatened species. • Government agencies may require relocation of the proposed discharge and/ or the provision of compensatory habitat to offset potential adverse impacts. • Environmental assessment and associated community engagement program would need to explain the desalination process and how water quality impacts (and associated impacts on estuarine biodiversity) would be mitigated.

Environmental Aspect	Risk Categories			Weighted Risk Rating	Comment
	Time	Cost	Approval		
Economic	Low	Low	Medium	Low	• DPE may require consideration of the economic impact and benefit of the proposed plant when addressing the consideration of alternatives, including the potential impact associated with not proceeding with the proposed plant. • Depending on the location of the intake and outfall points, there is the potential for adverse impacts on the commercial use of estuaries and waterways (such as oyster farming, aquaculture, commercial fishing and recreational fishing). While studies to address other aspects (such as ecological and human health, and water quality) will assess this, government agencies may require evaluation of the potential impacts on such businesses. • The community may raise concerns about the cost of construction and operation of desalination in relation to alternatives.
Energy, GHG and sustainability	Low	Medium	Medium	Medium	• The operation of desalination plants has a high electricity demand. Depending on the source of this electricity this could represent high greenhouse gas emissions. This could present a risk: • When considering the alternatives and a justification as to why higher greenhouse gas emissions are required for the water supply • if renewable energy was not proposed to power the proposed plant, Council would need to justify the use of traditional energy sources

Environmental Aspect	Risk Categories			Weighted Risk Rating	Comment
	Time	Cost	Approval		
					• the community is increasingly becoming concerned about greenhouse gas emissions and climate change. There is the potential for opposition to the proposed plant if renewable energy was not proposed to power the proposed plant. This could result in a delay to the approvals program, and could potentially influence the decision of the Minister for Planning to approve the proposed plant. • the regulation of greenhouse gas emissions is under ongoing review. If traditional (carbon intensive) energy sources were used, changes to NSW or federal regulatory requirements could represent a potential approval challenge.
Geology, soils and contamination	Medium	Medium	Low	Medium	• geotechnical investigations would need to be undertaken to determine that geotechnical (including hydrogeological) conditions do not present a significant (engineering and financial) risk to construction of the proposed plant.
Heritage	Medium	Low	Medium	Medium	• a detailed assessment of the significance of impact or potential impacts on Aboriginal heritage will need to be undertaken in consultation with Aboriginal community representatives who hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects in the area (this is known as an Aboriginal Cultural Heritage Assessment Report (ACHAR)). • there are set statutory timeframes that need to be adhered to when preparing an ACHAR and

Environmental Aspect	Risk Categories			Weighted Risk Rating	Comment
	Time	Cost	Approval		
					engaging with the Aboriginal community. The requirements of this process would influence project delivery time frames.
Ecological and human health	Low	Low	High	Medium	• it is anticipated that the key ecological and human health issue from government agencies and the community would be associated with the outfall at the discharge location, its impacts on water quality and the potential for impacts on recreational users of the area. • An assessment of ecological and human health would include identification of any change to the risk to ecological and human health, including mitigation measures and management to ensure appropriate standards are met.
Water quality	Low	High	High	High	• Government agencies may identify issues with the potential impacts on water quality from the brine discharge, depending on the outcomes of the discharge water quality modelling. • Community concerns in relation to impacts on water quality could result in delays to the approval process, and could potentially influence the decision of the Minister for Planning to approve the proposed plant.
Hydrology and flooding	Low	High	High	High	• Given the likely location of the plant and infrastructure, there is the potential for it to be located on flood prone land. The potential for impacts on flooding on the Proposal, and the

Environmental Aspect	Risk Categories			Weighted Risk Rating	Comment
	Time	Cost	Approval		
					influence the Proposal (including any filling) could have on flooding would need to be assessed.
Noise and vibration	Medium	Medium	Low	Medium	• While the plant design is likely to incorporate noise attenuation measures it is anticipated that the local community would identify operational noise impacts as a key issue if the plant is located close to sensitive receivers. Government agencies will require a detailed operation noise and vibration impact assessment for construction and operational phases.
Social	High	Medium	Medium	High	• The community's perception in relation to water quality (and potential impact on recreational and commercial use of areas near the discharge outfall and impacts on the estuarine environment) could potentially influence approval of the Proposal. • Early consultation with the community, special interest groups and recreational users of the area as well as the Aboriginal stakeholders will assist in understanding the potential social impacts of the Proposal and reduce the risks associated with them. It would also help the community to understand the community benefits associated with water security, and the potential benefits of the Proposal compared to other additional water supply options.

Environmental Aspect	Risk Categories			Weighted Risk Rating	Comment
	Time	Cost	Approval		
Terrestrial biodiversity	Very High	High	High	Very High	• The development of a greenfield (previously undeveloped) property for the plant may require direct disturbance of threatened species, form part of a threatened ecological community and/ or provide habitat for threatened species, or be located within koala planning areas. • Significant impacts on threatened species, threatened ecological communities and/ or habitat for threatened species would require detailed investigation and may require the provision of biodiversity credits which may be costly.
Traffic and access	Low	Medium	Low	Medium	• The potential impacts of traffic from the Proposal during construction is likely to be an issue identified by the community and local councils, particularly in relation to the state of some local roads. Similarly Transport for NSW and the local councils are also likely to require a detailed traffic impact assessment to be completed. Operational traffic will also need to be considered. • commitment to upgrade roads impacted by the Proposal may be required.
Visual	Low	Medium	Low	Medium	• Due to the nature and scale of the infrastructure associated with the proposal in relationship to potential existing land uses nearby, the proposal could be considered by the local community and government agencies to present an adverse visual impact (depending on proximity to residences, community facilities and open space).

Environmental Aspect	Risk Categories			Weighted Risk Rating	Comment
	Time	Cost	Approval		
Waste	Low	Medium	High	Medium	• Key waste management risk is associated with the brine management.

APPENDIX 1
LEP LAND USE ZONING PERMISSIBILITY

Key to **Table A-3-3**:

C	Permitted under the relevant LEP
P	Prohibited under the relevant LEP
SP	Permitted under the T&I SEPP
N/A	Land zoning not applicable to the relevant LEP and is not a prescribed zone under the T&I SEPP

Table A-3-3: Land Zoning Permissibility for the Proposal

Land Use Zone	Ballina LEP 2012	Byron LEP 2014	Lismore LEP 2012	Richmond Valley LEP 2012
RU1 Primary Production	SP	SP	SP	SP
RU2 Rural Landscape	SP	SP	SP	SP
RU3 Forestry	N/A	N/A	P	P
RU5 Village	N/A	P	C	C
R1 General Residential	N/A	N/A	P	P
R2 Low Density Residential	C	P	P	N/A
R3 Medium Density Residential	C	P	P	N/A
R5 Large Lot Residential	N/A	P	P	P
E1 Local Centre	C	P	P	P
E2 Commercial Centre	C	N/A	P	P
E3 Productivity Support	C	P	P	N/A
E4 General Industrial	SP	SP	SP	SP
MU1 Mixed Use	N/A	P	P	N/A
SP1 Special Activities	SP	SP	SP	SP
SP2 Infrastructure	SP	SP	SP	SP
SP3 Tourist	N/A	P	P	N/A
RE1 Public Recreation	C	P	P	P
RE2 Private Recreation	C	P	P	P
C2 Environmental Conservation	N/A	P	P	P
C3 Environmental Management	N/A	P	P	P
C4 Environmental Living	N/A	P	P	N/A
W1 Natural Waterways	P	P	P	P
W2 Recreational Waterways	P	P	P	P
W4 Working Waterfront	N/A	N/A	N/A	C

Appendix B. Flow Rates

Drought level by type and LGA (BA=Ballina, By=Byron, Li=Lismore, Rich=Richmond Valley)

Input	kL/d Drought Supply (Extreme)		
	2021	2030	2060
Res BA	3,520	4,324	4,638
Res By	2,064	2,597	3,012
Res Li	2,913	3,359	4,831
Res Rich	611	663	832
Non-Res BA	941	1,340	1,583
Non-Res By	1,162	1,332	1,511
Non-Res Li	715	772	909
Non-Res Rich	146	154	173
Rous Retail	1,217	1,368	1,394
Filling Stations (Water Carting)	266	318	378
Rous Losses	998	1,065	1,207
NRW	4,596	4,929	5,239
Total	**19,149**	**22,221**	**25,707**
Add Multiplier x1.12	**21,446**	**24,888**	**28,792**

Sensitivity: General

Supply Point	LGA	Drought Demand (2030)						Drought Demand (2060)					
		Level 0	Level 1	Level 2	Level 3	Level 4	Emerg.	Level 0	Level 1	Level 2	Level 3	Level 4	Emerg.
		0.0%	7.5%	1.5%	22.5%	30.0%	37.5%	0.0%	7.5%	1.5%	22.5%	30.0%	37.5%
Dunoon Demand	Lismore City Council	0.66	0.61	0.65	0.51	0.46	0.41	0.82	0.76	0.81	0.63	0.57	0.51
Clunes Demand	Lismore City Council	0.20	0.18	0.20	0.15	0.14	0.12	0.32	0.30	0.31	0.25	0.22	0.20
Tullera Demand	Lismore City Council	0.86	0.80	0.85	0.67	0.60	0.54	3.29	3.04	3.24	2.55	2.30	2.05
Pineapple Rd Demand	Lismore City Council	0.14	0.13	0.14	0.11	0.10	0.09	0.47	0.43	0.46	0.36	0.33	0.29
Holland St Demand	Lismore City Council	1.62	1.50	1.60	1.26	1.14	1.02	2.50	2.31	2.46	1.94	1.75	1.56
Ross St Demand	Lismore City Council	3.37	3.12	3.32	2.61	2.36	2.11	4.37	4.05	4.31	3.39	3.06	2.73
High St Demand	Lismore City Council	1.61	1.49	1.59	1.25	1.13	1.01	2.00	1.85	1.97	1.55	1.40	1.25
Belvedere Dr Demand	Lismore City Council	3.22	2.97	3.17	2.49	2.25	2.01	3.68	3.41	3.63	2.85	2.58	2.30
Tanelawn Demand	Lismore City Council	0.39	0.36	0.38	0.30	0.27	0.24	0.49	0.45	0.48	0.38	0.34	0.31
Bangalow Demand	Byron Shire Council	0.67	0.62	0.66	0.52	0.47	0.42	0.77	0.71	0.75	0.59	0.54	0.48
Brunswick Demand	Byron Shire Council	0.81	0.75	0.80	0.63	0.57	0.51	0.91	0.84	0.89	0.70	0.63	0.57
Byron Bay Demand	Byron Shire Council	1.77	1.64	1.75	1.37	1.24	1.11	1.96	1.82	1.93	1.52	1.37	1.23
Coopers Shoot Demand	Byron Shire Council	3.72	3.44	3.66	2.88	2.60	2.32	4.22	3.90	4.15	3.27	2.95	2.64
St Helena Tunnel Emergency	Byron Shire Council	2.43	2.25	2.39	1.88	1.70	1.52	2.42	2.23	2.38	1.87	1.69	1.51
Warrambool Demand	Byron Shire Council	0.44	0.40	0.43	0.34	0.30	0.27	0.47	0.44	0.47	0.37	0.33	0.30
Wategos Demand	Byron Shire Council	0.26	0.24	0.26	0.20	0.18	0.16	0.26	0.24	0.26	0.20	0.18	0.16
Yamble Dr Demand	Byron Shire Council	1.30	1.20	1.28	1.00	0.91	0.81	1.40	1.29	1.38	1.08	0.98	0.87
Mullumbimby Supply	Byron Shire Council	1.99	1.84	1.96	1.54	1.39	1.24	2.64	2.44	2.60	2.04	1.85	1.65
Ballina Heights Demand	Ballina Shire Council	0.53	0.49	0.52	0.41	0.37	0.33	0.94	0.87	0.93	0.73	0.66	0.59
Ballina Heights Reuse Demand	Ballina Shire Council	0.96	0.89	0.95	0.75	0.68	0.60	1.72	1.59	1.69	1.33	1.20	1.07
Ross Lane 200 Demand	Ballina Shire Council	0.10	0.10	0.10	0.08	0.07	0.06	0.11	0.11	0.11	0.09	0.08	0.07
Ross Lane 450 Demand	Ballina Shire Council	6.77	6.27	6.67	5.25	4.74	4.23	5.75	5.32	5.67	4.46	4.03	3.60
Water Wheels Demand	Ballina Shire Council	3.66	3.39	3.61	2.84	2.56	2.29	5.72	5.29	5.63	4.43	4.00	3.57
Wollongbar Demand	Ballina Shire Council	3.23	2.98	3.18	2.50	2.26	2.02	3.44	3.18	3.39	2.66	2.41	2.15
North Woodburn Demand	Richmond Valley Council	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02
Broadwater Demand	Richmond Valley Council	0.38	0.36	0.38	0.30	0.27	0.24	0.57	0.53	0.56	0.44	0.40	0.36
Coraki Demand	Richmond Valley Council	0.37	0.35	0.37	0.29	0.26	0.23	0.37	0.34	0.36	0.29	0.26	0.23
South Evans Head Demand	Richmond Valley Council	1.05	0.97	1.03	0.81	0.73	0.65	1.34	1.24	1.32	1.04	0.94	0.84
Woodburn Demand	Richmond Valley Council	0.20	0.19	0.20	0.16	0.14	0.13	0.22	0.21	0.22	0.17	0.16	0.14
		42.76	**39.55**	**42.12**	**33.14**	**29.93**	**26.73**	**53.20**	**49.21**	**52.40**	**41.23**	**37.24**	**33.25**

Appendix B. Site Shortlisting Memo

To:	Jeremy Wilson Recycled Water Project Manager, Rous County Council	From:	Steve McAleer Senior Environmental Engineer, Beca Hunter H2O
		Date:	24 January 2024
Subject:	Rous County Council – Desalination Site Selection: Longlisting and Shortlisting		

Context

This Longlisting and Shortlisting Memo is the second deliverable of the Temporary Desalination Options Assessment project being undertaken by Beca HunterH2O with Rous County Council. The intent of the project is to provide Council with an understanding of the practicalities of implementing a Temporary Desalination Plant as an emergency response measure to a severe and ongoing drought. The work addresses the activation requirements as detailed in Table 1-2 from the 2016 DMP, specifically, what and how much time is required to enable a desalination plant to be able to meet emergency supply requirements. It also considers options for permanent desalination plants delivered in non-drought conditions.

The Memo summarises the collaborative process from the initial identification of possible sites, refinement to plausible sites, and shortlisting to preferred sites using the knowledge and decision criteria identified in the Strategic Considerations Memo, as well as the expertise and local knowledge of Council.

The work is a critical input to Council's future drought response planning, as well as for bulk supply investment planning.

1 Approach

Decision criteria identified in the Strategic Considerations Memo submitted as Stage 1 – Task 1 were applied in three phases. The first phase was to develop a longlist of reasonable options for further consideration, with reasonable in this case considered to be sites without clear fatal flaws as determined through discussion with Council and other stakeholders (NSW EPA and Department of Planning, Industry and Environment (DPIE)). The second phase was to refine that longlist by clustering and comparing sites within similar areas and applying local knowledge provided by Council to develop a list of viable sites. The third phase was to develop a shortlist of identified sites through a more detailed application of assessment criteria, in discussion with Council through a collaborative workshop.

In addition to the key assumptions detailed in the Strategic Considerations Memo (Beca HunterH2O, 2023), the following key assumptions were made through the initial site identification:

- The capacity of emergency sites were determined to be up to 10 ML/d, and permanent sites were above 10 ML/d.
- Emergency sites includes a plant and intake/outfall that are delivered within a drought and can be decommissioned/demobilised post-drought.
- Permanent sites include a plant and intake/outfall which are predominantly constructed outside of a drought. The plant may operate as a baseload supply, or be mothballed in non-drought periods.
- The potential sites were limited to within the Rous County Council area of operations, which aligns with the Council areas of Byron Bay, Lismore, Ballina and Richmond Valley.
- Compulsory acquisitions and/or displacement of residents or businesses was to be avoided.

The development of the longlist and shortlist of options to progress for further feasibility for both Permanent Drought Response Plants and Emergency Temporary Desalination Plant is described below.

1.1 Longlist

A preliminary longlist of sites was developed by applying agreed exclusion criteria and reviewing the remaining study area for sites which provided sufficient available land area (i.e. land not in use). Exclusion criteria was established through engagement with Council, DPIE and NSW EPA, with the agreed criteria shown below and described in more detail in Appendix A.

- Distance greater than 4km to reliable saline or brackish water
- Within National Parks
- Within Coastal Wetlands
- Within Littoral Rainforest
- Within Residential Areas

The proportion of the study area impacted by the exclusion area was significant, as shown in the maps included as Appendix B.

In addition to the above, areas of extreme flooding as categorised by Council and/or State mapping, and sites with gradients above 40% were added as exclusion areas. This list was then reviewed with Council in the longlisting workshop held on 25 October 2023 to confirm whether sites should be considered in the longlist and what additional sites should be added based on Council's knowledge of the area. The final longlist and information gained on key constraints and opportunities for consideration in the shortlisting process is summarised in Appendix C.

1.2 Refined Longlist

Given that 34 sites were identified in the longlisting stage, a refinement of the longlist was undertaken by Beca HunterH2O to develop a more manageable number of sites to progress to the shortlisting workshop. The key steps undertaken in the shortlisting phase were:

Sites were grouped into spatial clusters. Where sites had similar constraints and opportunities, predominantly dictated by the location, these sites were grouped into clusters. If a site within a cluster was clearly less constrained than others within that cluster, this site was progressed. The underlying assumption is if the best site within a cluster fails to outperform the best site of an alternative cluster, it reasonable to assume that the other sites within that cluster would also not be preferred, barring any unique differentiators.

