Future Water Strategy

Groundwater Schemes and Whole of Life Cycle Costings - Report B

Rev C Final

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Rous County Council

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Contents

Important note about your report

The sole purpose of the report is to assess and identify potential groundwater sources for Rous County Council to access for augmentation of the urban water supply.

Data supplied by or sourced from DPI NSW, PWA NSW, NSW Allwater and Pineena groundwater database and Rous County Council has been utilised in this report and as such the data was presumed to be accurate in preparing the report.

This report is to be read in full; excerpts may not be representative of the findings.

The report has been prepared exclusively for Rous County Council and no liability is accepted for any use or reliance on the report by third parties.

1. Introduction

1.1 Background

In previous reports four potential groundwater supply options had been identified:

- Option 1 a. - Newrybar Central aquifer with 5 bores (low TDS assumed)
- Option 1 b. - Newrybar North aquifer with 5 bores (low TDS assumed)
- Option 1 c. - Tyagarah North 5 bores aquifer with (low TDS assumed)
- Option 1 d. - Alstonville 2 bores in fractured basalt, one existing bore at Lumley Park and a replacement bore at Convery's Lane (both low TDS)

Since then, further desktop hydrogeological investigations have identified alternative options that change the original options as follows. These must be verified by thorough field testing of pilot production bores. The yields are qualitative best estimates as no bores have been constructed and pump tested as yet; i.e. these are yield estimates calculated from data obtained during drilling of test holes or referencing nearby relevant results.

- **Option 1 a. - Newrybar Central borefield -** has been found to have an unreliable aquifer salinity profile. Continuous operation will draw in brackish 5,000 TDS groundwater resulting in the need for brackish water desalination at the groundwater treatment plant (GWTP) to produce potable water from this borefield. This option was renamed as **Option 1 a. - Newrybar South High TDS Option** and identified as having the potential to provide a reliable supply of brackish groundwater requiring desalination using reverse osmosis (RO) with a maximum of 5 production bores and a standby bore, each capable of producing 15 L/s/bore, or 75 L/s for a period of 22 hrs/day, or a daily production capacity of 6.0 ML/d.
- **Option 1 b. - Newrybar North Low TDS -** remains a viable option for the supply of low TDS groundwater. This option was identified as having the potential to provide a reliable supply of low TDS groundwater with a maximum of 5 production bores and a standby bore, each capable of producing 5 L/s/bore or 25 L/sec for a period of 22 hrs/day, or a daily production capacity of 2.0 ML/d.
- **Option 2 - Tyagarah North borefield -** has been identified as having a potentially high production capacity of low TDS groundwater. This option was identified as having the potential to provide a reliable supply of low TDS groundwater supply with approximately 11 production bores and 2 standby bores, each capable of producing 25 L/s/bore, or 275 L/s, for a period of 22 hrs/day, or a daily production capacity of 22 ML/d. This option supersedes the former Option 1 c. - Tyagarah North with 5 bores. This option could supply much more than the projected system shortfall of 12.5 ML/d in the Byron/Brunswick Heads region, however the configuration of the local supply from St Helena Reservoir at present is not compatible with making use of this additional capacity.
- **Option 3 - Alstonville borefield –** this existing borefield has 2 production bores in fractured basalt, one bore at Lumley Park and one at Convery's Lane. (both are low TDS). It is proposed that the Lumley Park bore would be retained and the Convery's Lane bore would be replaced, if this borefield was placed into service as a permanent water supply source. Additional investigations show a similar capacity bore could be installed in Elverys Lane. These bores have formed part of the Rous CC drought management plan to date. The bore water is disinfected at the head of the bore and pumped into Wollongbar Reservoir. The drinking water quality risk assessment identified significant potential risks related to the security of the drinking water quality that will require water treatment to mitigate those risks.

1.2 Objectives

The objectives of this report are to:

a) Summarise the findings of other reports to develop options relevant to the augmentation of the Rous County Council water supply.
b) Identify the works required to treat the groundwater supply to produce drinking water that will comply with ADWG 2019 and Rous County Council Service Level Agreements (SLAs)

c) Identify the waste streams from these treatment processes that will require a sustainable method of treatment and disposal
d) Identify how the options will contribute to achieving a reliable water supply of peak day production to meet projected future shortfall in water supply capacity compared to demand of of approximately 18 ML/d and annual demand of 6500 ML p.a.by 2060.
e) Identify for each option the groundwater supply headworks necessary to transfer raw water to the treatment plant(s)
f) Identify for each option the connecting works required to transfer treated water into the appropriate Rous Water storage and distribution systems, and
g) Provide preliminary estimates of capital operating costs, and annualised costsfor each option.

1.3 Integration of Groundwater Supplies into Rous CC Distribution Systems

Rous CC has the objective of matching the groundwater production capacity with projected 2060 WTP target production capacity required to supply projected annual average daily demands (AADD) within the supply areas the borefields are located; with an allowance for loss of production of 5 to 10% for conventional drinking water treatment to provide for backwash and maintenance.

