Mackay Water Strategy

PPB-029

March 2016

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Revision No.	Title	Approved By	Position	Signature	Date
0	*PPB-029* *MACKAY WATER STRATEGY*	Sarah Lethbridge	Planning & Sustainability Manager		
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1					
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Executive Summary

Mackay Water has undertaken an update of the water strategy for the Mackay urban area supplied by the Nebo Road Water Treatment Plant (WTP). The aim of this revised strategy is to develop a robust, sustainable capital investment program for the Mackay urban area to update the Long Term Financial Forecast (LTFF) up to ultimate demand (current Planning Scheme buildout plus Ooralea and Richmond growth corridors). The revised strategy has considered the supply of Sarina as a demand export from the Mackay urban area via the Sarina pipeline, but has not quantified the ultimate transfer infrastructure upgrades required to supply Sarina into the future.

Population and Demand Assessment

The assessment of the population and demand forecasts identified and adopted the following assumptions:

1. The existing total population of 119,320 EP will increase to 215,358 EP at ultimate. This includes population growth within Ooralea and Richmond Growth corridors which are currently outside the current Priority Infrastructure Area (PIA).
2. The ultimate population is realised at:
    a. 2047 based on 2.4% growth rate.
    b. 2065 based on 1.57% re-based growth rate.
3. The base demand adopted is 240 L/EP/d (which does not include for non-revenue water). Unit demand has seen a downward trend from 2009 to 2013 but decreased substantially to 215 L/EP/d in 2014. To provide for a factor of safety in the baseline demand forecasting a 10% allowance has been added to the 2014 demands which is line with 240 L/EP/d.
4. The overall peaking factors adopted in the water strategy, based on analysis of the AMR data, are:
    a. 1.75 for Peak Day
    b. 1.45 for MDMM
5. The existing AD demand of 33.2 ML/d is estimated to increase to 60 ML/d at ultimate.
6. It is estimated that existing PD demand of 54.8 ML/d will increase to 98.3 ML/d at ultimate.
7. It is anticipated that Sarina will be supplied via the Mackay Sarina trunk main under MDMM flow, which is estimated to grow from 3.3 ML/d to 5.9 ML/d at ultimate. The Sarina flow export has been incorporated into the demand forecasting and all strategic options assessed.
8. Based on demand forecasting and analysis of persistent demands the requirement to upgrade the water supply system (in terms of adding greater WTP capacity or adding

additional storage) assuming the Nebo Road WTP design capacity is 75 ML/d is as follows:

a. Using 2.4% growth rate:
    i. Upgrade to storage/ bulk supply is required in 2037
    ii. Upgrade to storage/ bulk supply is required in 2031 with Sarina Supply
b. Using 1.57% growth rate
    iii. Upgrade to storage/ bulk supply is required in 2045
    iv. Upgrade to storage/ bulk supply is required in 2038 with Sarina Supply

9. Based on the growth scenarios presented, the preferred growth scenario using a pragmatic outlook is the 1.57% growth rate with Sarina supply. This scenario indicates the trigger for upgrade to the WTP capacity and/or increase to storage volume occurs at 2038.

10. The adopted standards deviate from the draft CTM guidelines as follows:

    a. Unit Demands decreased from 340 L/EP/d (includes non-revenue water) to 240 L/EP/d plus 16% NRW (40 L/EP/d).
    b. Peaking factors defined per demand sector to provide overall peaking factors of:
        i. 1.45 for MDMM to Average Day ratio.
        ii. 1.75 for Peak Day to Average Day ratio.

11. If the Average Day unit demand of 215 L/EP/d and NRW reduces to 12% there is opportunity to defer major capital infrastructure by 12 years to year 2050 based on the preferred growth scenario (refer item 9 above).

12. If the Average Day unit demand is further decreased to 200 L/EP/d and NRW reduces to 12% there is opportunity to defer major capital infrastructure by 21 years to year 2059 based on the preferred growth scenario (refer item 9 above).

Water Allocation

Mackay Water has an annual allocation of 16,000 ML from the Pioneer River system which will be exceeded by:

- 2029 under 240 L/EP/d and 40 L/EP/d NRW demand and a re-based average growth rate of 1.57% with supplying Sarina.
- 2039 under 215 L/EP/d and NRW reduction from 16% to 12% using a re-based average growth rate of 1.57% and supplying Sarina.
- 2047 under 200 L/EP/d and NRW reduction from 16% to 12% using a re-based average growth rate of 1.57% and supplying Sarina.

Upgrade to Achieve 75 ML/d at the Existing Nebo Road WTP

The Nebo Road WTP Pinch Point Workshop held on 1 September 2015, reviewed the process of water treatment from raw water extraction to distribution to the network. The review highlighted that the raw water quality characteristics have changed significantly from the design envelopes used to upgrade the WTP in 2012. Based on the new design

itprevents the current plant to meet the expected 75 ML/d design capacity. The summary of the draft minutes for the workshop are provided in Section 8 of the technical memorandum.

Since there were upgrades required prior to the 75 ML/d capacity, a comparison of the upgrade costs to meet the 75 ML/d and the ultimate capacity of 90 ML/d were done by City Water Technology. The WTP Upgrades and Cost Estimation paper (refer Appendix Q) indicates there is marginal cost difference in upgrading the Nebo Road WTP to 75 ML/d or increasing capacity to 90 ML/d. Therefore, for a capital planning profile, the costs for the capital investment program have included the requirement to upgrade key components of the Nebo Road WTP directly to 90 ML/d in 2030. However, some of these upgrades are likely to be required earlier and there will be detailed planning undertaken to better define the scope, costing and timing of the upgrades for the following assets:

- Raw Water Pump Station
- Raw Water Mains
- Clarifiers
- Chemical Dosing System
- Sludge Management System.

Strategic Options Assessed

The identified strategic options assessed under an MCA process, as agreed with stakeholders, were as follows:

- Option 1 – as per current strategic approach (i.e. new southern WTP and reservoir located at Walkerston) however infrastructure sizing and timing based on demand persistence requirements and the adopted standards of service as well as the 1.57% growth rate.
- Option 2 – Augment Nebo Road WTP to 90 ML/d and construct a new reservoir at Erakala at 70 m AHD with associated trunk mains.
- Option 2A - Augment Nebo Road WTP to 90 ML/d and construct a new reservoir at Walkerston at 70 m AHD with associated trunk mains and other network infrastructure.
- Option 3 – Construct a new Northern WTP and new reservoir at Erakala at 70 m AHD with associated trunk mains and other network infrastructure.

Preferred Strategic Option

The strategic options were assessed against whole of life costs and an MCA was undertaken with all MRC stakeholders. Option 2A involving the upgrading of the Nebo Road WTP to 90 ML/d and construction of a new storage at Walkerston, was identified as the preferred option for the following reasons:

- Lowest whole of life cost for MRC and community.

- Provides Mackay with the flexibility to construct a southern WTP beyond the build out of the current PIA and Ooralea and Richmond Growth corridors into the long-term.
- Maximises utilisation of existing assets.
- Constructing Walkerston reservoir allows greater driving head to transfer water to Sarina in the future and greater water security for South of the River in the event of emergency.
- There is minimal land acquisition issues as all sites are owned by MRC. There may be a requirement to find additional room onsite for the waste water system upgrade near the southern boundary of the site. If the bore water can be potentially diverted to the river water clarifiers, more room can be made available onsite where the bore water aeration basin exists (north western boundary of the site).
- Minimal easement issues other than trunk main requirements along Stockroute road up to Walkerston reservoir.
- The public will be likely to accept the strategy as it only requires upgrading the existing Nebo Road WTP to 90 ML/d, rather than new sites for WTP and/or a reservoir.

Network Upgrades

The only major upgrade of the distribution network was for the Shoal Point reservoir and associated, which was identified for upgrading to a volume of 2 ML at 2023. The required volume for Shoal Point reservoir has reduced from 3 ML to 2 ML based on the water demand and peaking factor assumptions adopted in the strategy. All other reservoirs have sufficient capacity to service Mackay up to ultimate demand under 3 x (MD-MDMM) sizing. Persistent demands in the Mackay network will be overcome by sizing the Nebo Road WTP greater than MDMM capacity.

There a no major water main upgrades required within the existing network with the exception of trunk mains to implement the preferred strategy and trunk main infrastructure required to service greenfield growth areas in Shoal Point, Blacks Beach, Richmond Growth Corridor and Ooralea. In the previous water strategy there were a number of proposed capacity upgrades identified that are not required in the revised strategy due to the change in spatial growth, water demand and peaking factor assumptions.

A fire flow assessment was completed and identified the requirement to implement 36 augmentations in 2015. A subsequent fire flow risk assessment was completed reducing the number of augmentations to 11, which are required to be implemented in 2015.

Capital Investment Program

The capital investment program requires $136.5 M to ensure the Mackay network can be serviced from 2016 up to ultimate (2064) demand.

Other Strategic Opportunities

Demand management initiatives are currently being undertaken by MWS in regards to installation of AMR devices linked to MiWater as well as public education to change behavioural use. Since the previous strategy water use has decreased from 300 L/EP/d to the adopted 280 L/EP/d (with NRW) for the revised water strategy and can be attributed to the demand management initiatives undertaken. There is potential for capital deferment of up to 21 years (from 2038 to 2059) if baseline demands of 225 L/EP/d (includes 12% NRW) are achieved. The requirement to acquire additional water allocations could also be deferred by 18 years. The target baseline demands are similar to demand standards applied in South-East Queensland.

There is significant capital deferment opportunities and savings by continuing to target the reduction of Average Day demand and NRW. Going forward, management of peak demands should also be included in Mackay Water's focus.

The development of data analytics in the following areas will assist MWS to track performance and plan assets to deliver the most cost effective solutions whilst managing delivery and timing risk:

- Leakage Assessment.
- Demand Analysis.
- Live Modelling.
- Energy Management.

The key activities of focus for Mackay Water for the next 5 years are as follows:

Focus Area	Activities
Nebo Road WTP Master Plan	• Develop a new master plan for the upgrading of the WTP to 90 ML/d. Review site constraints and detail footprint required. Determine if any additional land is required and confirm availability.
Monitoring	• Fire flow augmentations identified in the water strategy require field tests as part of the design to confirm the need and sizing. • Annual monitoring of baseline demands using the approach in Section 4 of this water strategy. • Using residential and non-residential AMR data, SCADA and DMA flow data, implement data analytics to better understand residential and non-residential use, as well as target and reduce system leakage. In addition, use the analytics to target customers and customer groups that have greatest influence on peak demands (e.g. residential external use).
Nebo Road Pinch Point Workshop Tasks Register	There are a number of tasks on the Pinch Point task register that require to be actioned. Refer to Appendix P pages 23-24 for further detail.

Focus Area	Activities
Nebo Road Pinch Point Workshop Maintenance Tasks Register	• There are a number of outstanding tasks on the Pinch Point maintenance task register that require to be actioned. These have since been completed. Refer to Appendix P page 25.
Planning Studies	• Revise the Nebo Road HLPS configuration in light of upgrading Nebo Road WTP capacity from 75 ML/d to 90 ML/d. • Develop a pressure management plan within the ultimate new Walkerston reservoir zone (South Mackay and Walkerston).
Energy Management	• An energy management plan should be developed reviewing both operational and equipment based solutions to maximise energy use and minimise the carbon footprint of the Mackay Water Supply System.

Recommendations

The water strategy recommends the following actions:

1. Adopt Strategic Option 2A option and capital investment program presented in this water strategy. The option includes the upgrading of the Nebo Road WTP to 90 ML/d in lieu of building a new southern plant. It is noted that there is a key risk to the implementation of Strategic Option 2A in regards to treatment site constraints. The preferred strategy depends on the ability to expand the southern boundary of the WTP site to accommodate an additional sludge tank, sludge thickener and possible clarifier. The reservoir site at Walkerston would be maintained as part of the strategy.
2. Implement the recommendations of the Nebo Road WTP Pinch Point Workshop.
3. Undertake detailed planning studies as soon as possible in the light of adopting Option 2A:
    a. Planning for the upgrade of the Nebo Road WTP to confirm land requirements and availability.
    b. Undertake an energy management investigation of the water supply system operation.
    c. Revise the Nebo Road HLPS configuration in light of upgrading Nebo Road WTP capacity from 75 ML/d to 90 ML/d.
    d. Develop a pressure management plan within the ultimate new Walkerston reservoir zone (South Mackay and Walkerston).
4. Review the upgrade requirements for the Nebo Road HLPS in light of the changed operational requirements of Option 2A.
5. Implement fire flow augmentations as identified in the strategy. Field tests should be undertaken as part of the design to confirm the need and sizing.
6. Implement data analytics to better understand demand characteristics for both residential and non-residential use, as well as to target and reduce system leakage.

7. Undertake specific detailed planning and feasibility studies prior to delivering the capital works identified within this strategic report, to ensure that the preferred and most efficient solutions are refined and delivered at the optimal time. Detailed planning studies will assist in developing more accurate cost estimates.
8. Review the water strategy in 2020.

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Abbreviations

Abbreviation	Definition
AC	Asbestos Cement
ACH	Aluminium chlorohydrate
AD	Average Day
AHD	Australian Height Datum
AMR	Automatic Meter Read
CBD	Central Business District
CTM	Cairns Townsville Mackay
DEHP	Department of Environment and Heritage Protection
DN	Nominal Diameter
EP	Equivalent Person
GFA	Gross Floor Area
GRP	Glass Reinforced Plastic
GST	Goods and Services Tax
HLPS	High Lift Pump Station
HLZ	High Level Zone
km	Kilometre
kW	Kilowatts
L/EP/d	Litres per Equivalent Person per day
L/p/d	Litres per Person per day
L/s	Litres per second
LGIP	Local Government Infrastructure Plan
LTFF	Long Term Financial Forecast
m	metre
M	Million
MCA	Multi Criteria Assessment
MDMM	Mean Day Maximum Month
MFR	Multi-Family Residential
MGAM	Mackay Growth Allocation Model
MIA	Mackay Infrastructure Alliance
ML	Megalitres
ML/d	Megalitres per day
MLZ	Mid Level Zone
mm	Millimetre
MRC	Mackay Regional Council
MWS	Mackay Water Service
NPV	Net Present Value
NRW	Non Revenue Water
OSR	Office of State Revenue
PD	Peak Day
PE	Polyethylene
PH	Peak Hour
PRV	Pressure Reducing Valve
RC	Reinforced Concrete
SCADA	Supervisory Control and Data Acquisition
SFR	Single Family Residential
TWL	Top Water Level
WTP	Water Treatment Plant

1 Introduction

1.1 Background

Mackay Water has undertaken an update of the water strategy for the Mackay urban area supplied by the Nebo Road Water Treatment Plant (WTP). The aim of this revised strategy is to develop a robust, sustainable capital investment program for the Mackay urban area to update the Long Term Financial Forecast (LTFF) up to ultimate demand. The revised strategy has considered the supply of Sarina as a demand export from the Mackay urban area via the Sarina pipeline, but has not quantified the ultimate infrastructure upgrades required to supply Sarina into the future.

The growth and demand forecasts for the Mackay urban area have changed significantly over the past five years since the development of the previous Mackay water strategy (MIA, 2010). A population movement away from Mackay and a decrease in the population growth rate has occurred together with a reduction in residential water use. This decrease in water use is the likely to have resulted from increased awareness of water use resulting from the AMR metering program and water conservation messaging ('Watch the flow of H2O'), as well as the mining sector downturn's impact on the residential sector.

Changes in growth rates mean that the medium series growth rate of 2.4% per annum provided by Queensland Office of State Revenue (OSR) and used as part of the draft planning scheme and Local Government Infrastructure Plan (LGIP) are likely to be unachievable in the long term. The updated water strategy will input into the LGIP using a 2.4% growth rate in the short term, however a re-based growth rate of 1.57% will be adopted by Mackay Regional Council (MRC) to inform the strategy in the long term.

1.2 Objectives

The primary objective of the Mackay Water Strategy is to develop a robust, sustainable capital investment program for the Mackay urban area up to ultimate and to update the LTFF.

The strategy is to address both capital and operational costs, as well as considering innovation and non-capital solutions, in developing the investment strategy. Opportunities for improvements that are expected to yield performance and operational benefits will be highlighted.

The water strategy investigation was divided into 3 phases:

- **Phase 1 – Inputs**. Establishment and understanding of strategy inputs.
- **Phase 2 – Assumptions / Strategy Development**. Development of strategy whilst clearly understanding and defining assumptions and sensitivities around each.
- **Phase 3 – Outputs / Deliverables**. Development of strategy whilst clearly understanding and defining assumptions and sensitivities.

Phase 1 and Phase 2 methodology and outcomes are detailed in technical memoranda provided as separate documents to MRC as part of the project:

- Phase 1 Outcomes Technical Memorandum (MWH, 2015). The technical memorandum includes a detailed summary on the following items related to the strategic plan methodology:
    - Stakeholder Workshop and Needs Analysis
    - Growth/ Population Projections
    - Data Collection and Gap Analysis
    - Raw Water Sources
    - Renewals
    - Cost Drivers
- Phase 2 Outcomes Technical Memorandum (MWH, 2015). The technical memorandum includes a detailed summary on the following items related to the strategic plan methodology:
    - Base Demand Forecasting
    - Peaking Factors
    - System Demand
    - Hydraulic model update and validation
    - Service Standards
    - Demand Management
    - Water Sources
    - Nebo Road WTP Capacity
    - Trunk network Security Assessment
    - Existing System Water Age Assessment
    - Strategic Options Identification

This report presents the key outcomes of all phases, the overall strategy and capital investment program required for growth up to ultimate population.

1.3 Stakeholders Consulted

A range of stakeholders have been involved in the development of the updated water strategy, inputting and/or attending key meetings throughout the development of the strategy. The key stakeholders are included in Table 1-1.

Table 1-1: Mackay Water Strategy Stakeholders

Program	Stakeholder
Water and Waste Services Management	David Brooker (Chief Operating Officer)
Planning and Sustainability	Linda Pearson, Kylie Rogers, Don Pidsley
Business Services	Stephen Fernando

Program	Stakeholder
Water Networks	Jason Cocker, Ken Martin, Warren Zunker
Water Treatment	Stuart Boyd
Infrastructure Delivery	John Cumming, Sarah Lethbridge
Strategic Planning	Jaco Ackerman, Philip Grobler, Jay Rosenberg
Planning and Project Development Panel Consultants	Ramesh Dhaka (Cardno), Shane O'Brien (MWH), Roger Crozier

1.4 Previous Studies

The Mackay Water Strategy (MIA, 2010) is the most recent planning study for the city, examining the trunk infrastructure requirements to supply the ultimate population of Mackay from 2009 to 2056. The outcomes of the previous strategy were:

- The adopted unit average day demand was reduced to 300 L/EP/day from the previous value of 500 L/EP/day.
- Mackay's current 16,000 ML/year annual water allocation from the Pioneer River would be exceeded by 2017.
- A new Southern WTP at Walkerston (Option C1), a new reservoir at Walkerston (70 ML) and associated trunk mains to supply the Mackay South water supply scheme would be required by 2021.

1.5 Other Relevant Reports

A number of studies and assets within the network were reviewed to ensure that the recent objectives of MWS could be integrated into the strategy, and that any localised network updates were included in the model.

- MWS Asset Management Plan – Water Network DRAFT (2014)
- MWS Asset Management Plan – Water Treatment DRAFT (2014)
- MRC Drinking Water Quality Management Plan (2014)
- TR-053 Leakage Detection and demand Management Report DRAFT (2014)
- Water Demand Forecasting model DRAFT – MWS (2014)
- PPB-026 Nebo Road Bores DRAFT (2014)
- TR-055 Nebo Road High lift pumps DRAFT (2014)
- TR-078 Water Main Renewals DRAFT (2014)
- TR-087 Southern WTP Siting Study (2015)
- TR-092 Water Pump Station Condition Assessment DRAFT (2014)
- Mackay Whitsundays Regional Water Supply Strategy DRAFT (2014)
- PPB-006 Sarina Water Supply Strategy DRAFT (2014)
- Leakage Management Plan (2012)
    - Recommends district metered area, including the isolation of the central business district (CBD) from the rest of the areas south of the Pioneer River.

- Capital Delivery Project Brief: Water Mains Renewals Mt Bassett Cemetery Road, June 2015
- Northern Beaches Water and Wastewater Master Plan (2014)
    - Shoal Point Reservoir
    - Update of Fireflow augmentations recommended in Water Strategy 2009
- Shoal Point Reservoir review
    - It is currently forecast that this reservoir will need to be upgraded by 2021.
- TR-074 Mt Oscar and Surrounds HLZ Investigation (2014)
    - The preferred solution valves and augmentations have been incorporated.
- TR-102 Pioneer Street HLZ Investigation (Draft)
    - This report recommended a solution to low pressures experienced at high elevations in the Pioneer Street area, however these solutions have not been approved by MWS and were not incorporated into the strategy.
- TR-107 Walkerston Water System Optimisation (Progressing)
    - Recommends that the multiple pumps and reservoir to service Walkerston be streamlined to one pump (Walkerston) and one reservoir (Silingardies Road). This configuration has been included in the strategy.
- Nebo Road WTP Upgrade Options and Costs Estimation Paper (2016)
    - The capital costs to upgrade Nebo Road WTP have been incorporated into the capital investment program.

2 Existing System Overview

This section provides an overview of the existing raw water infrastructure, water treatment plant and potable water supply distribution system and identifies existing issues and constraints.

2.1 Raw Water Supply

2.1.1 Surface Water System

The main raw water supply to Mackay is sourced from the river water intake situated on the southern side of the Pioneer River at the Dumbleton Weir. A dry well raw water intake on the southern bank of the river includes four variable speed pumps (350 x 400 – 500 Super Titan 375 kW) providing raw water to the Nebo Road WTP via two trunk mains. The intake suction manifold consists of a DN 1800 vertical column with four bell-mouth inlets stacked equally to supply water to the pumps at various river water levels. Only one suction inlet is open at one time and are typically the inlets at 12.85 m AHD or 10.6 m AHD. The two bottom suction inlets (at 8.35 m AHD and 6.037 m AHD) are rarely opened to avoid stratification issues. The key as-constructed drawings of the river water intake are shown in Appendix A to provide context around changes to the asset since the last strategic plan was completed in 2009.

The 4 river water pumps can only operate in the following pump combinations:

- Pump Pair 1: Pump 2 + Pump 1
- Pump Pair 2: Pump 4 + Pump 3
- Pump Pair 3: Pump 4 + Pump 1
- Pump Pair 4: Pump 2 + Pump 3

The Pump 1 discharge main (DN350) and Pump 3 (DN450) discharge main join into a single discharge main (DN 600) approximately halfway up the river water intake structure. Similarly, the Pump 2 discharge main (DN350) and Pump 4 (DN450) discharge main join into a single discharge main (DN 600) at the same point.

It is understood the above pump configurations are due to a limitation of the power supply to the Dumbleton weir. The pumps will be able to operate as Duty/Duty/Duty/Standby to meet higher level flow rate requirements when the power supply transformers are upgraded in future.

Pump 4 is currently experiencing excessive vibration issues and only 2 pump pairs are available to operate (pair 1 and pair 4) until these issues are addressed. This means that Pump 2 operation is critical.

A marked up as-constructed drawing of the two raw water trunk mains is provided in Figure 2-1 with tabulation of the trunk main details shown in Table 2-1. The DN 500 reinforced concrete (RC) main has a Pressure Reducing Valve (PRV) to limit the pressure and

minimise leaks that occur in the rubber ring joints. This PRV constrains the flow in the RC main to less than 240 L/s.

Table 2-1: River Water Trunk Main Infrastructure

Trunk Main	Length	Diameter	Material	Pressure Class
1	7,800 m	DN 500	RC	Reduced due to leaking rubber ring joints
	3,200 m	DN 525	Asbestos Cement (AC)	Class C
	100 m	DN500 / DN450	RC slip lined with Polyethylene (PE)	RC Unknown PE PN 16
Total Length	11,100 m			
2	5,011 m	DN 675	AC	Class 1.5
	5,200 m	DN 600	Glass Reinforced Plastic (GRP)	SN 5000 Class 10
	100 m	DN 700	PE	PN 12.5
Total Length	10,311 m			

The intake raw water pumps have been designed to deliver 75 ML/d (868 L/s over 24 hours), however the pumps have only been tested up to 68 ML/d (785 L/s over 24 hours) for a short period of time on the 24/6/2013. It is likely that the test was short due to downstream network demand and to avoid overflowing the clarifiers. The raw water mains can achieve up to 75 ML/d with excessive leaks occurring at the joints of the RC main (main delivering flow greater than 240 L/s). Theoretically, 71 ML/d can be delivered to Nebo Road WTP with the flow in the RC main limited to 240 L/s (to limit leaks at the joints) and with a pair of river water pumps operating.

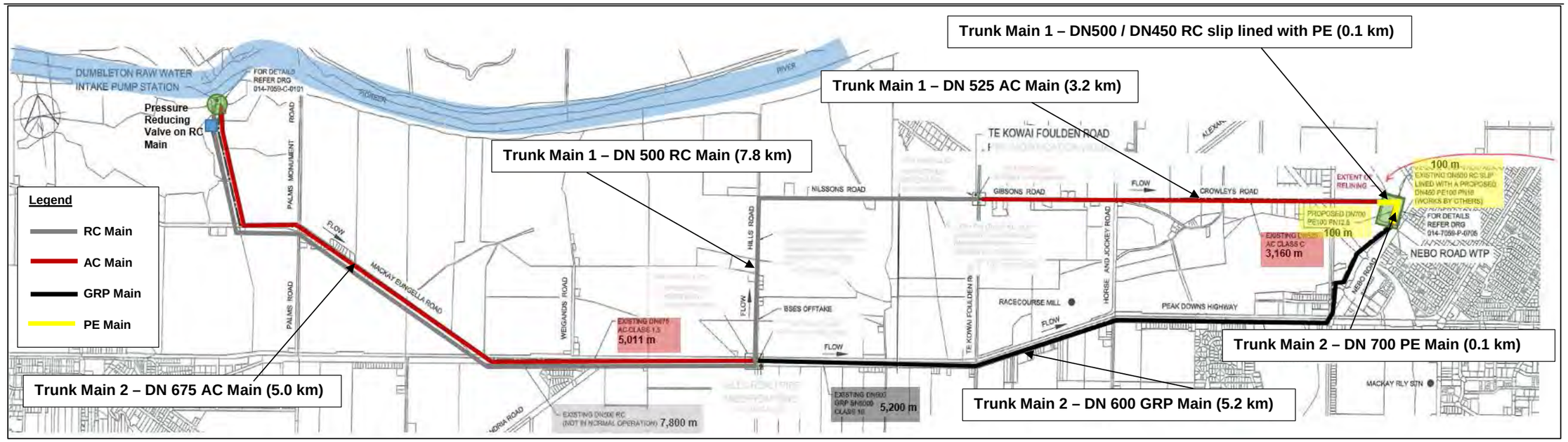


Figure 2-1: Existing Dumbleton Raw Water Trunk Mains

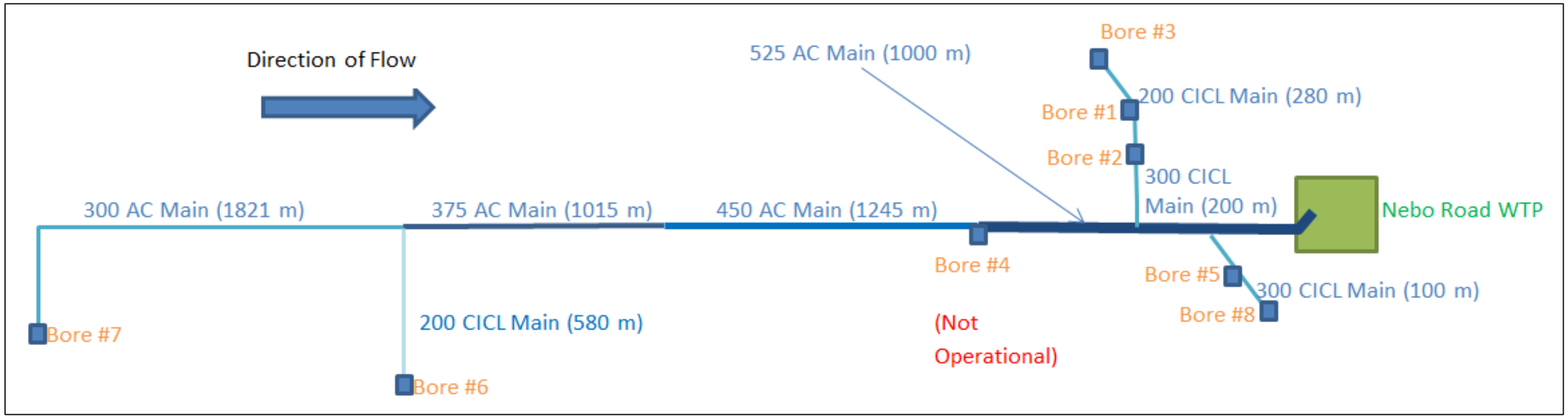


Figure 2-2: Existing Groundwater System Schematic

2.1.2 Groundwater System

The groundwater system that supplies to the Nebo Road WTP, during high turbidity period and other events, consists of 7 operational bores that are currently capable of delivering approximately 190 L/s to the WTP. The borefield previously comprised 8 bores however Bore 4 has recently been decommissioned due to bore collapse and water quality issues. Figure 2-2 (previous page) details the existing groundwater system.