Sites were ranked, not excluded. At this stage of the assessment, there is limited knowledge of the sites being considered and it is reasonable to assume that additional information may lead to some sites becoming less or more preferable as investigations progress. By retaining sites within clusters rather than excluding them at this stage, there are potential fall-back options if the primary site is found to be flawed.

Local knowledge. The additional information provided by Council on existing land-uses, additional sites for consideration, and practical opportunities for land acquisition was critical in informing the characterisation of sites as plausible rather than possible.

Critical Connections were considered at a high level. The proximity of sites to water and power connections, and the distance to likely intake and outfall locations was used to understand the potential relative cost differences between sites.

The sites progressed to the refined longlist is indicated in Appendix C as sites considered opportunities.

1.3 Shortlisting

The options included in the refined longlist were assessed against the 31 assessment criteria for emergency and permanent desalination plants included in Appendix D, which were based on the criteria established in the Strategic Considerations Memo. The assessment criteria were divided based on industry experience and discussion with Council into categories of impractical, poor, moderate or good. The scoring of each option was

completed by Beca HunterH2O and provided to Council for review and comment prior to the shortlisting workshop in December 2023.

Based on the initial assessment of the options, it became clear that the performance of sites was sensitive to a small number of critical criteria, and whether these criteria were considered as exclusion criteria would significantly impact the shortlisting process.

As such, the workshop initially focussed on the discussion of these criteria prior to further shortlisting. In particular, the workshop focussed on the impact of the Marine Park and Councils position that no intake or outfall was to be constructed within the Sanctuary or Habitat zone. This had two critical impacts on six of the eight permanent options being considered, firstly that this would result in an extremely long intake and/or outfall structure to avoid these zones, and that the depth of these structures in some cases would be beyond what is considered practical based on industry standards (generally 12-20 metres as discussed in the Strategic Considerations Memo).

The extent of the Marine Park and definitions of the Marine Park zones are included as Appendix H. Whilst the legislation supporting the Marine Park (the Marine Estate Management Act 2014) does not prohibit the required infrastructure, it does state that approval not be granted unless the proposal takes into consideration the purpose of the Marine Park.

The decision was made to retain these zones as exclusion areas and include the intake and outfall length to avoid these areas and the resultant depth as assessment criteria.

The options were then discussed individually, with the key points noted in Table 1.

Table 1: Workshop Outputs - key discussion points

Summary of Workshop Discussion	
Preferred Sites	
New Brighton Sports Fields	Considered reasonable to progress as an emergency site given the open space available and the proximity to the ocean. Concerns regarding the distance to power and water connections were raised as a probable challenge.
Boather Reserve	Considered reasonable to progress as an emergency site. It was noted that the distance to the ocean and constructing an intake in the estuary were key challenges, but the available space and better connections to power and water compared to New Brighton Sports Fields led to the site being considered as a reasonable emergency site to progress. Investigation of the likelihood of being able to construct an estuary intake is a critical question to be addressed.
Suffolk Park Tallows Beach	These sites were considered similar given the same connections to water and power, and intake/outfall locations. They were considered likely to be favourable given the proximity to significant water and power connection points, and the current former uses of the sites – being an existing substation and former wastewater treatment works, respectively. The key challenge is the Marine Park and required intake and outfall depth and length. The sites were proposed to progress as an emergency and permanent option together given their proximity.
Ross Lane Newry bar	The two sites were considered similar and worth progressing as either an emergency or permanent facility. There may be additional benefits in the area given the proximity of brackish to saline bore water, which could allow a staged approach where a groundwater plant is developed in non-drought periods and expanded when required in drought. The distance to the ocean and the additional length of pipe required to avoid the Marine Park was noted as a key constraint to the option. The opportunity to use the Lennox Head outfall for brine disposal was to be investigated as an opportunity.
Lighthouse Parade etc.	The shoreline areas in Ballina, include Lighthouse Pde, Compton Road and Boomerang Park were considered potential small scale emergence sites. Interactions with community uses and the distance to significant water and power connections were seen as the main challenges, as well as the fluctuating salinity in the estuary and estuary plume. Boomerang Park was considered the least likely site given that it is privately held, and the focus was suggested to be the other two sites.
Non-Preferred Sites	

Wooyung	The site was considered to be too far from the existing water network to be practical, although it may be a good site if an interregional transfer between the Rous County Council and Tweed Heads areas of operation was delivered. The site also has a significant number of nearby AHIMS records, and it was agreed in the workshop that this indicated that indigenous artefacts may be a significant constraint.
Former WWTP, Brunswick Heads	The site was not considered further given the distance to ocean and onsite environmental values.
Skennars Head	The site was considered to have clear benefits given the open-space and proximity to the ocean and Lennox Head wastewater outfall, however, the distance to water and power connection were considered problematic.
Gallans Road	The site was noted to have significant benefit in that it was in close proximity to water and power connections, and is owned by Rous County Council. The distance to the ocean is considered a significant constraint which would make the site impractical, however there may be options to progress the site as an estuary intake. Given that the estuary fluctuated between saline, brackish and freshwater states, it was noted that an intake would either require significant expenditure in the plant to cope with variable salinity inflows (for example, variable pressure pumps and duplicated RO trains), or only be operated in periods of suitable salinity.
The Saddle	The distance to the ocean was considered to be a major constraint, and the site was not considered to be practical moving forward.
Brunswick Heads	The site has reasonable flood risks and the distance to the ocean and large water connections compared to other sites led to the site being considered impractical.

1.3.1 Postworkshop Assessment

Following the workshop, the desktop assessment was refined with the input from Council and weighted and non-weighted scoring was undertaken to sense check the workshop outcomes.

To score options, the assessments were converted to numerical scores using the scoring matrix shown as **Table 1**. Scores were then summed to determine the non-weighted scoring included in Appendix F and Appendix G.

Table 2: Scoring Matrix

Impractical	Poor	Moderate	Good
-1	0	0.5	1

In order to develop weighted scores, the impact of the assessment criteria was considered based on the risk of that criteria to project approval, or the relative costs to overcome that issue if present. Given the early stage of the project, a high-level assessment was undertaken based on the definitions below.

- **Critical** – High impact on project feasibility. Likely to lead to significant project approval or technical feasibility risks which are not solvable, or the solution is of significant relative cost (i.e. >20% of project budget)
- **High** - High impact on project feasibility. Likely to lead to ongoing project approval or technical feasibility risks which require significant or non-standard changes in approach, or the solution is of significant relative cost (i.e. >10-20% of project budget)
- **Moderate** – Moderate impact on project feasibility. Likely to lead to notable but manageable project approval or technical feasibility risks, which may lead to additional relative cost (i.e. >5-10% of project budget)
- **Low** – Low impact on project feasibility. Likely to lead to minor ongoing project approval or technical feasibility risks, which are of low relative cost (i.e. 1-5% of project budget)
- **Minor** – Negligible impact on project feasibility, and low relative costs (<1% of project budget)

The rating of criteria based on this approach is included as Appendix E.

These ratings were then used to apply a weighting to the criteria, and weighted scores were developed using the baseline weighted values below:

- Critical – 40%
- High – 30%
- Moderate – 20%
- Low/Minor – 10%

2 Shortlisted Sites

The workshop discussions and ranking of sites through weighted and non-weighted scoring have led to broadly consistent recommendations in terms of which sites to progress for further analysis. Given that the criteria used for discussion in the workshops and for developing scores for sites were the same, this is consistent with expectations but provides an additional layer of robustness and transparency to the outcome.

The outcome of the scoring and workshop discussions is summarised as Appendix F and Appendix G.

Where there is discrepancy between the outcomes is for Gallans Road, which scores well but was not preferred by the majority of workshop participants, and for Tyagarah, which was ruled out during the workshop but was ranked 3rd in non-weight scores and 4th in weighted scores.

For Gallans Road the major qualitative risk which was not well reflected in the scoring is the limitation of having an estuary intake due to fluctuating salinity levels, and the distance and difficulty in construction of a coastal intake or outfall. There may be opportunities for a small emergency response plant to discharge brine to Ballina Wastewater Treatment Plant (WWTP), however, whilst the resultant increase in the salinity of the plant effluent may be beneficial for disposal to the estuary, it may negatively impact the current high recycled water use from the plant. The advice from DPE was clear that new estuary discharges are unlikely to be approved, so outside of using the Ballina WWTP, the options would be a 4 kilometre pipeline to Lennox Head outfall, which would introduce additional complexities, or a 6 km outfall pipeline though Ballina township. There is the potential that a pipeline linking Ballina WWTP and Lennox Head WWTP would have additional benefit by removing discharges from the estuary, however consideration of that option is outside the scope of this project.

To overcome the distance to the coastline for raw water supply, an intake could be constructed in the estuary for supply in periods of drought where the salinity would be relatively stable as seawater, however there would be periods where the plant would not be able to operate unless high-cost treatment processes are included to adapt to a highly variable salinity and high turbidity load in rainfall periods. It should be noted that there is no reliable salinity data for the lower estuary, and therefore the impacts on operation aren't well understood at this time.

Given that the Lighthouse Pde/Compton Road sites are shortlisted to progress, it is recommended that the intake solutions and water and power connections developed for those sites are used to inform the viability of a Gallans Road site, which would only progress if an outfall solution is determined - likely to be either direct discharge to Ballina WWTP, or to Lennox Head WWTP.

For the Tyagarah site, the workshop discussion led to the site being considered impractical given the National Park and offshore distance to avoid the Marine Park. The non-weighted scoring doesn't reflect the importance of this criteria, and it is therefore recommended that the site is excluded based on the outcomes of the workshop and weighted scoring.

3 Next Steps

Based on the discussions with Council and the outcomes of the technical work undertaken in Stage 1 of the project, it is recommended that the scope outlined in Task 3 is progressed for the shortlisted sites.

Maps of the shortlisted sites are included as Appendix I.

Appendix A. Longlist Criteria

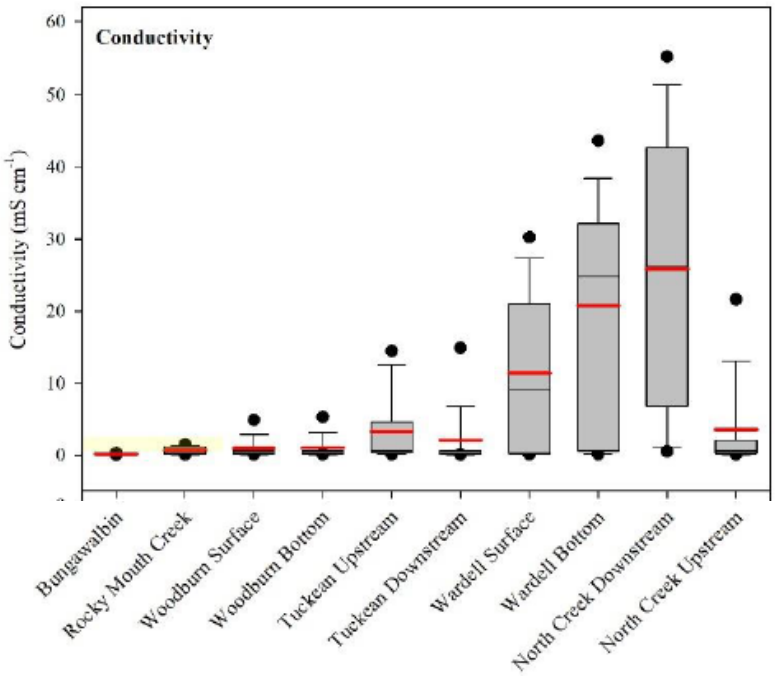
<table>
<tr><th>Criteria</th><th>Description</th></tr>
<tr><td>Proximity to Salt Water</td><td>
Desalination as a water supply option is not feasible unless a reliable source of saline or brackish water is available. In the case of Rous CC, it is assumed that in all cases the plant should be able to source saline or brackish water in drought, and in some cases non-drought conditions. Therefore, it is assumed for this analysis that the desalination plant should be within a reasonable distance of either:
a) the ocean,
b) an estuary which is predominantly saline or brackish, or
c) a saline or brackish groundwater source.
To determine what represents a reasonable distance, a preliminary value of 4 km has been applied. This value considers the challenges in transporting saline water through long pipelines, the requirement for brine disposal, and the limited receiving capacity of inland creeks/estuaries, and the cost of intake and outfall pipelines. It is also expected that viable sites will be available within this area, which negates the benefit in analysing sites further inland.

Application of estuary limits
Three main estuaries were noted in the area which were considered large enough to act as potential sources or disposal points for desalination, these being the Brunswick River, Richmond River, and the Evans River.

For the Richmond River, there is limited salinity data available. A State Pollution Control Commission report from 1987 provides salinity data over ten sampling events and reports the salinity range in Table 3, which indicates that brackish to saline water is available in low to medium flow conditions downstream of Wardell.
Table 3: Salinity data from Water Quality in the Richmond River (SPCC, 1987)
<table>
<tr><th rowspan="2">Site</th><th rowspan="2">Distance (km)</th><th colspan="3">Salinity (ppt)</th></tr>
<tr><th>Low Flow</th><th>Medium Flow</th><th>High Flow</th></tr>
<tr><td>River Mouth</td><td>0</td><td>32</td><td>31</td><td>18</td></tr>
<tr><td>Emigrant Creek Downstream</td><td>7</td><td>31</td><td>12</td><td>9</td></tr>
<tr><td>Pimlico Island downstream</td><td>12</td><td>19</td><td>10</td><td>1</td></tr>
<tr><td>Wardell Bridge</td><td>18</td><td>14</td><td>3</td><td>0</td></tr>
<tr><td>Broadwater Downstream</td><td>23</td><td>8</td><td>0</td><td>0</td></tr>
<tr><td>Pelican Island Upstream</td><td>27</td><td>0</td><td>0</td><td>0</td></tr>
</table>

This data is supported by the more recent Rous CC Water Quality Report (January 2023), which provide a review of data from February 2021 to January 2023, and the Council water quality dashboard which provides more recent data. These datasets also include Wardell as a monitoring location and indicate that the water at Wardell ranges from about 0 to 20,000 TDS at the surface, with a median at about 7,000 TDS (see Figure 1). This data also indicates that the water quality at Woodburn is predominantly fresh.

Given these values, it is considered that a conservative upper limit for reliable brackish or saline water would be Wardell. However, it should be noted that the data is quite limited and both the 1987 and Rous CC data were taken in relatively wet periods. It is likely that in a period of sustained drought that higher salinity water would be available at Wardell and
</td></tr>
</table>

	upstream, however the data indicates that the predominant state of the river in these areas is as a freshwater system, and based on the information available it is assumed that upstream of Wardell would be susceptible to becoming freshwater in non-drought breaking rainfall, which would put the supply at risk.  *Figure 1: Salinity at monitoring locations.* For the Evans and the Brunswick Rivers, there was no available salinity data to allow for an analysis of possible intake areas. To determine an upper limit, a relatively conservative assumption was made for an upper limit in each system based on a visual assessment of the area, the openness of the mouth and with reference to the data available in the Richmond River, for which there was more detailed information available. • for the Brunswick River, the limit was set at 6 km from the mouth near the confluence with Kings Creek, • for the Evans River, the limit was set at 7 km from the mouth at the border of Evans Head and Doonbah.
National Parks	Council has instructed that National Parks plus a reasonable buffer are excluded from consideration. This position was supported by participants in the Stakeholder Workshop. The National Park and Wildlife Services (NPWS) Estate data – Version 2/2023 spatial layer has been mapped as an exclusion area, with a 100-metre and 250-metre buffer included for consideration.
Coastal Wetland	As agreed with Council and participants in the Stakeholder Engagement workshop, Coastal Wetlands are excluded due to the significant barriers to project approval, likely environmental impacts, and flood risks. Coastal wetland areas were mapped using the NSW EPI Coastal Wetlands layer, as well as the NSW Biodiversity Values Map (Coastal Management Act – Wetlands layer) (October 2023).

Littoral Rainforest	As agreed with Council and participants in the Stakeholder Engagement workshop, Littoral Rainforests are excluded due to the significant barriers to project approval and likely environmental impacts. Littoral rainforest areas were mapped using NSW Biodiversity Values Map (Coastal Management Act – Wetlands layer) (October 2023).
Residential Areas	As agreed with participants of the longlisting workshop, sites zoned as low, medium or high density residential were excluded from consideration.