Rous CC has provided the estimated ADD and required WTP production for the areas the borefields are located in and has nominated the storage reservoir in the distribution system that the treated groundwater would be discharged to. These are summarised in Table 1.1.

Table 1.1: Integration of Groundwater Supply with Rous CC Distribution System

Borefield	Supply Reservoir	Total ADD (ML/d) 2013	Total ADD (ML/d) 2030	Total ADD (ML/d) 2060	2060 WTP target production (ML/d)
Options 1 a. and 1 b. Newrybar North and South	Knockrow Reservoir	7.9	11.9	17.5	19.5
Option 2 Tyagarah North/ Brunswick Heads	Ocean Shore Reservoir (Brunswick Heads area)	3.6	4.8	5.6	7.5 (supplied from Ocean Shore Reservoir)
Option 2 Tyagarah North/ Brunswick Heads and Byron Bay	St Helena Reservoir (Oceans shore & Byron Bay areas)	7.0	9.2	10.6	12.5 (Supplied from St Helena Reservoir incl Ocean Shore)
Option 3 Alstonville	Wollongbar Reservoir	1.9	2.5	3.3	4.0

The options developed in this report are scoped and sized to meet the projected 2060 WTP target treated water production in ML/day presented in **Table 1.1**, or to utilise the full estimated sustainable production capacity of the borefield; whichever is the lesser.

2. Development of Groundwater Supply Options

2.1 Previous Reports

This report draws on findings from previous reports including:

- Report issued to Rous January 2020, on Groundwater Source Drinking Water Quality Risk Assessment
- Report issued to Rous February 2020, on Estimation of Groundwater Yields for Newrybar, Tyagarah North and Alstonville borefields.
- Report issued to Rous September 2019, on Newrybar Central, Newrybar North, Tyagarah North and Alstonville options with preliminary cost estimates,
- Newrybar Central, Newrybar North, Tyagarah North and Alstonville cost estimate in September 2019 Report,
- Report issued to Rous June 2018, on Woodburn option with preliminary cost estimates,

2.2 Drinking Water Quality

The water quality risk assessment carried out for each of these areas provided guidance for development of these options indicating the appropriate drinking water treatment processes that should be applied in each area to deliver water that complies with the Australian drinking water guidelines in quality and meets an acceptable level of risk mitigation related to the potential hazards identified due to the location of the bores and the nature of the borefield recharge areas.

Generally, for low salinity (<600TDS) groundwater supplies in this area, it is assumed that the required water treatment processes are as described below. This assessment is based on qualitative assessments of limited quantitative water quality data or in several areas no water quality data. In addition, this assessment acknowledges the sophisticated level of drinking water treatment implemented by Rous CC at its Nightcap and Emigrant Creek surface WTPs and assumes that a similar level of water treatment will be required to produce a drinking water quality that is perceived by customers to be as close as possible to equivalent to the supplies from those plants.

Aeration - to oxidize reduced metal ions particularly iron and manganese and to strip out dissolved gases including carbon dioxide and hydrogen sulphide

Chemical coagulation - for removal of colloidal particles including colour turbidity and precipitated metal salts

Clarification by Sedimentation in an upflow clarifier producing hey supernatant quality of less than 5 NTU

Granular Filtration to remove residual particulate matter to reduce the load on subsequent processes including ozone and GAC or Reverse Osmosis

Ozonation and GAC Filtration for disinfection of protozoa and removal of organic compounds which may cause taste and odour; contain toxins such as pesticides; or be precursors of disinfection by-products (DBPs)

UV Disinfection – Eliminate pathogens particularly chlorine resistant species including *Cryptosporidium*.

Chlorination residual disinfection to ensure removal of bacterial and viral pathogens, and to provide a residual disinfection barrier to protect the downstream systems in case of ingress of contamination.

Wastewater recovery to maximise drinking water production and minimise waste flows and associated costs and impacts. Wastewater recovery of clarifier sludge and filter backwash flows by storage in a balancing storage, sedimentation/decanting supernatant and disinfection of recovered supernatant water.

Generally, for brackish (3000 TDS) groundwater supplies in this area, it is assumed that the required water treatment processes are as described below. This assessment is based on qualitative assessments of limited quantitative water quality data or in several areas no water quality data and assumes that the WTP will be required to produce a drinking water quality that is perceived by customers to be as close as possible to equivalent to the supplies from the surface water WTPs.

Aeration - to oxidize reduced metal ions particularly iron and manganese and to strip out dissolved gases including carbon dioxide and hydrogen sulphide

Chemical coagulation – needed for removal of colloidal colour, turbidity and precipitated metal salts

Clarification by Sedimentation in an upflow clarifier producing supernatant quality of less than 5 NTU

Granular or Membrane Filtration to remove residual particulate matter to reduce the load on subsequent processes including ozone and GAC or Reverse Osmosis

Pre-treatment for RO – comprising disinfection to prevent biofouling, de-chlorination to protect membranes, acid dosing to increase solubility of scaling salts and inhibit scaling, cartridge filtration to prevent any solids entering RO membranes

RO – separation of brackish water into a low salinity product water and saline waste stream. RO removes the need for ozone-BAC and UV disinfection processes because RO will remove these contaminants.