MWS has a groundwater allocation from the State Government of 5,500 ML/year. The allocation for 2015 was reduced to an emergency supply of 300 ML/year due to dry weather occurring over the previous 2 years. Groundwater is a contingency supply only and is mainly used when the river water has high turbidity after significant rain events. Thus, bore supply rarely exceeds more than 5% of its annual allocation.

A recent planning study (PPB-026, MWH) investigated an increase of the extraction rate to 240 L/s to meet contingency supply conditions. The study recommended a number actions which have been included in the capital investment program in Appendix O:

1. Implement a Maintenance and Monitoring Plan that was developed as part of the project so bore assets are routinely maintained going forwards and future data is correctly recorded and managed.
2. Undertake immediate specified maintenance on the bore sheds, painting of pipework and monitoring bores at an estimated cost of $67,200.
3. Install water level monitors in production bores and monitoring bores and connect to telemetry.
4. Implement further testing to confirm bore flow meter inaccuracy and implementation of replacing shaft driven pumps with submersible pumps going forwards, based on a decision process provided in the report. The total estimated cost to replace the shaft driven pumps over time (as they fail) with submersible pumps and to drill a replacement for Bore 4 is $504,300.
5. Define the criteria for pump failure to determine pump replacement in line with the decision process.
6. Implement immediate works to gain flow efficiencies with Bore 5 and Bore 8 at an estimated cost of $72,900.
7. Consider the requirement to replace Bore 4 with a new bore for redundancy purposes before 2019. If a new bore is drilled it is recommended that the bore design includes a sump below the screen at the base of the bore, i.e. over-drill the hole by 6 m in the granite. This will allow the pump inlet to be set lower and increase available drawdown. If the submersible pump is installed within the screens it will require motor shrouding. The estimated cost of the new bore is $112,700.
8. Complete an options assessment based on the emergent issues of the planning report to provide sufficient log removal in the treatment of the bore water in line with the Drinking

Water Quality Management Plan. The following options (to be investigated in the future) were suggested to achieve the 3 log water quality:

- Provide sufficient log removal by adding to the raw water treatment train. From a long term perspective this option could potentially increase the Nebo Road WTP capacity and potentially delay the need to construct an additional WTP.
- Provide a connection between the bore water aeration basin and the WTP clarifiers. This option will provide the best solution based on the current outcomes of the planning report especially in regards to submersible pump selection. In addition, there is no requirement to change the inlet configuration to the Nebo Road WTP.
- Provide direct connection from the bore raw water main to the Nebo Road WTP clarifiers. This option provides sufficient log removal by adding the bore water to the river water treatment train, however from a long term perspective it may constrain the capacity of the Nebo WTP to that of the river water treatment train capacity. In addition, the submersible pump selection would need to allow for the additional static head to pump into the clarifiers.

2.2 Nebo Road Water Treatment Plant

The Nebo Road Water Treatment Plant (WTP) is located in West Mackay and is the sole source of treated water to the Mackay water network. The WTP receives raw water from the Dumbleton Weir under normal operating conditions and the groundwater system under contingency conditions. The process flow diagram based on the upgrade by the Mackay Infrastructure Alliance (MIA) in 2012 can be found in Appendix A.

The nominal design capacity of the Nebo Road WTP is 75 ML/d. A workshop was conducted on the 1st September 2015 to determine the “pinch points” that may restrict current capacity of the Nebo Road WTP or that may limit the future (90 ML/d) upgrade options.

Based on the outcomes of the workshop the primary “pinch points” for meeting the currently assumed 75 ML/day maximum capacity are:

- Raw Water Pump Station. The maximum pumping rate recorded for the pump station was 785 L/s which is equivalent to 67.8 ML/d over a 24 hour operation.
- Raw Water Mains Capacity. The raw water mains have a capacity of 71 ML/d. The old RC main is limited to 240 L/s and would require relining to achieve 75 ML/d.
- Clarifier Capacity. The existing clarifiers can operate at about 60 ML/d with good quality raw water and require conversion to high rate clarification to achieve 75 ML/d.
- Chemical Dosing System. The aluminium chlorohydrate (ACH) dosing system, the filter aid poly dosing system and the centrifuge poly dosing system require upgrade to achieve 75 ML/d.
- Sludge Management Facilities. For increased plant throughput and higher solids volumes, a second sludge thickener and thickened sludge tank would be required to achieve 75 ML/d though space is restricted. There is also a requirement to determine the size/space requirements of the centrifuge based on the new design envelope.

The Pinch Point workshop concluded that some work was required to achieve the nominal WTP capacity of 75 ML/d. Meeting minutes from the pinch point workshop can be found in Appendix P. For this report it has been assumed that the upgrade to supply 75 ML/d will be required for all strategic options and as such the costs have not been included in the strategic options assessment however have been included in the capital investment program in Appendix O. It is recommended that MWS prioritise investment into the asset management of the current Nebo Road WTP to ensure that the plant can achieve the design capacity of 75 ML/d. The tasks identified in the workshop should be actioned as part of this work.

2.3 Nebo Road High Lift Pump Station

Treated water is transferred from the Nebo Road balance tanks (total volume 10 ML) by the Nebo Road high lift pump station (HLPS).

The Nebo Road HLPS pumps water into the 800 mm diameter pipeline connection to the Mt Pleasant and Mt Oscar reservoirs (TWL 51.1 m AHD and 48.7 m AHD respectively) in north Mackay. The high lift pumps also supply water directly into the south Mackay network via three trunk mains:

- 450 mm diameter Cemetery Road main
- 600 mm diameter Thorning Street main
- 300 mm diameter Nebo Road (Walkerston) main.

All of Mackay's potable water reservoirs, with the exception of the existing Walkerston reservoirs, are located on the northern side of Pioneer River. The distribution system to the south of the river is primarily pressurised by the Nebo Road HLPS. As a result of the supply arrangement the pumps operate almost continuously. Pump and motor details of each pump at the HLPS, as well as the current status and any observed issues are summarised in Table 2-2.

Table 2-2: Status of Nebo Road High Lift Pumps (MWS, September 2014)

Pump	Nominal Capacity (L/s)	Pump Description	Motor Description	Status	Issues
1	630	1995 Weir SDB 400/500B Uniglide vertical axial split case. 555 mm diameter impeller	1995 Teco 375 kW, 985 RPM, 620 amp	In operation	Cavitation
2	130	1965 Thompson 7"/8" Class CH	2011 CMG 90kW	In operation	None
3	150	1952 Thompson 8"/10" CMA Class C	Year Unknown - Siemens 90 kW 154 amps	In operation	None
4	240	1976 Indeng Uniflow 250 mm x 230 mm	2013 Weg 90 kW	In operation	Motor undersized, should be 150 kW

5	370	1970s Indeng	2013 CMG 220 kW	In operation	Leak at pump gland
6	340	1967 Thompson 12”/14” Class CM	Not available (new motor)	In operation	None

There are 6 pumps of various sizes that are capable of supplying the network. Pump 1 experiences significant cavitation issues. Typically Pumps 3, 5 and 6 are mostly used to match the required demand in the network. Pump 2 was overhauled in April 2015 and a new motor installed. Pump 4 has an undersized motor constraining performance.

A recent planning project (TR-055, MWH, 2015) was undertaken to determine the existing future capacity requirements of the Nebo Road HLPS, to review the current operation and to determine the most effective and efficient network strategy to meet the existing and future capacity. The study focused on meeting a nominal design capacity of 75 ML/d assuming that the new Southern WTP near Walkerston would be constructed. The main outcomes of the study included:

- The existing pump combination of Pumps 4 (or 3), 5 and 6 can theoretically provide the combined capacity to deliver the maximum WTP capacity of 75 ML/d. However, using this combination of existing pumps to deliver the 75 ML/d does not provide the required back up capacity to the network in case of failure and additional capacity is therefore required.
- A primary (visual) condition assessment was completed in June 2014 on the HLPS and the following main observations were made:
    - It was confirmed that Pump 1 cavitates heavily.
    - Pumps 2, 3, 4, 5 and 6 require internal inspection assessment and measurement of impeller shrouds.
    - A condition assessment of the larger valves is required with replacement scheduled as early as possible due to the criticality of the station.
- The current open system operation was identified as the preferred network configuration.
- The preferred pump strategy for Nebo Road HLPS identified was to utilise the existing pump station capacity with a staged replacement/upgrade of Pumps 4, 5 and 6 to 430 L/s each and replacement of Pump 2 and 3 with 175 L/s pumps to provide an instantaneous capacity of 1,035 L/s and back up capacity for the jockey (175 L/s) pump.

The recommendations from the study and the status of the recommendations are as follows:

1. Install pressure monitors on suction and discharge of each pump a new distribution flow meter (connected to SCADA).
2. Undertake a detailed internal inspection of all pumps (except Pump 1) to establish remaining life based on impeller shroud wear. Internal condition assessment of pump 2 and pump 5 have been completed by the mechanical fitters of MWS.
3. Define the replacement criteria for Pumps 2 to 6.

4. Perform performance testing of the existing pumps and pump combinations. This action will be undertaken beyond April 2016.
5. Implement Option 1 upgrade of the HLPS (which is the open system operation and preferred pump strategy).
6. In the short term, replace the motor on Pump 4 and relocate the motor from Pump 4 to Pump 3.
7. Retain Pump 1 for single pump or standby operation and to provide backup capacity to the future Walkerston WTP.
8. Update the Mackay population model as the existing population growth appears to be conservative. This action has been undertaken as part of this water strategy for the 2.4 % growth scenario. However the hydraulic model will be required to be updated further for the 1.57% growth scenario.
9. Calibrate the relevant trunk main components of the hydraulic model prior to the detailed design of the HLPS upgrade.

2.4 Distribution Network

The existing water supply network for Mackay is shown in Figure 2-3. The following sub-sections provide an overview of the existing system operation.

2.4.1 Mt Pleasant and Mt Oscar Reservoir Zone

The Mt Pleasant and Mt Oscar reservoir zone incorporates the Nebo Road HLPS, Mount Pleasant reservoir and Mt Oscar reservoir which are key trunk supply and storage assets of the Mackay network. As stated in Section 2.3 the Nebo Road HLPS pumps water into the 800 mm diameter pipeline connection to the Mt Pleasant and Mt Oscar reservoirs. The high lift pumps also supply water directly into the South Mackay network via three trunk mains:

- 450 mm diameter Cemetery Road main.
- 600 mm diameter Thorning Street main (South Mackay Trunk Main).
- 300 mm diameter Nebo Road (Walkerston) main.

The Mt Pleasant reservoir complex consists of 3 x 18.2 ML tanks (total volume of 54.6 ML) at a TWL of 51.1 m AHD. The Mt Oscar reservoir complex consists of 2 x 6.75 ML tanks (total volume of 13.5 ML) at a TWL of 48.7 m AHD.

The Mt Pleasant and Mt Oscar reservoir zone directly feeds the majority of demand south of the Pioneer river, north Mackay, Glenella, Beaconsfield and Andergrove. The reservoirs also feed the Berry Street Reservoir, Green Street reservoir, Janes Creek pump station (that supplies to Farleigh, The Leap and Seaforth), Creese Street booster pump station, Illalangi booster pump station, Golf Links pump station (that supplies to Northern Beaches) and Mt Bassett reservoir and Slade Point pump station (that supplies Mt Bassett and Slade Point).

2.4.2 Mt Oscar High Level Zones

The area adjacent to the Mt Oscar reservoir, has properties at elevations that cannot be serviced by the hydraulic grade of the Mt Pleasant and Mt Oscar reservoir zone. A recent

planning report (TR-074, Cardno) was undertaken for Mt Oscar and Surrounds HLZ. The investigation identified that two high level pumped supply zones are required in the Mt Oscar reservoir zone to service these highly elevated properties:

- Berry Street Mid Level Zone (MLZ) – Maximum water supply elevation 40 m AHD. The reservoir has a volume of 1.13 ML and a TWL of 63.7 m AHD. The area is serviced by the mid-level pump station when filling Berry Street reservoir and gravity supplied from Berry Street reservoir when the pumps are off.
- Green Street HLZ – Maximum water supply elevation 66 m AHD. The Green Street reservoir has a volume of 0.9 ML and a TWL of 37 m AHD with a booster pump downstream that pressurises the HLZ area.

INSERT

Figure 2-3: Existing Water Supply Network

2.4.3 *Northern Beaches Pressure Zones (Rural View, Blacks Beach, Shoal Point)*

From the Mt Pleasant reservoir, water is transferred via the Mackay-Bucasia Road 750 mm and 375 mm diameter trunk main to Golf Links pump station. The Golf Links pump station transfers water to the Rural View reservoir via a 450 mm / 600 trunk main which in turn supplies the Blacks Beach reservoir and Shoal Point reservoir. The Rural View reservoir has a volume of 10 ML and a TWL of 65.3 m AHD and directly supplies the suburbs of Rural View and Bucasia. There are a number of new highly elevated properties located near the Rural View reservoir that are within a pump boosted HLZ that was built in 2015. In addition the Premier Gardens pump station was also constructed in 2015 to supply highly elevated properties adjacent to the Rural View Reservoir.

The Blacks Beach reservoir complex consists of a 2.25 ML tank and 4.6 ML tank (total volume of 13.5 ML) at a TWL of 65.4 m AHD. The Blacks Beach reservoir directly supplies the suburbs of Blacks Beach, Eimeo and Dolphin Heads. The Blacks Beach reservoir is supplied through a 375 mm/ 300 mm trunk main and an additional new transfer pump station (that assists with improving reservoir turnover) from Rural View reservoir and/ or Golf Links pump station. There is small booster zone adjacent to the Blacks Beach reservoir to serve the highly elevated properties on Eulbertie Avenue and Blacks Beach Reservoir Road. The small booster pump station is located in the same building as the new Blacks Beach transfer pump station located at the base of and Blacks Beach Reservoir Road on Alan Naish Court. In addition there is the Dolphin Heads booster zone that supplies the high elevated areas of Dolphins Heads.

The Shoal Point reservoir has a volume of 0.5 ML and a TWL of 47.1 m AHD and directly supplies the suburb of Shoal Point. Shoal Point reservoir is filled via a 375 mm / 300 mm trunk main and altitude valve that is supplied by Rural View reservoir and/ or Golf Links pump station. In future the Shoal Point reservoir zone will expand to accommodate growth within the suburb of Shoal Point. A 2 ML reservoir is proposed to replace the existing 0.5 ML reservoir based on the unit demand and peaking factor assumptions adopted in this strategy.

2.4.4 *Mt Bassett and Slade Point Pressure Zones*

The Mt Bassett and Slade Point pressure zones are supplied under gravity from the Mt Oscar reservoir via a 600 mm / 525 mm / 250 mm / 300 mm trunk main and actuated valve arrangement. The actuated valve, located at the corner of Mackay-Slade Point Road and Ron Searle Drive, is controlled by water levels in the Mt Bassett reservoir.

The Mt Bassett reservoir has a volume of 5.5 ML at a TWL of 36.2 m AHD. The reservoir supplies the Mackay Port through the Mackay Harbour booster zone (booster pump situated on Mulherin Drive). The Mt Bassett reservoir, along with the actuated valve, also feeds the Slade Point pump station that operates at a fixed speed to serve the Slade Point elevated tower. This elevated reservoir has a volume of 0.45 ML and a TWL of 47.3 m AHD supplying the suburb of Slade Point.

2.4.5 Farleigh/ The Leap/ Seaforth/ Ball Bay Pressure Zones

Water is transferred from the Mt Pleasant reservoirs through a 450 mm / 375 mm / 250 mm trunk main via the Janes Creek Pump Station (located on the Bruce Highway) which supplies to the Farleigh Reservoir. Two PRV zones (Glenella PRV and Peppermint Grove PRV) are situated directly downstream of the Janes Creek pump station to supply low lying areas within the Farleigh pressure zone.

The Farleigh reservoir has a volume of 5 ML and a TWL of 107 m AHD. The Farleigh reservoir supplies the local area and the Sunset Drive booster pump station, which is turn serves the elevated properties on Sunset Drive adjacent to the Farleigh reservoir.

From the Farleigh reservoir, water is conveyed through the Ashburton pump station via a 250 mm trunk main to The Leap Break Tank. The Leap Break Tank has a volume of 0.7 ML and a TWL of 98 m AHD and supplies properties at The Leap and properties along the Bruce Highway and Yakapari-Seaforth Road from Ashburton pump station to upstream of the Seaforth reservoir. Between Ashburton pump station and The Leap Break Tank, there are elevated properties on Bonson Scrub Road and Ian Reddacliff Drive. A booster pump station, located at the corner of the Bruce Highway and Bonson Scrub Road, boosts pressure to properties on Bonson Scrub Road and also supplies water to the two Bonson Scrub tanks (2 x 0.03 ML, TWL 193.3 m AHD) situated on Ian Reddacliff Drive. From the Bonson Scrub tanks there is a small booster pump station that supplies properties in the Bonson Scrub HLZ adjacent to the tanks.

From The Leap Break Tank water gravitates to the Seaforth reservoir and the Ball Bay reservoir via a 250 mm diameter trunk main. Both the Seaforth and Ball Bay reservoirs have altitude valves controlling inflows.

The Seaforth reservoir has a volume of 2 ML with a TWL of 59.6 m AHD supplying the suburb of Seaforth. Downstream of the Seaforth reservoir is the Mt Vista pump station and reservoir (0.3 ML 115.6 m AHD) that was constructed to serve elevated areas along Aviland Drive and View Court. Currently the Mt Vista pump station and reservoir do not operate as no houses are constructed within the Mt Vista pressure zone.

The Ball Bay reservoir has a volume of 1.5 ML with a TWL of 58.9 m AHD supplying the suburbs of Ball Bay and Haliday Bay. Currently the Ball Bay reservoir is offline and the area is supplied through a pressure reducing valve located on Ball Bay Road (just before the Haliday Bay Road turnoff) which can serve both Ball Bay and Haliday Bay and properties as far as Cape Hillsborough.

The Cape Hillsborough pump station, situated on Buoro Street in Ball Bay, assists supply to properties on Kippen Drive. However it is noted that this pump station is not required to operate as the existing PRV on Ball Bay Road has a sufficient hydraulic grade setpoint to supply the properties on Kippen Drive.

2.4.6 Walkerston Pressure Zone

Until recently, Walkerston has been divided into two pressure zones. The Walkerston elevated tower situated on the northern side of Bakers Creek was supplied from the Walkerston pump station via the 300 mm trunk main from Nebo Road WTP. The elevated tower supplied all properties located on the northern side of Bakers Creek. All properties located on the southern side of Bakers Creek were supplied by the Silingardies Road reservoir which received water from the Walkerston elevated tower via the Bold Street pump station and a 200 mm trunk main.

Recently, the Walkerston pumps and reservoirs have been rationalised into one pressure zone so that the Bold Street Pump Station and Walkerston elevated tower no longer operate and all of Walkerston is supplied by the Silangardies Road reservoir hydraulic grade via the Walkerston pump station. The Silangardies Road reservoir has a volume of 2.25 ML and a TWL of 62.5 m AHD.

2.4.7 Supply to Sarina

Sarina can be supplied from the Nebo Road WTP via an existing 300 mm trunk main and actuated valve located at Alligator Creek. Water is pumped to the Alligator Creek ground level tank. The Alligator Creek pump station then supplies water from Alligator Creek ground level reservoir to Sarina northern beaches and Sarina Township to the south. Transferring flow from Mackay to Sarina commenced in February 2015 at a rate of 2-2.5 ML/d. The water strategy considers the Sarina supply as a flow export by the simplification of a point demand source (in the hydraulic model) on the existing Sarina trunk main and impact on trunk infrastructure and timing.

3 Population Projections

3.1 Existing Residential Population

The existing residential population served by the Nebo Road WTP is estimated at 85,702 persons based on assessment of the number of residential dwellings contained in the water consumption billing data for the period from March 2014 to March 2015.

The residential connections were divided into attached and detached dwellings to calculate the population using the following occupancy rates:

- Detached dwelling – 2.69 persons/ connection
- Attached dwelling – 1.72 persons / connection

The occupancy rates are based on the average 2011 occupancy census data which included provisions for vacant properties. Table 3-1 summarises the population growth estimate based on detached and attached water connections for 2014.

Table 3-1: Existing Mackay Residential Population

Residential Connection Type	Connections	Residential EP
Residential Detached Connections	28,371	76,318
Residential Attached Connections	5,456	9,384
Total Residential Population	**33,827**	**85,702**

Existing Sarina residential population (includes beaches) is estimated to be 7,912 EP based on the Mackay spatial distribution model (MGAM).

3.2 Existing Non-Residential Population

The existing non-residential population served by the Nebo Road WTP is estimated at 33,517 EP based on dividing the water consumption billing period from March 2014 to March 2015 by unit demand consumption. Table 3-2 summarises the existing non-residential population.

Table 3-2: Existing Mackay Non-Residential Population

Non-Residential Demand Category	Non-Residential EP
Commercial	16,566
Industrial	13,125
Public	171
Open Space	3,655
Total Non-Residential Population	**33,517**

Existing Sarina non-residential population (includes beaches) is estimated to be 1,582 EP. This estimate was based on an assumption of a 20% proportion of the residential population.

3.3 Total Existing Population

The existing total population of Mackay served by the Nebo Road WTP is 119,320 EP with an additional potential existing supply to Sarina of 9,494 EP. Table 3-3 summarises the total existing EP of Mackay and Sarina.

Table 3-3: Total Existing EP – Mackay and Sarina

Sector	Mackay	Sarina	Mackay plus Sarina
Residential EP	85,702	7,912	93,614
Non-Residential EP	33,517	1,582	35,099
Total EP	**119,320**	**9,494**	**128,814**

3.4 Equivalent Population Projections

The Mackay Growth Allocation Model (MGAM) was used to provide the spatial allocation of growth assumptions used in draft Planning Scheme and based on a medium series growth rate of 2.4% per annum. The medium series growth scenario provided the following information on a lot level basis:

- Residential Population for 2014, 2016, 2021, 2026, 2031 and 2036 planning horizons.
- Gross Floor Area (m^2) for 2014, 2016, 2021, 2026, 2031 and 2036 planning horizons.
- Land Use.

Population projections were based on the Queensland Government's Statistical Office (QGSO) average growth rate for Mackay of 2.4% in line with LGIP. The spatial distribution of EP growth from 2016 to 2036 is shown by heat maps in Appendix C for the 2.4% growth rate as outputs of MGAM. These growth maps depict EP growth within the draft planning scheme (current PIA). It is noted that the 2036 planning horizon assumes build out of the current Priority Infrastructure Area (PIA) boundary.

Ultimate population has been calculated based on the current PIA boundary as well as two prominent growth corridors in Mackay:

- Ooralea – 15,000 persons ~ 18,000 EP. Development likely to occur after 2036.
- Richmond Growth Corridor – 10,000 persons ~ 12,000 EP. Development likely to occur after 2036.

A re-based average growth rate of 1.57% derived from MRC's analysis was also used to against the QGSO growth rate of 2.4%.

Mackay population estimates for the 2.4% and 1.57% growth rates are summarised in Table 3-4. It is assumed that Sarina will grow at a rate of 1.57% per annum.

Table 3-4: Equivalent Population and Demand based on 2.4% Growth Rate

Growth Rate	2014	2016	2021	2026	2031	2036	2046	Ultimate
Mackay @ 2.4%	119,320	121,670	137,058	149,817	166,463	184,589	211,831	214,558
Mackay @ 1.57%	119,320	123,067	132,433	141,800	151,166	160,533	179,266	214,558
Sarina @ 1.57%	9,494	9,793	10,538	11,283	12,028	12,774	14,264	17,097

The ultimate equivalent population of Mackay including the two growth corridors outside the current PIA boundary is approximately 215,000 EP. The ultimate population is realised at:

- 2047 based on 2.4% the growth rate.
- 2065 based on 1.57% the growth rate.

The equivalent population projections adopted for the water strategy are shown in Figure 3-1. There is an 18 year difference in the realisation of ultimate growth when adopting the medium series (2.4%) growth rate compared to adopting the re-based average (1.57%) growth rate.

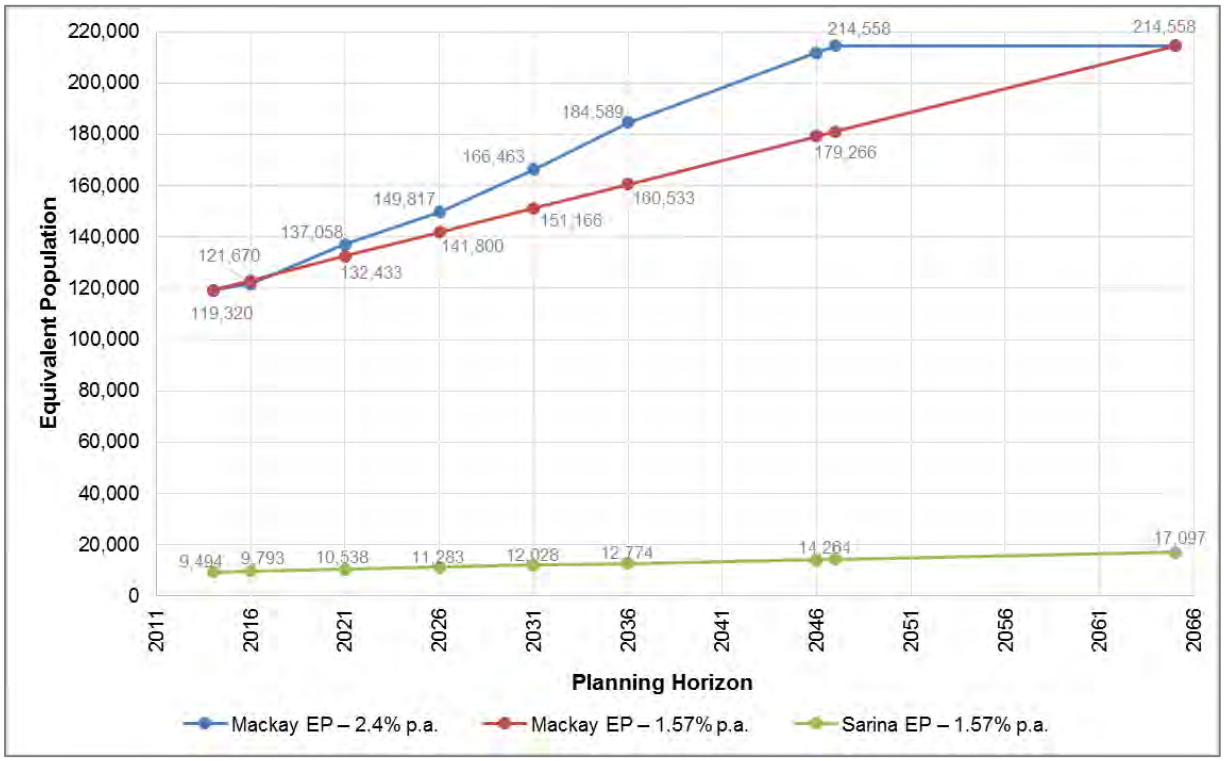


Figure 3-1: Equivalent Population Projections

3.5 Spatial Distribution of Population

Mackay is anticipated to grow from an existing 119,320 EP to an ultimate 215,000 EP based on the build out of the current PIA plus Ooralea to the south and Richmond Growth Corridor to the north. Table 3-5 summarises the growth EP for the Northern Scheme (includes Mackay CBD growth) and the Southern Scheme (all growth south of the Pioneer River with the exception of the Mackay CBD). The Northern and Southern Scheme definitions align with the 2009 water strategy when major WTP upgrades are required. The separation of the network in to two schemes will primarily change network configuration and operation and service pressures in the southern areas of Mackay. Appendix D shows the boundary of separation between Northern and Southern Schemes as well as the ultimate pressure zones. Table 3-5 indicates that most of the growth within Mackay occurs in the Northern Scheme which includes growth in the Mackay CBD.

Table 3-5: Spatial Distribution of Demand

Scheme	Existing EP	Ultimate EP	Growth EP
Northern Scheme	69,818	140,041	70,223
Southern Scheme	49,502	74,517	25,015

Growth in the Northern Scheme is attributed to the following areas:

- Northern Beaches
- Northern Mackay which includes suburbs such as Glenella, North Mackay, Beaconsfield and Andergrove (mainly infill growth)
- Richmond growth corridor (which adjoins Northern Mackay to Northern Beaches)
- Mackay CBD (mainly infill growth).