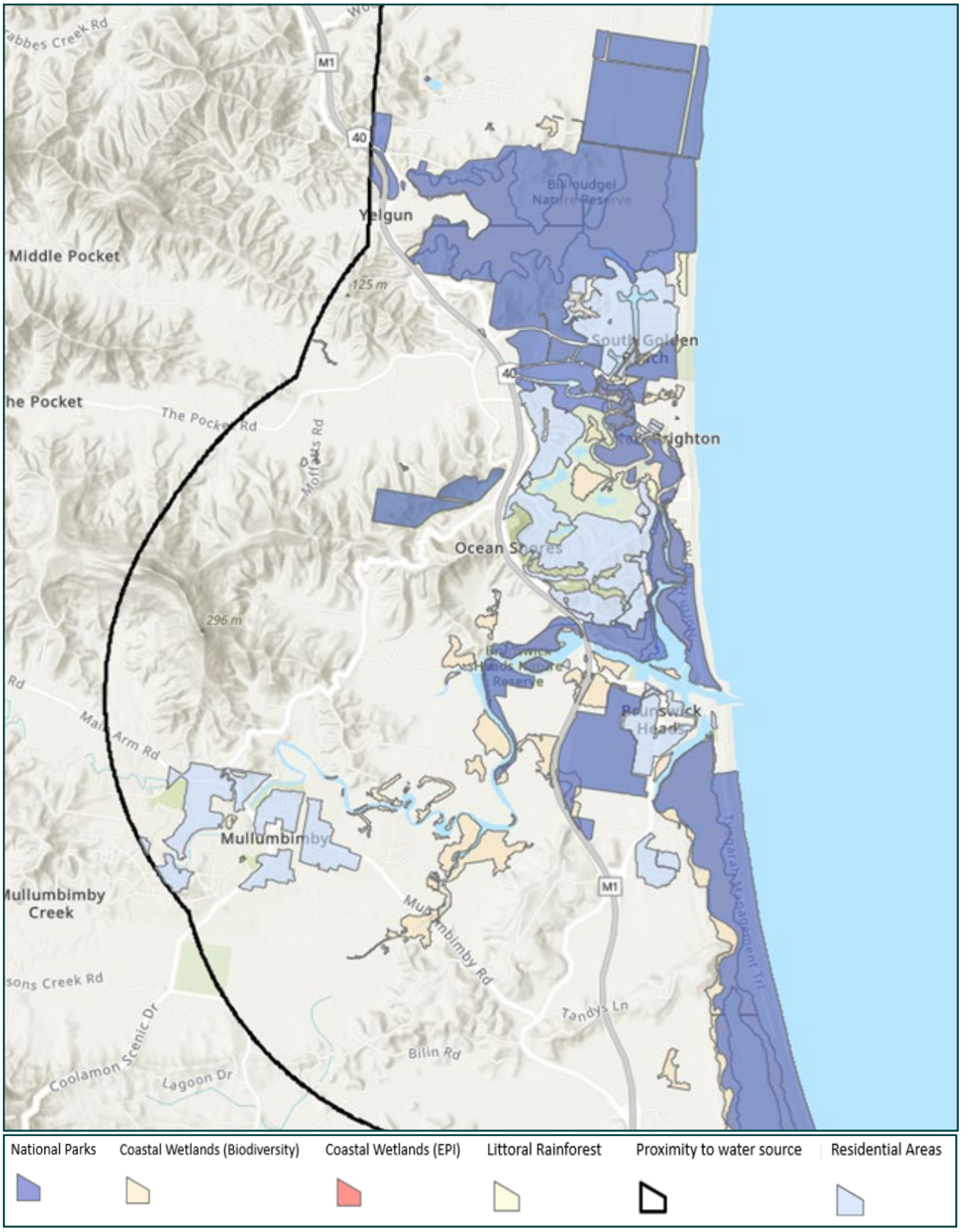
Additional Layers applied as exclusion areas for longlisting:

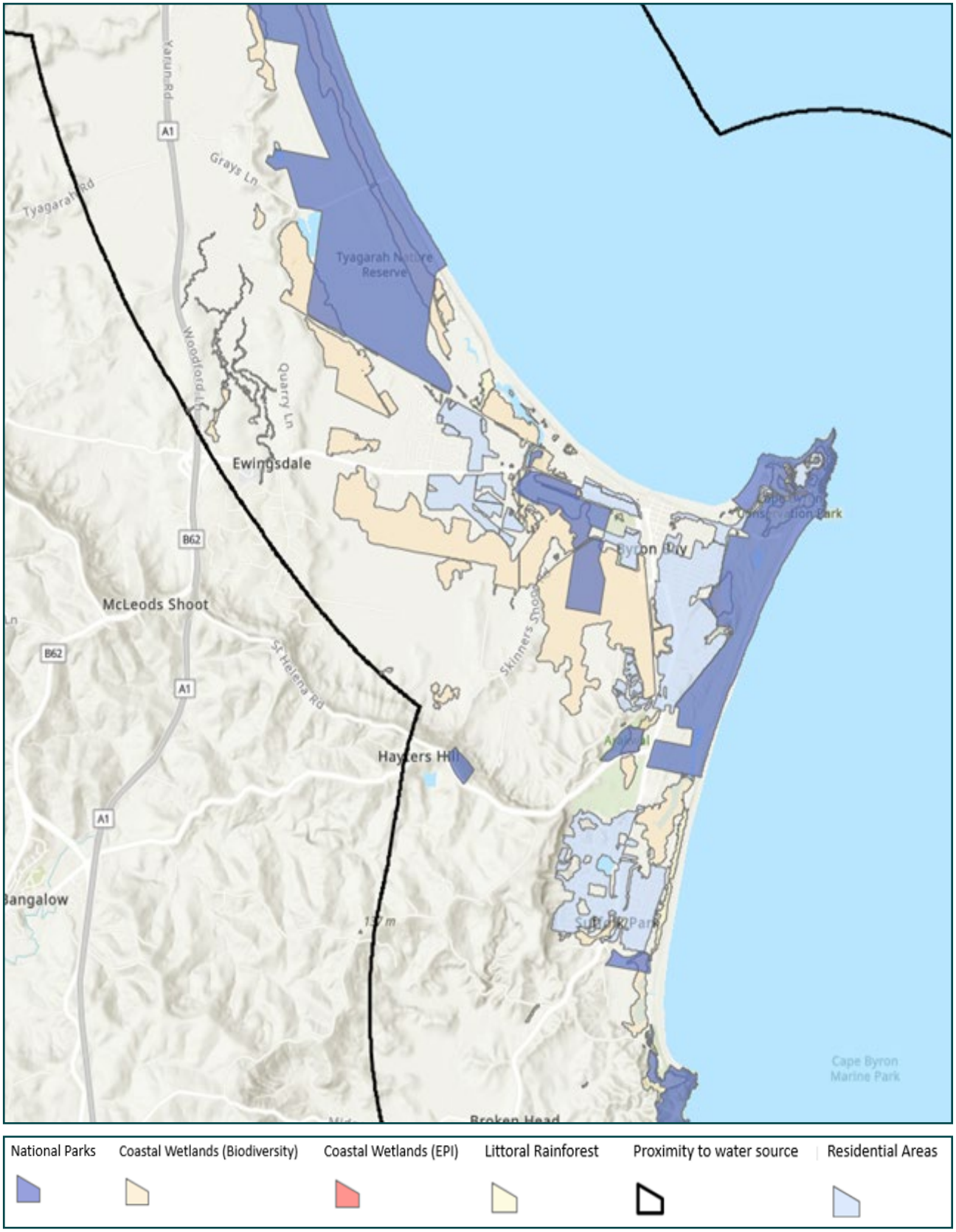
Criteria	Description

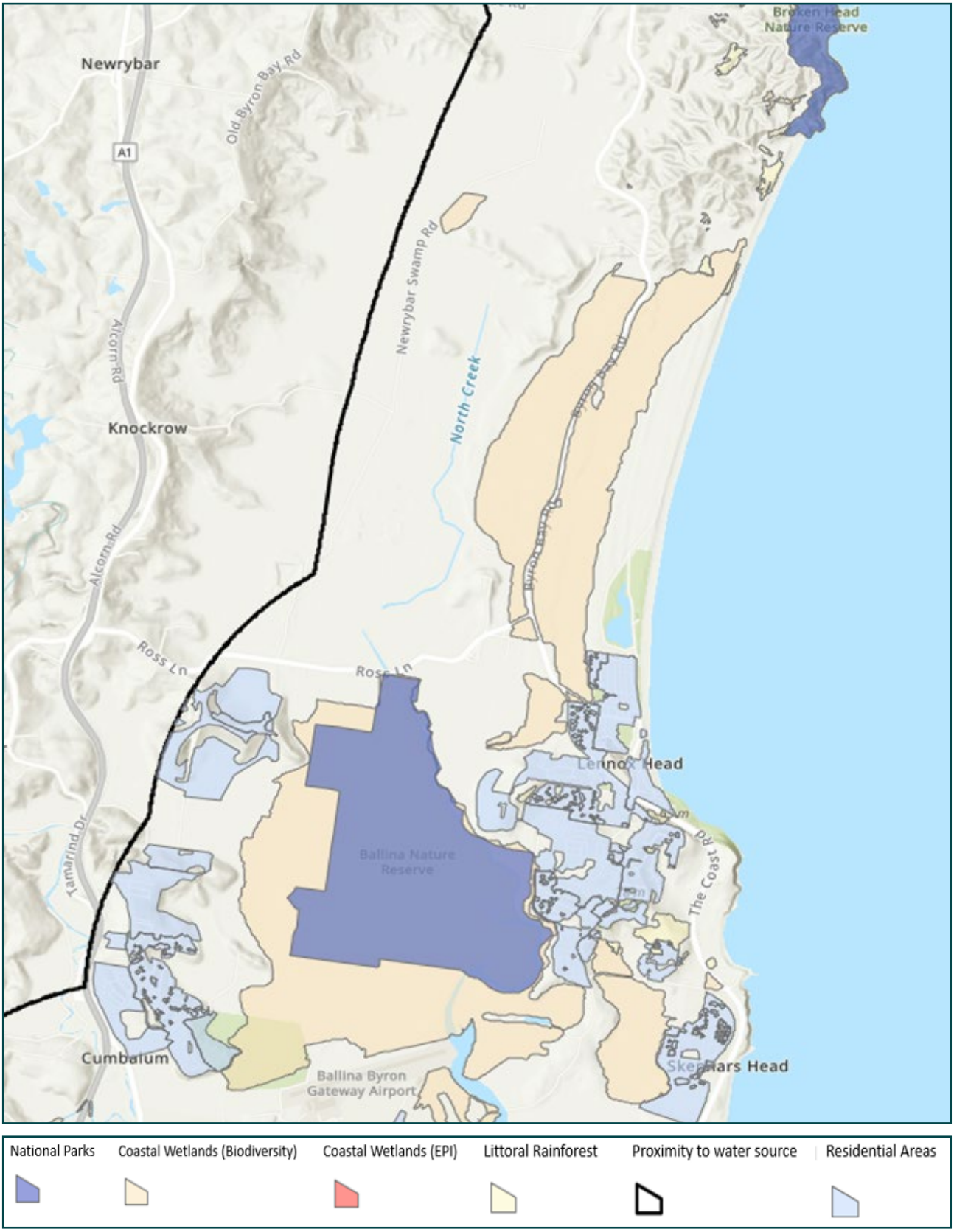
Flooding	Flooding areas have primarily been informed by the Northern Rivers Reconstruction Corporation's (NRRC) Resilient Homes Program (2023) pdf maps, which were published in 2023 and represent the most up to date information available.
	
	Additional flooding data was also obtained from the following sources and were included in the review of sites for consistency:
	• Council Data
	  ○ Byron Bay Council data request – *Flood Prone Land* and *Fill exclusion zones* spatial layers
	  ○ Ballina Council data request – Archived flood mapping data (new layers are drafted and under review)
	  ○ Richmond Vally flood data was requested but not provided in time for the analysis.
	• NSW State EPI flood data layer.
	
	The interpretation of the layers for exclusion criteria was based on the following:
	• For Council data, the *NSW government Flood risk management guideline FB03 (2023)* was applied with the H6 category considered as an exclusion zone for a desalination plant i.e. an area "unsafe for vehicles and people. All building types considered vulnerable to failure".
	• For NRRC data, the Australian Resilience Handbook Collection Flood Hazard Guideline 7-3 was used to inform exclusion areas, with Priority 1 and 2 areas excluded from further consideration, i.e. a 1 in 100 year likelihood of catastrophic impacts (equivalent to H6).

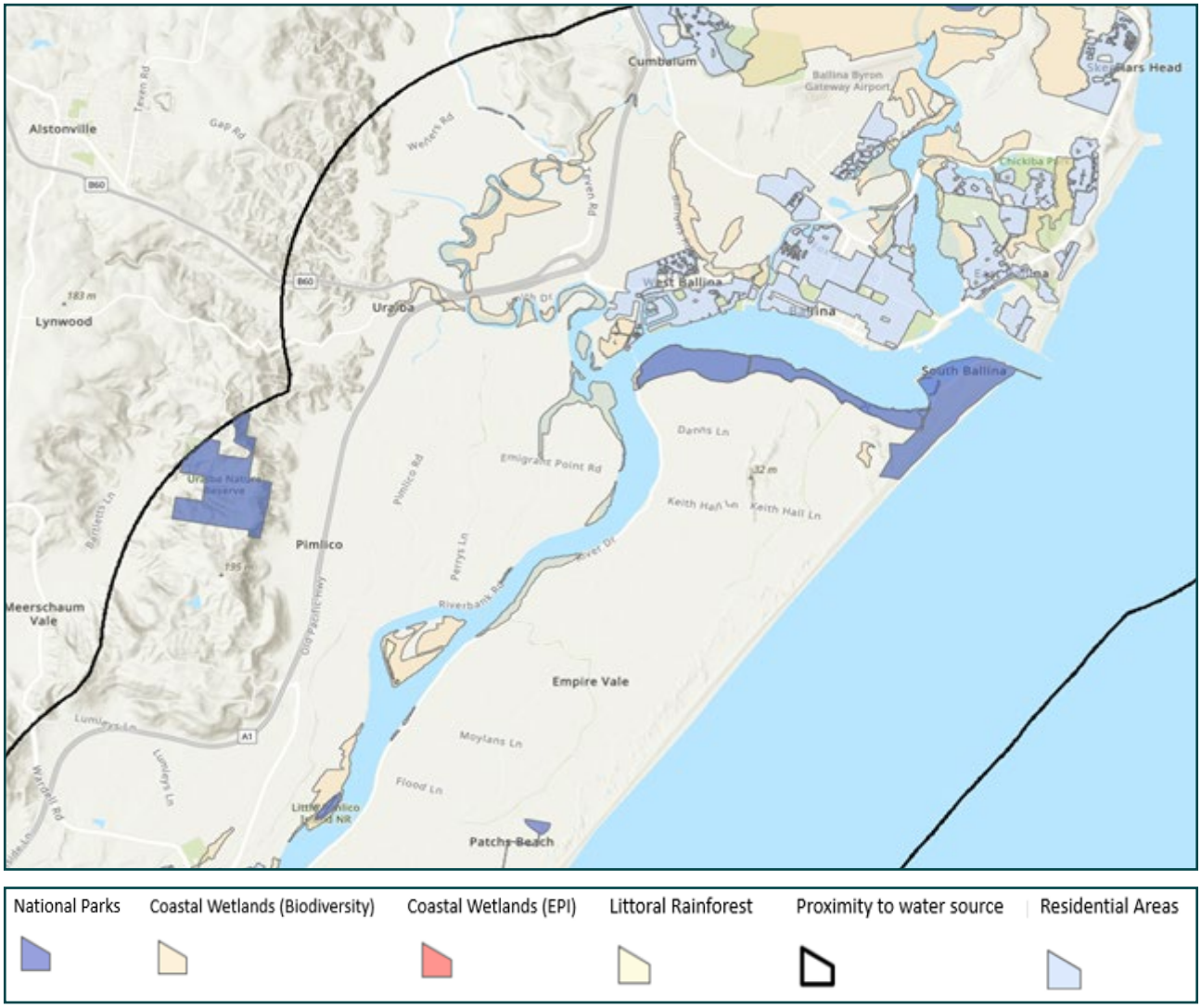
Site gradient	A limit of 40% grade was applied as a reasonable barrier to effective construction and operation of a plant. Grade across the study area was mapped using the Geoscience Australia's LiDAR 5 metre grid.