Chlorination disinfection to ensure removal of bacterial and viral pathogens, and to provide a residual disinfection barrier to protect the downstream systems in case of ingress of contamination.

Wastewater recovery to maximise drinking water production and minimise waste flows and associated costs and impacts. Wastewater recovery of clarifier sludge and filter backwash flows by storage in a balancing storage, sedimentation/decanting supernatant. RO reject recovery by second phase RO process to concentrate estimated 15,000 TDS brackish RO reject to recover 50%as low TDS permeate and produce 50% 30,000 TDS waste.

2.3 Approach

The hydrogeological survey has identified four areas where a significant groundwater supply can be harvested by the installation of multiple bores, Tyagarah North, Newrybar North, Newrybar Central and Alstonville. The Alstonville bores at Convery's Lave and Lumley Park are currently operational and are planned for use in drought management or in an emergency. The Convery's Lane bore is at the end of its useful asset life and is planned to be replaced. There are no developed production bores in the other three areas.

The water quality from each area differs. In relation to salinity the Tyagarah North, Newrybar North and Alstonville are expected to provide a reliable low salinity supply (<600 TDS), whereas Newrybar Central is expected to produce a reliable brackish supply of approximately 3,000mg/L or 5,000EC.

All areas will require a drinking water WTP to treat the groundwater to produce a drinking water quality that meets Rous CC target customer service objectives and can be used as a permanent supply source as a base load plant 365 days per year.

Each area can be assessed for daily production by assuming that the borefield can be operated for 22 hours continuously in any 24-hour period to discharge to a WTP that is assumed to have 5 to 10% losses from processes including filter backwash, and 25% losses for processes including RO desalination.

Each option has been developed as a desktop concept design to include the infrastructure required to integrate each of these groundwater supplies into the Rous CC drinking water distribution system, as follows:

a) Borefield works – production bores, monitoring bores, bore pump station and bore head works connecting to a network of borefield collection mains which connect to the GWTP

b) The groundwater treatment plant and treated water storage including GWTP wastewater management and disposal

c) Treated water pump station and pressure mains discharging to the Rous CC regional distribution storage nominated in **Table 1.1**

2.4 Summary of Options developed

A summary of the four options developed is shown in the following table:

Table 2.1: Summary of Groundwater Options Developed for Augmentation of Rous CC water supply

	Borefield Production, WTP Production and WTP Waste Flows							**Treatment processes**							
Option	**Borefield**	**Yield Borefield**	**Salinity TDS**	**Wastewater production**	**Wastewater recovery**	**WTP Production** ML/d	**Waste discharge** ML/d	Aeration	Clarification	Filtration	Ozonation- BAC	UV Disinfection	Brackish-RO	Chlorination	TW Storage
1 a	Newrybar South (high TDS)	5 bores 6.0 ML/d	3000	20%	50%	5.4	0.6 ML/d 35000 TDS	✓	✓	✓	×	×	✓	✓	✓
1 b	Newrybar North 5 bores (low TDS)	4 bores 2.0 ML/d	<400	10%	90%	1.9	0.1 ML/d	✓	✓	✓	✓	✓	×	✓	✓
2.	Tyagarah North (low TDS)	11 bores 22ML/d	<400	10%	90%	20	0.5 ML/d	✓	✓	✓	✓	✓	×	✓	✓
3.	Alstonville (low TDS)	2 bores 4.5 ML/d	<400	10%	90%	4.4	0.1 ML/d	✓	✓	✓	✓	✓	×	✓	✓

3. Concept Design and Cost Estimates for Options

3.1 Newrybar Groundwater Supply

Table 1.1 shows that Rous CC has projected the 2060 WTP target production to supply Knockrow Reservoir to be 19.5 ML/d. Investigations to date indicate that the Newrybar Groundwater Supply cannot supply this volume of water sustainably.

It is proposed that the two feasible Newrybar groundwater options, Option 1 a. and 1 b. be combined to provide a lower capital cost outcome as explained below. The balance of water supply would be made up from other supplies such as Emigrant Creek supply or the Rocky Creek Dam Supply.

3.1.1 Option 1 a. - Newrybar South High TDS Option

The central and south areas of the Newrybar aquifer have an unreliable salinity profile. Continuous operation will draw in brackish 5,000 TDS groundwater resulting in the need for brackish water desalination of the groundwater to provide drinking water. The groundwater treatment plant (GWTP) would comprise conventional treatment to clarify the water before reverse osmosis (RO) of the clear water to produce low salinity drinking water (<250 TDS) from this borefield.

Based on the results from test bores in the vicinity of the corner of Martins Lane and the Newrybar Swamp Road, this option was identified as having the potential to provide a reliable supply of brackish groundwater (3000 mg/L TDS) with a maximum of 5 production bores and a standby bore, each capable of producing 15 L/s/bore, or 75 L/s for a period of 22 hrs/day, or a daily brackish groundwater production capacity of 6.0 ML/d.