Growth in the Southern Scheme is mainly attributed to the suburb of Ooralea. In addition to the Southern Scheme growth, there is potential to supply Sarina and beaches existing and ultimate population which is expected to grow from approximately 9,500 EP to an ultimate 17,000 EP. If Sarina is added to the Southern Scheme growth, this causes the Southern Scheme growth to increase from 25,015 EP to just over 42,000 EP. Even with Sarina growth added to the Southern Scheme, the distribution of growth is significantly towards the north.

4 Baseline Demand Assessment

Understanding historic unit demand is key to determining the baseline demand for system planning. As part of the water strategy a number of key pieces of information and tools were used to determine the baseline unit demand and non-revenue water:

- Previous 5 years of WTP daily production and rainfall
- Previous 5 years of customer billing data to undertake a sectoral assessment
- MWH's in-house WaterTrac and ConTrac models to climate correct production and water use (essentially removing climate as a variable).

4.1 Nebo Road WTP Historic Daily Production

Production data from the Nebo Road WTP for the past 6 years was graphed against rainfall and is shown in Figure 4-1. In 2010, over 3,000 mm of rainfall was recorded which is approximately 30% more than rainfall recorded from 2011 to 2013. Subsequently the 2010 rainfall limited the level of outdoor water use and negated the peak demand. Conversely, the maximum peak demand over the past 5 years was 57.47 ML which occurred on the 6th December 2012. This peak demand period coincided with a prolonged periods of dry weather. The 6 year peak day average (excluding 2010 data) is 54 ML/d and has remained relatively constant over the past five years.

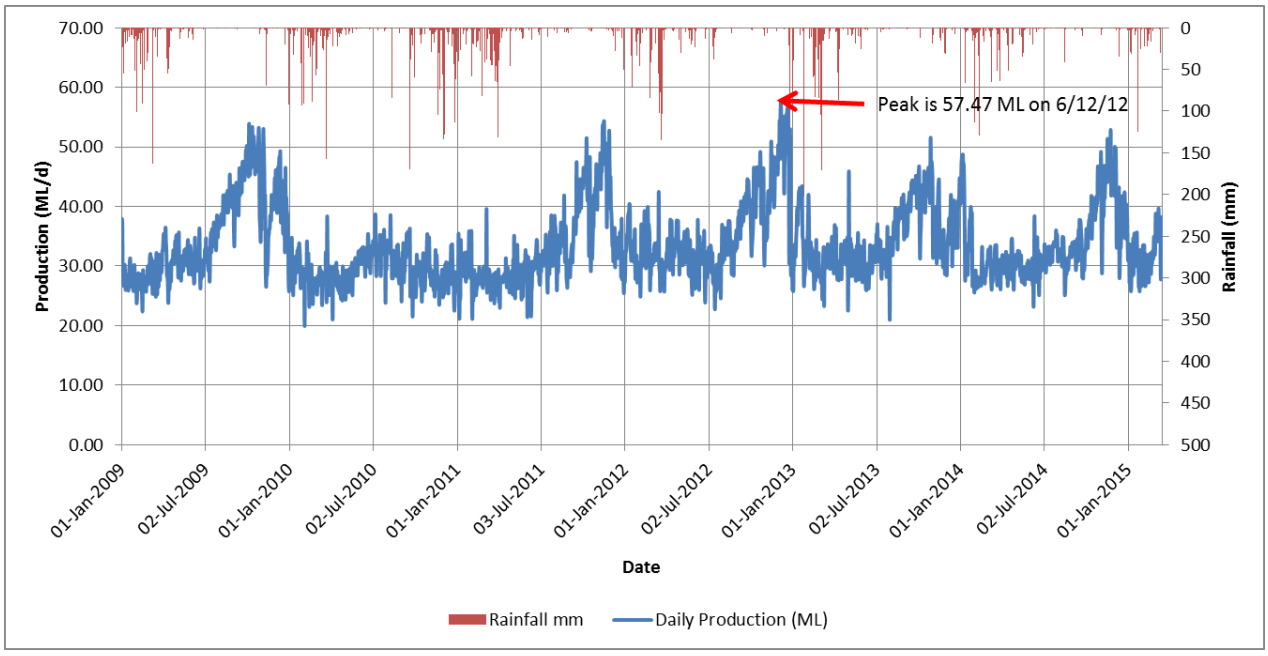


Figure 4-1: 2009 to March 2015 Nebo Road WTP Daily Production Data (ML/d)

Mackay's peak demand periods are characterised by periods of up to 30 days (1 month) where demand is lower than PD demand but higher than MDMM demand. Figure 4-2 shows

the 3 day to 31 day moving average of demand in the maximum peak period over the last 5 years which occurred between 23 November and 23 December 2012.

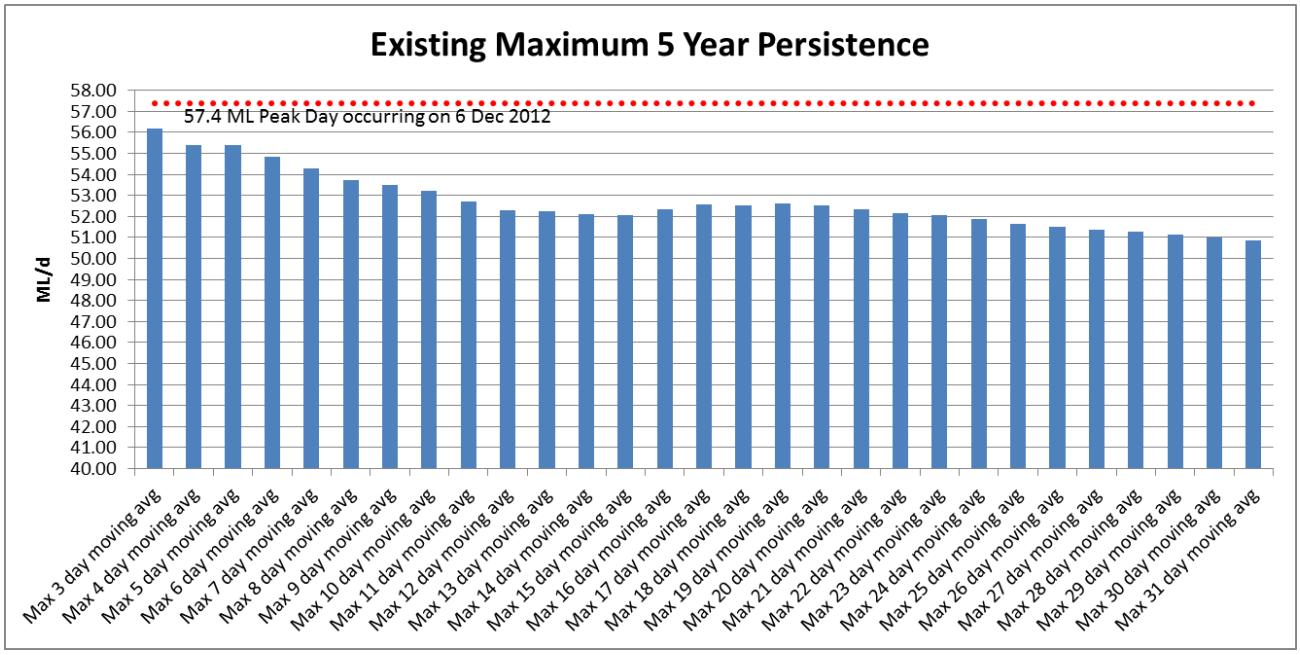


Figure 4-2: Maximum Demand Persistence of Mackay Production – Past 5 years

Peak persistent demands as identified by Figure 4-2 impact on the typical sizing of storages using the 3 x (PD-MDMM) approach. There is sufficient spare capacity at Nebo Road WTP to overcome existing peak persistent demands. However, in the future as PD demand increases to above the capacity of the Nebo Road WTP (75 ML/d) there is a risk that storages will deplete after 9 to 10 days based on the peak persistent demand characteristics of Mackay.

The sizing and timing of any new WTP and major storages in the Mackay system will need to take into account persistence to ensure storages do not empty. It is recommended to use the maximum 5 year persistence trend in the timing and sizing of the new WTP and major storages as shown by Figure 4-2.

4.2 Customer Billing Data Assessment

4.2.1 Water Consumption per Sector

The water billing data for the previous 5 years was analysed and divided into the following key demand categories:

- Single Family Residential
- Multi-Family Residential
- Commercial
- Industrial

- Public
- Open Space.

The Planning Scheme Zones for existing connections were allocated to the key demand categories as outlined in Table 4-1.

Table 4-1: Planning Zones Assigned to Demand Category

Demand Category	Planning Zones
Single Family Residential	EMCM, Emerging Community, Emerging community zone, Low Density Residential, RESL, Township, TWNS
Multi Family Residential	High Density Residential, Medium Density Residential, Residential choice zone, RESM,
Commercial	CTRP, District Centre, Local Centre, Major Centre, Mixed use zone, Principal Centre, Special Purpose, Special Purpose Zone, Specialised centre zone, SPURP, Tourist
Industry	High Impact Industry, High impact industry zone, INDH, INDL, Industry investigation zone, Low Impact Industry,
Public	CMTY, Community Facilities, Neighbourhood Centre
Open Space	Conservation, Open Space, OPSP, Sport and Recreation, SPRC
Rural with water (assigned to Single Family Res or Commercial depending on connection type)	Rres, Rural, Rural Residential, Rural zone, RURL

A summary of the water consumption per demand category for 2014 is shown in Table 4-2. It is noted that the water consumption billing period is from March 2014 to March 2015. The average daily water consumption for 2014 was 27.9 ML/d. Residential demand (both detached and attached dwellings) makes up 19.8 ML/d.

Table 4-2: 2014 Consumption by Demand Category

Demand Category	ML/year	ML/d
Residential (Detached)	6,327.3	17.3
Multi-Family Residential (Attached)	899.6	2.5
Commercial	1,386.5	3.8
Industrial	1,147.5	3.1
Public/ Open Space (Sporting and Community)	435.1	1.2
Total Consumption	**10,196**	**27.9**

Figure 4-3 shows the percentage of water consumption per demand category. The ratio between residential and non-residential water consumption is 71% to 29%, respectively. The ratio between residential and non-residential water consumption from 2010 to 2014 is very similar to that shown in Figure 4-3.

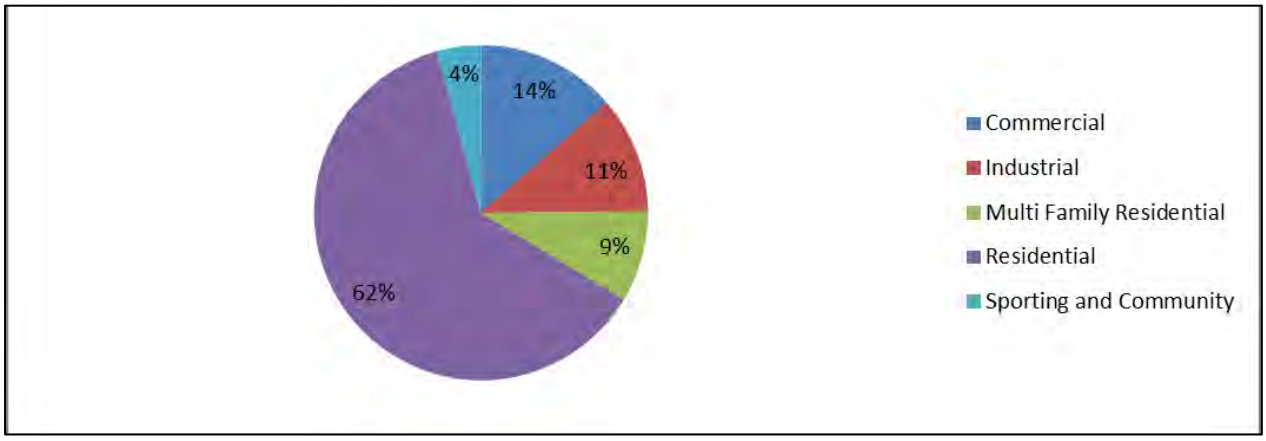


Figure 4-3 : 2014 Consumption per Demand Category

4.3 Non-Revenue Water

Using the WTP production figures and the billing data Non-Revenue Water (NRW) was calculated at between 15 and 20% (refer Table 4-3). A baseline of 16% NRW has been adopted for the water strategy in calculating demand forecasts.

Table 4-3: 5 Year Non-Revenue Water Rates

	2010	2011	2012	2013	2014
Average Production kL/d	29,487	33,627	35,348	34,462	33,460
Average Consumption kL/d	23,728	28,582	28,986	29,252	27,934
Non-Revenue Water kL/d	5,759	5,045	6,362	5,210	5,526
Non-Revenue Water %	20%	15%	18%	15%	17%

4.4 GFA to EP Conversion Rates

As part of the water strategy, the planning scheme growth assumptions were used and input into the Mackay Growth Allocation Model (MGAM) which assisted in providing a spatial representation of growth over time. Growth included residential population growth and non-residential growth in gross floor area (square metres). Existing customer billing data was used to determine the existing non-residential EP and also determine GFA to EP (EP/m^2) conversion rates to be used for future non-residential growth.

Using the 2015 water meter read data (from March 2014 to March 2015) and the 2014 GFA linked to individual MRC lots, GFA to EP conversion rates were able to be calculated for Commercial, Industrial and Sporting and Community (Public and Open Space) properties. For

each land use, the 50th percentile, average and 90th percentile L/100m^2 GFA rates were calculated. Large water users were omitted from the analysis.

The adopted GFA to EP conversion rates are summarised in Table 4-4.

Table 4-4: GFA to EP Conversion per Demand Category

Demand Category	Conversion Rate (L / 100 m^2)	EP / m^2	EP / ha
Commercial	100	0.0043	30
Industry	100	0.0043	30
Public and Open Space	141 properties coded individually due to the variability of data		

4.5 Climate Correction of Production and Demand Data

Two in-house models that MWH employs have been utilised to understand long-term trends in per capita water demand with the influence of climate removed. This understanding aids in the selection of a suitable starting point for future water needs forecasts. The two tools are:

- WaterTrac – Water production trend tracking tool.
- ConTrac – Water consumption trend tracking tool.

4.5.1 Water-Trac Model and Results

WaterTrac has been used for demand assessment for many water utilities, local and state governments. It has previously been used for Mackay to develop the Residential Water Consumption Reporting Tool for MWS by MWH in 2010. The tracking tool was designed to track per capita water consumption on a daily basis using daily water production data.

The process of climate correction can be summarised as follows:

- A soil moisture index is derived from climate data and is included as one of four climate variables.
- A regression model is progressively calibrated using four climate variables and appropriate statistical techniques. The calibration is undertaken over a period of 'normal' water consumption with a reasonable range of climatic conditions.
- A hindcast is developed which uses the calibrated model to predict water production over a given period to verify the long-term stability of the model. This hindcast is examined for any abnormalities, and is also used in the sectoral consumption trend tracking model as the basis for climate-correction.
- Statistical techniques are used to generate a climate corrected trend of water production and a 365 day rolling average of observed versus climate corrected water production.

The following data was used in WaterTrac to produce a climate corrected trend of total water production:

- Daily production data from the Nebo Road WTP (1/7/2008 to 17/3/2015).
- Climate data for Mackay was obtained from SILO Data Drill. The Data Drill accesses grids of climate data interpolated from point observations by the Bureau of Meteorology.
- Serviced population was determined from an assessment of number of residential connections multiplied by the occupancy rate (2.69 for detached dwellings (SFR) and 1.72 for attached dwellings (MFR)). Vacant connections (assumed to be less <50 L/connection/day) were removed and not included in the population assessment.

The WaterTrac model was calibrated over a period of January 2011 to January 2013. The results are shown in Figure 4-4. Overall, a good correlation between observed and predicted demand was achieved between 2009 and 2013 indicating that production and climate are strongly related. A deviation of the observed against the predicted was observed after August 2013 when water use shows a steady decline.

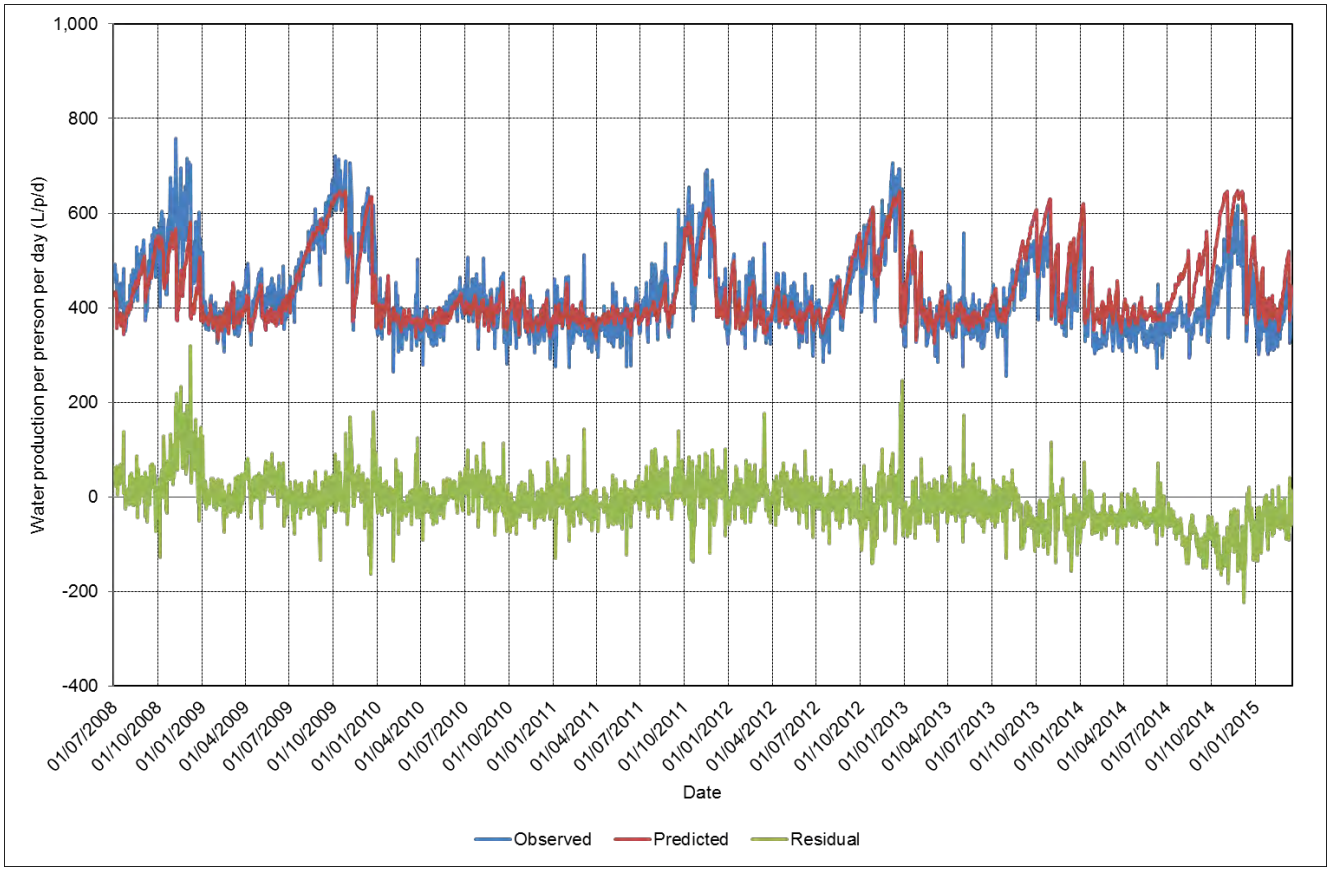


Figure 4-4: Observed, Predicted and Residual Daily Demands (L/person/d)

4.5.1.1 Hindcasting of WaterTrac Model

The WaterTrac model includes a hindcast of predicted per capita daily water demand (for the baseline period) over the full climate record. The hindcast can be used to estimate the long run frequency distribution of demands. The model hindcast also provides a "sanity" check on the regression model. A stable regression model will provide sensible demand estimates through the full period of the climate record.

SILO Data Drill provides estimates of many climate parameters back to 1857, however evaporation data is only available from 1980 onwards. For this reason, the model hindcasts were conducted over the 30 plus years since 1980. The model hindcast is shown in Figure 4-5. The hindcast shown is relatively stable which provides confidence that the regression model is valid over the full range of climatic conditions.

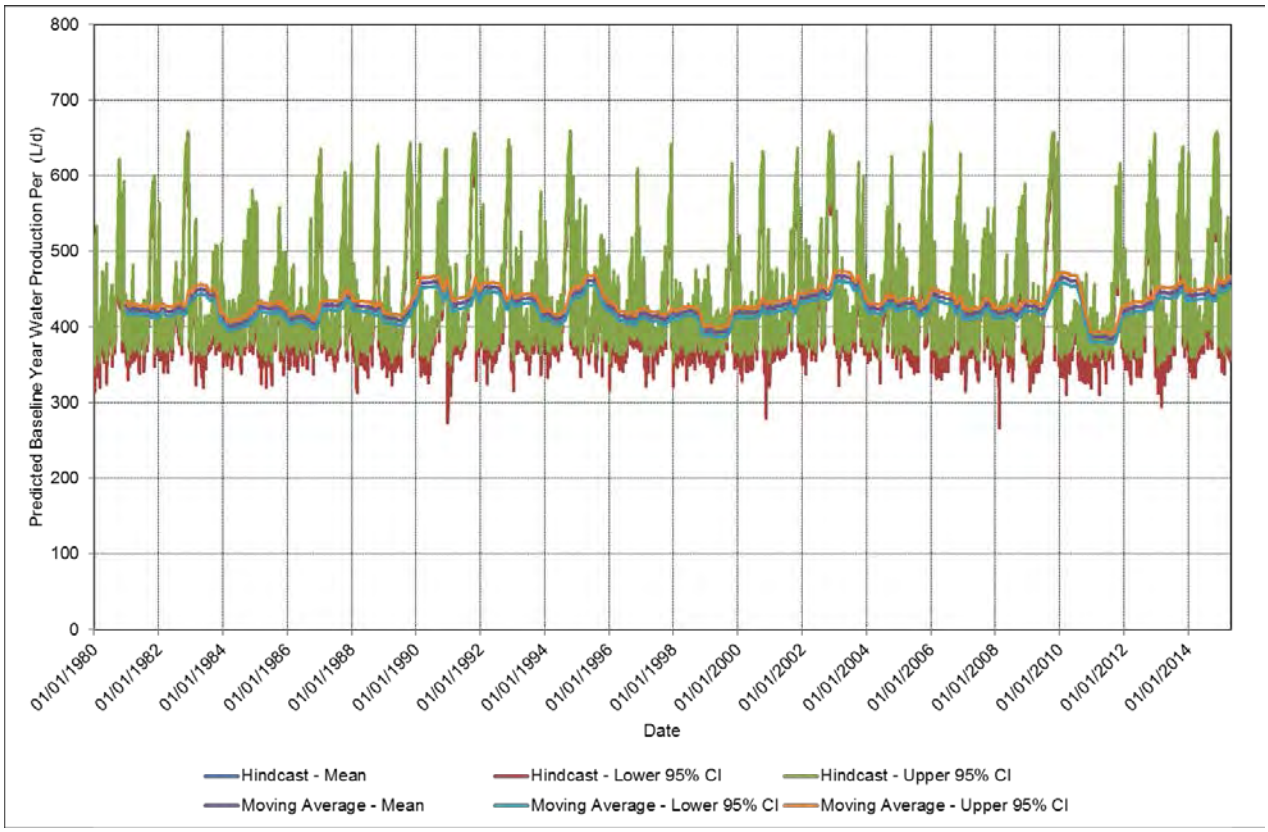


Figure 4-5: Baseline Model Hindcast

4.5.1.2 WaterTrac Model Results

The climate correction procedure uses a polynomial curve fit on observed and predicted baseline data to provide an estimate of the change in both the fixed and seasonal demands. Climate correction was carried out on a 365 day moving average basis starting from when the first full 365 days of water demand records were available.

Figure 4-6 shows the observed and climate corrected demands. The climate corrected trend shows that water use was relatively stable between 2009 and 2013 but has reduced since 2013 from 420 L/p/d to 380 L/p/d. The reason for this decrease is thought to be the combined impact of new AMR metering increasing the awareness of water use, water conservation messaging ('Watch the flow of H2O') and possibly lower population due to downturn in the mining sector. It is noted that there has been a downward trend in the residential sector since at least 2009 and therefore the extent to which the population or the demand is decreasing is not clear.

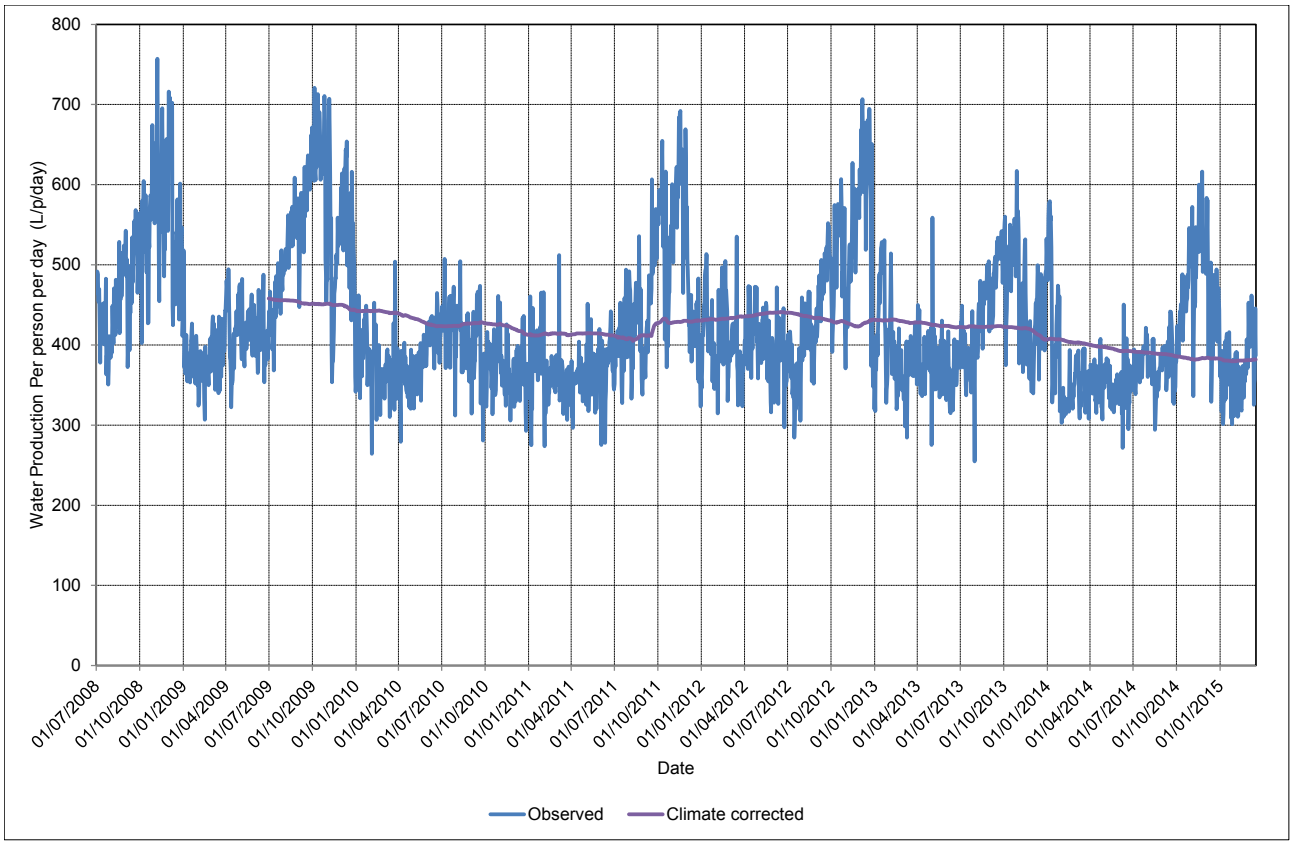


Figure 4-6: Observed and climate corrected per person water consumption (L/p/d)

4.5.2 ConTrac Model and Results

The consumption trend tracking model (ConTrac) utilises aggregated consumption (or customer billing) data. Climate-correction of this data was used to allow the tracking of trends by customer sector. The customer sectors analysed were:

- Single Family Residential (detached dwellings)
- Multi-Family Residential (attached dwellings)
- Commercial
- Industrial
- Public and Open Space.

The process applied was as follows:

- The total consumption and number of accounts for each customer sector was input into the consumption trend tracking model for the billing months from March 2009 to March 2015.
- The hindcast from the water production model (L/p/d) was input into the sectoral consumption model in order to form a pseudo climate index.
- The model's predicted consumption per account was calibrated for the reading dates.
- The hindcast data was used to climate-correct the consumption records, and a rolling average trend line of climate-corrected consumption per account was produced.
- Sectoral climate-corrected trends were then reviewed and a final trend figure for each sector was defined. The Single Family Residential per capita data was used as a basis to determine existing non-residential equivalent population from the water consumption data to be used as a basis for demand forecasting.