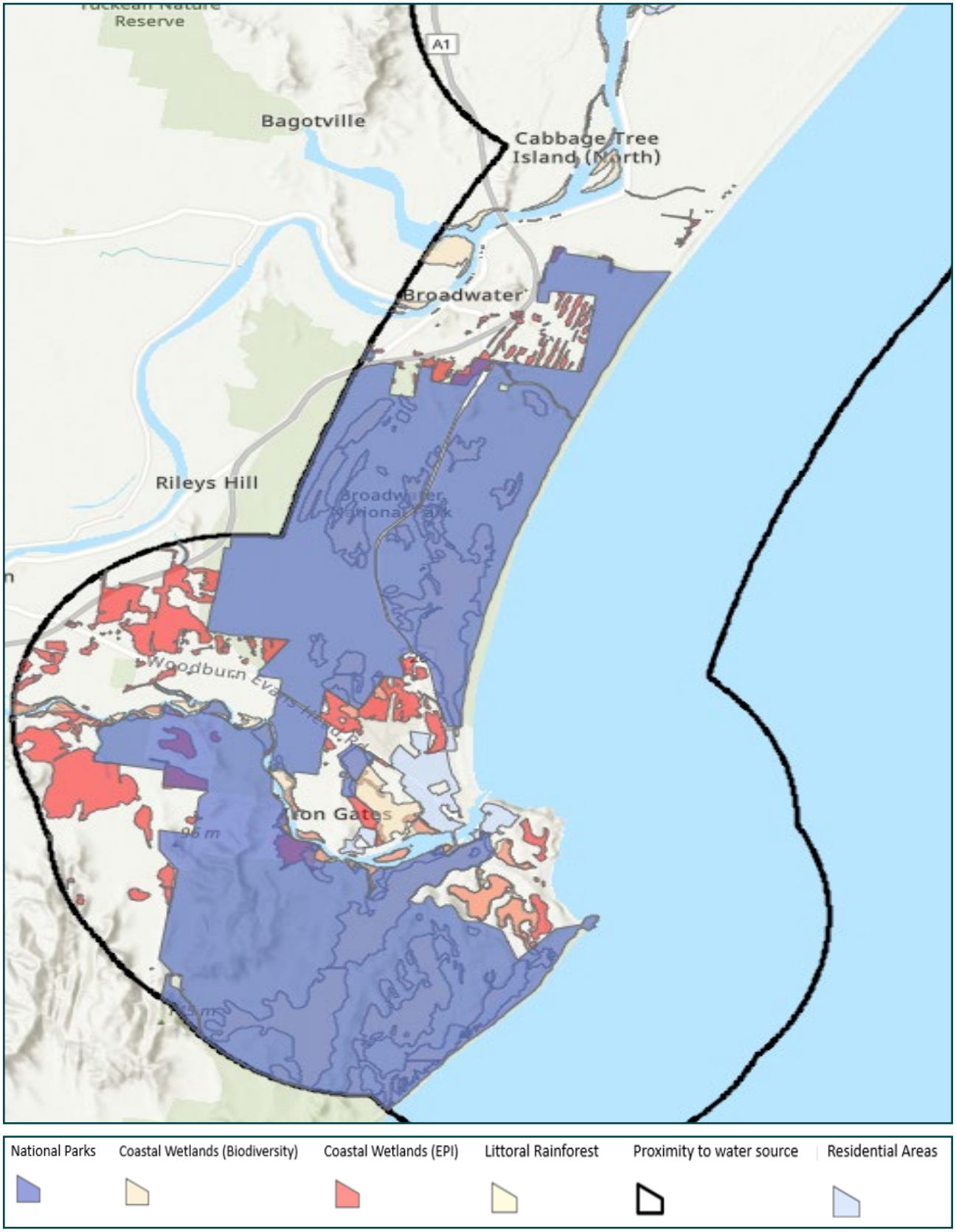
Appendix B. Maps of Longlist Criteria (North to South)




Yarun Rd
A1
Grays Ln
Tyagarah Rd
Tyagarah Nature Reserve
Woodford Ln
Quarry Ln
Ewingsdale
B62
McLeods Shoot
St Helena Rd
Skinners Shoot
Byron Bay
Hayters Hill
Bangalow
Cape Byron Marine Park
Broken Head
National Parks
Coastal Wetlands (Biodiversity)
Coastal Wetlands (EPI)
Littoral Rainforest
Proximity to water source
Residential Areas


Newrybar
Old Byron Bay Rd
A1
Alcorn Rd
Knockrow
Newrybar Swamp Rd
North Creek
Broken Head Nature Reserve
Ross Ln
Lennox Head
Ballina Nature Reserve
The Coast Rd
Tamarind Dr
Cumbalum
Ballina Byron Gateway Airport
Skennars Head
National Parks
Coastal Wetlands (Biodiversity)
Coastal Wetlands (EPI)
Littoral Rainforest
Proximity to water source
Residential Areas


Cumbalum
Ballina Byron Gateway Airport
Alstonville
Teven Rd
Gap Rd
Wetherill Rd
B60
Lynwood
183 m
Urliba
West Ballina
Ballina
South Ballina
Chickiba Pt
Emigrant Point Rd
Pimlico Rd
Pimlico
Meerschaum Vale
Old Pacific Hwy
Perrys Ln
Riverbank Rd
Keith Hall Ln
Empire Vale
Moylans Ln
Flood Ln
Lumleys Ln
A1
Patchs Beach
National Parks
Coastal Wetlands (Biodiversity)
Coastal Wetlands (EPI)
Littoral Rainforest
Proximity to water source
Residential Areas


Reserve
A1
Bagotvville
Cabbage Tree
Island (North)
Broadwater
Rileys Hill
Broadwater
National Park
Woodburn Evans Headland
Iron Gates
96 m
National Parks
Coastal Wetlands (Biodiversity)
Coastal Wetlands (EPI)
Littoral Rainforest
Proximity to water source
Residential Areas

Appendix C. Longlist of Sites

Site #	Site Name	Lot #	Emergency/Permanent	Longlisting Workshop Outputs
Cluster 1				
By-11	Yelgun Festival Grounds	Lot 2/DP1261334	Permanent	**Highly constrained** - Distance to water network, ocean and the current land use are all considered significant constraints based on workshop discussions with Council.
By-12	Mulli Mulli Road	Lots 50 and 52/DO1006418	Emergency	**Highly constrained** - high value vegetation on-site, proximity to residential and rainforest. It would be difficult to gain approval to clear the site in the short time period required for an emergency site, and better similar sites within the cluster (Flowers Park)
By-13	Raglan Road	Lot 51/DP1006418	Emergency	**Highly constrained** - endangered ecological ecosystems on-site, proximity to residential.
By-14	New Brighton Sports Field (formerly Flowers Park)	Lot 335/DP755687	Emergency	**Opportunity** - Cleared site with sufficient space for a small emergency plant. Proximity to ocean and lack of environmental constraints highly beneficial compared to similar sites in the area.
By-15	Ocean Shores Golf Club	Lot 2/DP859951	Emergency	**Constrained** - Privately owned, would be challenging to access land in a drought response unless upfront agreements were in place. Unlikely given the short drought drawdown period, and other sites within the area such as New Brighton Sports Field and Boather would likely be less challenging.
By-17	Billinudgel	Lot 12/DP612989	Permanent	**Highly constrained** - Flood prone land listed as Priority 2, long distance to the ocean.
By-16	Wooyung	Lot 1/DP779817	Both	**Opportunity** - Although not likely to be considered as a preferred site given the distance to the Rous water network, it may be a regional option and should be considered in the shortlisting phase for information.

Site #	Site Name	Lot #	Emergency/Permanent	Longlisting Workshop Outputs
Cluster 2				
By-6	Tyagarah North, Anderson Lane	Lot 5/DP863320	Permanent	**Highly constrained** - Current land use seen as significant constraint based on workshop discussion
By-7	The Saddle, Brunswick Heads	Lot 2/DP1159910	Permanent	**Opportunity** - Connection to water a material benefit, which may overcome distance to ocean compared to other sites.
By-8	Former WWTP, Brunswick Heads	Lot 1/DP560486	Emergency	**Opportunity** - As a former wastewater treatment works the site may be suitable for a desalination plant.
By-9	Brunswick Heads, Pacific Hwy	Lot 7/DP844554	Permanent	**Opportunity** - Progress to shortlisting given the size of the site and the connection to water network.
By-10	Current WWTP, Brunswick Heads	Lot 1/DP1052705	Both	**Highly constrained** - Environmental values seen as significant constraint based on workshop discussion.
By-18	Boather Reserve	Lot 1/DP811063	Emergency	**Opportunity** - small area, with difficult intake and outfall construction, however the site is cleared and may be able to be assumed by Council for an emergency delivery.

Site #	Site Name	Lot #	Emergency/Permanent	Longlisting Workshop Outputs
By-19	Kingsford Drive	Lot 13, DP1251383	Both	**Highly constrained** – The site is currently undergoing planning for residential development. Council have advised that this is last available residential land in the area, which means the site is high value and unlikely to be suitable/economical.
Cluster 3				
By-1	Byron Bay Quarry Lane	Lots 7,8,9/D7189	Both	**Constrained -** The distance for an intake and outfall, as well as the tourism value of the coast in the area, and marine park are significant constraints. The relatively straightforward connection to power and water are significant benefits. Tyagarah would be a less challenging site.
By-2	Solid Grain Timbers Ewingsdale Road	Lot 181/755695	Permanent	**Constrained** - Current use and coastal wetlands mean the site is not preferable when compared to Quarry Lane and Tyagarah.
By-5	Tyagarah	Lot 1/DP1779898 Lot 2/DP1126204	Both	**Opportunity** - difficult intake and outfall construction, but the roadway through the National Park and available land area may mean the site is preferable to others within the cluster.
Cluster 4				

Site #	Site Name	Lot #	Emergency/Permanent	Longlisting Workshop Outputs
By-3	Suffolk Park SubStation	Lot 2/DP1135605	Permanent	**Opportunity** - although the intake and outfall would be challenging, the connection to power and water would provide significant saving compared to other sites.
By-4	Broken Head Quarry, Broken Head Road	Lot 1/DP184443	Permanent	**Highly Constrained** - Current uses, topography and connections to power and water would make the site difficult without remediation.
By-20	Former Trickling Filter Plant, Tallow Beach	Lot 1/DP573835	Emergency, or Pump Station	**Opportunity** - Reasonable land area which would have historic contamination as a wastewater plant. Proximity to the ocean and relatively good water and power connections.
Cluster 5				
Ba-1	Bundaleer Road	Lot 7/DP840653	Both	**Constrained -** Intake and Outfall access through the Coastal Foundation landholding is seen as a significant constraint. Also more distant from power and water connection than alternative sites in the same cluster.
Ba-2	Newrybar	General Area	Permanent	**Opportunity** - Consider the two sites as a single area. Good water and power connections and land area. Intake and Outfall construction may provide most significant constraint.
Ba-3	Ross Lane	Lot 8/DP772192	Both	
Cluster 6				

Site #	Site Name	Lot #	Emergency/Permanent	Longlisting Workshop Outputs
Ba-4	North Creek	Lot 2/DP857481	Both	**Highly Constrained** - Recently released regional plan has the land marked for residential development, and the remainder of the property is flood prone. Anecdotal evidence indicates that the lot is generally water logged.
Ba-9	Skennars Head Road Sportsfields	Lot 239/DP1201225 or Lo13/DP1245669	Emergency	**Opportunity** - the proximity to the coast and wastewater outfall provide opportunities for an emergency site.
Ba-10	Lighthouse Pde, Compton Rd, Boomerang Park	Lot 3&4 of DP11977191 or 7016/DP1068899	Emergency	**Opportunity** - May be possible as emergency plants to supply the local area.
Cluster 7				
Ba-5	Ballina Airport	Lot 2/DP1277071	Both	**Constrained** - Gallans Road would be a preferable site given that it is owned by Council and has closer connections to water and power. The key issue would be the intake and outfall. The outfall could link to the Lennox Head wastewater outfall, and the intake would need to be an estuary intake. A new outfall could provide an outfall for the wastewater plant, which currently discharges to the estuary.
Ba-6	Ballina Wastewater Treatment Plant	General Area	Both	
Ba-11	Gallans Road	Lot 114/DP755684	Both	**Opportunity** - the site has better power and water network connections to sites within the cluster. Issue of the estuary intake and/or outfall needs to be considered. DPE advice was that approval of a new estuary brine discharge was very unlikley.

Site #	Site Name	Lot #	Emergency/Permanent	Longlisting Workshop Outputs
Cluster 8				
Ba-7	South Ballina to Patchs Beach	General Area	Permanent	**Highly constrained**: As noted in the workshop, this area is within the flood area of the Richmond River and is unlikely to be a reasonable site. The distance to network and power connections, and the cost to underbore the Richmond River, also make the site highly constrained.
Ba-8	Pimlico	General Area	Permanent	
RV-1	Broadwater Quarry	Lot 2/DP1085758	Permanent	**Highly constrained:** Given the region has reliable groundwater sources and is too distant to be a practical source for the broader region, it's unlikely to be a reasonable site
Cluster 9				
RV-2	Evans Head Transfer Station	Lot 10/DP1075394	Emergency	**Exclude:** Agreed in the longlisting workshop that this region has reliable groundwater sources and is too distant to be a practical source for the broader region
RV-3	Evans Head Airport	Lot 3/DP1217074	Emergency	

Appendix D. Shortlist Criteria

Crtieria	Emergency Criteria				Permanent Criteria			
	Impractical	Poor	Moderate	Good	Impractical	Poor	Moderate	Good
Proximity to Coast	5-3 km	3-1.5 km	<1.5 km	<500m	>5km	3>5km	1>3km	<1km
Intake/Outfall length to avoid Marine Park from Coast	>3km	>2km	>1km	<1km	>3km	>2km	>1km	<1km
Intake Outfall Minium length to 10 m depth	>2km	1.5-2km	1-1.5km	<1km	>2km	1.5-2km	1-1.5km	<1km
Intake Outfall Depth (Avoiding Marine Park)	<10, >25	20<25	NA	10 to 20m	<10, >25	20<25	NA	10 to 20m
Proximity to National Parks	National Park	100m National Park	250m National Park	>250m from National Park	National Park	100m National Park	250m National Park	>250m from National Park
Proximity to Residences	Houses	100m Houses	250m Houses	>250m from Houses	Houses	100m Houses	250m Houses	>250m from Houses
Terrestrial Biodiversity	NA	Construction footprint includes EECs (fauna)	Site or proximity includes EECs (fauna)	None	NA	Construction footprint includes EECs (fauna)	Site or proximity includes EECs (fauna)	None
Native Title	NA	Native Title Listed	Application for Native Title Pending	None	NA	Native Title Listed	Application for Native Title Pending	None
Proximity to Tourism Areas	Developed tourist site	Within 250m of dedicated tourist site	Visual impact to tourism site	No tourist site within vicinity	Developed tourist site	Within 250m of dedicated tourist site	Visual impact to tourism site	No tourist site within vicinity
Proximity to Water Network	20-12km	12-6km	3-6km	<3km		20	12	6
Contaminated land	Landfill Sites High Risk Known significant contamination	Expected but unknown extent	Known contamination, manageable	Low likelihood of low risk contaminants	Landfill Sites	Known significant contamination	Expected but unknown extent/risk	Low to moderate likelihood of low risk contaminants
Flooding	Below expected sea level , Or High Tide Level and 1 in 20 year flood H6 or P1 rating	50 Year Flood, +2m above High Tide Level H5 or P2 rating	100 Year Flood, +5m above High Tide FH4 or less, P3/4	None	Below expected sea level , Or High Tide Level and 1 in 20 year flood H6 or P1 rating	50 Year Flood, +2m above High Tide Level H5 or P2 rating	100 Year Flood, +5m above High Tide FH4 or less, P3/4	None
Sea Level Rise	Not considered				Included in Flood assessment			
Site gradient	Slope Exceeds 30%	Slope 30-20%	20-10%	Less Than 10%	Slope Exceeds 30%	Slope 30-20%	20-10%	Less Than 10%
Cultural Heritage	Council Heritage Site or AHIMS sites which significantly decreases available area	Council Heritage Site or AHIMS sites on site, outside of construction area	Council Heritage Site or AHIMS sites in neighbouring sites	None listed on site or in area	Council Heritage Site or AHIMS sites which significantly decreases available area	Council Heritage Site or AHIMS sites on site, outside of construction area	Council Heritage Site or AHIMS sites in neighbouring sites	None listed on site or in area

Vegetation Communities / Land	NA	Construction footprint includes EECs and/or High Value Vegetation	Construction area includes vegetation	Construction area has no vegetation
Coastal Wetland	Coastal Wetland	100m Coastal Wetland	250m Coastal Wetland	>250m from Coastal Wetland
Littoral Rainforest	Littoral Rainforest	100m Littoral Rainforest	250m Littoral Rainforest	>250m from Littoral Rainforest
Koala Habitat	"Sited"	Sited	Possible	None
Land Parcel Size	< Required plant footprint	100% of sites footprint	100-150% of plant footprint	>150% of plant footprint
Land Ownership	Landholding with significant current use	Private or Crown landholding with minimal current use	Council or State site with moderate current use	Empty site of Council or State ownership
Proximity to Power Network - distance to HV supply	>5km	1-5 km to feeder	1-5 km to substation	<1km to HV connection
Site elevation	>100m	100-50m	50-25m	25m
Land Zoning	NA	Prohibited by LEP and T&I SEPP	Prohibited by LEP, Allowed by SEPP	Allowed by LEP and T&I SEPP
Drinking Water Catchments	NA	<250m to storage	Within drinking water catchment	Not within a drinking water catchment
Bushfire Prone Land	NA	High Risk (Category 1)	Medium Risk (Category 2-3)	No Bushfire Risk
Road Access	No established road to within 5 km of site	Established road to within 1km of site	Established road to site boundary	Established road to site plant site
General source type	Upper Estuary	Lower Estuary	Sheltered Ocean / Beach Wells	Open Ocean
Estuary mixing plumes		Within 5 km of the Richmond River mouth	Within 3 km of minor river mouth	> 5km or 3km from major/minor river mouth
Proximity to point source pollutants	500m	1km	3km	5km
Community Impact	100m of Popular Beach	200m of Popular Beach	500m of Popular Beach	1000m of Popular Beach
Proximity to Wastewater network	Consider individually			
Acid sulfate soils	NA	High Risk	Medium Risk	None

NA	Construction footprint includes EECs and/or High Value Vegetation	Construction area includes vegetation	Construction area has no vegetation
Coastal Wetland	100m Coastal Wetland	250m Coastal Wetland	>250m from Coastal Wetland
Littoral Rainforest	100mLittoral Rainforest	250mLittoral Rainforest	>250m from Littoral Rainforest
Nil	Sited	Possible	None
< Required plant footprint	100% of sites footprint	100-150% of plnt footprint	>150% of plant footprint
Landholding with significant current use	Private or Crown landholding with minimal current use	Council or State site with moderate current use	Empty site of Council or State ownership
>10km	5-10km to any connection	<5km to feeder	<5km to substation
>100m	100-50m	50-25m	25m
NA	Prohibited by LEP and T&I SEPP	Prohibited by LEP, Allowed by SEPP	Allowed by LEP and T&I SEPP
NA	<250m to storage	Within drinking water catchment	Not within a drinking water catchment
NA	High Risk (Category 1)	Medium Risk (Category 2-3)	No Bushfire Risk
No established road to within 5 km of site	Established road to within 1km of site	Established road to site boundary	Established road to site plant site
Upper Estuary	Lower Estuary	Sheltered Ocean / Beach Wells	Open Ocean
	Within 5km of the Richmond River mouth	Within 3km of minor river mouth	> 5km or 3km from major/minor river mouth
500m	1km	3km	5km
100m of Popular Beach	200m of Popular Beach	500m of Popular Beach	1000m of Popular Beach
Consider individually			
NA	High Risk	Medium Risk	None