Using the same assumptions included in the summary **Table 2.1**, approximately 10% of the 6.0 ML/d groundwater inflow to the GWTP would be discharged as a waste flow from the conventional GWTP as clarifier sludge and filter backwash.

It is estimated that 20% of the 5.4 ML/d inflow too the RO plant would be discharged as a waste flow of RO reject or "brine".

These wastewaters would be processed to recover approximately 90% of the GWTP wastewater flow by sedimentation and disinfection, and 50% of the RO plant brine by a second "brine" recovery RO plant producing a more concentrated brine flow of 30,00-40,000TDS.

The resultant estimated output of the combined GWTP is 5.4 ML/d of drinking water discharged to Knockrow Reservoir, and 0.6 ML/d of 35,000 TDS brine either combined with or kept separate from the 3000TDS GWTP residual sludge flow from clarifier and waste backwash discharges, after wastewater recovery.

The use of RO for desalination reduces the number of processes in addition to the conventional drinking water treatment processes of clarification and filtration. The processes that are not required in addition to clarification, filtration and residual chlorine disinfection are ozone-BAC and UV disinfection. This is because the RO membranes will exclude and reject large organic compounds and all microbiological species. Avoidance of biofouling of RO membranes and any form of chemical precipitation or entry of solid particles is critical to reliable and sustainable operation of the RO process. The pre-treatment processes including chlorination/dichlorination, acid dosing and cartridge filtration are used to protect membranes from clogging and damage. Clean in place processes are used to maintain membranes in optimal operation.

3.1.2 Option 1 b. - Newrybar North Low TDS

Option 1 b. - Newrybar North Low TDS remains a viable option for the supply low TDS groundwater with a maximum of 5 production bores and a standby bore, each capable of producing 5 L/s/bore or 25 L/sec for a period of 22 hrs/day, or a daily production capacity of 2.0 ML/d.

It is proposed that the Newrybar North Low TDS groundwater supply be blended with the Newrybar South High TDS groundwater supply and be treated in a single plant including RO desalination as described above.

3.1.3 Integrated Newrybar Groundwater Scheme

Using the same processes described for Option 1 b. described in Section 3.1.2, the combined flow rate from the two borefields would be from the 5 No. Newrybar South production bores producing 15 L/s/bore, plus the 5 No. Newrybar South production bores producing 5 L/s/bore; operating 22 hours per day to produce an inflow to the GWTP of 8.0 ML/d with a reduced salinity of 2400 TDS to produce 7.2 ML/d plus 0.6 ML/d of 35,000 TDS brine either combined with or kept separate from the 0.2 ML/d 2400TDS GWTP residual sludge flow from clarifier and waste backwash discharges, after wastewater recovery.

No method or cost for transfer and disposal of these waste flows has been included in this concept design or cost estimates at this stage.

The following capital cost estimates have been prepared for this scheme.

Table 3.1: Option 1 a. and 1 b. Integrated Newrybar Groundwater Scheme Capital Cost Estimate

Project Component	Preliminary Capital Cost Estimate $ (2020)
Option 1 a. and 1 b. - Integrated Newrybar Groundwater Scheme **5 No. Production Bores and Standby Newrybar North (Low TDS)** **5 No. Production Bores and Standby Newrybar South (High TDS)** **8 ML/d Conventional GWTP, RO Desalination Plant, 4 ML CWS and TW Transfer**	
Bores and Bore Pump Stations	$4,200,000
Spur and Collector Pipework	$256,000
Civil Works	$122,000
Land Acquisition	$5,625,000
Newrybar North Transfer Pipeline to Newrybar South GWTP	$2,695,000
Power Supply	$350,000
Conventional Groundwater Treatment Plant	$9,425,000
RO Desalination Process after Conventional Water Treatment (incl. Brine Recovery RO)	$7,470,000
Clear Water Storage	$5,500,000
Disinfection	$800,000
Miscellaneous GWTP Items	$ 63,000
Treated Water Transfer Pump Station	$670,000
Treated Water Transfer Pipeline	$4,730,000
Connection to Existing Assets	$190,000
TOTAL CONSTRUCTION COST - Borefield, WTP, CWS and Treated Water Transfer	**$42,100,000**
Design, Project Management and Permits (20%)	$8,420,000
Contingency (25%)	$12,630,000
ESTIMATED CAPITAL COST Stage 1 - Borefield, WTP, CWS and Treated Water Transfer	**$63,150,000**

3.2 Option 2 - Tyagarah North Borefield

From **Table 1.1** there are two alternatives for utilising part of the available production capacity from Tyagarah North borefield. This report only considers options that are compatible with the Rous CC distribution system. A separate study is required to investigate how to optimise the use of up to the potential yield of 22 ML/d of groundwater from the Tyagarah North borefield. Each bore is estimated to produce 25 L/s for 22 hours per day or 2.0 ML/d.