4.5.2.1 ConTrac Model Results

The observed, predicted, residual and climate corrected trends for the Single Family Residential sector is shown in Figure 4-7. As with the bulk water production trend (WaterTrac), Single Family Residential water use has been on a downward trend since 2009. On average water use has been approximately 650 L/account/day (240 L/p/day) but has since decreased to around 580 L/account/day (215 L/p/day) since September, 2013.

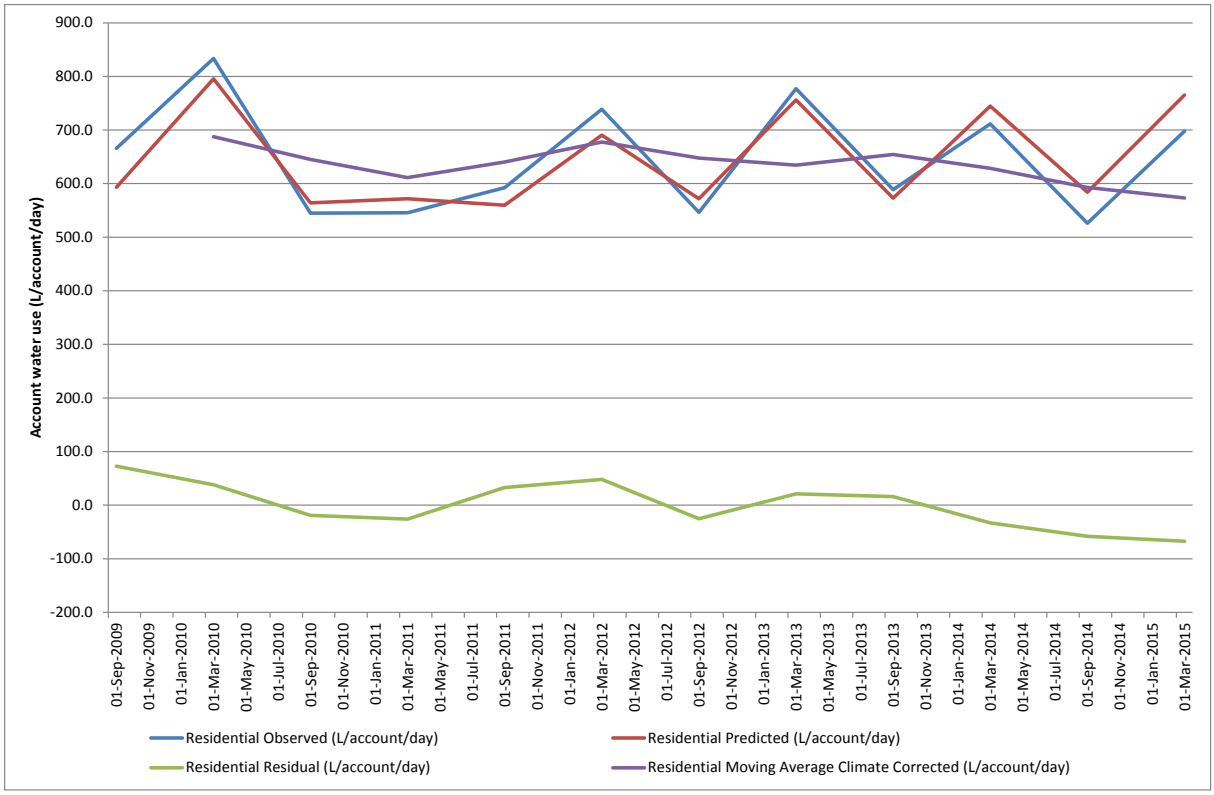


Figure 4-7: Observed, predicted, residual and climate corrected Single Family Residential sector water use

Outcomes of the additional demand sectors are as follows:

- Multi-Family Residential water use has remained steady since 2010 at around 510 L/account/day. It has recently decreased to around 450 L/account/day since September, 2013.
- Commercial demand has steadily reduced from 3,300 L/account/day to 2,700 L/account/day. The major decrease over the past 12 months is likely due to the fall in hotel demand.
- Industrial demand was very steady at around 3,000 L/account/day but has fluctuated in the past few years and the climate correction has responded to this.
- Sporting and recreation demand has been variable, most likely in response to higher than average rainfall in 2010 and lower than average rainfall in 2014. The current climate corrected demand is 2,700 L/account/day which is close to the long term average demand for this sector.

4.6 Peaking Factor Assessment

Each customer sector has a different water usage behaviour. Water use behaviour in Single Family Residential (detached) dwellings typically drives the maximum peak use in a system such as Mackay due to external use. Typically, Multi-Family Residential (attached) and non-residential customers will have a reduced peaking factor compared to Single Family Residential customers due to the limit on external use in these demand sectors.

Mackay Water has recently rolled out Automatic Meter Read (AMR) devices on all residential (detached and attached) properties which has provided a snapshot (2014) in understanding behaviour of residential customers under average day, mean day maximum month and peak day conditions. AMR meters are currently being rolled out to non-residential properties which will assist in informing customer behaviour going forwards and will inform the Mackay water strategy going forwards.

An assessment of residential customer behaviour (majority of water use) using the AMR data for both Single Family Residential (detached) and Multi-Family Residential (attached) dwellings was completed to understand Average Day, Mean Day Maximum Month and Peak Day diurnal patterns and to inform peaking factors.

The AMR data was broken down by suburb and the date at which the maximum daily water use by suburb occurred. Consumption per hour on the maximum day of use was provided to understand the diurnal use over a day within each suburb. This approach was completed for a selected average day (1st March 2015). Interestingly, the overall peak day recorded by the Nebo Road WTP operations spreadsheet was the 24th November 2014, however the overall peak day recorded by suburb for detached and attached dwellings did not occur on the 24th November 2014. One third of suburbs had a peak day for detached dwellings that occurred on the 23rd November 2014 which indicates that the WTP operation output has a lag response to peak day demand that occurs in the network. All major Mackay suburbs peak days for detached dwellings occurred within the month of November 2014, which was the maximum month for 2014.

Attached dwelling peak day behaviour was somewhat different and did not mimic detached dwelling behaviour, however diurnal peaks showed that there was a high level of external use in the Multi-Family Residential (attached dwelling) sector. This is likely driven by duplexes and other attached dwellings that have small yards that provides opportunity for outdoor use.

The AMR diurnal data was normalised based on overall average day use for 2014 per suburb. An average diurnal was then created for both residential detached and attached dwellings (with diurnal outliers removed). The diurnal patterns for residential detached and attached dwellings were then used as known inputs to make informed decisions for peaking factors to be used in the non-residential demand component (currently unknowns).

The peaking factors for each demand sector must add up to the adopted overall peaking factors which are:

- 1.75 for Peak Day
- 1.45 for MDMM.

Appendix H summarises the peaking factors adopted per demand sector. The peaking factors for each demand sector sum up to the adopted overall peaking factors.

4.7 Summary of Baseline Demand Assumptions

From the baseline demand assessment the following planning assumptions have been adopted as part of the water strategy and development of future demand:

- 240 L/EP/day for residential and non-residential equivalent population. It is noted demand peaking factors are applied to this unit demand component. The adopted unit demand allows for approximately 10% rebound in unit demand.
- 16% NRW which equates to 40 L/EP/d. It is noted, no demand peaking factors are applied to the NRW component.
- Total baseline unit demand is 280 L/EP/d.

The previous water strategy adopted a baseline unit demand of 340 L/EP/d for existing and 300 L/EP/d for demand forecasting. From the latest assessment future forecasting has seen reduction from 300 L/EP/d to 280 L/EP/d.

4.8 Sensitivity to Baseline Unit Demand

A sensitivity assessment has been applied to the baseline demand assumptions:

- 215 L/EP/day for residential and non-residential equivalent population. 215 L/EP/d is current consumption and assumes that unit demand will not rebound.
- 12% NRW reduced from 16%. It is noted, no demand peaking factors are applied to the NRW component.
- Total baseline unit demand sensitivity is 240 L/EP/d.

5 Standards of Service

A review of the existing Mackay service standards was completed based on the draft Cairns Townsville Mackay (CTM) Alliance design guideline document. Each criteria was individually reviewed for input into the water strategy. The following standards of service criteria was derived from recent historical data for use in the water strategy:

- Average Day demand. As per methodology in Section 4 of this report (particularly Section 4.5.2.1). Average Day demand is 240 L/EP/day for residential and non-residential equivalent population. The adopted unit demand allows for approximately 10% rebound in unit demand. It is noted demand peaking factors are applied to this unit demand component.
- Non-revenue water. As per methodology in Section 4.3 of this report. NRW is 16% which equates to 40 L/EP/d. As per methodology in Section 4.6 of this report. It is noted, no demand peaking factors are applied to the NRW component.
- Peak Hour to Average Day factors. As per methodology in Section 4.6 of this report. It is noted that the peak hour factors for residential use only have been derived from automatic meter read (AMR) information. When non-residential properties have AMRs installed and sufficient information is available in the future, the peak hour factors for non-residential can be refined along with residential peaking factors for input into the next water strategy review.
- Storage capacity for major trunk reservoirs based on persistence analysis. As per Section 4.1 using the maximum peak persistence trend that occurred in November/ December 2012 to derive storage deficits into the future.

5.1 Adopted Standards

A review of the service standards to be adopted for the water strategy was completed based on the draft Cairns Townsville Mackay (CTM) Alliance design guideline document. Table 5-1 shows the service standards adopted for the Mackay Water Strategy. The proposed service standards were presented to Mackay Water in the Phase 2A workshop with endorsement. The changes from the draft CTM guidelines are summarised in Table 5-1.

Table 5-1: Comparison between draft CTM guidelines and Water Strategy Standards of Service

Criteria	CTM Mackay Standards of Service	Adopted Water Strategy Standards of Service
Average Day Demand	340 L/EP/d	240 L/EP/d
Non-Revenue Water	N/A (included in Average Day Demand)	40 L/EP/d
Peaking Factors		
MDMM/ AD	1.5	1.45
PD/ AD	2	1.75
PH/ AD	4	See Appendix H
Minimum Service Pressure	22 m at the property boundary	18 m for 2 hours under peak hour conditions at the property boundary

Criteria	CTM Mackay Standards of Service	Adopted Water Strategy Standards of Service
Hazen Williams Pipe Friction Factors	Dia <= 100 mm, C =100 Dia >150-300 mm, C = 110	<= 300 mm, C = 110 >300 mm – 600 mm, C = 120 > 600 mm, C = 130
Maximum allowable headloss rate	5 m /km for Dia <= 150 mm 3 m/ km for Dia >= 200 mm	Don't use. Only guideline to flag potential augmentations
Maximum allowable velocities in pipes	2.5 m/s for peak hour 4 m/s for fire flow	Should only be a guideline not a criteria.

The desired standards of service adopted in the water strategy are provided in Appendix H of this report.

6 Demand Projections

This section provides a detailed summary of the Average Day (AD), Mean Day Maximum Month (MDMM) and Peak Day Peak Day demand projections for the Mackay urban area. Demand projections are summarised for the following growth rates:

- 2.4% per annum (medium series)
- 1.57% per annum (re-based average)

The 1.57% re-based growth rate applies supply to Sarina Township via the existing Mackay to Sarina pipeline. In addition, a summary of demand by pressure zone is provided to understand pressure zones where demand growth occurs.

6.1 Demand Projection Based on 2.4% Growth Rate

Using the population projections, adopted baseline unit demands and peaking factors, Table 6-1 summarises the demand projections up to Ultimate for the 2.4% growth rate.

Table 6-1: Equivalent Population and Demand (ML/d) based on 2.4% Growth Rate

	2014	2016
Mackay EP	119,320	121,670
Mackay AD	33.2	33.9
Mackay MDMM	46.3	47.2
Mackay PD	54.8	55.9

Figure 6-1 shows the AD and PD demand growth over from existing to ultimate. At ultimate is calculated that Mackay's AD will be 60 ML/d and PD will be 98 ML/d.

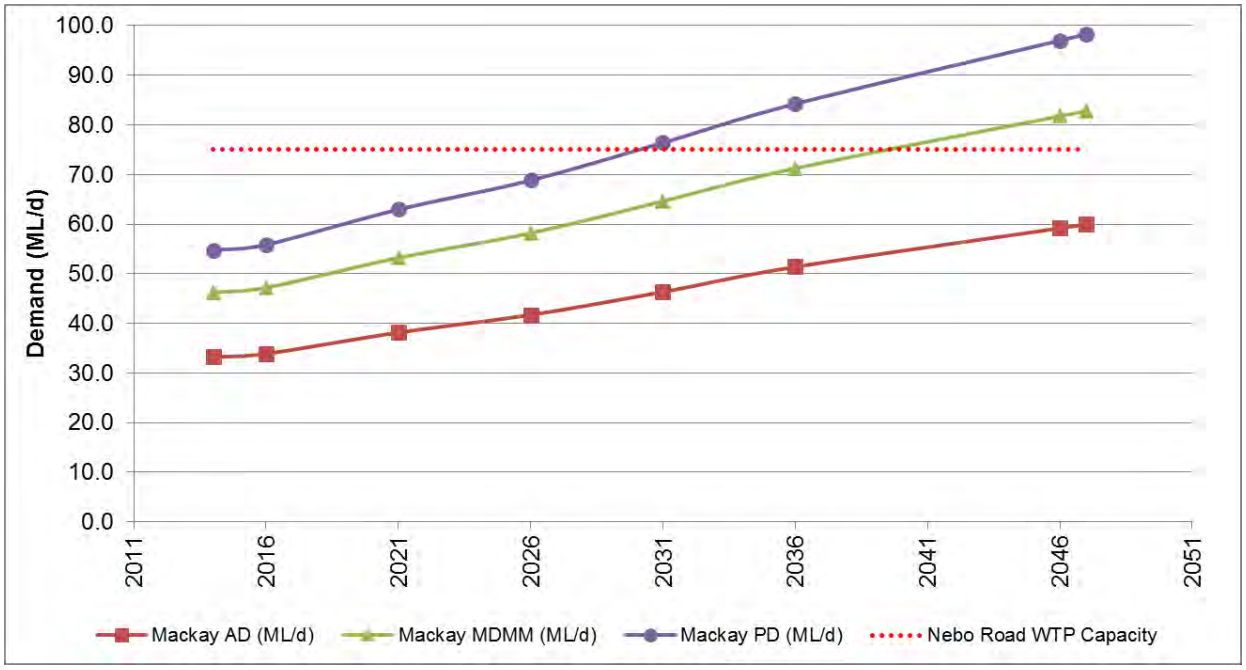


Figure 6-1: AD and PD Demands for 2.4% Growth Rate

6.2 Demand Projection Based on 1.57% Growth Rate

The forecast EP and demand growth for all planning horizons at 1.57% growth rate are summarised in Table 6-2. Supply projections for Sarina are assumed to be provided at MDMM rather than PD.

Table 6-2: Equivalent Population and Demand (ML/d) based on 1.57% Growth Rate

	2014	2016	2021	2026	2031	2036	2046	2056	Ultimate (2065)
Mackay EP	*119,320*	*123,067*	*132,433*	*141,800*	*151,166*	*160,533*	*179,266*	*198,000*	*214,558*
Mackay AD	33.2	34.3	36.9	39.5	42.1	44.7	49.9	55.1	60.0
Mackay MDMM	46.1	47.6	51.2	54.8	58.4	62.0	69.3	76.5	82.8
Mackay PD	54.7	56.4	60.7	65.0	69.3	73.6	82.2	90.8	98.3
Sarina EP	*9,494*	*9,793*	*10,538*	*11,283*	*12,028*	*12,028*	*14,264*	*15,755*	*17,097*
Sarina AD	2.7	2.7	3.0	3.2	3.4	3.4	4.0	4.4	4.8
Sarina MDMM	3.3	3.4	3.7	3.9	4.2	4.4	5.0	5.5	5.9
Mackay AD plus Sarina AD	35.9	37.0	39.8	42.6	45.5	48.1	53.9	59.5	64.8
Mackay MDMM plus Sarina MDMM	49.4	51.0	54.8	58.7	62.6	66.5	74.2	82.0	88.8
Mackay PD plus Sarina MDMM	58.0	59.8	64.4	68.9	73.5	78.0	87.1	96.2	104.2

Figure 6-2 shows the AD and PD demand growth over from existing to ultimate with Sarina supply. At ultimate with supply to Sarina it is calculated that Mackay's AD will be 65 ML/d, MDMM will be 89 ML/d and PD will be 104 ML/d.

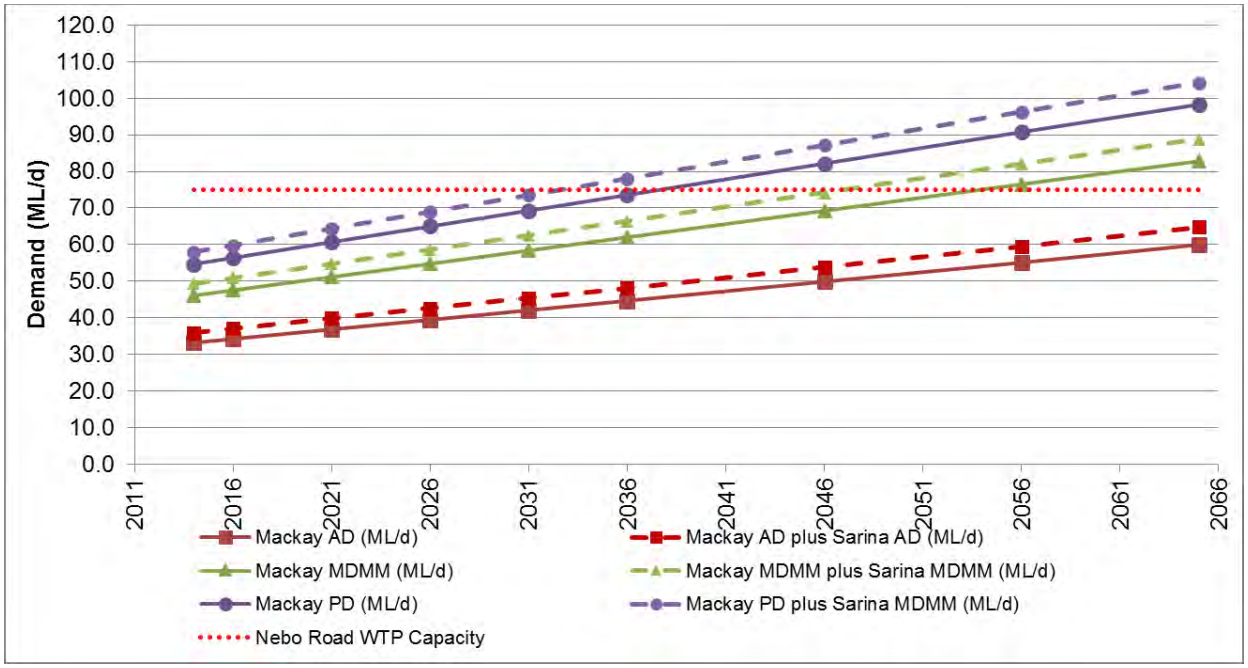


Figure 6-2: AD and PD Demands for 1.57% Growth Rate with Sarina Supply

6.3 Adopted Demand by Zone

A summary of existing and ultimate AD, MDDM and PD demand by zone is provided in Table 6-3. The major growth in demand is anticipated in the following pressure zones:

- Blacks Beach
- Rural View
- Shoal Point
- Silangardies Road (Walkerston)
- Mackay Low Level Zone which will be divided into the Mt Pleasant and Walkerston reservoir zones. This zone serves the following suburbs:
    - Mackay CBD, South Mackay, West Mackay, North Mackay, Glenella, Mt Pleasant, Beaconsfield, Andergrove, Paget, Bakers Creek, Ooralea and Richmond.

Table 6-3: Adopted Demand by Zone

Pressure Zone	Scheme	Exist. EP	Ult. EP	Exist. AD (ML/d)	Ult. AD (ML/d)	Exist. MDMM (ML/d)	Ult. MDMM (ML/d)	Exist. PD (ML/d)	Ult. PD (ML/d)
Ashburtons Road	Northern	89	80	0.02	0.02	0.04	0.03	0.04	0.04
Ball Bay / Haliday	Northern	652	800	0.18	0.21	0.27	0.32	0.31	0.38
Berry Street	Northern	557	630	0.15	0.17	0.23	0.25	0.27	0.30
Blacks Beach	Northern	7,509	12,519	2.1	3.3	3.0	4.8	3.5	5.8
Bonson Scrub	Northern	79	81	0.02	0.02	0.03	0.03	0.04	0.04
Bronson Scrub Road	Northern	27	34	0.01	0.01	0.01	0.01	0.01	0.02
Cape Hillsborough	Northern	235	230	0.07	0.06	0.09	0.09	0.11	0.11
Creese Street Booster	Northern	128	134	0.04	0.04	0.05	0.05	0.06	0.06
Dolphin Heads	Northern	326	366	0.09	0.10	0.13	0.15	0.16	0.17
Farleigh	Northern	1,248	1,148	0.3	0.3	0.5	0.5	0.6	0.5
Glenella PRV	Northern	180	230	0.05	0.06	0.07	0.09	0.09	0.11
Green Street HLZ	Northern	233	254	0.06	0.07	0.09	0.10	0.11	0.12
Harbour Village	Northern	1,196	1,525	0.3	0.3	0.4	0.5	0.4	0.5
Ilallangi Booster	Northern	31	31	0.01	0.01	0.01	0.01	0.01	0.01
Mt Bassett	Northern	3,137	3,145	0.9	0.9	1.1	1.1	1.4	1.4
Mt Vista	Northern	14	85	0.00	0.02	0.01	0.03	0.01	0.04
Peppermint Grove PRV	Northern	259	405	0.07	0.11	0.11	0.16	0.12	0.19
Premier Gardens HLZ	Northern	100	924	0.03	0.24	0.04	0.36	0.05	0.43
Rural View	Northern	11,658	32,376	3.2	8.6	4.7	12.6	5.5	15.1
Seaforth	Northern	1,435	1,516	0.40	0.40	0.57	0.60	0.68	0.71
Seaforth	Northern	69	60	0.02	0.02	0.03	0.02	0.03	0.03
Shoal Point	Northern	803	6,423	0.22	1.70	0.32	2.49	0.38	2.98
Shuttlewoods	Northern	43	88	0.01	0.02	0.02	0.04	0.02	0.04
Slade Point	Northern	4,516	5,056	1.3	1.3	1.8	1.9	2.1	2.3
Slade Point HLZ	Northern	27	32	0.01	0.01	0.01	0.01	0.01	0.02
Sunset Drive	Northern	23	15	0.01	0.00	0.01	0.01	0.01	0.01
The Leap Break Tank	Northern	619	538	0.17	0.14	0.25	0.21	0.29	0.25
Mackay Low Level Zone	Northern/ Southern	79,779	139,030	22.2	40.0	30.6	53.7	36.3	63.4
McEwen's Beach	Southern	613	674	0.17	0.18	0.23	0.27	0.28	0.32
Silingardies Road	Southern	3,736	6,159	1.0	1.6	1.5	2.4	1.8	2.9
Total		**119,320**	**214,589**	**33.2**	**60.0**	**46.1**	**82.8**	**54.7**	**98.3**

Figure 6-3 shows the Northern and Southern EP growth based on the 1.57% growth rate from existing to ultimate. The Northern and Southern scheme boundaries are shown in Appendix D. The trend indicates most of the demand growth is identified in the Northern Scheme as discussed in Section 3.5. It is noted that the Southern Scheme EP growth trend includes Sarina population.

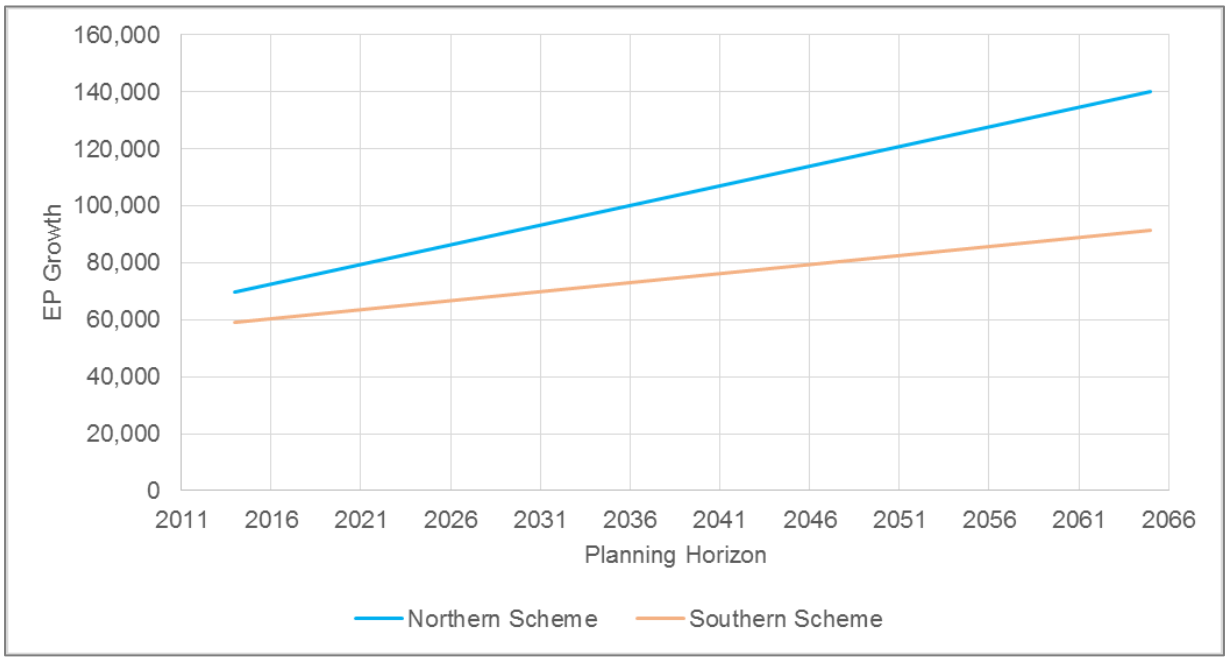


Figure 6-3: Northern and Southern Scheme Population Growth – EP

Figure 6-4 provides a summary of Northern and Southern scheme demand trends (AD, MDMM and PD) based on the 1.57% growth rate from existing to ultimate. It is noted that the Southern Scheme demand trends includes AD and MDMM supply to Sarina.

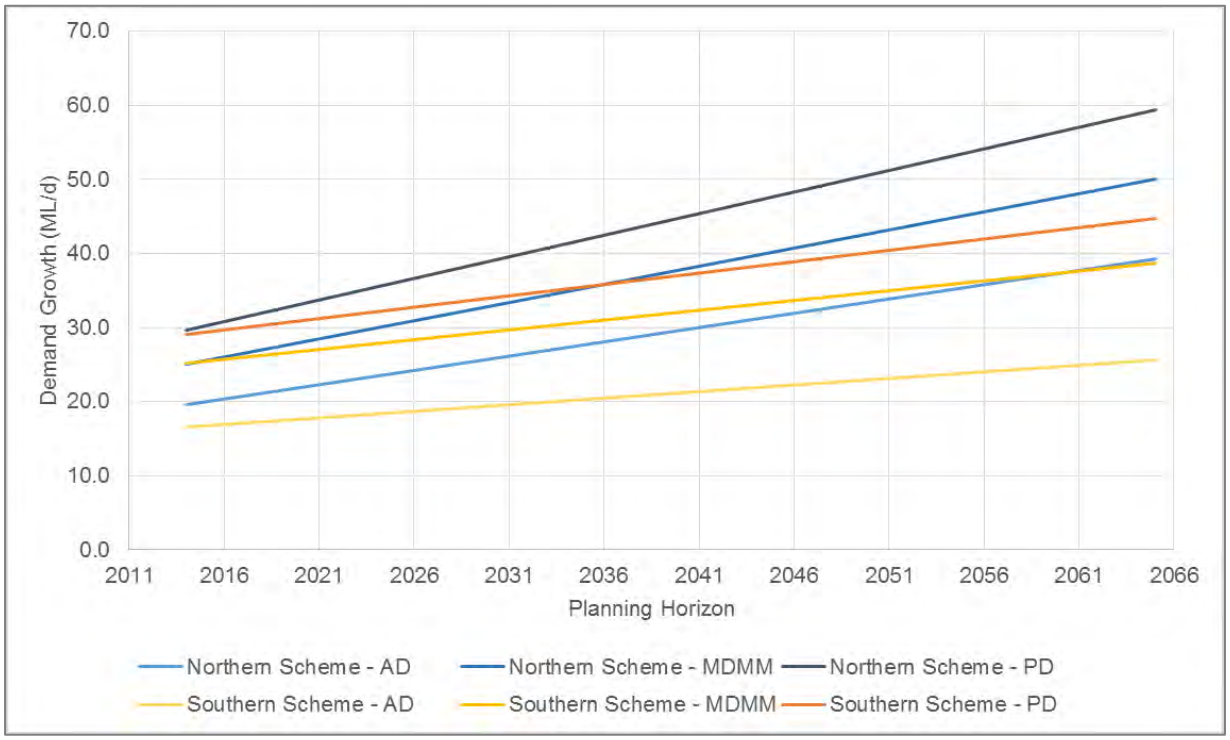


Figure 6-4: Northern and Southern Scheme Demand Growth – AD, MDMM and PD

6.4 Trunk Infrastructure Upgrade Timing Requirements

Upgrades to the water storage/ bulk supply were assessed based on the outcomes of the peak demand persistence analysis. The upgrade timing with and without Sarina supply is provided in Table 6-4. It was assumed that Nebo Road WTP can produce 75 ML/d.