Appendix E. Impact Scores for Assessment Criteria

Criteria	Impact		
	Impact of Approvals	Impact on cost	Highest Score
Proximity to Coast	Minor	Critical	Critical
Intake/Outfall length to avoid Marine Park from Coast	Minor	Critical	Critical
Intake Outfall Minium length to 10 m depth	High	Critical	Critical
Intake Outfall Depth (Avoiding Marine Park)	Minor	Critical	Critical
Proximity to National Parks	High	Minor	High
Proximity to Residences	High	Minor	High
Terrestrial Biodiversity	High	Minor	High
Flooding	Low	High	High
Proximity to Tourism Areas	High	Low	High
Proximity to Water Network	Minor	High	High
Native Title	Moderate	Minor	Moderate
Contaminated land	Minor	Moderate	Moderate
Sea Level Rise	Low	Moderate	Moderate
Site gradient	Minor	Moderate	Moderate
Cultural Heritage	Moderate	Low	Moderate
Vegetation Communities / Land	Moderate	Moderate	Moderate
Coastal Wetland	Moderate	Minor	Moderate
Littoral Rainforest	Moderate	Minor	Moderate
Koala Habitat	Moderate	Minor	Moderate
Land Parcel Size	Minor	Moderate	Moderate
Land Ownership	Minor	Moderate	Moderate
Proximity to Power Network - distance to HV supply	Minor	Moderate	Moderate
Site elevation	Minor	Low	Low
Land Zoning	Low	Minor	Low

Criteria	Impact		
	Impact of Approvals	Impact on cost	Highest Score
Drinking Water Catchments	Low	Minor	Low
Bushfire Prone Land	Low	Minor	Low
Road Access	Low	Low	Low
General source type	Low	Low	Low
Estuary mixing plumes	Low	Low	Low
Proximity to point source pollutants	Low	Low	Low
Community Impact	Low	Low	Low
Proximity to Wastewater network	Minor	Low	Low
Acid sulfate soils	Minor	Minor	Minor

Appendix F. Shortlisted Emergency Sites

	New Brighton Sports	Wooyung	Former WWTP, Brunswick Heads	Boather Reserve	Tyagarah	Former Trickling Filter Plant, Tallow Beach	Ross Lane	Skennars Head Road Sportsfields	Lighthouse Pde, Compton Rd, Boomerang Park	Gallans Road
Non-Weighted Scores										
2ML/d	23	21.5	21	23.5	21.5	23.5	21.5	21.5	23.5	22
5ML/d	23	21.5	21	23	21.5	23.5	21.5	20.5	22.5	22
10ML/d	22.5	21.5	20	21.5	21.5	23	21.5	20.5	22.5	20
Non-Weighted Ranking										
2ML/d	4	6	10	1	6	1	6	6	1	5
5ML/d	2	6	9	2	6	1	6	10	4	5
10ML/d	2	4	9	4	4	1	4	8	2	9

Weighted Scores										
2ML/d	0.60	0.52	0.48	0.62	0.50	0.57	0.54	0.55	0.59	0.59
5ML/d	0.60	0.52	0.48	0.60	0.50	0.57	0.54	0.51	0.55	0.59
10ML/d	0.58	0.52	0.44	0.53	0.50	0.55	0.54	0.51	0.55	0.50
Weighted Ranking										
2ML/d	2	8	10	1	9	5	7	6	4	3
5ML/d	1	7	10	2	9	4	6	8	5	3
10ML/d	1	6	10	5	9	2	4	7	3	8

Workshop Recommendation	✔	x	x	✔	x	✔	✔	x	✔	x

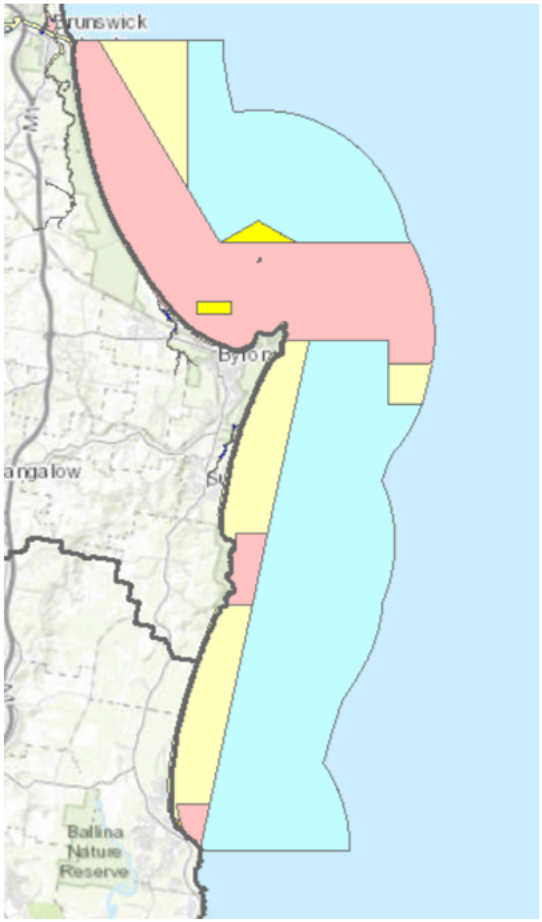
Appendix G. Shortlisted Permanent Sites

	Wooyung	The Saddle, Brunswick Heads	Brunswick Heads, Pacific Hwy	Tyagarah	Suffolk Park SubStation	Newrybar	Ross Lane	Gallans Road
Non-Weighted Scores								
10ML/d	21	21	21	24	27	26.5	23.5	21.5
>15ML/d	18.5	22	21.5	26.5	31	30.5	27.5	23.5
>25 ML/d	21	20	20	23	26	25.5	22.5	20.5
Non-Weighted Ranking								
10ML/d	6	6	6	3	1	2	4	5
>15ML/d	8	6	7	4	1	2	3	5
>25 ML/d	5	7	7	3	1	2	4	6

Weighted Scores								
10ML/d	0.47	0.54	0.57	0.61	0.69	0.68	0.63	0.59
>15ML/d	0.43	0.49	0.52	0.59	0.69	0.68	0.63	0.57
>25 ML/d	0.43	0.49	0.52	0.59	0.69	0.68	0.63	0.57
Weighted Ranking								
10ML/d	8	7	6	4	1	2	3	5
>15ML/d	8	7	6	4	1	2	3	5
>25 ML/d	8	7	6	4	1	2	3	5

Workshop Recommendation	x	x	x	x	✔	✔	✔	x

Appendix H. Cape Byron Marine Park

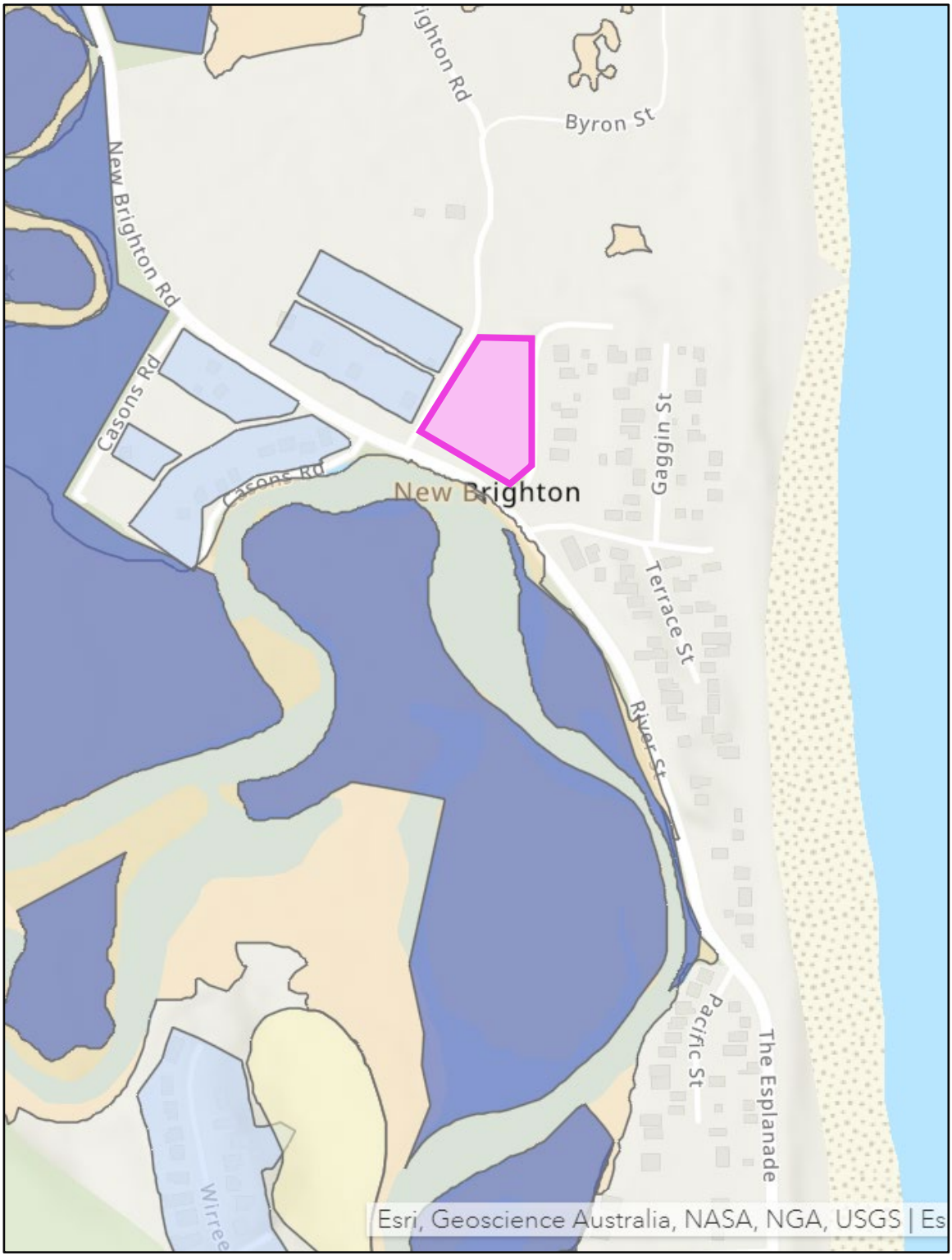


General Use Zone (IUCN VI)
Habitat Protection Zone (IUCN IV)
Habitat Protection Zone (Restrictions Apply) (IUCN IV)
Sanctuary Zone (IUCN II)

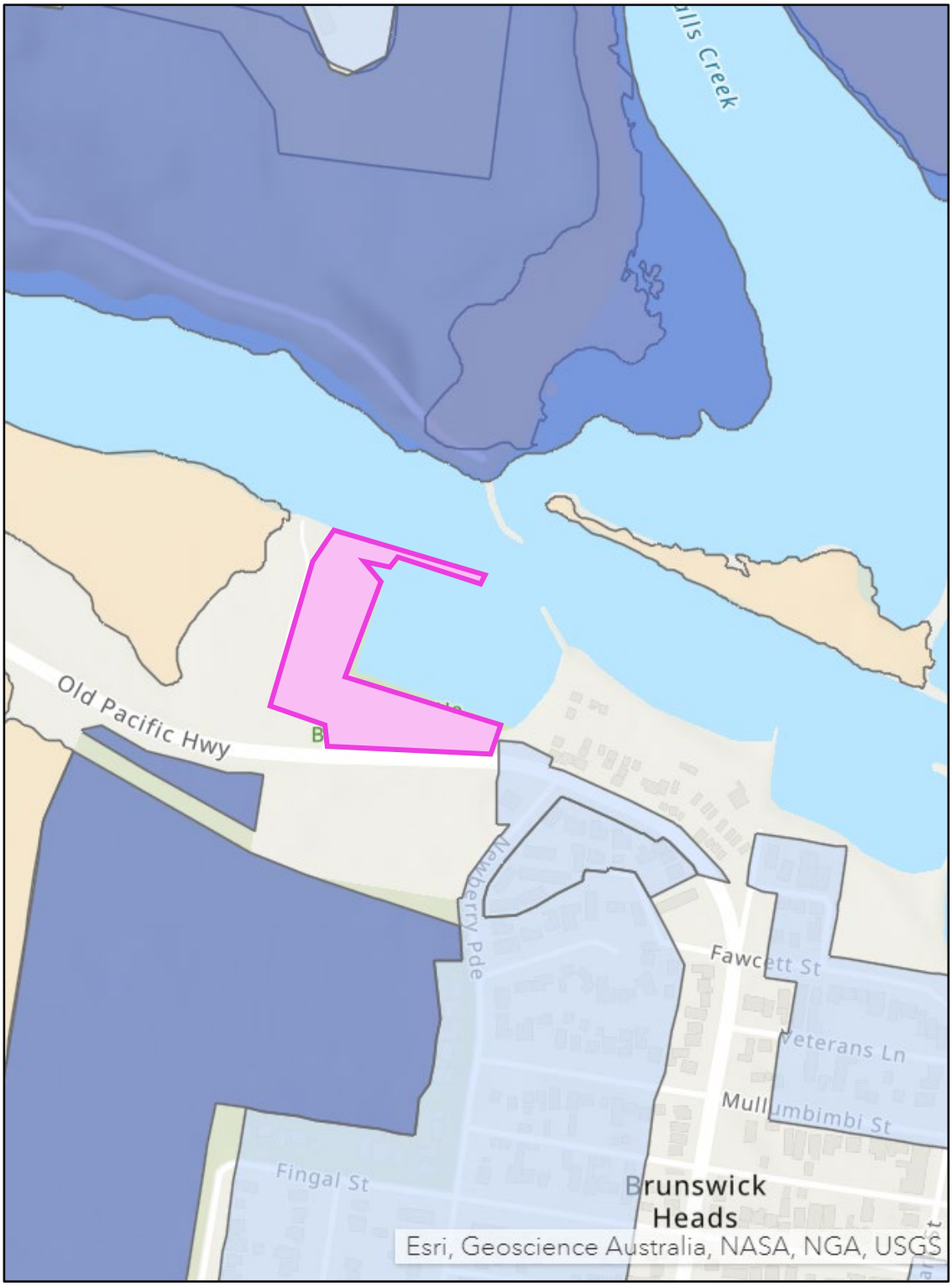
The objects of the sanctuary zone are — Sanctuary Zone **NO HARM OR INTERFERENCE**	(a) to provide the **highest level of protection** for biological diversity, habitat, ecological processes, natural features and cultural features (both Aboriginal and non-Aboriginal) in the zone, and	(b) where consistent with paragraph (a), to provide opportunities for the following activities in the zone— (i) recreational, educational and other activities **that do not involve harming any animal or plant** or **causing any damage to or interference with natural or cultural features or any habitat**, (ii) scientific research.
The objects of the habitat protection zone are— Habitat Protection Zone **NO SIGNIFICANT IMPACT**	(a) to provide a **high level of protection** for biological diversity, habitat, ecological processes, natural features and cultural features (both Aboriginal and non-Aboriginal) in the zone, and	(b) where consistent with paragraph (a), to provide opportunities for recreational and commercial activities (including fishing), scientific research, educational activities and other activities, **so long as they are ecologically sustainable and do not have a significant impact on any fish populations or on any other animals, plants or habitats.**
The objects of the general use zone are— General Use Zone **ECOLOGICALLY SUSTAINABLE**	(a) to **provide protection** for biological diversity, habitat, ecological processes, natural features and cultural features (both Aboriginal and non-Aboriginal) in the zone, and	(b) where consistent with paragraph (a), to provide opportunities for recreational and commercial activities (including fishing), scientific research, educational activities and other activities **so long as they are ecologically sustainable**.