Scheme 1: In 2060, Scheme 1 would supply 7.5 ML/d of treated water to Ocean Shore Reservoir that supplies Brunswick Heads area, and allowing for 10% water use in plant for clarifier sludge waste and filter backwash the WTP inflow from the borefield required would be 8.3 ML/d. This is equivalent to 5 production bores and one standby. The GWTP would operate at an inflow rate of 105 L/s, equivalent to 9.1 ML/d. This scheme could be staged to supply the same ratio to ADD in 2030, which would be 6.4 ML/d of treated water to Ocean Shore Reservoir. Applying the same factors, the borefield production would be 7.1 ML/d, equivalent to 4 production bores and one standby. Stage 2 with an extra bore would be constructed in 2045. It is assumed the same capacity GWTP would be constructed to be commissioned in 2025 to treat both Stages.

Scheme 2: In 2060, Scheme 2 would supply 12.5 ML/d of treated water to St Helena Reservoir that supplies Byron Bay and Brunswick Heads areas, and allowing for 10% water use in plant for clarifier sludge waste and filter backwash the WTP inflow from the borefield required would be 13.9 ML/d. This is equivalent to 7 production bores and 2 standby bores. The GWTP would operate at an inflow rate of 175 L/s, equivalent to 15.1 ML/d. This scheme could be staged to supply the same ratio to ADD in 2030, which would be 10.8 ML/d of treated water to St Helena Reservoir. Applying the same factors, the borefield production would be 12.1 ML/d, equivalent to 6 production bores and one standby. Stage 2 with an extra bore and standby would be constructed in 2045. It is assumed the same capacity GWTP would be constructed to be commissioned in 2025 to treat both Stages.

Table 3.2: Tyagarah North Option Alternative Schemes

Borefield	Supply Reservoir	Total ADD (ML/d) 2013	Total ADD (ML/d) 2030	Total ADD (ML/d) 2060	2060 WTP target production (ML/d)
Scheme 1: Option 2 Tyagarah North/ Brunswick Heads	Ocean Shore Reservoir (Brunswick Heads area)	3.6	4.8	5.6	7.5 (supplied from Ocean Shore Reservoir)
Scheme 2: Option 2 Tyagarah North/ Brunswick Heads and Byron Bay	St Helena Reservoir (Oceans shore & Byron Bay areas)	7.0	9.2	10.6	12.5 (Supplied from St Helena Reservoir incl Ocean Shore)

The following capital cost estimates have been prepared for these schemes.

Table 3.3: Option 2 - Tyagarah North Scheme 1 Capital Cost Estimate

Project Component	Preliminary Capital Cost Estimate $ (2020)
Scheme 1 Stage 1: 4 No. Production Bores and 1 No. Standby **9 ML/d Conventional GWTP, Ozone-BAC, UV Disinfection, 4.5 ML CWS and TW Transfer**	
Bores and Bore Pump Stations	$ 2,325,000
Spur and Collector Pipework	$ 162,000
Civil Works	$ 55,000
Land Acquisition	$ 4,531,000
Power Supply	$ 550,000
Conventional Water Treatment Plant	$ 8,650,000
Ozone/Bac Process after Conventional Water Treatment	$10,266,000
Clear Water Storage	$ 2,750,000
Disinfection	$ 2,320,000
Miscellaneous GWTP Items	$ 63,000
Treated Water Transfer Pump Station	$ 580,000
Treated Water Transfer Pipeline	$ 564,000
Connection to Existing Assets	$ 370,000
TOTAL CONSTRUCTION COST - Borefield, WTP, CWS and Treated Water Transfer	**$33,186,000**
Design, Project Management and Permits (20%)	$6,637,000
Contingency (25%)	$9,957,000
ESTIMATED CAPITAL COST Stage 1 - Borefield, WTP, CWS and Treated Water Transfer	**$49,780,000**
Scheme 1 Stage 2: 1 No. Production Bore, Pump Station and Pipeline	
Bores and Bore Pump Stations	$465,000
Spur and Collector Pipework	$85,000
Civil Works	$19,000
Land Acquisition	$156,000
Power Supply	$20,000
TOTAL CONSTRUCTION COST – Single Production Bore and Pump Station	**$745,000**
Design, Project Management and Permits (20%)	$110,000
Contingency (25%)	$215,000
ESTIMATED CAPITAL COST Stage 2- Single Production Bore and Pump Station	**$1,070,000**
ESTIMATED CAPITAL COST – Stages 1 and 2	**$50,850,000**