Table 6-4: Storage/ Bulk Supply Upgrade Timing

Growth Scenario	Timing of Upgrades without Sarina Supply	Timing of Upgrades with Sarina Supply
2.4% Growth Rate	2037	2031
1.57% Growth Rate	2045	2038

The growth scenario adopted for this strategy is the re-based growth forecast of 1.57% with Sarina supply. Under this growth scenario, the Nebo Road WTP upgrade and/or additional storage are needed at 2038. This timing was adopted for strategic options in Section 8.

6.5 Sensitivity Assessment based on Demand and Leakage Management

Two sensitivity assessments were completed based on reduction in baseline demand in conjunction with leakage management:

1. 2014 demand (215 L/EP/d) and NRW being reduced from 16% from 12%. Based on these assumptions the ultimate AD demand reduces by 8.9 ML/d and the PD demand by 12.5 ML/d. This would result in a delay of up to 12 years in major system augmentation (refer Figure 6-5).
2. A 10 % reduction on 2014 demand (200 L/EP/d) and NRW being reduced from 16% from 12%. Based on these assumptions the ultimate AD demand reduces by 12.8 ML/d and the PD demand by 18.9 ML/d. This would result in a delay of up to 19 years in major system augmentation (refer Figure 6-6).

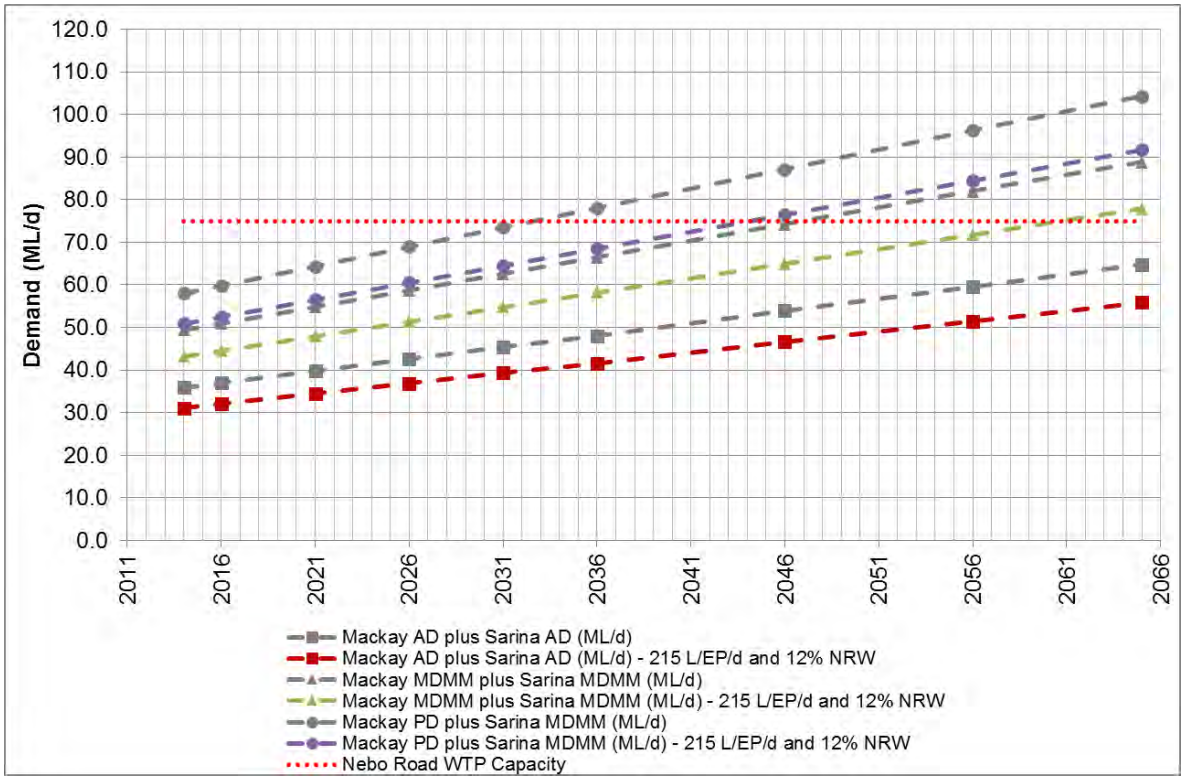


Figure 6-5: Sensitivity Assessment on Baseline Demand Forecasting (215 L/EP/d, 12% NRW)

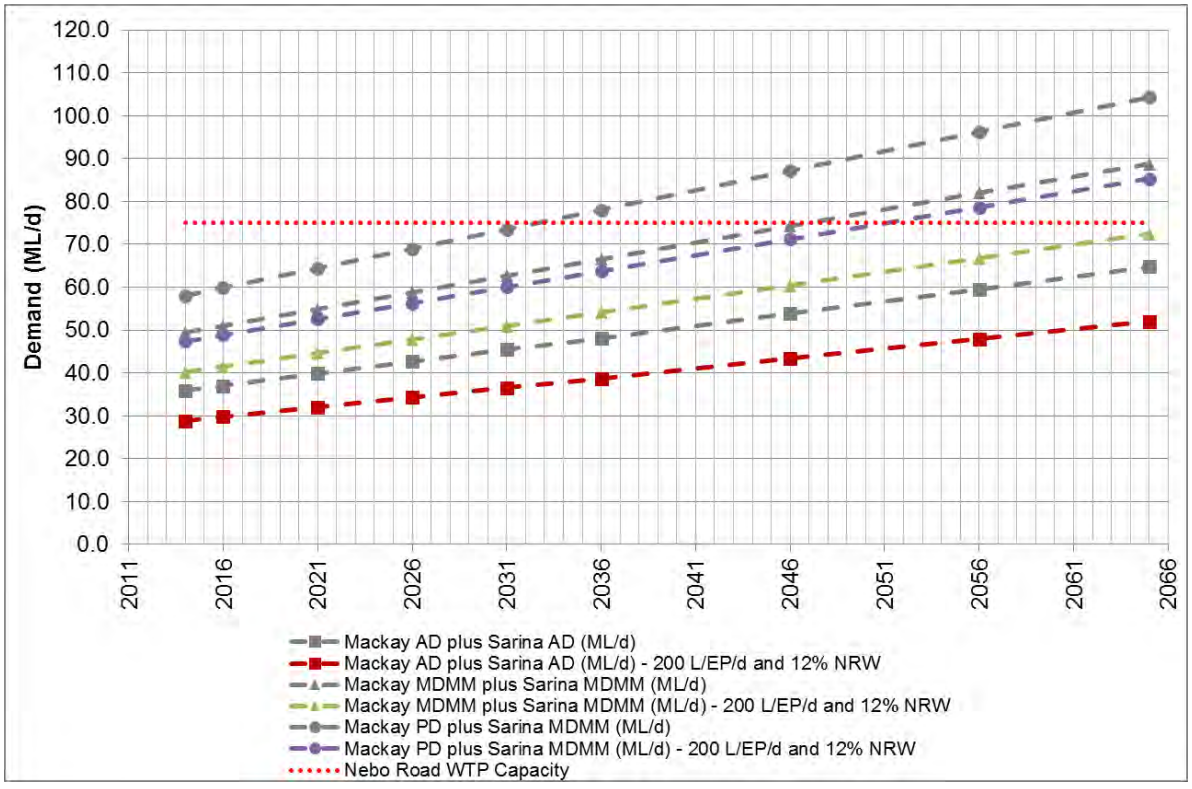


Figure 6-6: Sensitivity Assessment on Baseline Demand Forecasting (200 L/EP/d, 12% NRW)

7 Surface Water Allocation

Mackay Water has an annual allocation of 16,000 ML from the Pioneer River system. The Phase 1 Water Strategy technical memorandum completed a preliminary analysis of the requirement to buy additional High Class A priority water from SunWater.

7.1 Annual Allocation Projection

The water allocation assessment for the Pioneer River system has taken into consideration the following four scenarios using 240 L/EP/d plus 16% non-revenue water:

- Mackay Urban Area only at 2.4 % growth
- Mackay urban Area and supplying Sarina at 2.4% growth
- Mackay Urban Area only at 1.57 % growth
- Mackay urban Area and supplying Sarina at 1.57% growth.

Figure 7-1 shows the four projected annual allocation scenarios.

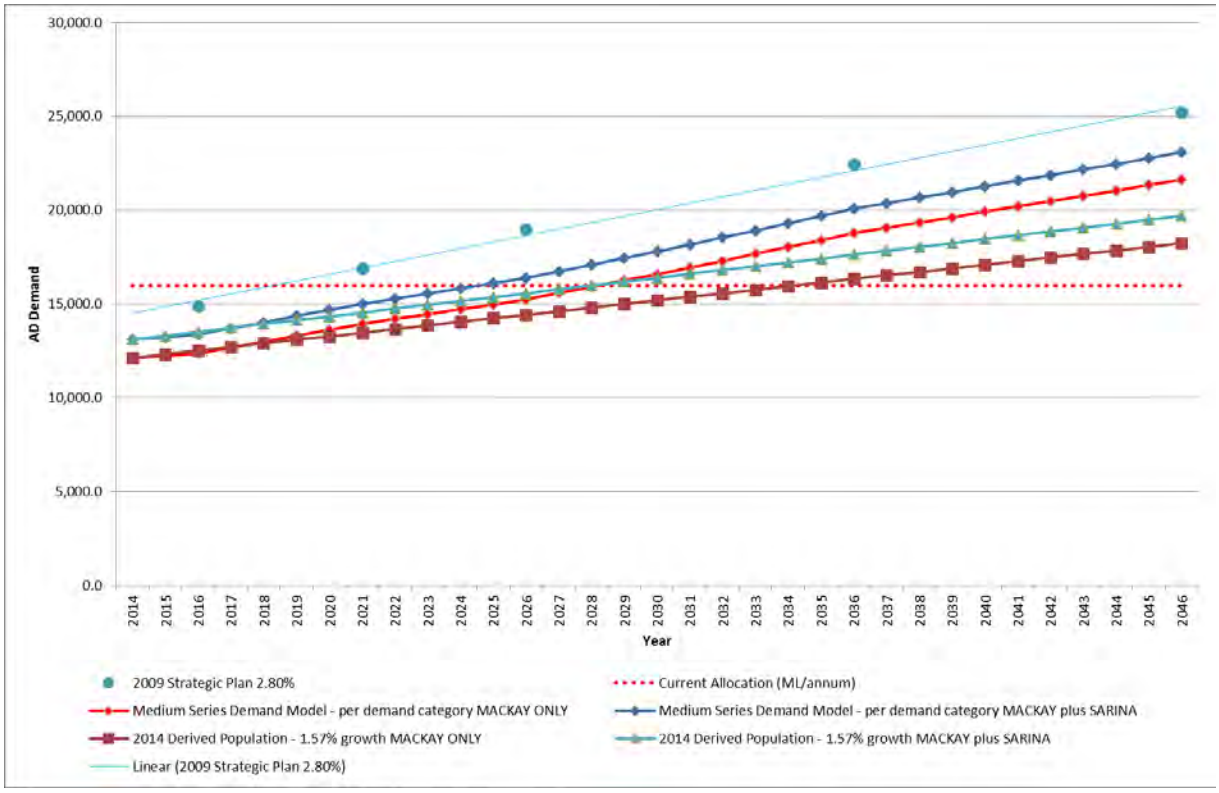


Figure 7-1: Annual Allocation Projection at 240 L/EP/d and 16% NRW

The 2009 water strategy estimated that the current annual allocation would be exceeded by 2018. Based on the revised water strategy baseline assumptions and using a growth rate of 1.57% (with supplying Sarina from Nebo Road WTP) the annual allocation will not be exceeded until 2029.

7.2 Sensitivity Assessment on Annual Allocation Projection

A sensitivity analysis was completed on a reduction in unit demand to 215 L/EP/d (actual 2014 unit demand) and a reduction in NRW from 16% to 12%. Figure 7-2 shows the sensitivity assessment of the four projected annual allocation scenarios.

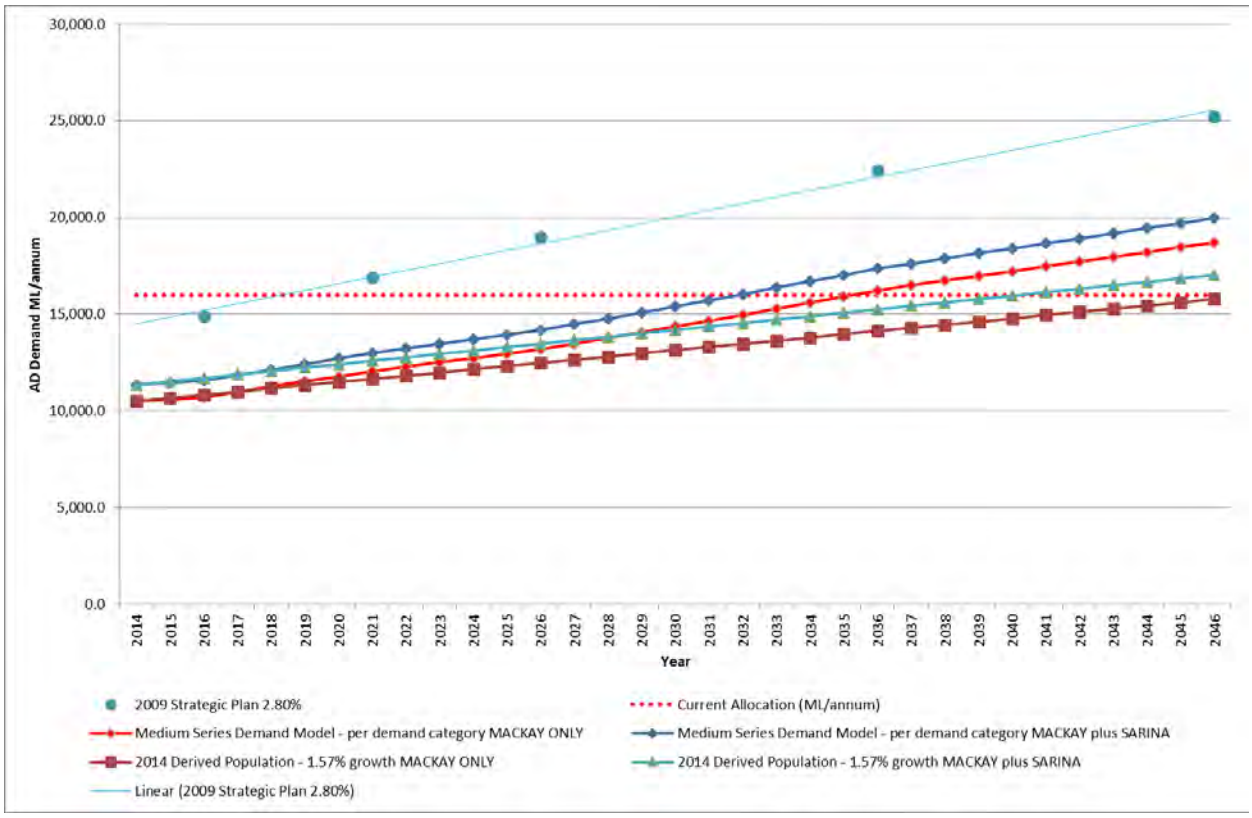


Figure 7-2: Annual Allocation Sensitivity Projection at 215 L/EP/d and 12% NRW

The sensitivity assessment on unit demand and NRW indicates that the annual allocation will be exceeded in 2039, which defers purchasing water for an additional 10 years compared to the baseline estimate of 2029 as shown in Figure 7-1.

A second sensitivity analysis was completed on a 10% reduction on 2014 unit demand (215 L/EP/d) to 200 L/EP/d and a reduction in NRW from 16% to 12%. Figure 7-3 shows the sensitivity assessment of the four projected annual allocation scenarios.

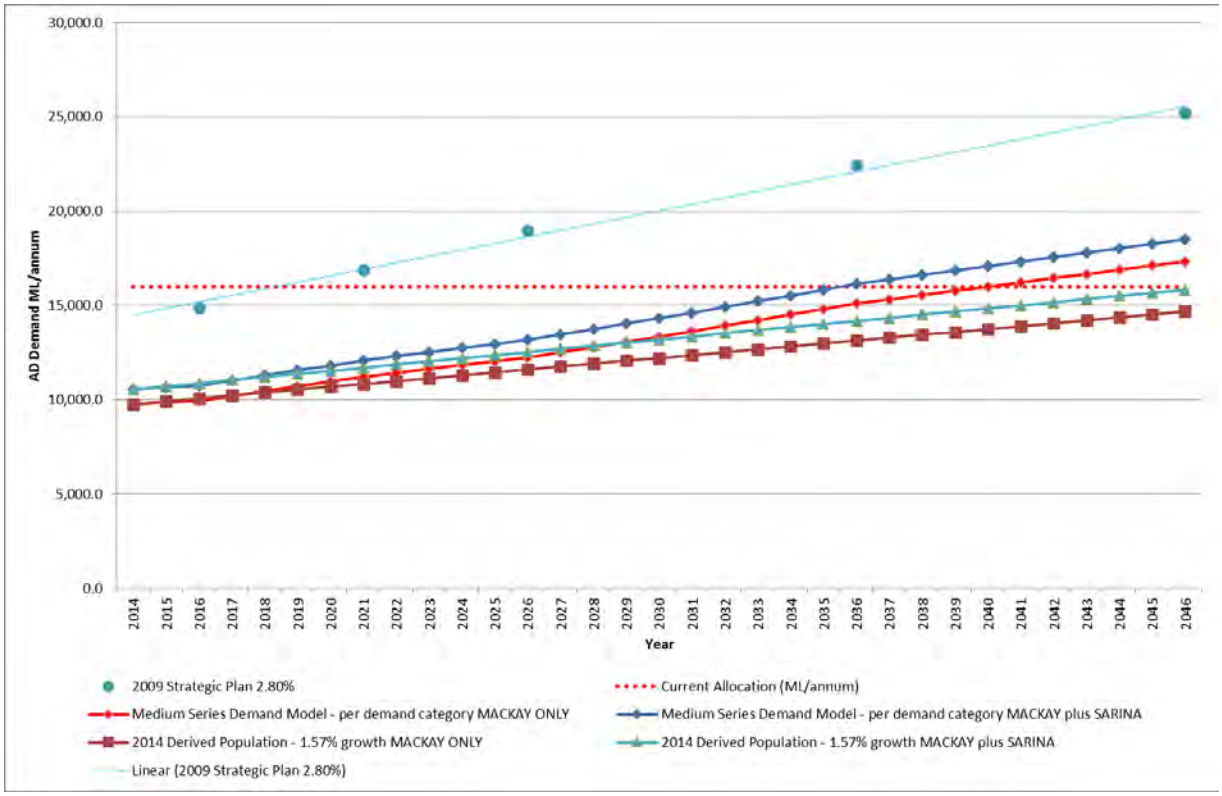


Figure 7-3: Annual Allocation Sensitivity Projection at 200 L/EP/d and 12% NRW

The second sensitivity assessment on reduced unit demand and NRW indicates that the annual allocation will be exceeded in 2047, which defers purchasing water for an additional 18 years compared to the baseline estimate of 2029 as shown in Figure 7-1.

8 Strategic Options Assessment

This section of the report details the strategic options assessment for the raw water transfer, water treatment and major network trunk infrastructure required to service Mackay to ultimate demand.

8.1 Assumptions

The strategic options assessment is premised by the following assumptions:

- Nebo Road WTP's current maximum theoretical output of 75 ML/d is adopted for all options. This capacity is used as the trigger point for all major strategic upgrade strategies. However, section 2.2 provides a summary to the existing raw water infrastructure and treatment constraints of the Nebo Road WTP that do not meet the 75ML/day theoretical capacity. Capital investment is required to ensure that the capacity of 75 ML/d is achieved at the Nebo Road WTP. Based on the Nebo Road WTP Upgrade Options and Cost Estimation report (City Water Technology, 2016) (refer Appendix Q) the total capital cost to upgrade the WTP to 75 ML/d is estimated at $10.2 M. The timing of this work will be subject to further detailed planning and may be brought forward.
- Based on the Mackay's demand persistence, the current WTP issues are required to be upgraded as follows:
    - Resolve vibration issues at Pump 4 as soon as possible
    - Upgrade the power at the Dumbleton River intake by 2032
    - Upgrade the existing RC raw water trunk main to achieve reliability of supply. The reliability of supply to the Nebo Road WTP is significantly impacted due to the maximum flow limitation of 240 L/s in the RC raw water trunk main. If the primary AC/ GRP raw water trunk main failed, there would be a significant supply constraint to the Nebo Road WTP. The existing RC trunk main capacity of 20 ML/d and current Nebo Road bores capacity of 12 ML/d can supply existing Mackay AD demand. When the bore efficiency works are undertaken to the Nebo Road bores (as discussed in Section 2.1.2) the bore capacity will increase to 20 ML/d. This will allow a total contingency capacity of 40 ML/d. On this basis the RC trunk main would require upgrade by 2026.
    - Upgrade the clarifiers by 2022. It is assumed that there is a requirement to increase the WTP capacity beyond 75 ML/d, therefore replacing the existing clarifiers with two new shallow clarifiers with tube settlers would be the preferred approach.
    - Upgrade to the waste water system which includes a second sludge thickener, thickened sludge tank and centrifuge.

It is noted that the process requirements and costing has been revised by City Water Technology to achieve the 75 ML/d as well as look at the specific treatment processes required to increase the capacity of the WTP up to 90 ML/d. The costs to achieve the

required capacity at the Nebo Road WTP will be included in the capital investment program (Section 10).

8.2 Considerations for Developing Options

As part of the strategic options identification process, a number of factors were considered to understand the drivers and requirements of the existing trunk system to satisfy levels of service now and into the future. These items include and are discussed in further detail in the following sections:

- Spatial Distribution of Demand
- Existing Constraints and Issues of Existing Water Supply System
- Previous Strategic Options Assessment completed in 2009 Report.

Based on the items listed above, a stakeholder workshop was held on the 17th June 2015 discuss, identify and confirm the strategic options to take forward to the MCA.

8.2.1 Existing Constraints and Issues

There are a number of constraints and issues with the existing system that frame the identification of strategic options. The constraints and issues include:

- Persistence of peak month demands. As explained in the Phase 1 Technical Memorandum of the water strategy, Mackay demands have persistent peak month demand characteristics that are slightly higher than Mean Day Maximum Month demand but lower than Peak Day demands. As growth occurs in the Mackay network and Mean Day Maximum Month demands approach 75 ML/d (capacity of the Nebo Road WTP), there is a risk that storages can empty due to persistent demand characteristics (greater than MDMM) occurring over a 30 day period. Persistent demands can be overcome by adding more storage to the system or increasing the WTP production to overcome storage deficits.
- Reliability of existing system. Reliability is defined as any element of the system that consistently performs according to its design specifications. The main reliability issues as discussed in the Nebo Road Pinch Point workshop:
    - River water intake pumps. Only two combinations of pumps are available due to vibration of Pump 4
    - Raw water mains. The older AC/ RC main experiences excessive leaks when greater than 240 L/s is pumped through the main. Reliability of raw water supply is compromised if ever the newer AC/ GRP main were to fail, as the AC/ RC main does not have capacity.
    - Treatment capability of high turbidity water due to the existing clarifiers. Under significant rain events, highly turbid river water is received at the Nebo Road WTP and is very difficult to treat based on current treatment process. In these events, the existing Nebo Road borefield is relied upon to supply raw water to the WTP which currently has an emergency allocation of 300 ML/yr only. The emergency allocation is equivalent to 25 days of supply at 12 ML/d.

- Resilience of supply. Resilience is defined as the ability and flexibility for the system to adjust and recover quickly from reliability issues. The main resilience issues are:
    - One WTP supplying the whole of Mackay with limited flexibility to take the WTP offline for maintenance purposes. In the future the WTP will operate at 75 ML/d for up to 30 days (maximum month).
    - Two raw water sources:
        - River source – this is the main supply and raw water infrastructure limited to a theoretical 75 ML/d. Based on the Pinch Point workshop, a reported 68 ML/d capacity can be achieved currently through the existing raw water infrastructure. Therefore an upgrade to the the river source capacity has been planned.
        - Bore source – this is a contingency supply only and is limited to a maximum 16 ML/d (185 L/s) and a current sustainable daily average of 12 ML/d (140 L/s). There are bore efficiency works proposed to return the bore water supply to 20 ML/d (240 L/s) as per the Nebo Road Bores Planning Report (PPB-026). The borefield is to be used as contingency supply only when the river water quality is too difficult to treat due to high turbidity. Existing network reservoir levels are impacted due to the limited WTP production based on the bore supply only.
    - Combined Contingency Supply - Based on a current maximum bore supply of 16 ML/d, the water supply system can operate under 3 days of AD demand before major trunk storages deplete below 30%. Further work is required to develop a control integration plan between major infrastructure that treatment operations control and the network infrastructure which network operations control. The control integration plan would develop protocols so that the total system storage is relied upon in contingency supply periods. For example, reducing/ turning off supply to Golf Links WPS, Janes Creek WPS, Walkerston WPS and the Harbour actuated valve to ensure all reservoirs downstream of these pump stations are more effectively used under contingency supply conditions and supply load is taken off the major storages (Mt Pleasant and Mt Oscar) so that up to 5 days of AD demand can be supplied. The integration plan also needs to indicate the level of WTP production and time required to fill all system storages after a period of contingency supply.

8.2.2 Previous Strategic Water Supply Options (2009 Report)

The previous 2009 strategic report and compared three options:

- Option A1 – New Northern WTP with new river intake at Dumbleton Weir and reservoir at Erakala (50 m AHD – similar level to Mt Pleasant reservoir). The new reservoir would supply southern Mackay (excluding the CBD) via a two staged trunk mains crossing the Pioneer River via or near the upgraded base hospital bridge. The Nebo Road WTP would supply northern Mackay via the existing main.

- Option B1 – New Northern WTP with new river intake at Dumbleton Weir pumping to Mt Pleasant reservoir. The new WTP would supply northern Mackay. The Nebo Road WTP would supply southern Mackay (excluding the CBD).
- Option C1 – New southern WTP with exiting river intake and new reservoir at Walkerston (70 m AHD). The new reservoir would supply southern Mackay (excluding the CBD) via trunk mains along Stockroute Road. The Nebo Road WTP would supply northern Mackay.

Option C1, a new WTP on the southern side of the Pioneer River was selected as the preferred option. The major reasons for the decision were as follows:

- Allows for a configuration of the distribution system so that Nebo Road WTP does not pressurise the distribution system south of the Pioneer River in the longer term.
- Provided for reservoir storage on the southern side of the Pioneer River.

8.3 Options Developed for the 2015 Study

It was agreed at the MRC stakeholder meeting that four strategic options would be taken forward to a multi-criteria assessment (MCA). These include two options previously considered by the 2009 strategic plan as well as including an additional option with a sub-option. The options identified are as follows:

- **Option 1 –** Southern WTP with Walkerston Reservoir (Business As Usual Strategy based on 2009 Strategy)
- **Option 2 –** Upgrade Nebo Road WTP to 90 ML/d with Erakala Reservoir
- **Option 2A –** Upgrade Nebo Road WTP to 90 ML/d with Walkerston Reservoir
- **Option 3 –** Northern WTP with Erakala Reservoir (formerly Option A1 in 2009 Strategy).

Strategic options were limited due to the lack of suitable reservoir sites, including at the existing reservoir complexes. Based on assessment in this study there are only two potential reservoir sites, Walkerston (which has been purchased by MRC) and a potential site at Erakala.

Schematics outlining the key elements and sizing for each option are provided in Appendix E. It is noted the timing of infrastructure outlined in the schematics is in line with the re-based average growth of 1.57% per year.

8.3.1 Replacement of Nebo Road Raw Water RC/ AC Trunk Main

To achieve up to and beyond the 75 ML/d in supplying the Nebo Road WTP a new DN 525 main is required to replace the existing RC/ AC main. To achieve up to 90 ML/d, three existing pumps are required to operate in parallel. Figure 8-1 shows the existing system resistance curve for raw water infrastructure mains along with replacement requirements for the RC/ AC trunk main. The design requirement is applicable to all strategic options and is included in both the whole of life cost assessment and multi-criteria assessment.