Provided by Rous County Council

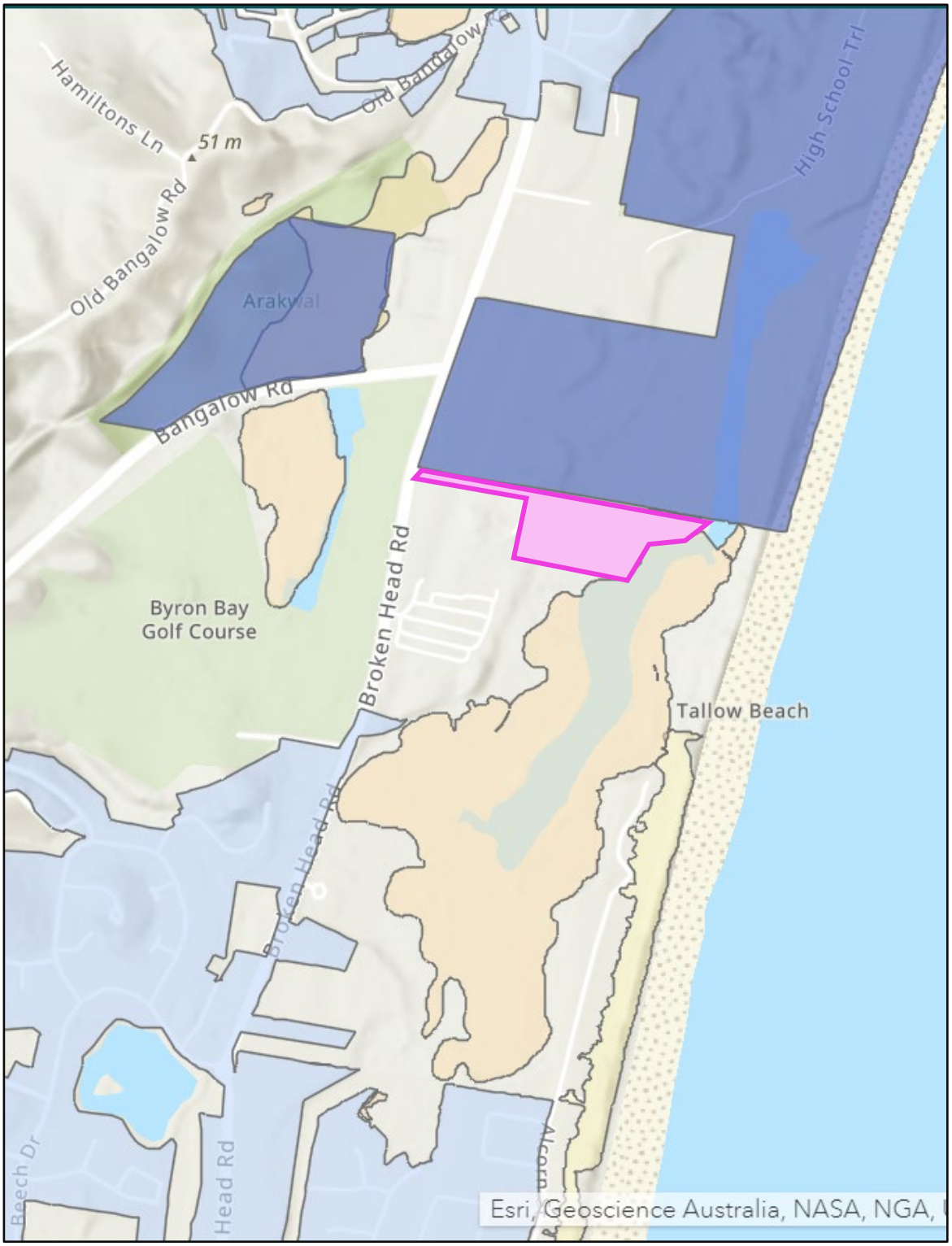
Appendix I. Shortlisted Site Locations



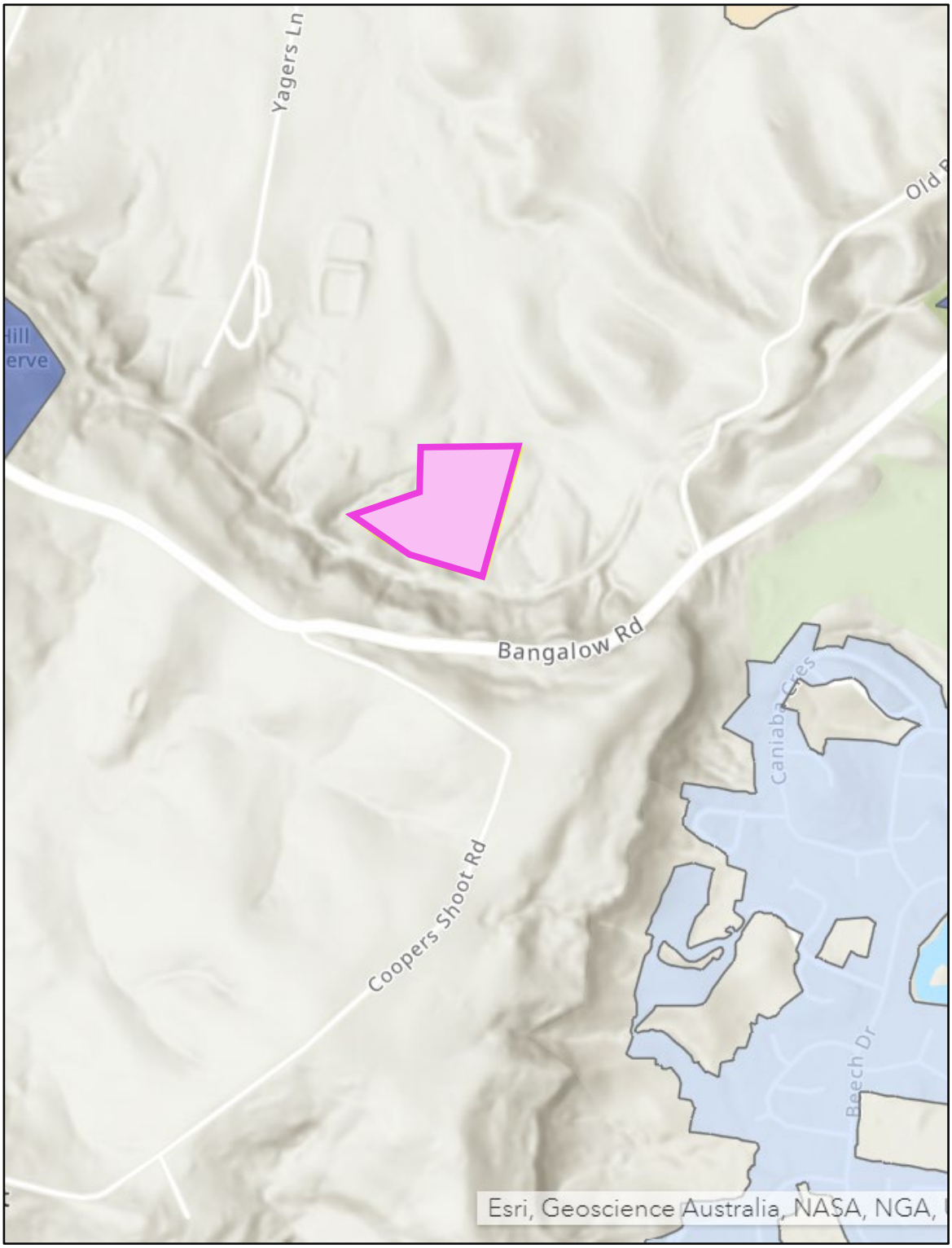
New Brighton Sports Fields



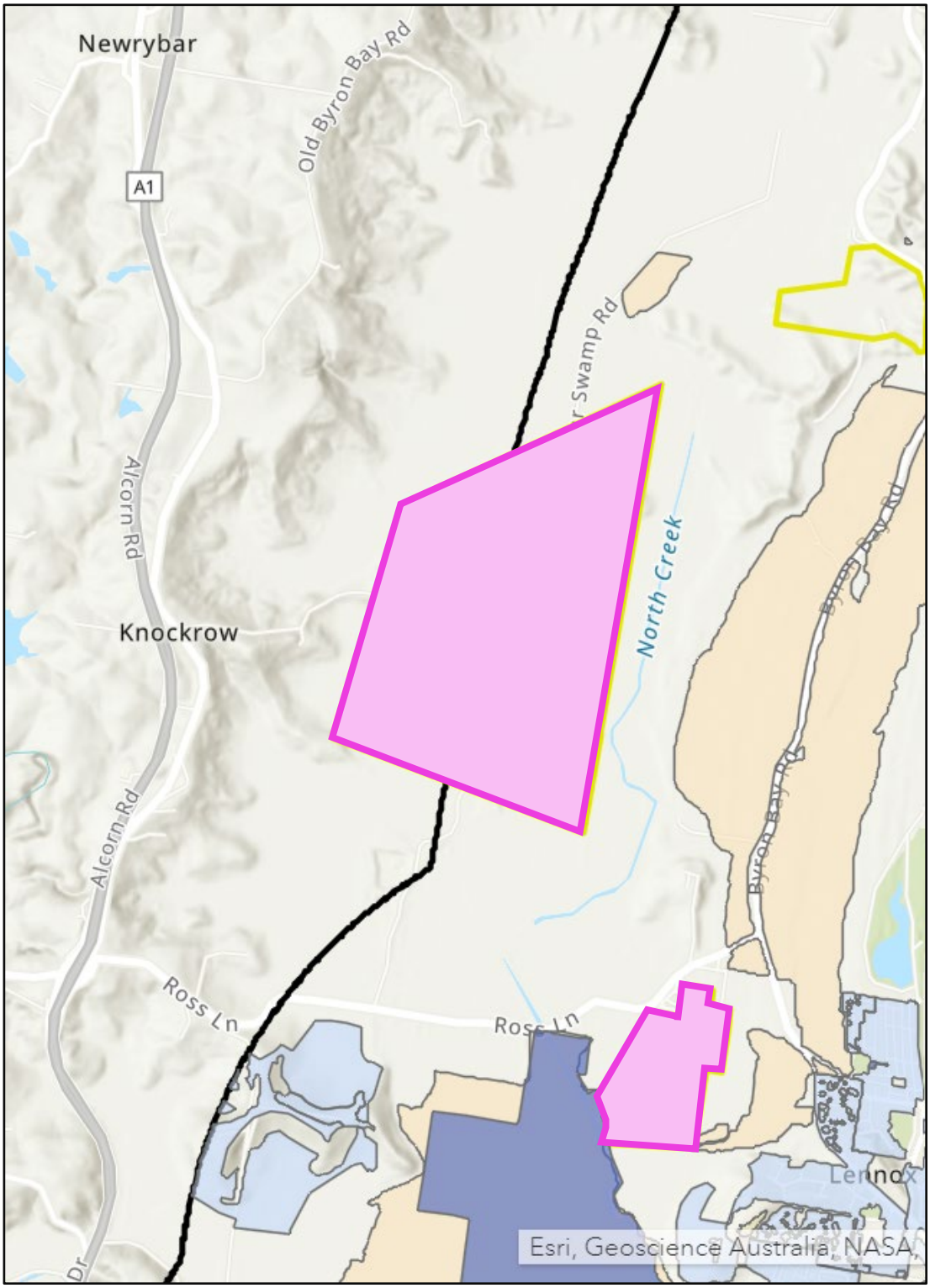
Boathar Reserve



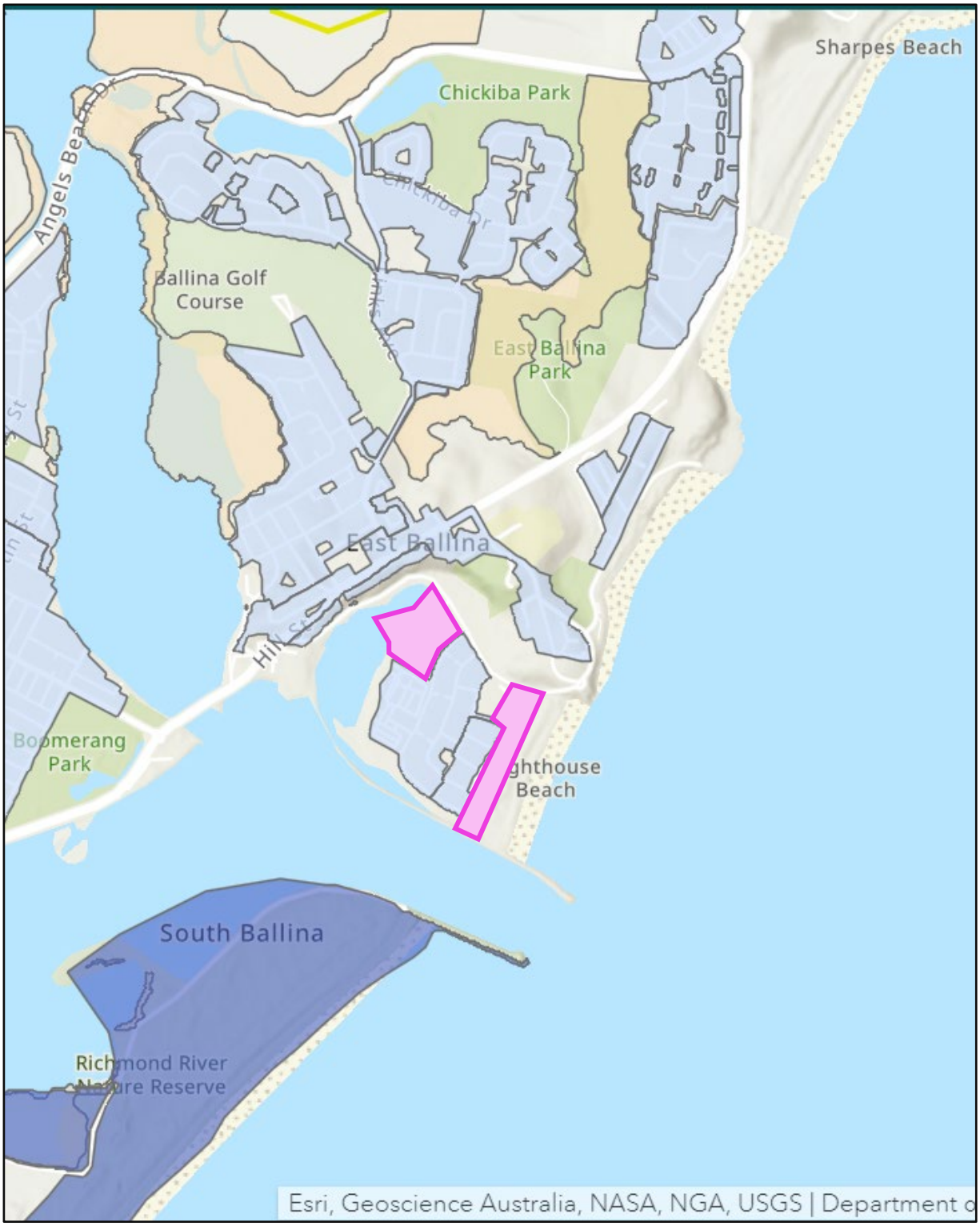
Former Trickling Filter Plant, Tallow Beach