Table 3.4: Option 2 - Tyagarah North Scheme 2 Capital Cost Estimate

Project Component	Preliminary Capital Cost Estimate $ (2020)
Scheme 2 Stage 1- 6 No. Production Bores and 1 No. Standby **15 ML/d Conventional GWTP, Ozone-BAC, UV Disinfection, 7.5 ML CWS and TW Transfer**	
Bores and Bore Pump Stations	$3,255,000
Spur and Collector Pipework	$262,000
Civil Works	$80,000
Land Acquisition	$4,844,000
Power Supply	$ 550,000
Conventional Water Treatment Plant	$16,150,000
Ozone/Bac Process after Conventional Water Treatment	$13,630,000
Clear Water Storage	$4,900,000
Disinfection	$3,420,000
Miscellaneous GWTP Items	$ 63,000
Treated Water Transfer Pump Station	$700,000
Treated Water Transfer Pipeline	$788,000
Connection to Existing Assets	$ 370,000
TOTAL CONSTRUCTION COST - Borefield, WTP, CWS and Treated Water Transfer	**$49,010,000**
Design, Project Management and Permits (20%)	$9,800,000
Contingency (25%)	$14,700,000
ESTIMATED CAPITAL COST Stage 1 - Borefield, WTP, CWS and Treated Water Transfer	**$73,510,000**
Scheme 2 Stage 2 - 1 No. Production Bore and 1 No. Standby, Pump Station and Pipeline "	
Bores and Bore Pump Stations	$930,000
Spur and Collector Pipework	$34,000
Civil Works	$11,000
Land Acquisition	$156,000
Power Supply	$40,000
TOTAL CONSTRUCTION COST – Single Production Bore and Pump Station	**$1,170,000**
Design, Project Management and Permits (20%)	$180,000
Contingency (25%)	$340,000
ESTIMATED CAPITAL COST Stage 2- Single Production Bore and Pump Station	**$1,690,000**
ESTIMATED CAPITAL COST – Stages 1 and 2	**$75,200,000**

As shown in **Table 2.1**, the GWTP in either Scheme will produce wastewater flows from clarifier sludge and filter backwash that will be processed to recover the useable water and result in a discharge from site of approximately 1.0% of plant inflow or 0.1 ML/d for Scheme 1 or 0.15 ML/d for Scheme 2.

No method or cost for transfer and disposal of these waste flows has been included in this concept design or cost estimates at this stage.

3.3 Option 3 - Alstonville borefield

3.3.1 Scheme Development

Table 1.1 nominates the projected ADD to be supplied from the Wollongbar Reservoir which would be the reservoir that a permanent groundwater supply from the Alstonville borefield would discharge to. This report only considers options that are compatible with the Rous CC distribution system.

In 2060, the target supply rate of treated water to Wollongbar Reservoir is 4.0 ML/d. Allowing for 10% water use in plant for clarifier sludge waste and filter backwash the corresponding target inflow from the borefield to the WTP would be 4.4 ML/d.

The existing Alstonville borefield has 2 production bores in fractured basalt, one bore at Lumley Park and one at Convery's Lane. (both low TDS). It is proposed that the Lumley Park bore would be retained and the Convery's Lane bore would be replaced if this borefield was placed into service as a permanent water supply source. The estimated long-term capacity of these bores to provide a continuous base load supply is Lumley Park at 22 L/sec and Converys Lane at 35 L/sec, at total of 57 L/sec for 22 hours per day, or 4.5 ML/d.

This matches the 2060 target inflow from the borefield to the WTP that would supply the target supply rate of treated water to Wollongbar Reservoir.

A standby bore would need to be constructed and equipped to provide the necessary level of operational security for the borefield.

The drinking water quality risk assessment identified significant potential risks related to the security of the drinking water quality that will require a new GWTP including conventional water treatment, ozone-BAC and UV disinfection to mitigate those risks.

To provide a reliable permanent groundwater supply from the Alstonville borefield, the following improvements are proposed for the concept design of Option 3, Alstonville borefield:

a) Retain Lumley Park bore and re-equip to supply 22 L/s to the new GWTP

b) Construct a new Converys Lane bore and equip to supply 35 L/s to the new GWTP

c) Construct a new standby bore in Elvery Lane capacity to supply 35 L/s to the new GWTP

d) New GWTP, CWS and transfer pump station and pipeline to Wollongbar Reservoir

The following capital cost estimates have been prepared for Option 3 Alstonville borefield.

Table 3.5: Option 3 - Alstonville Borefield Capital Cost Estimate

Project Component	Preliminary Capital Cost Estimate $ (2020)
2 No. Production Bores and Re-equip Lumley Park Bore **4.5 ML/d Conventional GWTP, Ozone-BAC, UV Disinfection, 2.5 ML CWS and TW Transfer**	
Bores and Bore Pump Stations	$1,825,000
Spur and Collector Pipework	$3,119,000
Civil Works	$24,000
Land Acquisition	$2,531,000
Power Supply	$600,000
Conventional Water Treatment Plant	$6,650,000
Ozone/Bac Process after Conventional Water Treatment	$6,995,000
Clear Water Storage	$2,750,000
Disinfection	$1,520,000
Miscellaneous GWTP Items	$63,000
Treated Water Transfer Pump Station	$180,000
Treated Water Transfer Pipeline	$27,000
Connection to Existing Assets	$240,000
TOTAL CONSTRUCTION COST - Borefield, WTP, CWS and Treated Water Transfer	**$26,520,000**
Design, Project Management and Permits (20%)	$5,300,000
Contingency (25%)	$7,960,000
ESTIMATED CAPITAL COST Stage 1 - Borefield, WTP, CWS and Treated Water Transfer	**$39,780,000**

As shown in **Table 2.1**, the GWTP for this Option will produce wastewater flows from clarifier sludge and filter backwash that will be processed to recover the useable water and result in a discharge from site of approximately 1.0% of plant inflow or 0.05 ML/d.