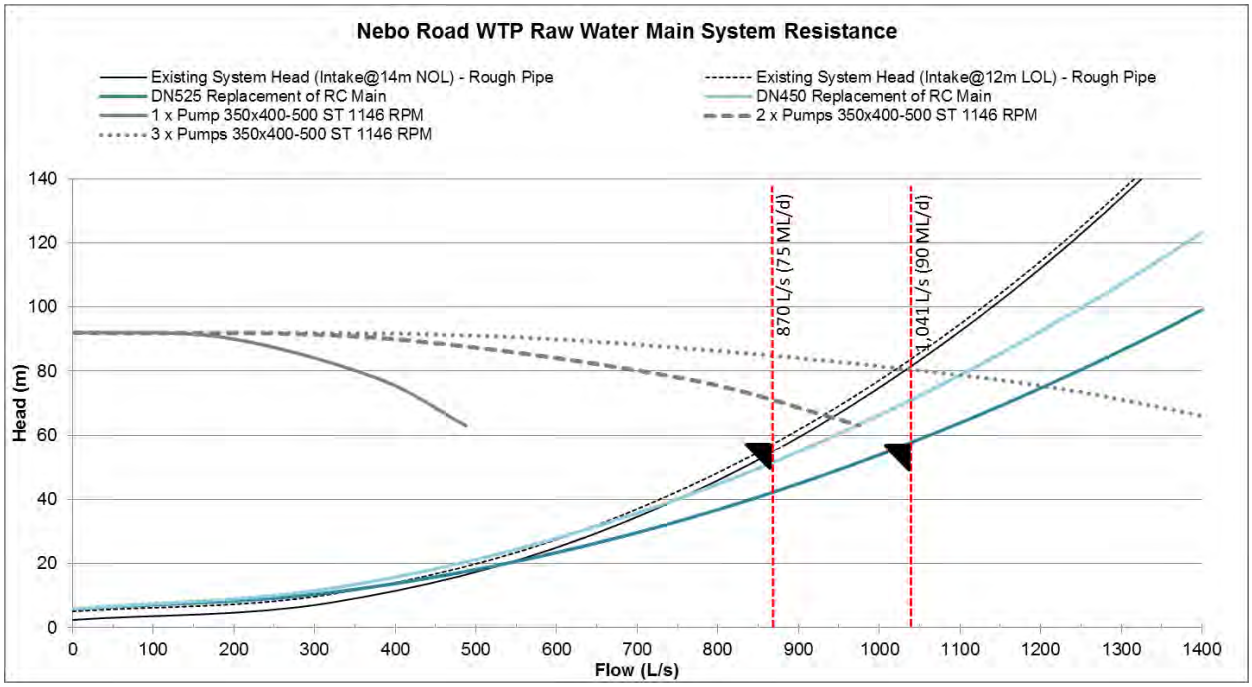


Figure 8-1: River Water Trunk Infrastructure System Resistance Curve

8.4 Option 1 – Southern WTP with Walkerston Reservoir

8.4.1 Overview

Option 1 is the current strategic approach adopted by MWS from the 2009 strategic planning study. The strategic infrastructure requirements for Option 1 are shown in Figure 8-2 and consist of the following:

- Construction of a new Southern WTP
- New 525 mm diameter raw water main from Dumbleton Weir to Nebo Road WTP
- New 600 mm diameter raw water main to the Southern WTP
- New 675 mm diameter treated water delivery main to feed Walkerston Reservoir
- A 16 ML reservoir at Walkerston (site already acquired by MRC)
- Twin 675 mm diameter mains from the Walkerston reservoir to the south Mackay zone via Stockroute Road.
- Associated trunk mains to sectorise the current system into a northern and a southern supply scheme. The new Southern WTP would serve the southern scheme of Mackay and the Nebo Road WTP would serve the northern area of Mackay including the CBD. The northern and southern schemes and ultimate pressure zone boundaries for the Mackay network are shown in Appendix D.

This option is the re-sizing of Option C1 from the previous water strategy completed in 2009. Changes to sizing are based on peak persistent demands requirements and the adopted standards of service as outlined in previous sections.

8.4.2 Raw Water Supply

Raw water infrastructure upgrades for Option 1 initially consist of constructing 11 km of 525 mm diameter main raw water main from the Dumbleton River intake to the Nebo Road WTP. This trunk main would replace the existing RC/ AC trunk main so as to achieve the 75 ML/d at the Nebo Road WTP and ensure security of supply. This trunk main would be required by 2026.

By 2038 the new Southern WTP will be required to service demand growth. The new Southern WTP will utilise the current river water intake and pumps at Dumbleton Weir. Construction of 750 m of 600 mm diameter raw water trunk main will be required to connect into the existing raw water mains at the corner of Mackay Eungella Road and Palms Road.

To achieve the 90 ML/d design requirement three of the four existing pumps at the Dumbleton River intake will be required to operate in parallel. Currently the river water pumps operate in a duty/ duty/ standby/standby arrangement. The power supply at the Dumbleton River intake will be required to enable the duty/duty/duty/standby arrangement to operate.

8.4.3 Water Treatment and Transfer

Option 1 requires the constructing of the Southern WTP at the corner of Peak Downs Highway and Palms Road which is the preferred site based on the Southern WTP Siting Study (Cardno, 2015). The new WTP would require a capacity of 35 ML/d and be constructed by 2038. A transfer pump station water would pump water to a 16 ML reservoir located at Walkerston. The new WTP will be constructed in a single stage as it is anticipated that the majority of the growth in the southern scheme will be complete with the exception of Ooralea.

The Nebo Road WTP will continue to service the Northern Scheme which includes the Mackay CBD. To ensure security of supply between the Southern WTP and the Nebo Road WTP, a new 600 mm diameter main and control valve is proposed to provide increased reliability at the Nebo Road WTP. This main will allow connection of the southern scheme to the Nebo Road WTP balance tanks. This will facilitate the shutting down of the Nebo Road WTP raw water and process infrastructure and will allow the northern scheme to be supplied via the southern scheme infrastructure and the Nebo Road HLPS.

Option 1 would maintain the recommendations of the Nebo Road High Lift Pump Station Planning Report (TR-055), i.e. upgrade the station to operate at 75 ML/d. The preferred pump strategy is to utilise the existing pump station capacity with a staged replacement/ upgrade of Pumps 4, 5 and 6 to 430 L/s each and replacement of Pump 2 and 3 with 175 L/s

pumps to provide an instantaneous capacity of 1,035 L/s and back up capacity for the jockey (175 L/s) pump.

It is noted that the recommendations in planning report TR-055 would be required for each strategic option. The costs associated with the preferred pump strategy are therefore not included in the strategic options assessment.

8.4.4 Storage

Option 1 storage requirements consist of constructing a new 16 ML reservoir at Walkerston (1052 Stockroute Road) at 2038. This reservoir would have a nominal top water level of 70 m AHD and serve a revised local Walkerston reservoir zone (refer Appendix D). The reservoir storage size is based on 3 x (MD-MDMM) approach as the new Southern WTP is sized to take into account persistent demand. The site for the new Walkerston reservoir has been purchased by MRC based on the 2009 Strategic Plan.

8.4.5 Trunk Mains

Required trunk mains from the Southern WTP to the storage consists of 6 km of 675 mm diameter pipeline in 2038.

Discharge trunk mains would be staged from the new Walkerston reservoir to the southern scheme via Stockroute Road. The first trunk main would consist of 9.1 km of 675 mm diameter main as well as an additional 2.8 km of 600 mm diameter main. This would connect into the existing 600 mm diameter southern distribution trunk main at the corner of Crichtons Road and Connors Road. The second 675 mm trunk main would follow a similar route as the first trunk main and would be required by 2056 to accommodate increased peak demand in the southern scheme. The second trunk main would end at Cowleys Road where peak flow would be transferred via the Stockroute Road trunk main and north via the future Cowleys Road trunk mains once development occurs in Ooralea.

Figure 8-2: Option 1 Strategic Infrastructure Requirements

8.4.6 *Summary of Required Works*

A summary of required works and staging for Option 1 is provided in Table 8-1.

Table 8-1: Option 1 Infrastructure Requirements

Infrastructure Type	Asset ID	Size (mm)	Length (m)	Year Required
Raw Water	Option_1_RW_001	525	11,000	2026
	Option_1_RW_002	600	750	2038
Water Treatment	Option_1_Southern_WTP	35 ML/d		2038
	Option_1_TM_008	600	130	2038
	Option_1_Reliability_Valve	500		2038
Trunk Mains	Option_1_TM_001	675	6,000	2038
	Option_1_TM_002	675	9,100	2038
	Option_1_TM_003	675	9,100	2056
	Option_1_TM_004	300	1,500	2038
	Option_1_TM_005	600	1,630	2038
	Option_1_TM_006	600	620	2038
	Option_1_TM_007	600	620	2038
Storage	Option_1_Walkerston_Res	16 ML		2038

8.5 Option 2 – Upgrade Nebo Road WTP with Erakala Reservoir

8.5.1 *Overview*

Option 2 examines the potential of increasing WTP production at Nebo Road to 90 ML/d with WTP sizing based on demand persistence requirements and the adopted standards of service highlighted in Section 5 of this technical memorandum. The strategic infrastructure requirements are shown in Figure 8-3. The option consists of the following major elements:

- Construction of a new 525 mm raw water main
- Upgrading the Nebo Road WTP from 75 ML/d to 90 ML/d
- Upgrading of the Nebo Road HLPS to have two separate sets of pumps servicing the northern and southern systems
- Construction of a new reservoir at Erakala at 70 m AHD
- Associated trunk mains and other network infrastructure.

The Nebo Road WTP would serve both the southern and northern schemes by reconfiguring the Nebo Road HLPS. The new Erakala Reservoir would serve the southern scheme of Mackay and the Mt Pleasant/ Mt Oscar reservoirs would serve the northern scheme of Mackay including the CBD.

The Nebo Road HLPS would be reconfigured to allow one set of pumps to serve the northern scheme of Mackay and a separate set of pumps to serve the southern scheme via a new Erakala reservoir. Details of the northern and southern schemes and the ultimate pressure zones are provided in Appendix D.

8.5.2 Raw Water

Raw water infrastructure upgrades under Option 2 consist of constructing 11 km of new 525 mm diameter main from the Dumbleton Weir intake to the Nebo Road WTP, required at 2026. This trunk main would replace the existing RC/AC trunk main to achieve 75 ML/d at the Nebo Road WTP and to ensure security of supply. The new raw water trunk main will have capacity to serve to 90 ML/d.

To achieve the 90 ML/d design requirement at the Dumbleton Weir intake, three of the four existing pumps would require to operate in parallel. Currently the river water pumps operate in a duty/duty/standby/standby arrangement. There would be a requirement to upgrade the power supply at the Dumbleton Weir intake to allow for a duty/duty/duty/standby arrangement.

8.5.3 Water Treatment

The Nebo Road WTP will service the entire Mackay water supply scheme and the Sarina scheme, requiring an upgrade from 75 ML/d to 90 ML/d. The upgrade requirements were determined by City Water Technology (refer Appendix Q). The following upgrades were identified. The timing of these upgrades is to be further refined during detailed planning:

- Upgrade of chemical dosing systems and dosing pumps, clarifiers, sludge management facilities and SCADA/ PLC modifications as summarised in Table 8-2 (excluding GST). Costs were taken from the Nebo Road WTP Upgrade Options and Cost Estimation report (City Water Technology, 2016).
- Reconfiguration of the Nebo Road HLPS to allow separate sets of pumps to supply to Mt Pleasant/ Mt Oscar reservoirs (northern scheme) and to the new Walkerston reservoir (southern scheme). The following upgrades are proposed:
    - Existing pumps 4, 5 and 6 would supply the northern scheme at the existing total duty of 878 L/s at 60 m.
    - A new isolation valve would separate pumps 4, 5 and 6 from pumps 1, 2 and 3 is required.
    - Pumps 1, 2 and 3 would be required to be upgraded to a total discharge of 450 L/s at 80 m.

Table 8-2: Option 2 - Nebo Road WTP Upgrade Requirements

WTP Asset	Upgrade Action	Estimated Cost
Chemical dosing systems	Upgrade chlorine gas dosing and centrifuge polymer batching system	$0.2M

Chemical dosing pumps	Upgrade ACH dosing pumps and Polymer dosing pumps	$0.14M
Clarifier	Replacement of existing clarifiers and installation of two circular shallow depth clarifiers with tube settlers	$8.9
Sludge management facilities	Installation new sludge thickener, new thickened sludge tank and new centrifuge	$3.1M
SCADA/PLC modification	Modification or integration of the SCADA/PLC of Stage 1 and 2 River Filters to with Stage 1 Bore Filters	$0.03M
HLPS Upgrade	Nebo Road HLPS Reconfiguration and Upgrade from 75 ML/d to 90 ML/d. Northern Scheme Required Supply Capacity - 53 ML/d, (Existing D/D/A arrangement 868 L/s at 60 m - Pumps 4, 5, 6). Southern Scheme Required Supply Capacity - 35 ML/d (New D/D/A arrangement 405 L/s at 80 m - replace Pumps 1, 2, 3)	$1.6M
Total Estimated Cost (including contingency)		**$14.0**

Figure 8-3: Option 2 Strategic Infrastructure Requirements

8.5.4 Storage

Option 2 storage requirements consist of constructing a new 16 ML reservoir at Erakala (368 Sugarshed Road) at 2038. This reservoir would have a top water level of 70 m AHD and serve the southern scheme (refer Appendix D). The reservoir storage size is based on the standard 3 x (MD-MDMM) approach as the Nebo Road WTP upgrade is sized to take account of persistent demand.

Initial assessment shows that this site is heavily vegetated and is located in an area identified as a regional ecosystem (as identified in state mapping). Further detailed environmental assessment will be required to assess the viability of the site.

8.5.5 Trunk Mains

Trunk mains required under Option 2 consist of staged mains from the upgraded Nebo Road WTP to a new reservoir at Erakala. Two 675 mm diameter trunk mains are required to supply ultimate peak hour flow from the reservoir into the system when the Nebo Road HLPS is not operating. The first trunk main would consist of 8.5 km of 675 mm diameter pipe and along the Mackay Bypass Road crossing the new Hospital Bridge. The trunk main would turn west at the corner of the Mackay Bypass Road and Sugarshed Road and then north approximately 250 m after Harvisons Road to connect to the Erakala Reservoir. The first trunk main would be required at 2038. To mitigate excessive pressures in the southern scheme network when the Nebo Road High Lift Pump Station is operating, a new 500 mm diameter PRV is proposed downstream of the pumps at the Nebo Road WTP. It is proposed to serve the existing 600 mm diameter and existing 300 mm diameter trunk mains through the new PRV set at 60 m pressure.

Along with the first trunk main, a reliability connection and control valve would be constructed along Heaths Road to connect into the existing 800 mm trunk main that supplies to Mt Pleasant Reservoirs. The reliability trunk main and control valve will allow greater flexibility in supplying the northern scheme from the southern scheme.

The second 675 mm trunk main from the Nebo Road WTP to the new Erakala reservoir would follow a similar route as the first trunk main. It is required by 2056 to accommodate increased peak demand in the southern scheme. The main would need to be placed on the new Hospital Bridge or may need to be drilled beneath the Pioneer River, if the bridge option is not available.

It is likely that water quality will be an issue with this option as the trunk main/ reservoir system would create a floating reservoir and negatively impact water age and reduce chlorine levels in the network. The second trunk main would allow the system to be setup so that this trunk main could act as a rising main to Erakala reservoir and the first trunk main act as a gravity backfeed into the network under low demand operating conditions. If the Nebo Road HLPS were to experience power failure under peak demand conditions, both trunk mains could supply the southern scheme to satisfy minimum pressure standards.

Additional 300 mm diameter trunk mains will service the Ooralea development and are required in 2046. The trunk mains will connect at the corner of Connors Road and Crichtons Road, then south along Connors Road and west along Stockroute Road, finishing at Cowleys Road.

8.5.6 Summary of Required Works

A summary of required works and staging for Option 2 are provided in Table 8-3.

Table 8-3: Option 2 Infrastructure Requirements

Infrastructure Type	Asset ID	Size (mm)	Length (m)	Year Required
Raw Water	Option_2_RW_001	525	11,000	2026
Water Treatment	Option_2_Nebo_WTP_Upgrade	90 ML/d		2038
	Option_2_TM_004	675	95	2038
	Option_2_PRV	500		2038
	Option_2_HLPS_Upgrade			2038
Trunk Mains	Option_2_TM_005	300	620	2038
	Option_2_TM_006	300	2,400	2038
	Option_2_TM_009	675	8,500	2038
	Option_2_TM_010	300	8,500	2056
	Option_2_TM_012	600	1,275	2038
	Option 2_Reliability_Valve	500	620	2038
Storage	Option_2_Northern_Res	16 ML		2038

8.6 Option 2A – Upgrade Nebo Road WTP with Walkerston Reservoir

8.6.1 Overview

- Similarly to Option 2, Option 2A involves the upgrading of the Nebo Road WTP to 90 ML/d based on demand persistence requirements and the adopted standards of service highlighted in Section 5 of this technical memorandum. The strategic infrastructure requirements for Option 2 are shown in

Figure 8-4.

Option 2A consists of the following key elements:

- New 525 mm diameter raw water main from Dumbleton Weir to Nebo Road WTP
- Upgrading of the Nebo Road WTP from 75 ML/d to 90 ML/d
- Upgrading of the Nebo Road HLPS to have two separate sets of pumps servicing the northern and southern systems
- Construction of a new 16 ML reservoir at Walkerston
- Associated trunk mains and other network infrastructure.

The Nebo Road WTP would serve both the southern and northern schemes by reconfiguring the Nebo Road HLPS. The new Walkerston Reservoir would serve the southern scheme and the Mt Pleasant/ Mt Oscar reservoirs would serve the northern scheme including the CBD.

Details of the northern and southern schemes and ultimate pressure zones for the Mackay network under this options are provided in Appendix D.

8.6.2 Raw Water

Option 2A raw water infrastructure requirements are the same as for Option 2 and consist of construction of 11 km of 525 mm diameter main from the Dumbleton Weir intake to the Nebo Road WTP and is required by 2026. This trunk main would replace the existing RC/AC trunk main, initially to achieve the 75 ML/d capacity of the existing Nebo Road WTP and ensure security of supply. The new raw water trunk main will also have sufficient capacity to serve up to 90 ML/d.

As for the other options the raw water pumping station at Dumbleton Weir will require upgrade to the power supply to allow for a duty/duty/duty/standby configuration to operate.

8.6.3 Water Treatment

The Nebo Road WTP will service the whole of Mackay and will be upgraded from 75 ML/d to 90 ML/d. The Nebo Road WTP clarifiers, filtration system and wash-water systems would be required to be upgraded as per Option 2.

Reconfiguration of the Nebo Road HLPS will be required to allow separate sets of pumps to supply to Mt Pleasant/ Mt Oscar reservoirs (northern scheme) and the new Walkerston reservoir (southern scheme). The following upgrades are proposed:

- Existing pumps 4, 5 and 6 would supply the northern scheme at the existing total duty of 878 L/s at 60 m.
- A new isolation valve would separate pumps 4, 5 and 6 from pumps 1, 2 and 3 is required.
- Pumps 1, 2 and 3 would be required to be upgraded to a total discharge of 450 L/s at 80 m.

Figure 8-4: Option 2A Strategic Infrastructure Requirements

8.6.4 Storage

Option 2A storage requirements consist of constructing a new 16 ML reservoir at Walkerston (1052 Stockroute Road) by 2038. This reservoir would be constructed with a top water level of 70 m AHD. As well as serving the southern Mackay scheme, the reservoir would serve the local Walkerston zone (refer Appendix D).

The reservoir storage size is based on 3 x (MD-MDMM) approach as the new southern WTP is sized to taken into account persistent demand. The site for the new Walkerston reservoir has been purchased by MRC based on the 2009 Strategic Plan.

8.6.5 Trunk Mains

Option 2A trunk mains consist of staged delivery of two major mains between the newly upgraded Nebo Road WTP and the new Walkerston reservoir. Two trunk mains are required to supply ultimate peak hour flow from the reservoir into the system if the Nebo Road High Lift Pump Station is not in operation during peak periods.

The initial trunk main would consist of 9.1 km of 675 mm diameter main as well as an additional 2.8 km of 600 mm diameter main connecting to the existing 600 mm diameter southern distribution trunk main at the corner of Crichtons Road and Connors Road. The first trunk main would be required by 2038.

The second 675 mm trunk main would connect to the existing 600 mm diameter trunk main at Paradise Street and follow the Peak Downs Highway to the new Walkerston reservoir via the following proposed route:

- Alexandria Road
- Walkerston Homebush Road
- Silangardies Road
- Bold Street
- Stockroute Road.

This second trunk main is required by 2056 to accommodate increased peak flow demand in the southern scheme as well as supply the Walkerston Township so that Silangardies reservoir and the Walkerston pump station could be turned off. The second trunk main would also provide improvements in water quality.

It is likely that water quality would present an issue with this option as the trunk main/ reservoir system would create a floating reservoir which could negatively impact water age and reduce chlorine levels in the network. This issue could be managed through the operational optimisation to ensure that turnover is achieved at Walkerston reservoir, however there may be a requirement to boost chlorine at the reservoir outlet. In addition the second trunk main would allow the system to be setup as a separate inlet and outlet for average demand conditions. To achieve this flexibility, a control valve would be required at Paradise Street to allow the second main to act as gravity backfeed into the network under

contingency operating conditions or at high demand. Under peak demand the Nebo HLPS would pump into the network and water would also feedback from the reservoir via both mains to satisfy minimum pressure standards in the network.

To mitigate excessive pressure in the southern scheme network when the Nebo Road High Lift Pump Station is operating, thirteen PRVs are proposed on branches of the existing 600 mm diameter trunk main that supplies the southern system. It is proposed to set these PRVs at 60 m pressure. This option will require further refinement in a planning study to plan the implementation of pressure managed areas (PMAs) for the southern system in line with proposals in Option 2A. The PMA planning study would optimise the pressure management requirements for the southern scheme by implementing Option 2A.

8.6.6 Summary of Required Works

A summary of required works and staging for Option 2A are provided in Table 8-4.

Table 8-4: Option 2A Infrastructure Requirements

Infrastructure Type	Asset ID	Size (mm)	Length (m)	Year Required
Raw Water	Option_2A_RW_001	525	11,000	2026
Water Treatment	Option_2A_Nebo_WTP_Upgrade	90 ML/d		2038
	Option_2A_HLPS_Upgrade			2038
Trunk Mains	Option_2A_TM_001	675	9,100	2038
	Option_2A_TM_002	600	1,630	2038
	Option_2A_TM_003	600	820	2038
	Option_2A_TM_004	600	620	2038
	Option_2A_TM_005	675	14,000	2056
	Option_2A_Control_Valve	500		2056
	Option_2A_TM_006	600	30	2038
	Option_2A_PRV-1	300		2038
	Option_2A_PRV-2	450		2038
	Option_2A_PRV-3	100		2038
	Option_2A_PRV-4	100		2038
	Option_2A_PRV-5	100		2038
	Option_2A_PRV-6	150		2038
	Option_2A_PRV-6A	100		2038
	Option_2A_PRV-7	150		2038
	Option_2A_PRV-8	250		2038
	Option_2A_PRV-9	150		2038
	Option_2A_PRV-10	250		2038
	Option_2A_PRV-11A	100		2038

	Option_2A_PRV-11B	200	2038
Storage	Option_2A_Walkerston_Res	16 ML	2038

8.7 Option 3 – Northern WTP with Erakala Reservoir

8.7.1 Overview

Option 3 consists of construction of a new Northern WTP with associated trunk mains with separate northern and southern zones as per other options. Details of the northern and southern schemes and ultimate pressure zone boundaries for the Mackay network are provided in Appendix D.

The strategic infrastructure requirements for Option 3 are shown in Figure 8-5. This option was assessed in the 2009 strategic water strategy, and was reassessed in this report taking account of a different reservoir site at Erakala.

Option 3 comprises the following key elements:

- Construction of a new Northern WTP
- New 525 mm diameter raw water main from Dumbleton Weir to Nebo Road WTP
- New intake tower and pumping station at Dumbleton Weir
- New 675 mm diameter raw water main to the Northern WTP
- A 16 ML reservoir at Erakala
- Twin 675 mm diameter mains from the Erakala reservoir to the south Mackay
- Associated trunk mains to sectorise the current system into a northern and a southern supply scheme.

8.7.2 Raw Water

As for other options, Option 3 would require an 11 km of 525 mm diameter main raw water main from the Dumbleton Weir intake to the Nebo Road WTP. This trunk main is required by 2026 to replace the existing RC/AC trunk main and achieve 75 ML/d at the Nebo Road WTP and ensure security of supply.

By 2038 the new Northern WTP will be required to service growth in demand. The Northern WTP will require a new river intake on the north side of the Dumbleton Weir. A new 600 mm diameter raw water trunk main would transfer flow to the new WTP. Under the current arrangements, Ergon advised that a new power supply would be provided with no additional cost to MRC.

8.7.3 Water Treatment

Water treatment requirements under Option 3 consist of new WTP at the end of Mallia Road adjacent to 19 Aprile Court. This proposed site, located on parcel 21/SP259201, is above the Q100 flood level. The new WTP would require a capacity of 35 ML/d and be constructed by 2038. The new WTP will be constructed in a single stage as it is anticipated that the majority

of the growth in the southern scheme will be realised, with the exception of Ooralea. Power supply would be made available by Ergon, under current arrangements.

The Nebo Road WTP will continue to service the northern scheme which includes the CBD. To ensure security of supply between the northern WTP and Nebo Road WTP a new 600 mm diameter reliability main and control valve would be provided at the Nebo Road WTP. This main will allow connection of the southern scheme via the Nebo Road balance tanks. The Nebo Road WTP raw water and process infrastructure could be shut down if required and the northern scheme supplied via the southern scheme infrastructure through the Nebo Road HLPS.

Option 3 would maintain the recommendations of the Nebo Road High Lift Pump Station Planning Report (TR-055), i.e. upgrade the station to operate at 75 ML/d. The preferred pump strategy is to utilise the existing pump station with a staged replacement/ upgrade of Pumps 4, 5 and 6 to 430 L/s each and replacement of Pump 2 and 3 with 175 L/s pumps to provide an instantaneous flow of 1,035 L/s and back up for the jockey (175 L/s) pump.

8.7.4 Storage

Option 3 storage requirements consist of constructing a new 16 ML reservoir at Erakala (368 Sugarshed Road) at 2038, as per Option 2A. This reservoir would be constructed at a nominal top water level of 70 m AHD and serve the southern scheme (refer Appendix D). The reservoir storage size is based on 3 x (MD-MDMM) approach as the northern WTP upgrade is sized to take into account persistent demand.

8.7.5 Trunk Mains

Option 3 trunk mains requirements consist of constructing 6.3 km of 675 mm diameter transfer main from the northern WTP to the new Erakala Reservoir. This trunk main would be a dedicated supply to the new Erakala reservoir and would be required by 2038.

Under Option 3, two major trunk mains would be staged from the new Erakala reservoir to the southern scheme. Two mains are required to supply ultimate peak hour flow. The first trunk main would consist of 8.5 km of 675 mm diameter main and would follow Sugarshed Road west to the corner of the Mackay Bypass Road and Sugarshed Road. The trunk main would then follow the Mackay Bypass Road crossing the new Hospital Bridge which allows for a single pipe crossing. The trunk main would then connect into the existing 600 mm diameter and 300 mm diameter trunk main at Nebo Road WTP.

The second 675 mm trunk main would follow a similar route as the first trunk main with a drilled crossing of the Pioneer River, unless approval is granted for a second bridge crossing. This main is required by 2056 to accommodate increased peak demand in the southern scheme. Additional 300 mm diameter trunk mains to service the Ooralea development are required by 2046. The trunk mains will connect at the corner of Connors Road and Crichtons Road and follow Connors Road south before turning west along Stockroute Road and finishing at Cowleys Road.

Figure 8-5: Option 3 Strategic Infrastructure Requirements

8.7.6 Summary of Required Works

A summary of required works and staging for Option 3 are provided in Table 8-5.

Table 8-5: Option 3 Infrastructure Requirements

Infrastructure Type	Asset ID	Size (mm)	Length (m)	Year Required
Raw Water	Option_3_RW_001	525	11,000	2026
	Option_3_RW_002	600	300	2038
	Option_3_Northern_River_Intake	35 ML/d		2038
Water Treatment	Option_3_Northern_WTP	35 ML/d		2038
Trunk Mains	Option_3_TM_003	675	75	2038
	Option_3_TM_004	600	140	2038
	Option_3_Reliability_Valve	500		2038
	Option_3_TM_005	300	620	2038
	Option_3_TM_006	300	2,400	2038
	Option_3_TM_007	675	6,320	2038
	Option_3_TM_008	675	8,000	2038
	Option_3_TM_009	675	8,000	2056
Storage	Option_3_Northern_Res	16 ML		2038

8.8 Comparison of Option Costs

8.8.1 Methodology and Assumptions

The four strategic options were assessed for whole of life costs to implement the trunk elements for each option. Options cost assessment did not include for the upgrade of the Nebo Road WTP to 75 ML/d as this was considered common to all options. WTP upgrade costs were however included in the final capital investment program.