Suffolk Park SubStation



Ross Lane and Newry Bar

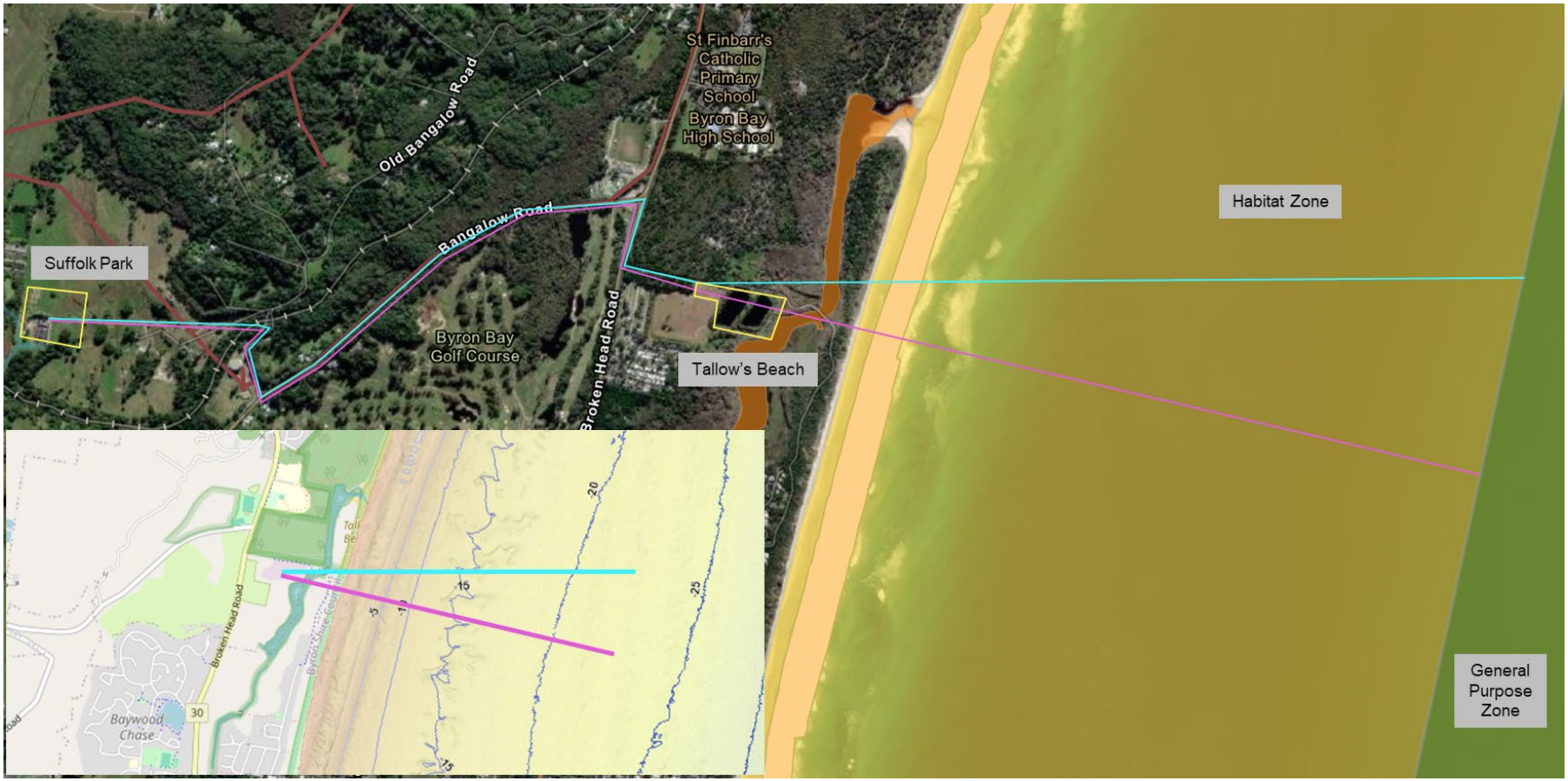


Lighthouse Beach and Compton Road

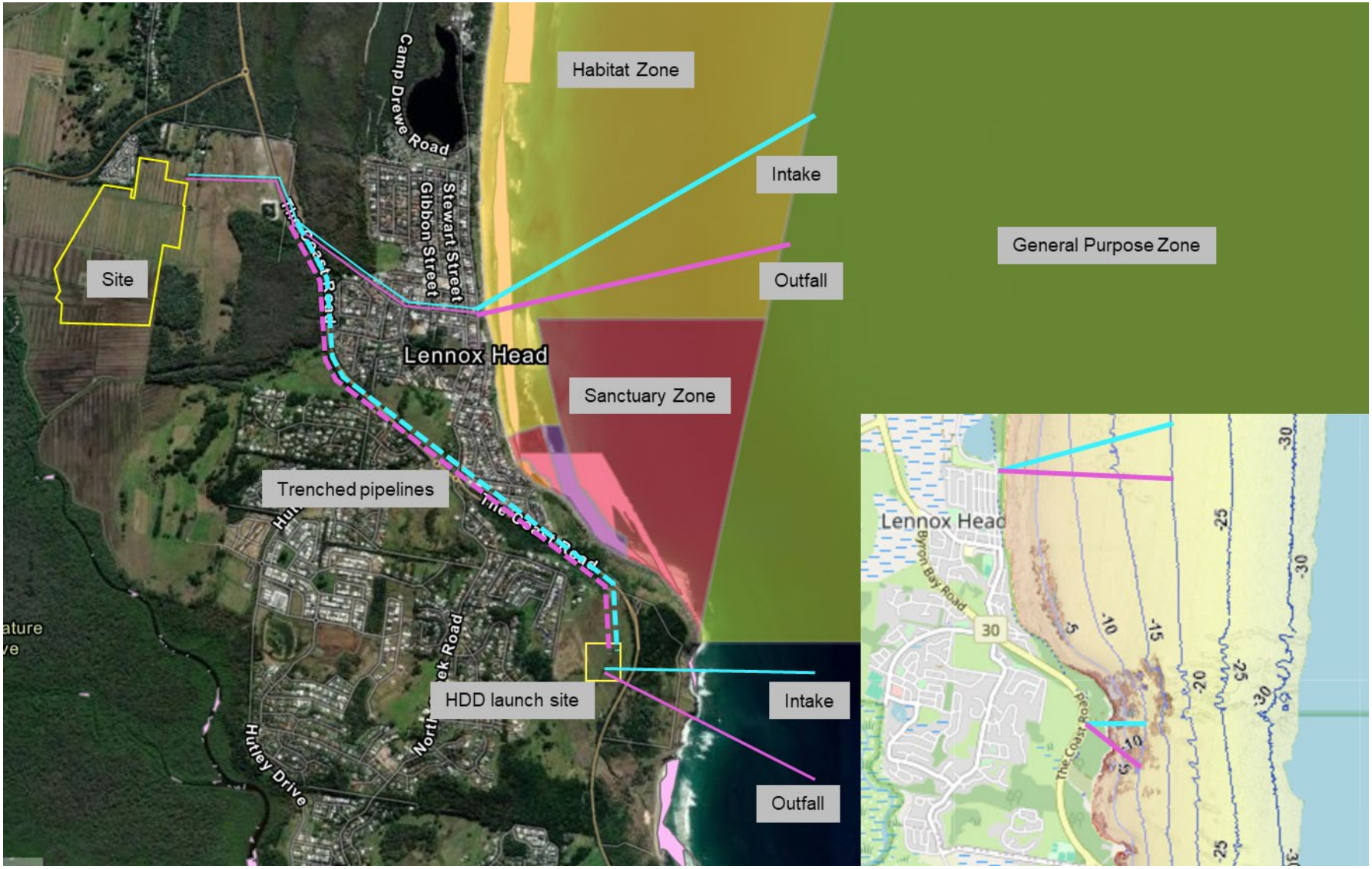
Appendix C. New Brighton Sports Field

Appendix D. Brunswick Heads Boat Harbour

Appendix E. Suffolk Park/Tallow's Beach

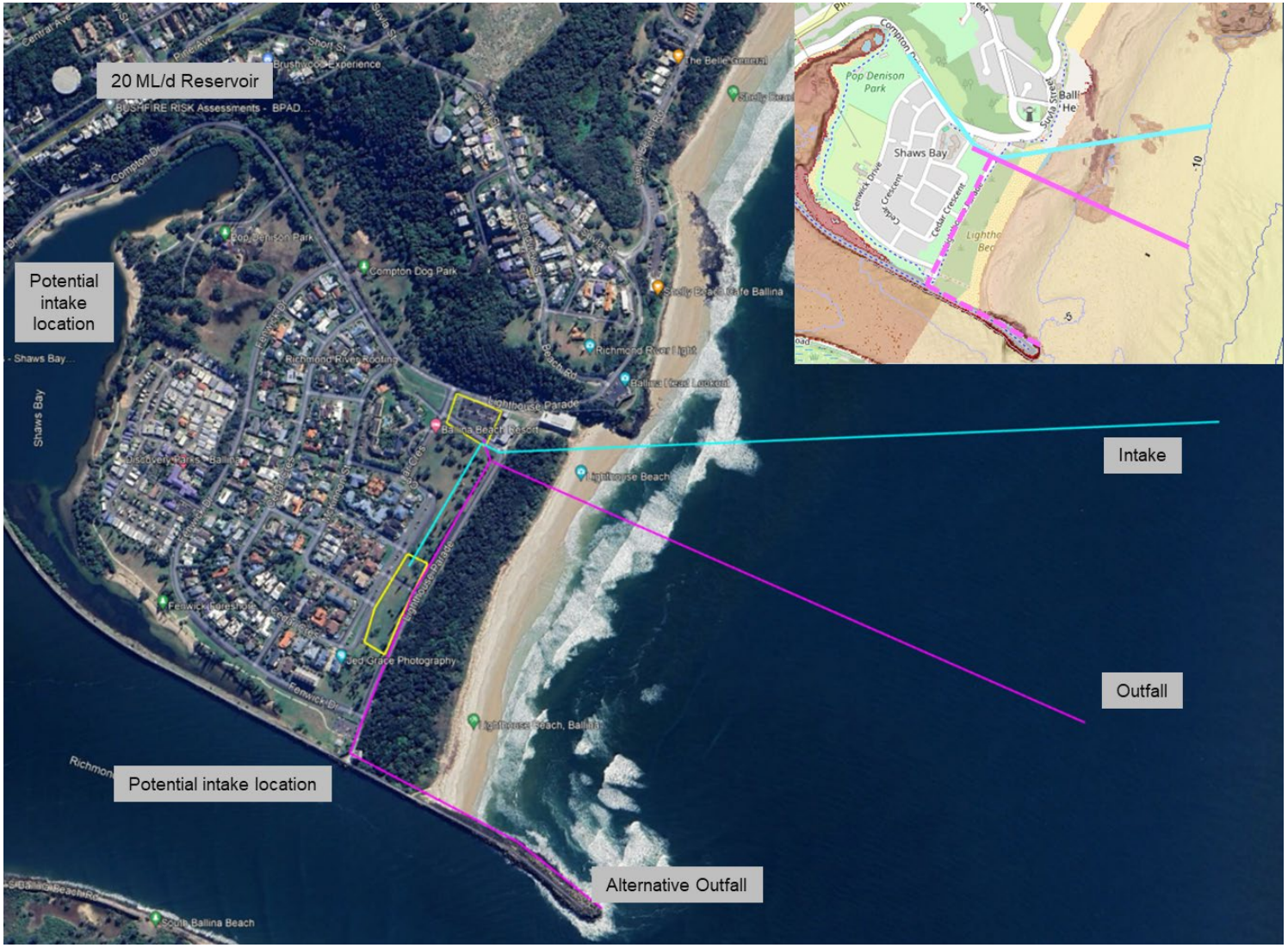


Appendix F. Newrybar/Ross Lane



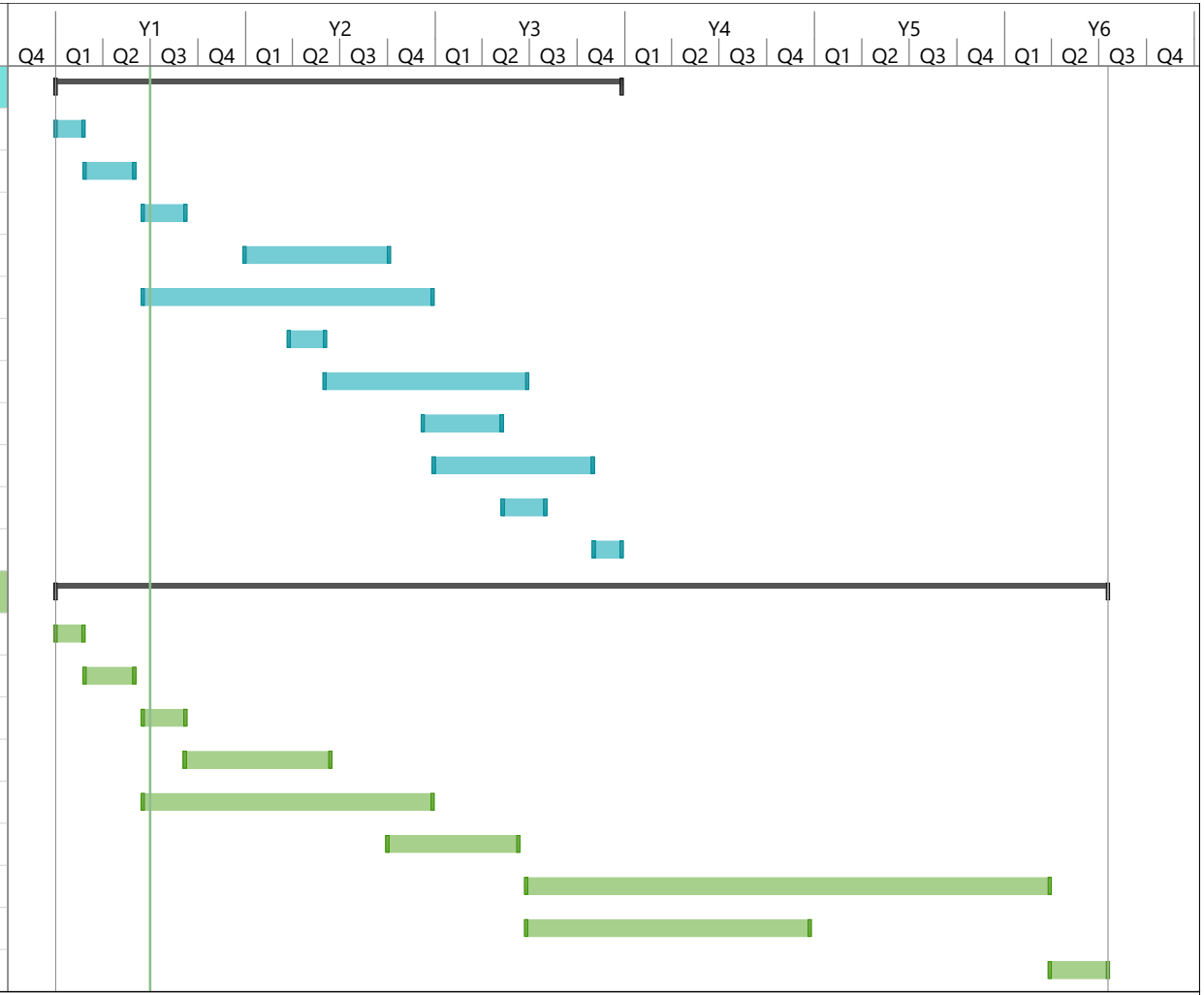
Appendix G. Skennars Head

Appendix H. Lighthouse Park



Appendix I. Strategic Delivery Program

ID	Task Name
1	**High Risk Example**
2	Project Inception, stakeholder briefings, project description
3	Preparation of scoping report and receiving SEARs.
4	Feasibility / investigations
5	Design
6	Planning Approvals (EIS)
7	Procurement and Finance Approvals
8	Package C1
9	Packages C2-C7
10	Construction
11	Power Augmentation
12	Commissioning
13	**Standard Example**
14	Project Inception, stakeholder briefings, project description
15	Preparation of scoping report and receiving SEARs.
16	Feasibility / investigations
17	Concept Design
18	Planning Approvals (EIS)
19	Procurement and Finance Approvals
20	Design and Construct
21	Power Augmentation
22	Commissioning



Project: Permanent Plant Progr
Date: Mon 1/07/24

Task	Inactive Summary	External Tasks
Split	Manual Task	External Milestone
Milestone	Duration-only	Deadline
Summary	Manual Summary Rollup	Progress
Project Summary	Manual Summary	Manual Progress
Inactive Task	Start-only	
Inactive Milestone	Finish-only	

Appendix J. Dam Depletion Time in Months

Dam Depletion Period in Months - Severe Drought Scenario

Dam Level Start and End	**90%**	**80%**	**70%**	**60%**	**50%**	**40%**	**30%**	**20%**	**10%**	**0%**
100%	1.9	3.7	5.3	6.9	8.6	10.6	13.0	15.6	18.1	**20.9**
90%		1.7	3.3	5.0	6.7	8.7	11.1	13.7	16.1	**19.0**
80%			1.6	3.3	4.9	7.0	9.4	12.0	14.4	**17.2**
70%				1.7	3.3	5.4	7.8	10.4	12.8	**15.6**
60%					1.7	3.7	6.1	8.7	11.1	**14.0**
50%						2.1	4.5	7.0	9.5	**12.3**
40%							2.4	5.0	7.4	**10.2**
30%								2.6	5.0	**7.8**
20%									2.4	**5.2**
10%										**2.8**

Dam Depletion Period in Months - Catastrophic Drought Scenario

Dam Level Start and End	**90%**	**80%**	**70%**	**60%**	**50%**	**40%**	**30%**	**20%**	**10%**	**0%**
100%	1.3	2.6	3.8	5.1	6.4	7.7	9.2	10.7	12.5	**14.5**
90%		1.3	2.5	3.8	5.1	6.4	7.9	9.5	11.2	**13.2**
80%			1.2	2.5	3.8	5.1	6.6	8.2	9.9	**11.9**
70%				1.3	2.6	3.9	5.4	6.9	8.7	**10.6**
60%					1.3	2.6	4.1	5.7	7.4	**9.4**
50%						1.3	2.8	4.4	6.1	**8.1**
40%							1.5	3.0	4.8	**6.7**
30%								1.6	3.3	**5.3**
20%									1.8	**3.7**
10%										**1.9**

Appendix K. Indicative Scope of Readiness Activities 1

Component	Category	Tasks
Planning (Initial Works)	Project Plan	Strategic Review of Project Timeline, Resourcing and Task List
		Planning Approval Pathway review
Concept Design	Design	Basis of Design Document
	Ocean Intake	Hydrodynamic Modelling
		Intake Siting Confirmation
		Pump Design
	Brine Discharge Pipeline	River Under bore
		Constraints analysis
		Geotech
	Brine outfall	Hydrodynamic Modelling
		Dispersion Modelling
		Water Sampling
		Geotech Review (Potential Geophysics)
	Plant Design	Review of previous design
		Water Quality Envelope
		Process Selection
		Operational Philosophy
		Strategic Master Planning
		Site Geotech
		Site Services
	Potable Connection	Demand modelling for drought
		Pipeline Geotech
		Pump sizing
	Cost Estimates	Likely to be AACE Class 4

	Delivery Program	Engagement with Suppliers
		Drawdown modelling
		Risk Analysis
EIS	Ecology Assessment	Desktop Review
		Site/Seasonal Assessment
	Marine Monitoring	Sediment and Benthic Flora and Fauna Assessments
	Indigenous Heritage Assessment	Desktop Review and Site walkovers
	Non-Indigenous Heritage Assessment	Desktop Review and Site walkovers
	Dewatering Plans	NRAR Engagement Licensing Options
	Flood modelling	1 in 100 and PMF levels
	Noise and Vibration Assessment	Expected to be minimal scope
	Traffic Assessment	Standard scope
	Groundwater Assessment	Expected to be minimal scope
	Stakeholder Engagement	Government Agencies
		Community Engagement
		Public Exhibition
		NSW Health
		NSW Premier Department
		Water NSW
		Internal Council
Procurement and Governance Strategy	Financial Approvals	Confirmation of Funding Sources
		Internal Council Financial Approvals
		NSW State Government Financial Approvals
	Governance Processes	Delegated Authorities