No method or cost for transfer and disposal of these waste flows has been included in this concept design or cost estimates at this stage.

3.3.2 Consideration of Upgrade and Use of Marom Creek WTP in Alstonville Groundwater Scheme

City Water Technology (CWT) was engaged by Ballina Shire Council to review the performance of the Marom Creek WTP and to evaluate options for its upgrade to meet drinking water quality requirements.

The existing plant that is owned and operated by Ballina Shire Council is a very basic clarifier-filtration process and is used to supply the small community of Wardell. The WTP draws water from a weir on Marom Creek, which collects surface water from its unprotected, very heavily developed, agricultural and horticultural catchment. The WTP process comprises alum dosing into an open settling lagoon with settled water passing through a single dual-media granular filter before being disinfected by chlorination, including detention in a chlorination contact tank. Treated water can be discharged to the Wollongbar Reservoir at a rate of 20L/s, when not supplying the Wardell system.

Rous CC is seeking to upgrade and operate this source to supplement the Wollongbar/Alstonville area as an additional source of supply, possibly in conjunction with the Alstonville bore field.

CWT had proposed four options for consideration by Council:

- Option 1 - Upgrade the existing plant, with static mixer, flocculation zone in the lagoon, tube settlers, vacuum sludge collection, and refurbishment of the filter.
- Option 2 – Abandon the existing plant and construct a new Clarifier-Filter WTP with UV disinfection to gain a significant increase is pathogen log removal. The report stated that the surface water catchment is High Risk Category 4, with livestock in the catchment.
- Option 2a – Abandon the existing plant and construct a new Clarifier-Filter WTP with Ozone/BAC treatment to remove larger percentages of organics in the water which may include pesticides and taste and odour compounds. Aerial photos of the storage behind the weir indicate that the nutrient levels in the water are very high and the stream appears to be eutrophic.
- Option 3 – Abandon the existing plant and construct a new DAFF WTP with Ozone/BAC

There was limited assessment done on the options and interim conclusions appeared to be that Option 3 was expected to achieve the required and best drinking water quality outcomes, and Option 1 would be the lowest cost option.

3.3.3 Potential Saving incorporating Marom Ck site

Rous CC is interested to determine how this site and facility could be integrated into the Alstonville groundwater scheme if this becomes a permanent base load supply.

The relevant components of the overall cost estimate summarised in **Table 3.5**

• Land acquisition	$2,531,000
• Conventional Water Treatment Plant	$6,650,000
• Ozone/Bac Process after Conventional Water Treatment	$6,995,000
• Clear Water Storage	$2,750,000
• Disinfection	$1,520,000

Opportunities presented by this scenario include:

- Incorporation of the Marom Creek surface water supply into the Rous CC water supply as a "new" source could augment the overall water supply by blending with the groundwater supply from Alstonville bores.
- Using the Marom Creek WTP site as the site for the future Alstonville GWTP rather than acquire a new site could make a significant cost saving and mitigate the risk of delays or frustration in the case where a new WTP site cannot be readily obtained in the area.
- Integration into this scheme of existing pipelines such as the pipeline that connects the existing Marom Creek WTP to Wollongbar Reservoir and is not in use at present. This could be used to transfer bore water to the new GWTP, which would offset costs of integrating Maron Creek WTP. However, this will also require a new pipeline from the Marom Creek WTP to the Wollongbar Reservoir, assuming a 5.5km DN300 at $1,200 per metre, would cost an additional $6.6M

4. Whole of Life Costs of Options

4.1 Summary of Concept Design and Cost Estimates of Options

Table 4.1 summarises the four options for evaluation of whole of life cycle costs for which the capital and operating costs are developed in Section 3. These estimates assume that the borefields and GWTPs operate continuously as baseload facilities at full production capacity for 320 days per year.

Table 4.1: Summary of Concept Design and Capital Cost Estimates of Options

Option	Reservoir	2060 Target	Borefield	GWTP Output	GWTP Output	Capex $
1. Integrated Newrybar Scheme	Knockrow	19.5 ML/d	8.0 ML/d	7.2 ML/d	2,300 ML p.a.	$63.2 M
2. Tyagarah North Scheme 1	Ocean Shore	7.5 ML/d	8.3 ML/d	7.5 ML/d	2,400 ML p.a.	$50.9 M
2. Tyagarah North Scheme 2	St Helena	12.5 ML/d	13.9 ML/d	12.5 ML/d	4,000 ML p.a.	$75.2 M
3. Alstonville Scheme	Wollongbar	4.0 ML/d	4.5 ML/d	4.0 ML/d	1,280 ML p.a.	$39.8M

The capital cost estimates include the following assumptions:

- Current January 2020
- Cost estimates have been developed based on similar projects elsewhere but with limited local site conditions input, given that no sites have been selected or investigated at this stage. The estimates are order of cost as is appropriate given that the project is in the Identification phase as discussed in the Department of Infrastructure, Regional Development and Cities guidelines for project cost estimation.
- An allowance of an additional 20% of project construction cost is added to make provision for scheme investigations costs, design and documentation costs, environmental, heritage and planning approvals, project management and project integration costs, allocated as follows:

Investigation	2%
Design and Doc	7%
Permits	4%
PM	2.50%
Integration	4%
	20%

- A contingency allowance of 25% of the estimated construction cost and project investigation design and management costs has been included to allow for variations in the quantities, site conditions and assumptions included in the high-level concept design prepared to date
- Detailed investigations will commence in 2024
- Designs will be completed ready for tender in 2025
- Approvals and land acquisition will be completed in 2026
- Construction will be completed in 2027 ready for commissioning in 2028

4.2 Whole of Life Cost Scenario

The scenario for which the whole of life costs of the four options has been evaluated is summarised in **Table 4.2**.

This is based on the Rous CC "Whole of Life Costing" spreadsheet method that totals all expenditure in current dollar values over the project life cycle analysis period (no escalation) and divides this by the number of years to provide the estimated Total Annualised Cost per year.

This evaluation is not for comparison of these options between each other, but for comparison against other water supply augmentation options being assessed by Rous CC.

Table 4.2: Whole of Life Cycle Cost Scenario for Evaluation of Options

Parameter				
Type of evaluation	Estimated Total Annualised Cost per year using Rous CC spreadsheet model			
Period of analysis	2020 – 2099 (80 years)			
Year 1 of Capex	2024			
Duration construction	2 years 2026-27			
Commence production	2028			
Asset life	Civil-Piping = 85 years	Bores = 50 years	Mech and Elec = 25 years	I&C=15 years
Depreciation	Depreciation not included – asset renewal at 100% capital cost at end of asset life – hence annualised cost includes renewals			
Residual asset value	Not accounted for			
Electrical Power Cost	$0.17/kWhr	Bores 45 m $50/ML, say $75 utilities	Newrybar GWTP (GWTP +RO= 250 m + 50m to Res) $300/ML	Newrybar Chem $125/ML
Production period / year	320 days			
Annual consumption ML	**2025**	**2035**	**2045**	**2060**
Newrybar Integrated	2560 ML p.a.	2560 ML p.a.	2560 ML p.a.	2560 ML p.a.
Tyagarah North Sch 1 Stg 1	2048 ML p.a.	2048 ML p.a.		
Tyagarah North Sch 1 Stg 2			2800 ML p.a.	2800 ML p.a.
Tyagarah North Sch 2 Stg 1	3456 ML p.a.	3456 ML p.a.		
Tyagarah North Sch 2 Stg 2			4000 ML p.a.	4000 ML p.a.
Alstonville				
	Newrybar	**Tyagarah Nth Scheme 1**	**Tyagarah Nth Scheme 2**	**Alstonville**
Repairs/unscheduled maintenance	$200,000 + increase 1% p.a.	$200,000 + increase 1% p.a.		$140,000 + increase 1% p.a.
Spare parts and accessories	25,000 +1000 p.a.	20,000 +1000 p.a.		15000 +1000 p.a.
Scheduled/preventative maintenance	0.5% construction cost	0.5% construction cost	0.5% construction cost	0.5% construction cost
Waste disposal	Unchanged	Unchanged	Unchanged	Unchanged
Staffing costs - Borefield and Transfer	$120,000	120,000	$150,000	60,000
Staffing costs - GWTP	130000	130000	$150,000	130000
Utilities - Borefield and Transfer	$75 /ML	$75 /ML	$75 /ML	$75 /ML
Utilities - GWTP	$300 / ML	$90 / ML	$90 / ML	$90 / ML
Chemical Supplies and consumables	$125 / ML	$100 / ML	$100 / ML	$100 / ML

The results of the Whole of Life Cycle Analysis using the Rous CC spreadsheet model are summarised in **Table 4.3**.

Table 4.3: Results of Whole of Life Cycle Cost Analysis for Each Option

Coat Component	Newrybar	Tyagarah Nth Scheme 1	Tyagarah Nth Scheme 2	Alstonville
Initial Capital Cost	$63,150,000	$50,852,000	$75,201,000	$39,787,000
Total Renewals Cost	$75,377,986	$73,001,986	$105,878,483	$51,965,390
Net acquisition costs	$138,532,986	$123,853,986	$181,079,483	$91,752,390
Total maintenance costs	$17,985,600	$8,882,510	$22,031,100	$12,236,400
Total operating costs	$107,352,000	$68,520,960	$102,633,120	$43,430,400
Total operating and maintenance costs	$125,337,600	$77,403,470	$124,664,220	$55,666,800
Total Cost Over 80 years	$263,870,600	$201,257,500	$305,743,700	$147,419,200
Total Annualised costs over 80 years	$3,298,400 p.a.	$2,515,720	$3,821,800	$1,842,740
Production /year (ML/yr)	**2304 ML p.a.**	**2400 ML p.a.**	**4000 ML p.a**	**1280 ML p.a**
Total Annualised Cost / ML	$1,431.59 /ML	$1,048.22 / ML	$955.45 / ML	$1,439.64 / ML