The following whole of life cost assumptions have been applied:

- Capital costs are based on:
  - Unit rates contained within the Cardno report, Provision of Unit Rates for Water and Wastewater Assets for 2011/12, and indexed to 2015 using a CPI of 7%.
  - A contingency of 38% based on the Contingency/Risk Worksheet (refer Appendix B).
  - Pump station efficiencies of 80% to derive pump kW size.
- Operational costs are based on:

- Actual raw water intake and treatment costs provided by MWS Treatment Operations Manager and indexed per year based on anticipated production.
- Fixed WTP labour costs at $800,000 per year.

- Whole of life costing and infrastructure timing based on 1.57% growth rate including supply to Sarina.
- Discount rate of 5%.
- Each option allows for the cost of replacing the existing RC raw water trunk main from Dumbleton Weir to Nebo Road WTP.

8.8.2 Comparison of Option Costs (NPV)

The whole of life cost assessment calculations (NPV) are provided in Appendix F. A comparison of whole of life costs for the four options is shown in Figure 8-6. Both Option 1 and Option 3 have a similar whole of life costs at around $121 M. Options 2 and 2A have significantly lower NPVs at $102.3 M and $105.7 M, respectively.

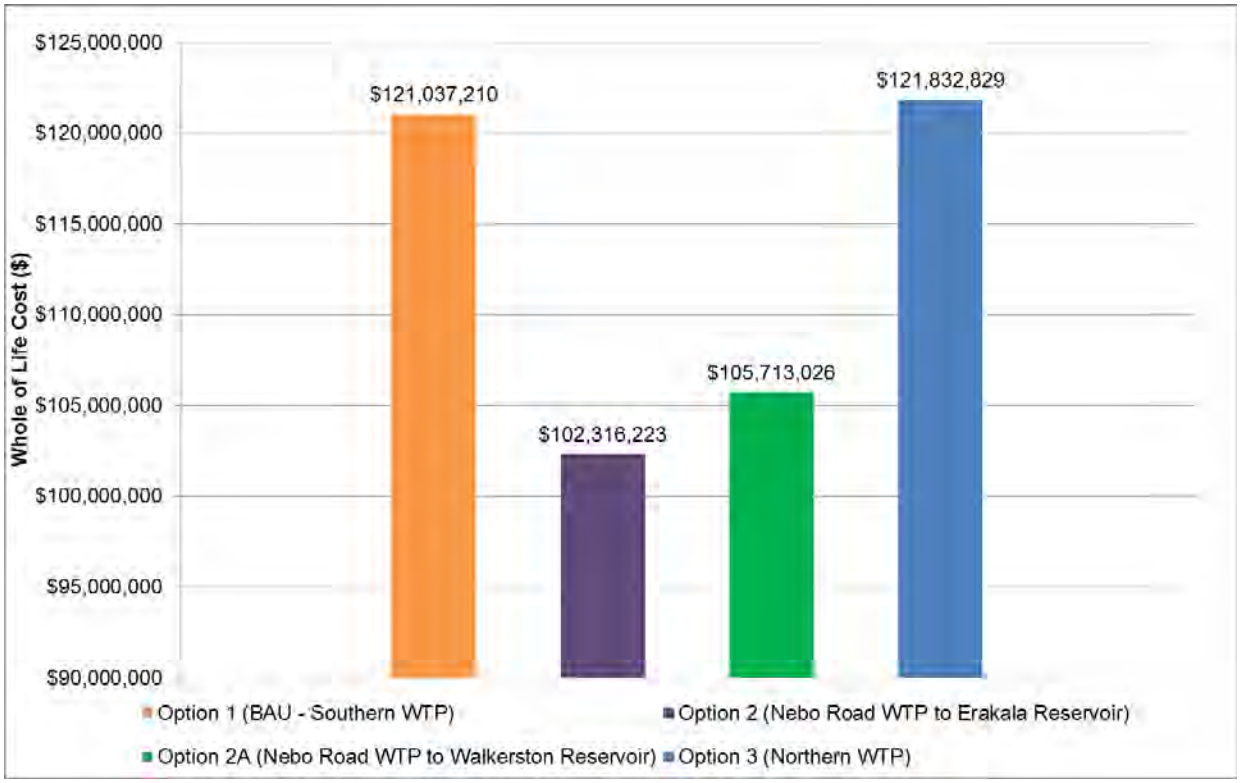


Figure 8-6: Strategic Options – Comparison of Whole of Life Costs (NPV)

A comparison of the whole of life capital cost and operational costs for all options is presented in Figure 8-7. The capital costs for each option is shown in Figure 8-8. From these figures it is evident that the difference between Options 1/3 and Options 2/2A is the capital cost contribution to the total NPV, i.e. higher treatment and/or mains investment is required.

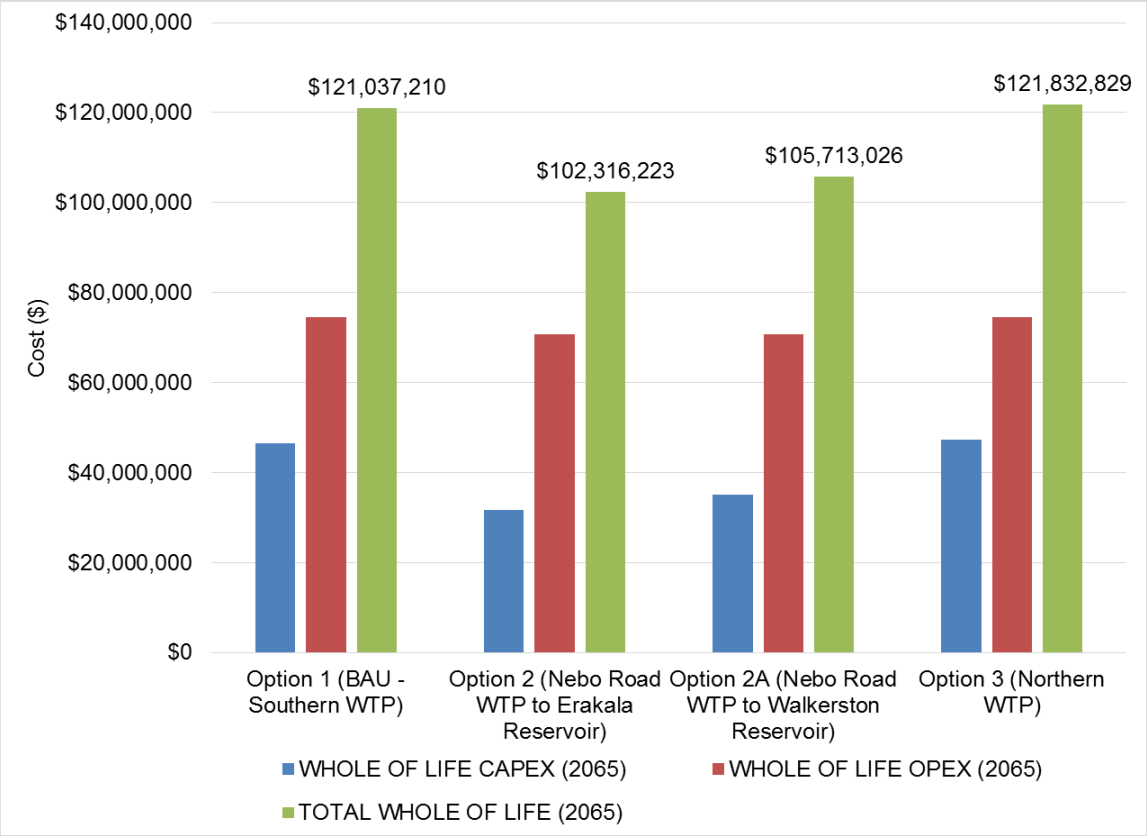


Figure 8-7: Strategic Options Whole of Life Capital and Operational Costs

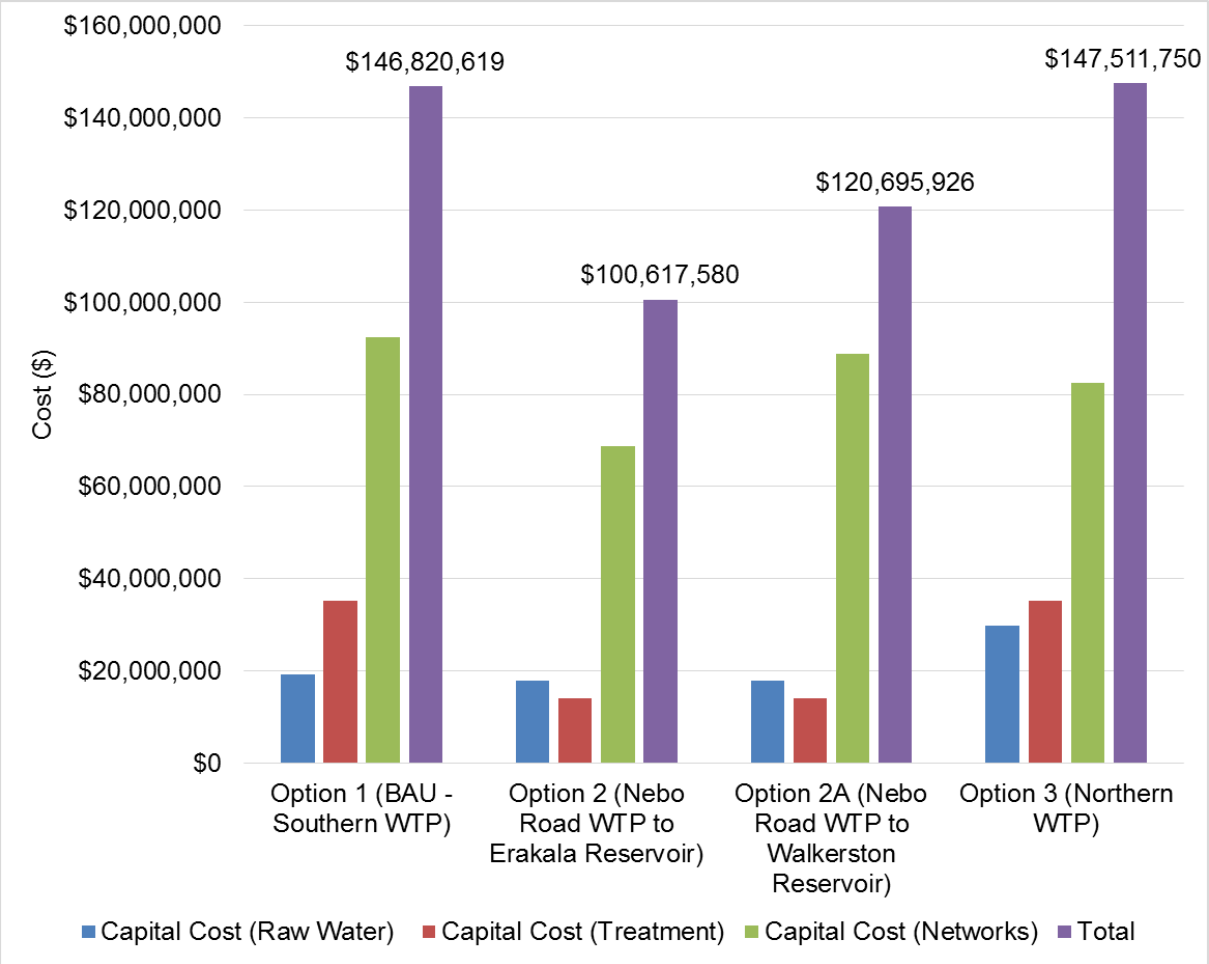


Figure 8-8: Strategic Options Capital Costs

8.9 Multi-Criteria Assessment

A multi-criteria assessment (MCA) process was utilised to determine the preferred strategic option. The MCA was targeted around meeting desired stakeholder outcomes. Stakeholders considered as part of the assessment included:

- Mackay Regional Council – Strategic Planning
- Mackay Water Services – Planning & Sustainability, Treatment, Networks, Business Services
- Public/ Farmers
- Department of Environment and Heritage Protection (DEHP).

The MCA was refined through a stakeholder workshop held on the 12th August 2015 and the final MCA is provided in Appendix F. Items in the MCA marked as a "Key Strategic Decision" were included in the MCA and provided weighting. Items in the MCA spreadsheet marked as "Issues/Risks" are not included in the MCA and not provided weighting. Items marked as

"Issues/Risks" are left in the MCA table for documentation purposes and will be considered in later revisions of the water strategy.

Each option was evaluated against the following criteria and where possible linked to MWS Business Drivers:

- Social/ Cultural linked to MWS Business Driver "Stakeholder Service Levels and Reputation". A weighting of 30% is applied to the MCA.
- Environmental linked to MWS Business Driver "Environment". All environmental aspects were identified as "Issues/Risks" and were not considered in the MCA calculation. No weighting is applied to the MCA.
- Technical aspects that are not linked to MWS Business Driver. These include:
    - Flexibility and Operability. A weighting of 30% is applied to the MCA.
    - Constructability. All aspects of constructability were identified as "Issues/Risks" and were not considered in the MCA calculation. No weighting is applied to the MCA.
- Economic (Whole Life Cost) linked to MWS Business Driver "Economic". A weighting of 40% is applied to the MCA.

The outcomes of the initial MCA scoring for the strategic options are compared in Figure 8-9. The sub-total score for each criteria (linked to business drivers) are also shown against each option. The highest total score of 450 was achieved by Option 2A. The main criteria that drives this high MCA score are the acceptance of the strategy, limited easement and land acquisition requirements and whole of life cost.

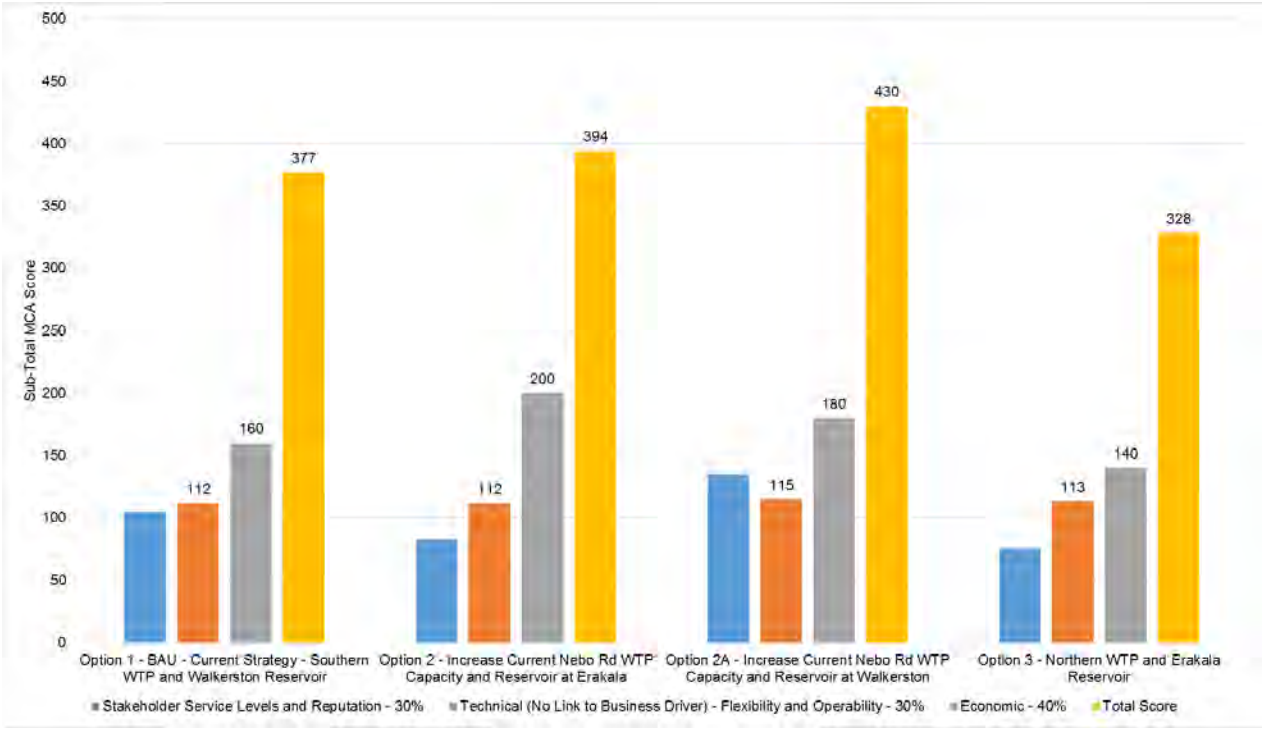


Figure 8-9: Strategic Options MCA Scores

A number of sensitivity trials were applied to the weightings of the MCA and Option 2A achieved the highest score under each assessment with the exception of sensitivity assessment 3 which considers 100% weighting on economic (refer to Appendix F). The sensitivity to the MCA weightings are summarised in Table 8-6.

Table 8-6: Applied MCA Sensitivity Weightings

MCA	Stakeholder Service Levels and Reputation	Environment	Technical (No Link to Business Driver) - Flexibility and Operability	Technical (No Link to Business Driver) - Constructability	Economic
Baseline	30%	No Weighting	30%	No Weighting	40%
Sensitivity 1	20%	No Weighting	40%	No Weighting	40%
Sensitivity 2	50%	No Weighting	50%	No Weighting	0%
Sensitivity 3	0%	No Weighting	0%	No Weighting	100%
Sensitivity 4	100%	No Weighting	0%	No Weighting	0%
Sensitivity 5	0%	No Weighting	100%	No Weighting	0%

8.10 Preferred Option

Option 2A is the preferred solution for the following reasons:

1. Lowest whole of life cost for MRC and community.
2. Provides Mackay with the flexibility to construct a southern WTP beyond the build out of the current PIA and Ooralea and Richmond Growth corridors into the long-term.
3. Maximises utilisation of existing assets.
4. Constructing Walkerston reservoir allows greater driving head to transfer water to Sarina in the future and greater water security for South of the River in the event of emergency.
5. There are minimal land acquisition issues as all sites are owned by MRC. There may be a requirement to find additional room onsite for the waste water system upgrade near the southern boundary of the site. If the bore water can be potentially diverted to the river water clarifiers, more room can be made available onsite where the bore water aeration basin exists (north western boundary of the site).
6. Minimal easement issues other than trunk main requirements along Stockroute road up to Walkerston reservoir.
7. The public will be likely to accept the strategy as it only requires upgrading the existing Nebo Road WTP to 90 ML/d, rather than new sites for WTP and/or a reservoir.

A significant qualification to the selection of Option 2A as the preferred solution is the ability to acquire additional land on the southern boundary of the site which is currently parkland. The additional land is for the construction of expanded sludge management facilities. Figure 8-1 shows the indicative land required on the southern boundary of the existing site.

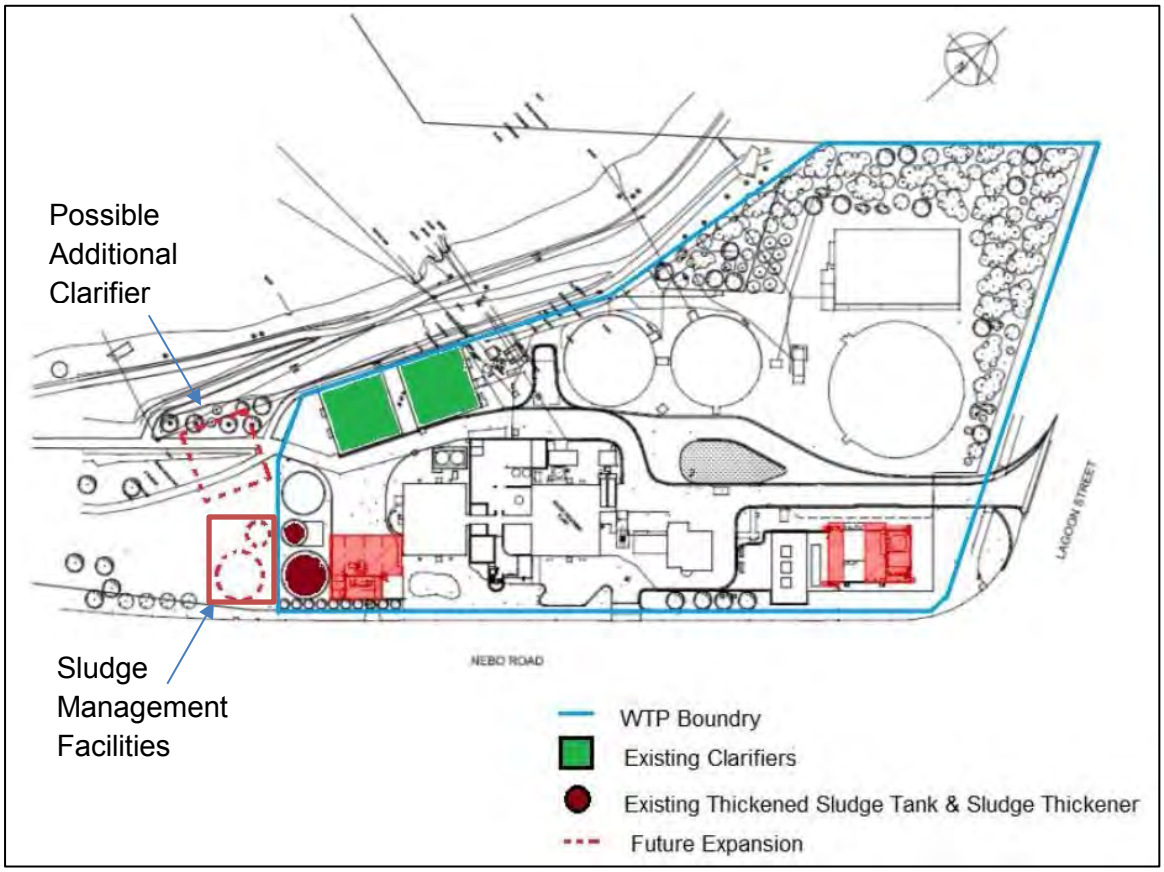


Figure 8-10: Option 2A: Nebo Road WTP Future Expansions Requirements (source: Figure 2-1 Nebo Road WTP Upgrade options and Cost Estimation Paper)

This option also provides the flexibility to construct a southern WTP if Mackay continues to grow beyond the build out of the current PIA and Ooralea and Richmond Growth corridors into the long-term future. It is however noted that further development could be accommodated under the Option 2A strategy if the average day demand remains at 215 L/EP/d or further reduces to 200 L/EP/d.

The infrastructure requirements for Option 2A are detailed in Appendix G, and includes the following:

- Construction of a new raw water 525 mm diameter trunk main at 2026.
- Decommissioning of the existing AC/RC raw water main.
- Upgrading of the Nebo Road WTP from 75 ML/d to 90 ML/d at 2038. It is noted that augmentations at the Nebo Road WTP will be required before 2038 as the Pinch Point workshop and further work undertaken by City Water Technology has confirmed that the existing WTP can not achieve 75 ML/d capacity. For a long term capital profile the upgrades have been scheduled for 2030, but there is further investigation work to better define timing and cost for the following upgrades:
    - Upgrade of chemical dosing systems
    - Upgrade of chemical dosing pumps

  - Installation of 2 x shallow depth clarifiers with tube settlers
  - Sludge management facilities upgrade
  - SCADA/ PLC modifications
- Construction of a new 16 ML reservoir at Walkerston at 70 m AHD with an associated 675 mm diameter trunk main from the reservoir into South Mackay.
- Reconfiguration and upgrading of the Nebo Road HLPS to have two separate pump sets by 2038:
  - Northern Distribution System - D/D/A arrangement Same arrangement as before 868 L/s @ 60 m
  - Southern Distribution System - D/D/A arrangement 450 L/s @ 80 m.
- Implementation of pressure management in the new Walkerston reservoir zone by constructing PRVs and creating Pressure Managed Areas off the existing 600 mm diameter southern distribution trunk main from Nebo Road WTP to the Walkerston reservoir. The PRVs would be set at a maximum hydraulic grade of 60 m AHD. The preferred strategic option considers the installation of up to 13 PRVs however this is not considered the optimal design. Further pressure management planning and concept design is required to ensure effective pressure management is achieved in the Southern Scheme.

9 Network Assessment

The network assessment takes into account the preferred trunk infrastructure strategy identified in Section 8. The network assessment includes capacity assessment of reservoirs and distribution infrastructure as well as identification of greenfield trunk infrastructure for growth areas, as well as a reticulation fire flow assessment. Compared to the trunk infrastructure to implement the strategic option identified in Section 8, there are minimal network capital works required to service ultimate demands.

In the 2009 water strategy there were a number of proposed capacity upgrades identified that are not required in the revised strategy due to the change in spatial growth, water demand and peaking factor assumptions.

9.1 Reservoir Capacity Assessment

A capacity assessment was undertaken for all network reservoirs to determine existing and future deficiencies. The capacity assessment presented in Table 9-1 is based on providing 3 x (PD-MDMM) operational storage with 0.5 ML emergency storage. All reservoirs with the exception of Shoal Point reservoir have sufficient storage to accommodate ultimate demand projections.

Table 9-1: Reservoir Capacity Assessment

Reservoir	Capacity (ML)	2014
Ball Bay*	1.5	0.8
Berry Street	1.13	0.5
Blacks Beach	6.85	4.7
Bonson Scrub+	0.06	0.04
Farleigh	5	4.1
Green Street	0.9	0.4
Mt Bassett/ Slade Point	5.95	3.6
Mt Pleasant and Mt Oscar	68.1	50.4
Mt Vista*+	0.3	0.3
Rural View	10	7.0
Seaforth	2	1.2
Shoal Point+	0.5	0.3
Silingardies Rd	2.25	0.9
The Leap	0.7	0.0

* Currently not in use

+ No emergency storage allowed for in capacity assessment. Shoal Point emergency storage is provided by the Rural View reservoir

The existing Shoal Point reservoir will fail to achieve the required standard by 2023 (assuming that emergency storage is provided by Rural View reservoir) based on a 2.4% growth rate and 2024 based on a 1.57% growth rate (as shown in Figure 9-1).

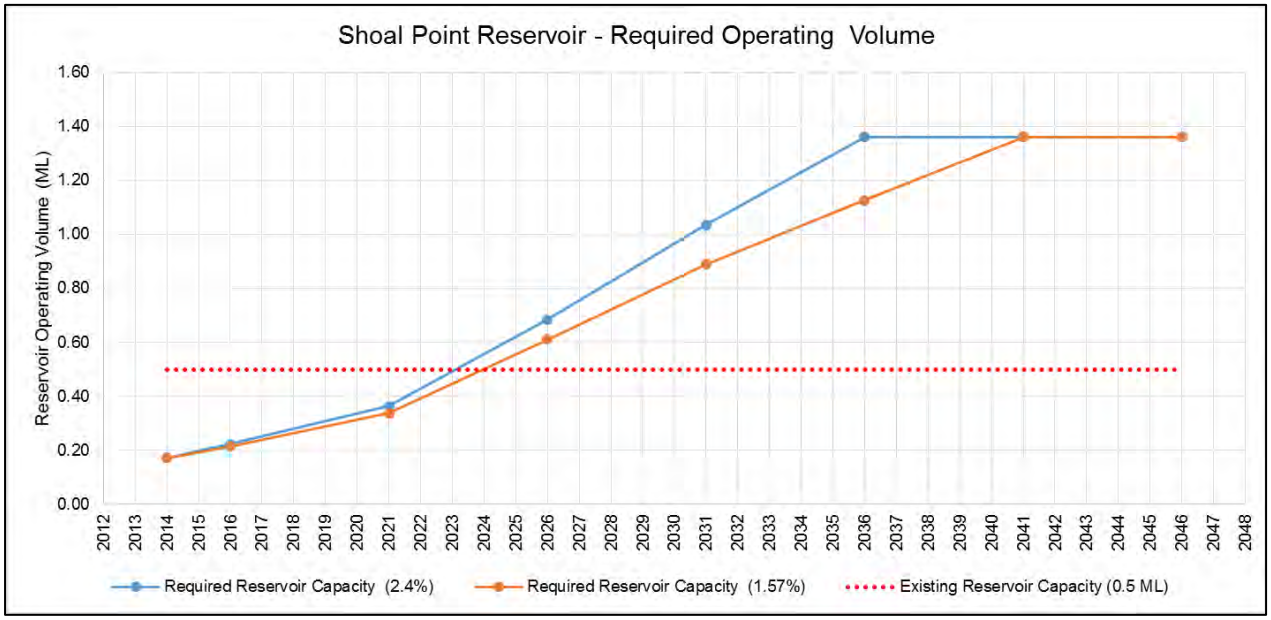


Figure 9-1: Shoal Point Reservoir - Required Operating Capacity

Table 9-2 shows the required operating capacity at Shoal Point for both 2.4% growth and 1.57% growth. The ultimate required operating capacity of Shoal Point reservoir is 1.4 ML. It is recommended to size the reservoir at 2 ML by adding 0.5 ML of emergency storage. The required volume for Shoal Point reservoir has reduced from 3 ML to 2 ML based on the water demand and peaking factor assumptions adopted in the strategy.