Appendix L. Comparative Costs – Emergency Sites

Desalination Cost Estimate Sheet

CAPEX

			Component	New Brighton Sports Field		Brunswick Heads Boat Harbour		Suffolk Park	Tallow's Beach	Newrybar/Ross Lane		Lighthouse Beach		Skennar's Head
				HDD Only	Trench + HDD	HDD Intake and Outfall	Pontoon plus HDD Outfall	Trench + HDD	HDD	HDD Intake and Outfall	Trench + HDD	HDD Intake and Outfall	Breakwall outfall and Inlet Intake	HDD Intake and Outfall
			Treated Water Pipeline	$2,404,000	$2,404,000	$2,404,000	$2,404,000	$420,700	$1,202,000	$961,600	$961,600	$841,400	$841,400	$841,400
			Intake	$2,780,800	$2,051,200	$4,491,400	$100,000	$8,826,200	$6,772,200	$9,623,200	$6,375,300	$3,351,000	$256,750	$3,065,900
			Outfall	$2,086,000	$1,472,000	$3,463,000	$3,463,000	$6,819,000	$5,299,000	$7,594,000	$4,746,000	$2,086,000	$1,390,000	$2,315,500
			Desalination Plant	$843,974	$843,974	$843,974	$843,974	$843,974	$843,974	$843,974	$843,974	$843,974	$843,974	$843,974
			Power Generation	$824,959	$824,959	$824,959	$824,959	$824,959	$824,959	$824,959	$824,959	$824,959	$824,959	$824,959
			Pumps, Tanks and Valves	$2,273,930	$2,273,930	$2,273,930	$2,273,930	$2,273,930	$2,273,930	$2,273,930	$2,273,930	$2,273,930	$2,273,930	$2,273,930
			Network Pump Station (allowance)	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
			Re-establishment (allowance)	$500,000	$500,000	$500,000	$500,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$500,000
			Land Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Direct - Totals	**$12,213,663**	**$10,870,063**	**$15,301,263**	**$10,909,863**	**$20,608,763**	**$17,816,063**	**$22,721,663**	**$16,625,763**	**$10,821,263**	**$7,031,013**	**$11,165,663**
Preliminaries, project management, profit / overhead														
Preliminaries, project management, profit / overhead	Contractor preliminaries, PM, profit, overhead and as-built drawings	%	5	610,683	543,503	765,063	545,493	1,030,438	890,803	1,136,083	831,288	541,063	351,551	558,283
Design and Approvals		%	10	1,221,366	1,087,006	1,530,126	1,090,986	2,060,876	1,781,606	2,272,166	1,662,576	1,082,126	703,101	1,116,566
Sub-Total 1 :				**1,832,049**	**1,630,509**	**2,295,189**	**1,636,479**	**3,091,314**	**2,672,409**	**3,408,249**	**2,493,864**	**1,623,189**	**1,054,652**	**1,674,849**
CONSTRUCTION Management														
Construction management - internal			10%	1,221,366	1,087,006	1,530,126	1,090,986	2,060,876	1,781,606	2,272,166	1,662,576	1,082,126	703,101	1,116,566
Construction management - external			10%	1,221,366	1,087,006	1,530,126	1,090,986	2,060,876	1,781,606	2,272,166	1,662,576	1,082,126	703,101	1,116,566
			Indirect - Totals	**$4,274,782**	**$3,804,522**	**$5,355,442**	**$3,818,452**	**$7,213,067**	**$6,235,622**	**$7,952,582**	**$5,819,017**	**$3,787,442**	**$2,460,854**	**$3,907,982**
Sub-Total :				**$16,488,445**	**$14,674,585**	**$20,656,705**	**$14,728,315**	**$27,821,830**	**$24,051,685**	**$30,674,245**	**$22,444,780**	**$14,608,705**	**$9,491,867**	**$15,073,645**
Risk and contingencies	Inherent Contingencies		15%	**$2,473,267**	**$2,201,188**	**$3,098,506**	**$2,209,247**	**$4,173,274**	**$3,607,753**	**$4,601,137**	**$3,366,717**	**$2,191,306**	**$1,423,780**	**$2,261,047**
	Strategic Contingencies		15%	**$2,473,267**	**$2,201,188**	**$3,098,506**	**$2,209,247**	**$4,173,274**	**$3,607,753**	**$4,601,137**	**$3,366,717**	**$2,191,306**	**$1,423,780**	**$2,261,047**
TOTAL CAPEX COMPARATIVE COST				**$21,434,978**	**$19,076,960**	**$26,853,716**	**$19,146,809**	**$36,168,378**	**$31,267,190**	**$39,876,518**	**$29,178,213**	**$18,991,316**	**$12,339,427**	**$19,595,738**

OPEX

	Component	New Brighton Sports Field		Brunswick Heads Boat Harbour		Suffolk Park	Tallow's Beach	Newrybar/Ross Lane		Lighthouse Beach		Skennar's Head
		HDD Only	Trench + HDD	HDD Intake and Outfall	Pontoon plus HDD Outfall	Trench + HDD	HDD	HDD Intake and Outfall	Trench + HDD	HDD Intake and Outfall	Breakwall outfall and Inlet Intake	HDD Intake and Outfall
	Treated Water Pipeline	Included in generator operating costs										
	Intake Pumping											
	Outfall Pumping											
	Upfront Operation Costs (Contracts)	$3,399,127	$3,399,127	$3,399,127	$3,399,127	$3,399,127	$3,399,127	$3,399,127	$3,399,127	$3,399,127	$3,399,127	$3,399,127
	Response Operation Costs (Labour, Fuel)	$2,252,850	$2,252,850	$2,252,850	$2,252,850	$2,252,850	$2,252,850	$2,252,850	$2,252,850	$2,252,850	$2,252,850	$2,252,850
	Sub-total	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**
TOTAL OPEX COMPARATIVE COST		**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**	**$5,651,977**
TOTEX Comparative Cost		**$27,086,955**	**$24,728,937**	**$32,505,693**	**$24,798,786**	**$41,820,355**	**$36,919,167**	**$45,528,495**	**$34,830,190**	**$24,643,293**	**$17,991,404**	**$25,247,715**

Appendix M. Comparative Costs – Permanent Sites

Desalination Cost - Permanent Plants

CAPEX

				15			25		
			Component	Suffolk Park	Newrybar/Ross Lane		Suffolk Park	Newrybar/Ross Lane	
				Trench + HDD	HDD Intake and Outfall	Trench + HDD	Trench + HDD	HDD Intake and Outfall	Trench + HDD
			Treated Water Pipeline	$848,400	$1,939,200	$1,939,200	$6,043,800	$2,302,400	$2,302,400
			Intake	$91,332,000	$192,000,000	$16,231,000	$136,446,000	$192,000,000	$18,180,500
			Outfall	$33,678,000	$86,400,000	$12,236,500	$91,332,000	$128,000,000	$13,031,000
			Balance of Plant	$150,000,000	$150,000,000	$150,000,000	$250,000,000	$250,000,000	$250,000,000
			Power Connection	$1,000,000	$10,000,000	$10,000,000	$1,000,000	$10,000,000	$10,000,000
			Direct - Totals	**$276,858,400**	**$440,339,200**	**$190,406,700**	**$484,821,800**	**$582,302,400**	**$293,513,900**
Preliminaries, project management, profit / overhead									
Preliminaries, project management, profit / overhead	Contractor preliminaries, PM, profit, overhead and as-built drawings	%	8	22,148,672	35,227,136	15,232,536	38,785,744	46,584,192	23,481,112
Design and Approvals		%	3	8,305,752	13,210,176	5,712,201	14,544,654	17,469,072	8,805,417
Sub-Total 1 :				**30,454,424**	**48,437,312**	**20,944,737**	**53,330,398**	**64,053,264**	**32,286,529**
CONSTRUCTION Management									
Construction management - internal			5%	13,842,920	22,016,960	9,520,335	24,241,090	29,115,120	14,675,695
Construction management - external			5%	13,842,920	22,016,960	9,520,335	24,241,090	29,115,120	14,675,695
Indirect - Totals				**$58,140,264**	**$92,471,232**	**$39,985,407**	**$101,812,578**	**$122,283,504**	**$61,637,919**
Sub-Total :				**$334,998,664**	**$532,810,432**	**$230,392,107**	**$586,634,378**	**$704,585,904**	**$355,151,819**
Risk and contingencies	Inherent Contingencies		15%	**$50,249,800**	**$79,921,565**	**$34,558,816**	**$87,995,157**	**$105,687,886**	**$53,272,773**
	Strategic Contingencies		15%	**$50,249,800**	**$79,921,565**	**$34,558,816**	**$87,995,157**	**$105,687,886**	**$53,272,773**
TOTAL CAPEX COMPARATIVE COST				**$435,498,263**	**$692,653,562**	**$299,509,739**	**$762,624,691**	**$915,961,675**	**$461,697,365**

OPEX

				Suffolk Park	Newry Bar/Ross Lane		Suffolk Park	Newry Bar/Ross Lane	
			Component						
				Trench + HDD	HDD Intake and Outfall	Trench + HDD	Trench + HDD	HDD Intake and Outfall	Trench + HDD
			Fixed Costs	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000
			Variable Costs	$5,250,000	$5,250,000	$5,250,000	$8,750,000	$8,750,000	$8,750,000
			Sub-total	**$7,250,000**	**$7,250,000**	**$7,250,000**	**$10,750,000**	**$10,750,000**	**$10,750,000**
Risk and contingencies	Inherent Contingencies		15%	**$1,087,500**	**$1,087,500**	**$1,087,500**	**$1,612,500**	**$1,612,500**	**$1,612,500**
TOTAL OPEX (annual)				**$6,868,132**	**$6,868,132**	**$6,868,132**	**$11,446,886**	**$11,446,886**	**$11,446,886**
Rank				2	3	1	2	3	1
TOTEX Comparative Costs				**$442,366,395**	**$699,521,693**	**$306,377,871**	**$774,071,578**	**$927,408,562**	**$473,144,251**

Appendix N. Differentiating Criteria

Permanent Sites

Crtieria	Description	Criteria Ratings				Sites	
		Impractical	Poor	Moderate	Good	Suffolk Park SubStation	Ross Lane
Cultural Heritage	Aboriginal or non-Aboriginal heritage sites may lead to sites being unsuitable.	Council Heritage Site or AHIMS sites which significantly decreases available area	Council Heritage Site or AHIMS sites on site, outside of construction area	Council Heritage Site or AHIMS sites in neighbouring sites	None listed on site or in area	None listed on site or in area	Council Heritage Site or AHIMS sites in neighbouring sites
Vegetation Communities / Land	Vegetated areas of high value outside of National Parks, for example, State Conservation Areas. Includes seagrass meadows for intake/outfall structures.	NA	Construction footprint includes EECs and/or High Value Vegetation	Construction area includes vegetation	Construction area has no vegetation	Construction area includes vegetation	Construction area has no vegetation
Land Ownership	Land already owned by Council will lead to cost and time savings, as well as reduce program risks.	Landholding with significant current use	Private or Crown landholding with minimal current use	Council or State site with moderate current use	Empty site of Council or State ownership	Empty site of Council or State ownership	Private or Crown landholding with minimal current use
Cost Risk - Marine	Critical cost differentiator will be intakes and outfalls and power, with the final costs unable to be known priorir to further investigations and design						
Cost Risk - Power	Critical cost differentiator will be intakes and outfalls and power, with the final costs unable to be known priorir to further investigations and design						

Drought Response Sites

Category	Criteria	Sites					
		New Brighton Sports		Brunswick Heads Boat Harbour	Skennars Head Road Sportsfields	Lighthouse Pde	
		Trench/HDD	HDD	Pontoon Intake		HDD	Breakwall and Estuary
Community Impact	Community Impact	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	1000m of Popular Beach	200m of Popular Beach	200m of Popular Beach
		No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity	No tourist site within vicinity	Within 250m of dedicated tourist site	Within 250m of dedicated tourist site
		Moderate	Best	Best	Best	Worse	Worse
		100m Houses	100m Houses	>250m from Houses	250m Houses	100m Houses	100m Houses
Water Salinity	Estuary mixing plumes	Within 3 km of minor river mouth	Within 3 km of minor river mouth	Within Estuary	> 5km or 3km from major/minor river mouth	Within 3 km of minor river mouth	Within Estuary
Water Quality	Proximity to point source pollutants	5km	5km	1km	1km	3km	1km
Financial	Potential Upfront Expenditure	$4,184,801	$7,868,033	$6,651,969	$8,715,979	$8,819,591	$370,183
	Cost Risk - Intake/Outfalls	800	1600	1400	1800	1800	0
	Comparative Cost - Single Delivery	$24,804,559	$27,162,577	$24,874,408	$25,323,337	$24,718,915	$18,067,026
	Comparative Cost - Staged Delivery	$26,930,959	$30,913,810	$28,063,377	$29,407,916	$28,827,339	$18,437,209

Appendix O. Non-Differentiating Criteria

Permanent Sites

Non-Differentiating Criteria			
Community Impact		1000m of Popular Beach	1000m of Popular Beach
Proximity to Residences	Visual and noise/vibration impacts on residents may be unacceptable and introduce challenges to gaining planning approval.	>250m from Houses	>250m from Houses
Terrestrial Biodiversity	Impacts on high value biodiversity will lead to significant investigations to prove the acceptability of the impact and/or risk planning approval.	None	None
Proximity to Tourism Areas	Visual and noise impacts to tourism sites will lead to planning approval challenges.	No tourist site within vicinity	No tourist site within vicinity
Proximity to National Parks	Community expectations may be for a buffer zone around National Parks	>250m from National Park	>250m from National Park
Flooding	Significant risk to medium to long-term assets, and/or cost increases to build up sites	None	None
Native Title		None	None
Contaminated land	Significant cost and time risks if contaminated spoil is required to be disposed off-site, or treated on-site. For emergency sites, investigations to understand the extent and signficance of the contamination can be time consuming.	Low to moderate likelihood of low risk contaminants	Low to moderate likelihood of low risk contaminants
Coastal Wetland	Proximity to coastal wetlands would require significant investigations to demonstrate acceptable impacts.	>250m from Coastal Wetland	250m Coastal Wetland
Littoral Rainforest	Proximity to littoral rainforests would require significant investigations to demonstrate acceptable impacts.	>250m from Littoral Rainforest	>250m from Littoral Rainforest
Koala Habitat	Clearing of Koala habitat will prevent a significant barrier to planning approvals.	None	Possible
Land Parcel Size	The available land area will directly impact the potential capacity of the plant, or, lead to higher delivery costs.	>150% of plant footprint	>150% of plant footprint
Proximity to Power Network - distance to HV supply	Critical to costs and timeframe for delivery. May need to be an upfront if a significant upgrade to transformers or transmission wires is required. Delivery may be dependent on third party (Essential Energy in this case)	<5km to substation	<5km to substation
Road Access		Established road to site plant site	Established road to site plant site
Land Zoning	The land zoning will directly impact whether the proposal is permissible, noting that Council can re-zone land if required.	Prohibited by LEP, Allowed by SEPP	Prohibited by LEP, Allowed by SEPP
Drinking Water Catchments	Construction within a drinking water catchment will add to the approvals and costs of the proposal	Not within a drinking water catchment	Not within a drinking water catchment
General source type	Stable intake quality is a critical input to the RO process.	Open Ocean	Open Ocean
Estuary mixing plumes		> 5km or 3km from major/minor river mouth	> 5km or 3km from major/minor river mouth
Proximity to Wastewater network	Increases the risk of flooding and erosion through storm surge. Can lead to sites becoming unviable in the medium to long term, or increased costs to armour sites.		
Bushfire Prone Land	Site longevity is at risk for sites which are prone to bushfire impacts, particularly with projected climate change impacts. May also add construction and operting costs if buffer zones are required to protect assets, or underground pipelines/power lines are needed.	Medium Risk (Category 2-3)	High Risk (Category 1)
Sea Level Rise	For smaller plants, use of the wastewater network to dispose of brine is a potential option.		

Drought Response Sites

Non-differentiating Criteria										
Site gradient	Less Than 10%	Less Than 10%		Less Than 10%	Less Than 10%	Less Than 10%	Less Than 10%	Less Than 10%	Less Than 10%	
General source type	Open Ocean	Open Ocean		Open Ocean	Open Ocean	Open Ocean	Open Ocean	Open Ocean	Open Ocean	
Road Access	Established road to site plant site	Established road to site plant site		Established road to site plant site	Established road to site plant site	Established road to site plant site	Established road to site plant site	Established road to site plant site	Established road to site plant site	
Drinking Water Catchments	Not within a drinking water catchment	Not within a drinking water catchment		Not within a drinking water catchment	Not within a drinking water catchment	Not within a drinking water catchment	Not within a drinking water catchment	Not within a drinking water catchment	Not within a drinking water catchment	
Site elevation	25m	25m		25m	25m	25m	25m	25m	25m	
Vegetation Communities / Land	Construction area has no vegetation	Construction area has no vegetation		Construction area has no vegetation	Construction area has no vegetation	Construction area has no vegetation	Construction area has no vegetation	Construction area has no vegetation	Construction area has no vegetation	
Proximity to Power Network - distance to HV supply	1-5 km to feeder	1-5 km to feeder		1-5 km to substation	1-5 km to substation	1-5 km to substation	>5km	1-5 km to substation	1-5 km to substation	Generators to be used for emergency sites
Proximity to Wastewater network	Consider individually									
Terrestrial Biodiversity	None	None		None	None	None	None	None	None	
Native Title	None	Native Title Listed		None	None	None	None	None	None	Whole area listed, not specific site. Site already developed.
Littoral Rainforest	>250m from Littoral Rainforest	>250m from Littoral Rainforest		>250m from Littoral Rainforest	>250m from Littoral Rainforest	>250m from Littoral Rainforest	250m Littoral Rainforest	>250m from Littoral Rainforest	>250m from Littoral Rainforest	Skennars Head - Littoral Rainforest across main road on other side of lot, unlikely to have material impact
Bushfire Prone Land	No Bushfire Risk	No Bushfire Risk		No Bushfire Risk	High Risk (Category 1)	High Risk (Category 1)	No Bushfire Risk	No Bushfire Risk	No Bushfire Risk	Newrybar/Ross Lane site large enough for buffer and to avoid bushfire rated areas.
Land Zoning	Allowed by LEP and T&I SEPP	Allowed by LEP and T&I SEPP		Prohibited by LEP, Allowed by SEPP	Prohibited by LEP, Allowed by SEPP	Prohibited by LEP, Allowed by SEPP	Allowed by LEP and T&I SEPP	Allowed by LEP and T&I SEPP	Allowed by LEP and T&I SEPP	