Table 9-2: Shoal Point Reservoir – Required Operating Capacity

Reservoir Capacity	2014	2016	2021	2026	2031	2036	2041
Existing (ML)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Required @ 2.4%	0.17	0.22	0.36	0.68	1.03	1.36	1.36
Required @ 1.57%	0.17	0.21	0.34	0.61	0.89	1.13	1.36

9.2 Distribution System Capacity Assessment

A capacity assessment of all transfer pump stations and trunk mains was undertaken to determine existing and future deficiencies as shown in Table 9-3. All pump stations and gravity trunk mains have sufficient capacity to accommodate ultimate demand projections. A marginal deficiency does occur at Golf Links Drive pump station, however upgrade is deemed unnecessary as the spare capacity assessment is based on 20 hrs MDMM flow.

Table 9-3: Pump Station and Gravity Trunk Main Spare Capacity Assessment

Supply Pump	Hydraulic Model Pump Capacity (L/s)	2014	2016	2021	2026	2031	2036	2046	Comments
Ashburtons Road	56	39.2	40.4	39.5	38.7	38.3	37.9	37.9	Includes all MDMM demand downstream to Seaforth
Berry Street	24	20.8	20.8	20.7	20.6	20.5	20.4	20.4	
Golf Links Drive	290	175.8	163.7	118.5	79.1	19.4	-3.2	-3.2	Marginal spare capacity deficit at 2036. Would not recommend upgrading Golf Links Drive Pump Station as deficit is based on 20 hrs MDMM flow.
Janes Creek	80	46.5	47.7	47.3	46.2	44.7	43.7	43.7	Includes all MDMM demand downstream to Seaforth
Nebo Road HLPS	870	438.5	433.6	401.3	377.6	352.0	289.8	95.4	Spare Capacity reduces significantly between 2036 and 2046 due to Ooralea and Richmond Growth. Nebo Road HLPS will be reconfigured when Nebo Road WTP is upgraded
Slade Point	65	39.8	39.9	39.8	39.0	37.8	36.9	36.9	
Walkerston	35	13.9	14.4	9.5	5.3	4.0	0.1	0.1	Pump Station to be taken offline at 2038 when new Walkerston reservoir is built
Gravity Trunk Main - Harbour Road Trunk Main	54	7.9	8.2	7.7	7.0	5.2	3.4	3.4	Includes MDMM demand at Harbour and Slade Point. Actual Harbour Road Gravity Main Capacity is up to 70 L/s thus actual spare capacity is in the order of 18-22 L/s
Gravity Trunk Main - The Leap Trunk Main	25	11.5	12.1	11.3	10.5	10.2	9.8	9.8	Includes all MDMM demand downstream to Seaforth and Ball Bay

9.3 Reticulation System Assessment

Service pressure assessment has been undertaken for reticulation mains based on the service standards in Section 5 over all planning horizons using the updated and verified MWS hydraulic water model. For details on the hydraulic model update and verification refer to the Mackay Water Strategy Phase 2 technical memorandum (MWH, 2015).

All existing reticulation mains have sufficient capacity. Augmentations recommended by TR-074 Mt Oscar and Surrounds HLZ Investigation (Cardno, 2014) are still required due to the highly elevated areas around Mt Oscar.

9.3.1 Greenfield Infrastructure Requirements

There are a number of greenfield areas identified as having growth of more than 100 EP between the present and Ultimate (2014 to 2036). The location of these areas is shown in Appendix C. Most of the proposed areas are small enough that they can be serviced by extending the existing reticulation mains and do not require significant sized trunk mains or infrastructure to be added.

The following areas will require trunk infrastructure:

1. ***Shoal Point*** will require a reservoir upgrade by 2023. Based on water strategy standards of service assumptions, the reservoir is required to be 2 ML. The 2 ML volume include emergency storage.
2. ***Premier Gardens*** is not predicted to grow in the Mackay Growth Allocation Model until 2021, however blocks of land in the elevated parts of Bjelke Circuit, Gair Street and Morehead Drive have already been sold. There have been recent customer complaints in the these areas. Consequently MRC have recently constructed the Premier Gardens Booster Pump Station.
3. ***Richmond Hills*** is serviced by the Rural View reservoir and will require a HLZ booster pump station to service land on the western boundary of the development. The Bovey's Road Booster will be required to be 11 kW and boost 25 m head.
4. ***Richmond*** growth corridor is forecast to be developed between 2036 and 2046. A HLZ booster pump station is required to service the elevated land on the western boundary of the development. The pumps will be required to boost 20 m head and will be 26 kW.
5. ***Ooralea*** growth corridor is forecast to be developed between 2036 and 2046. The greenfield area requires distribution mains for the new development that will eventually connect to the 675 mm diameter trunk from Walkerston as outlined in the proposed strategic Option 2A. A number of 250 and 300 mm diameter trunk mains will be required.
6. ***Blacks Beach*** is currently being developed. From the Northern Beaches Masterplan report, there are four sections of trunk main programmed to be completed including one section by 2016 a further three sections by 2021. This strategic plan has not changed the timing or sizing of the required trunk mains.

9.4 Fire Flow Assessment

A firefighting capacity assessment was undertaken using the updated hydraulic model based on the following firefighting design criteria:

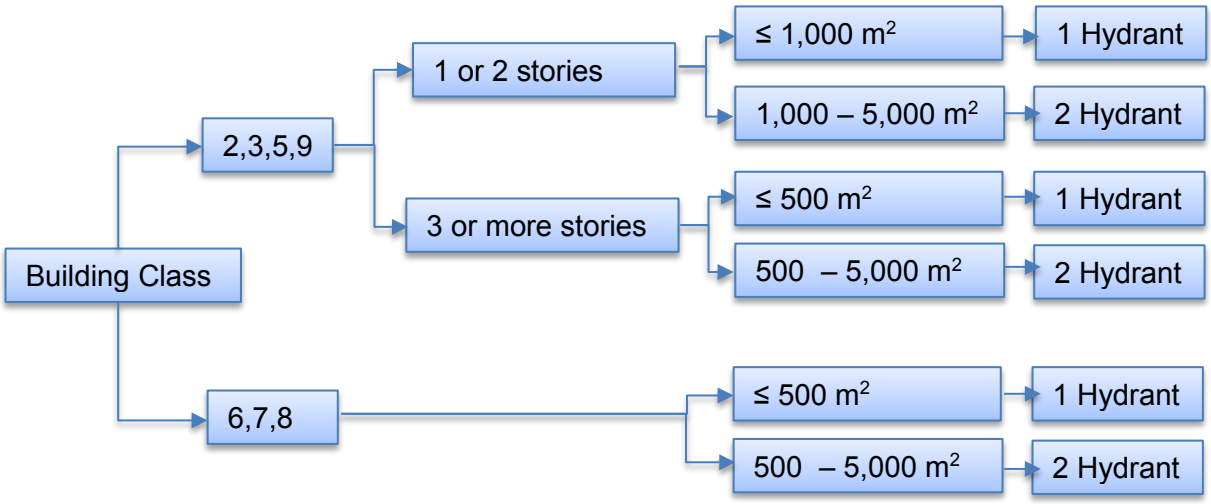
- 15 L/s at 12 m for residential properties
- 30 L/s at 12 m for all commercial properties
- 7.5 L/s at 12 m for rural residential.

The fire flow results are presented in Appendix K. A total of 98 fire flow failures were identified. All failures occur in the existing planning horizon.

9.4.1 Fireflow Risk Assessment

A total of 36 fire flow augmentations identified to resolve the identified failures. A fire flow risk assessment was undertaken to understand the level of risk associated by not constructing all 36 fire flow augmentations. The risk assessment rationalised the fire flow failures by removing marginal failures and failures that are serviced by booster pumps that have fire pumps installed. It should be noted that the hydraulic model does not include fire pumps at the booster pump stations, therefore the presence of fire flow pumps was confirmed with operations.

In addition to the rationalisation task, the risk assessment has taken into account achieving Australian Standard (AS) 2419 instead of achieving MWS design standards. AS2419 specifies the number fire hydrants and flow required based on floor area and building class for the design of internal fire systems. AS 2419 is frequently referred to by the Queensland Fire and Emergency Services (QFES) for street hydrants as well as internal hydrants. A similar risk assessment approach was used in the Northern Beaches Master Plan report to reduce the number of augmentations required. The number of hydrants required to supply 10 L/s at 20 m head through a single hydrant is based on building class, height and gross floor area. The following decision tree demonstrated the process.



The properties that failed fire flow under MWS standards were assessed against AS2419 to understand compliance to the code. The results of the risk assessment are provided in Appendix L. Based on the assessment the number of proposed augmentations can be reduced from 36 to 11.

10 Capital Investment Program

Capital cost estimates for proposed augmentations within this report have been developed based on the following cost assumptions:

- Unit rates contained within the Cardno Provision of Unit Rates for Water and Wastewater Assets for 2011/12 and indexed to 2015 using a CPI of 6.8% growth;
- A contingency of 38% based on the Contingency/Risk Worksheet (refer Appendix B) using the Mackay Regional Council Water and Waste Services Cost Estimation Manual; and
- Pump station efficiencies of 80% to derive pump kW size.

Augmentation maps (including fire flow augmentations) have been provided in the following locations of the report:

1. Strategic Infrastructure – Figure 8-4, page 75
2. Mt Oscar HLZ Augmentations – Figure I1, Appendix I
3. Greenfield Infrastructure – Figure J1-J3, Appendix J
4. Fire Flow Augmentations – Figure M1, Appendix M

The capital works have been presented in the following format:

- Overall Capital Investment Program.
- Option 2A trunk infrastructure.
- Greenfield trunk infrastructure including Mt Oscar HLZ augmentations.
- Fire flow augmentations.

10.1 Overall Capital Investment Program

A summary of the overall investment program is provided in Table 10-1. The overall capital investment program is detailed in Appendix O. Map references are provided for each item of infrastructure in the Capital Investment Program. The total capital works to service the Mackay water supply network up to ultimate demand is $136.5 M. The costs to upgrade the Nebo Road WTP to 75 ML/d have been added to the overall capital investment program once finalised. Based on City Water Technology's WTP Upgrades and Cost Estimation paper (refer Appendix Q) there is only marginal cost difference between upgrading the Nebo Road WTP to 75 ML/d or increasing capacity to 90 ML/d. Therefore the Capital Investment Program has included the costs to upgrade the Nebo Road WTP directly to 90 ML/d. The treatment upgrades are currently planned for 2030, but there will be further planning to better define the timing and cost of these upgrades.

Table 10-1 Overall Investment Program

Infrastructure Category	Existing	2016	2021	2026	2031	2036	2041	2046	2056
Nebo Road WTP Upgrades			$1.6 M		$13.0 M	$1 M			
Option 2A Strategic Infrastructure				$17.8 M			$44 M		$46.5 M
Greenfield Infrastructure		$ 0.7 M		$2.2 M				$8.3 M	
Fire Flow Infrastructure	$1.4 M								
Total	$1.4 M	$ 0.7 M	$1.6 M	$20 M	$13.0 M	$1 M	$44 M	$8.3 M	$46.5 M

*** Nebo Road WTP upgrades to Nebo Road HLPS, Nebo Road Bores, Treatment Process and River Pump Power and Reconfiguration Costs to achieve 75 and 90 ML/d**

10.2 Option 2A Infrastructure

The following tables provide infrastructure cost estimation outcomes for each proposed infrastructure item as part of the Option 2A preferred option. The detailed infrastructure map for Option 2A is provided in Figure 8-4 and the capital works schedule is provided in Appendix O.

Table 10-2: Option 2A Infrastructure

Asset Type	Existing	2016	2021	2026	2031	2036	2041	2046	2056
Raw Water				$17.8 M		$1 M			
Water Treatment					$13 M		$1.6 M		
Trunk Mains							$37.3 M		$46.5 M
Storage							$5.1 M		
Total				**$17.8 M**	**$13 M**	**$1 M**	**$44 M**		**$46.5 M**

Total capital cost for Option 2A infrastructure is $122.3 M. Capital costs have been included based on the recommendations from the Nebo Road High Lift Pump Station planning report (TR-055) as well as the Nebo Road Bores planning report (PPB-026) and are detailed in Appendix N.

10.3 Greenfield Trunk Infrastructure and Mt Oscar HLZ Augmentations

The following tables provide infrastructure cost estimation outcomes for each proposed infrastructure item for the Greenfield trunk augmentation costs (which includes infrastructure augmentation costs for the Mt Oscar HLZ as they have not been constructed as yet). The infrastructure capital works schedule is provided in Appendix O and Mt Oscar augmentations and Greenfield augmentations maps are provided in Appendix I and Appendix J, respectively.

Table 10-3: Greenfield Trunk Augmentations and Mt Oscar HLZ Augmentations

Asset Type	Existing	2016	2021	2026	2031	2036	2046	2056
Mains		$680 k*		$150 k			$7.9 M	
Reservoirs				$1.7 M				
Pump Stations				$350 k			$340 k	
Total		**$680 k**		**$2.2 M**			**$8.24 M**	

* Mt Oscar HLZ Augmentations as shown in Appendix I

Total estimated cost of Greenfield Infrastructure including Mt Oscar HLZ augmentations is $11.1 M.

10.4 Fire Flow Augmentations

Based on the fire flow analysis and refined through the fire flow risk assessment, the 11 fire flow augmentations identified in the network are all required in 2015 and will provide sufficient fire flow capacity up to ultimate demand. Total estimated cost of fire flow augmentations is $1.4 M. The infrastructure capital works schedule is provided in Appendix O and the Fire Flow augmentation map is provided in Figure M1 of Appendix M.

Table 10-4: Fireflow Augmentations

Asset Type	Existing	2016	2021	2026	2031	2036	2046	2056
Fire Flow Main	$1.34 M							
Fire Flow Pump	$ 40 k							
Total	**$1.38 M**							

11 Strategic Opportunities

11.1 Demand Management

MWS are currently undertaking a range of demand management initiatives which include the installation of AMR devices on all customer meters (linked to MiWater) as well as using media campaigns to educate customers on water behaviour use.

AMR devices have been installed on all residential meters within the Mackay region and are being installed on all non-residential meters over the next 3 years. Customers are able to monitor and manage their water use and compare their water use against network average use. MWS are also using the AMR system to respond more promptly to internal household leaks that occur by issuing letters to customers to fix the identified leaks.

Average day unit demand has reduced significantly from 500 L/EP/d (planning assumption) pre 2009 water strategy to 280 L/EP/d (including 16% NRW) based on assessment of demand in this strategy. The 280 L/EP/d allows for a 10% factor of safety on actual 2014 baseline demand and is a prudent approach to apply in baseline demand forecasting. The reduction in use over the past 2 years is likely to be due to the demand management initiatives undertaken and using field data to assess actual demand.

The 2014 demand analysis indicates that actual average day unit demand is 250 L/EP/d (including 16% NRW) which is a 10% reduction from 2013 demands (based on WaterTrac model results). This level of demand is significant, however it is not known whether the 2014 demand can be maintained or whether further reductions will occur with continuing demand management activity. If the 2014 demand can be maintained or even reduced further to 225 L/EP/d (which includes 12% NRW) significant deferment of capital can be achieved along with the requirement to acquire additional water allocations.

Table 11-1 shows the opportunity to defer major capital expenditure and acquire additional water allocations compared with the preferred growth scenario (1.57% supplying Sarina) and assuming Nebo Road WTP can reliably produce 75 ML/d.

Table 11-1: Timing of Nebo Road WTP/ Storage Upgrades

Unit Demand with NRW	280 L/EP/d (incl. 16% NRW)	250 L/EP/d (incl. 16% NRW)	225 L/EP/d (incl. 12% NRW)
Nebo Road WTP/ Storage Timing	2038*	2050	2059
Water Allocations Timing	2029*	2039	2047

*** preferred growth scenario of 1.57% and assuming Nebo Road WTP can reliably produce 75 ML/d**

There is potential for capital deferment of up to 21 years if baseline demands of 225 L/EP/d (includes 12% NRW) are achieved. The requirement to acquire additional water allocations can be deferred by 18 years if baseline demands of 225 L/EP/d (includes 12% NRW) are achieved.

Going forwards, maintaining focus on reducing average day unit demand and leakage as well as management of peak demands should be Mackay Water's focus. This could include identifying, using AMR data analysis, customers and customer groups that have the greatest influence on peak demand (e.g. residential external use) and developing demand management strategies to reduce the demand. It may also include implementing peak demand tariffs in the future similar to what is being currently proposed by the energy industry. Management of peak demands in the Mackay water network will further defer the requirement to upgrade Nebo Road WTP or construct a new WTP into the future.

11.2 Development of Analytics

Modern water authorities are developing analytics tools to turn the extensive collected data stored in GIS, SCADA, Water Billing and other systems into intelligence to improve operation and performance. Based on the development of this water strategy we have identified a range of analytics that would be useful for MWS in the future:

1. Leakage Assessment – Three types of analytics would be advantageous for the identification of leakage in the water network:
    a. Flow and pressure assessment to identify leaks in DMAs and the balance of the network in close to real time.
    b. Trending of nightlines for all DMAs to help identify the economic point to implement leak detection or step testing.
    c. Continuous water balance assessment could also be developed to combine SCADA flow data and billing data to provide tracking and trending of water loss KPIs.

    This type of analysis could be set up in software such as Innovyze's SCADAWatch, a cost effective analytics tool that links to any SCADA data store. Such a system could be implemented for around $75k and be available to both the engineering and operations personnel.

2. Demand Analysis – Detailed demand analysis should be undertaken much more frequently than is currently the case in Mackay. As stated above the per capita demand has been falling which has significant impacts on future capital investment. MRC are investing in demand management activities and the return on investment can only be determined from being able to quantify demand reductions. At present MWS is developing MiWater to assess customer demand. This system could use a similar approach to MWH's WaterTrac and ConTrac to assess demand at a customer category level with in-built climate correction.

3. Live Modelling – Water models can be linked to SCADA and be continuously updated for use in the control room for planning emergency and routine shutdowns, whilst minimising the impact on customers. Innovyze's H2OMAP Live and IWLive products are being implemented in a number of authorities such as South East Water, SAWater, Watercare and other agencies globally.

4. Energy Management – MRC's water supply system has a substantial number of pumping stations and further stations proposed to service future demand. The water model can be used to optimise the operation of the system to minimise the energy used and reduce carbon footprint. This can be done in real time using either the Live models or a simplified optimisation model.

11.3 Key Activities for Next 5 Years

The key activities of focus for Mackay Water for the next 5 years is provided in Table 11-2.

Table 11-2: Key Activities for Next 5 years

Focus Area	Activities
Monitoring	• Fire flow augmentations identified in the water strategy require field tests as part of the design to confirm the need and sizing. • Annual monitoring of baseline demands using approach in Section 4 of this water strategy. • Using residential and non-residential AMR data, System and DMA flow data, implement data analytics to better understand residential and non-residential use, as well as target and reduce system leakage. In addition target customers and customer groups that have greatest influence on peak demands (e.g. residential external use).
Nebo Road Pinch Point Workshop Tasks Register	• There are a number of outstanding tasks on the Pinch Point task register that require to be actioned. There are 14 outstanding tasks out of the 27 tasks identified. The outstanding tasks are: 3A, 4, 5A, 5B, 6, 7, 8, 9,10, 16, 18, 25, 26 and 27. Refer to Appendix P pages 23-24.
Nebo Road Pinch Point Workshop Maintenance Tasks Register	• There are a number of outstanding tasks on the Pinch Point maintenance task register that require to be actioned. There are 8 outstanding tasks out of the 8 tasks identified. Refer to Appendix P page 25.
Planning Studies	• Revise the Nebo Road HLPS configuration in light of upgrading Nebo Road WTP capacity from 75 ML/d to 90 ML/d. • Develop a pressure management plan within the ultimate new Walkerston reservoir zone (South Mackay and Walkerston).
Energy Management	• An energy management plan should be developed reviewing both operational and equipment based solutions to maximise energy use and minimise the carbon footprint of the Mackay Water Supply System.

12 Conclusions

The conclusions to the water strategy are as follows:

1. The existing total population of 119,320 EP will increase to 214,558 EP at ultimate. This includes population growth within Ooralea and Richmond Growth corridors which are currently outside the current Priority Infrastructure Area (PIA).
2. The ultimate population is realised at:
    c. 2047 based on 2.4% growth rate.
    d. 2065 based on 1.57% re-based growth rate.
3. The base demand adopted is 240 L/EP/d (which does not include for non-revenue water). Unit demand has seen a downward trend from 2009 to 2013 but decreased substantially to 215 L/EP/d in 2014. To provide for a factor of safety in the baseline demand forecasting a 10% allowance has been added to the 2014 demands which is in line with 240 L/EP/d.
4. The overall peaking factors adopted in the water strategy, based on analysis of the AMR data, are:
    c. 1.75 for Peak Day
    d. 1.45 for MDMM
5. The peaking factors for each customer sector adopted in the water strategy are provided in Table 1 of Section 2.3.
6. The existing AD demand of 33.2 ML/d is estimated to increase to 60 ML/d at ultimate.
7. It is estimated that existing PD demand of 54.7 ML/d will increase to 98.3 ML/d at ultimate.
8. It is anticipated that Sarina will be supplied via the Mackay Sarina trunk main under MDMM flow, which is estimated to grow from 3.3 ML/d to 5.9 ML/d at ultimate. The Sarina flow export has been incorporated into the demand forecasting and all strategic options assessed.
9. Based on demand forecasting and analysis of persistent demands the requirement to upgrade the water supply system based on Nebo Road WTP reliably supplying 75 ML/d (in terms of adding greater WTP capacity or adding additional storage) is as follows:
    c. Using 2.4% growth rate:
        v. Upgrade to storage/ bulk supply is required in 2037
        vi. Upgrade to storage/ bulk supply is required in 2031 with Sarina Supply
    d. Using 1.57% growth rate
        vii. Upgrade to storage/ bulk supply is required in 2045
        viii. Upgrade to storage/ bulk supply is required in 2038 with Sarina Supply

10. Based on the growth scenarios presented, the preferred growth scenario using a pragmatic outlook is the 1.57% growth rate with Sarina supply. This scenario indicates the trigger for upgrade to the WTP capacity and/or increase to storage volume occurs at 2038.

11. Service standards were adopted and are summarised in Section 5. The key changes from the draft CTM guidelines are as follows:

    c. Unit Demands decreased from 340 L/EP/d (includes non-revenue water) to 240 L/EP/d plus 16% NRW (40 L/EP/d).
    d. Peaking factors defined per demand sector to provide overall peaking factors of:
        iii. 1.45 for MDMM to Average Day ratio.
        iv. 1.75 for Peak Day to Average Day ratio.

12. A baseline demand forecasting sensitivity was completed by reducing the 240 L/EP/d to 215 L/EP/d and reducing the NRW component from 16% to 12%. Supply to Sarina was included. The sensitivity assessment shows that if baseline demands are further decreased it can defer major capital spend by up to 12 years based on the preferred growth scenario (refer conclusion 10).

13. If the Average Day unit demand is further decreased to 200 L/EP/d and NRW reduces to 12% there is opportunity to defer major capital infrastructure by 19 years to year 2059 based on the preferred growth scenario (refer conclusion 10).

14. Mackay Water has an annual allocation of 16,000 ML from the Pioneer River system which will be exceeded by:

    a. 2029 under 240 L/EP/d and 40 L/EP/d NRW demand and a re-based average growth rate of 1.57% with supplying Sarina.
    b. 2039 under 215 L/EP/d and NRW reduction from 16% to 12% using a re-based average growth rate of 1.57% and supplying Sarina.

15. The Nebo Road WTP Pinch Point workshop held on the 1st September 2015 highlighted a number of elements that require upgrade to meet 75 ML/d and also increase the WTP to 90 ML/d. The raw water quality characteristics have changed significantly from the design envelopes used to upgrade the WTP in 2012 and require re-assessment. The final Pinch Point workshop minutes are provided in Appendix P of this report. Based on the outcomes of the meeting the primary pinch points for accommodating the 75 ML/day requirement and the 90 ML/d, the following assets will need to be upgraded:

    a. Raw Water Pump Station
    b. Raw Water Mains
    c. High Lift Pump Station
    d. Clarifiers
    e. Chemical Dosing System and Dosing Pumps.
    f. Sludge Management Facilities.

g. SCADA/ PLC.

From the Pinch Point workshop it has indicated there are works required to increase nominal WTP capacity to 75 ML/d. All upgrade assumptions within the water strategy have been based on the Nebo Road WTP being able to supply 75 ML/d.

The estimated cost including contingency to upgrade the Nebo Road WTP from current capacity to 90 ML/d is $14.0 M. This cost includes the upgrade cost of the Nebo Road HLPS.

16. The identified strategic options assessed under whole of life costs and MCA process were as follows:
    a. Option 1 – as per current strategic approach however infrastructure sizing and timing based on demand persistence requirements and the adopted standards of service as well as the 1.57% growth rate.
    b. Option 2 – Augment Nebo Road WTP to 90 ML/d and construct a new reservoir at Erakala at 70 m AHD with associated trunk mains.
    c. Option 2A - Augment Nebo Road WTP to 90 ML/d and construct a new reservoir at Walkerston at 70 m AHD with associated trunk mains and other network infrastructure.
    d. Option 3 – Construct a new Northern WTP and new reservoir at Erakala at 70 m AHD with associated trunk mains and other network infrastructure.

16. The strategic options were assessed against whole of life costs and an MCA was undertaken with all MRC stakeholders. Option 2A was identified as the preferred option for the
    a. Lowest whole of life cost for MRC and community.
    b. Provides Mackay with the flexibility to construct a southern WTP beyond the build out of the current PIA and Ooralea and Richmond Growth corridors into the long-term.
    c. Maximises utilisation of existing assets.
    d. Constructing Walkerston reservoir allows greater driving head to transfer water to Sarina in the future and greater water security for South of the River in the event of emergency.
    e. There is minimal land acquisition issues as all sites are owned by MRC. There may be a requirement to find additional room onsite for the waste water system upgrade near the southern boundary of the site. If the bore water can be potentially diverted to the river water clarifiers, more room can be made available onsite where the bore water aeration basin exists (north western boundary of the site).
    f. Minimal easement issues other than trunk main requirements along Stockroute road up to Walkerston reservoir.

g. The public will be likely to accept the strategy as it only requires upgrading the existing Nebo Road WTP to 90 ML/d, rather than new sites for WTP and/or a reservoir.

17. Option 2A consists of upgrading the Nebo Road WTP to 90 ML/d and construct a new 16 ML reservoir at Walkerston at 70 m AHD. This option is similar to Option 2 however with the reservoir location moving from Erakala to Walkerston with associated trunk mains and other network infrastructure. The Nebo Road WTP would serve both the Southern and Northern schemes by re-configuring the Nebo Road HLPS. The new Walkerston Reservoir would serve the southern scheme of Mackay and the Mt Pleasant/ Mt Oscar reservoirs would serve the northern scheme of Mackay including the Mackay CBD. Pressure management in the new Walkerston reservoir zone would be required to ensure maximum pressure standards of 80 m are not exceeded when Nebo Road HLPS is filling Walkerston reservoir. A significant qualification to the selection of Option 2A as the preferred solution is the ability to acquire additional land on the southern boundary of the site which is currently parkland. The additional land is for the construction of additional sludge management facilities.
18. Shoal Point reservoir was identified for to a volume of 2 ML at 2023. All other reservoirs have sufficient capacity to service Mackay up to ultimate demand under 3 x (MD-MDMM) sizing. Persistent demands in the Mackay network will be overcome by sizing the Nebo Road WTP greater than MDMM capacity.
19. All transfer pump stations and trunk mains have sufficient capacity to service Mackay up to ultimate 20 hrs MDMM demand.
20. A fire flow assessment was completed using Section 5 desired standards of service which identified the requirement implement 36 augmentations in 2015. However a fire flow risk assessment was completed which reduced the amount of augmentations to 11 to be implemented in 2015.
21. The capital investment program requires $136.5 M to ensure the Mackay network can be serviced from 2016 up to ultimate (2064) demand and is detailed in Section 10.
22. Demand management initiatives are currently being undertaken by MWS in regards to installation of AMR devices linked to MiWater as well as public education to change behavioural use. Since the previous strategy water use has decreased from 300 L/EP/d to the adopted 280 L/EP/d (with NRW) for the revised water strategy and can be attributed to the demand management initiatives undertaken. Going forward, continuing management average day demand and leakage as well as management of peak demands should be Mackay Water's focus.
23. The development of data analytics in the following areas will assist MWS to track performance and plan assets to deliver the most cost effective solutions whilst managing delivery and timing risk:
    a. Leakage Assessment
    b. Demand Analysis

c. Live Modelling

d. Energy Management.

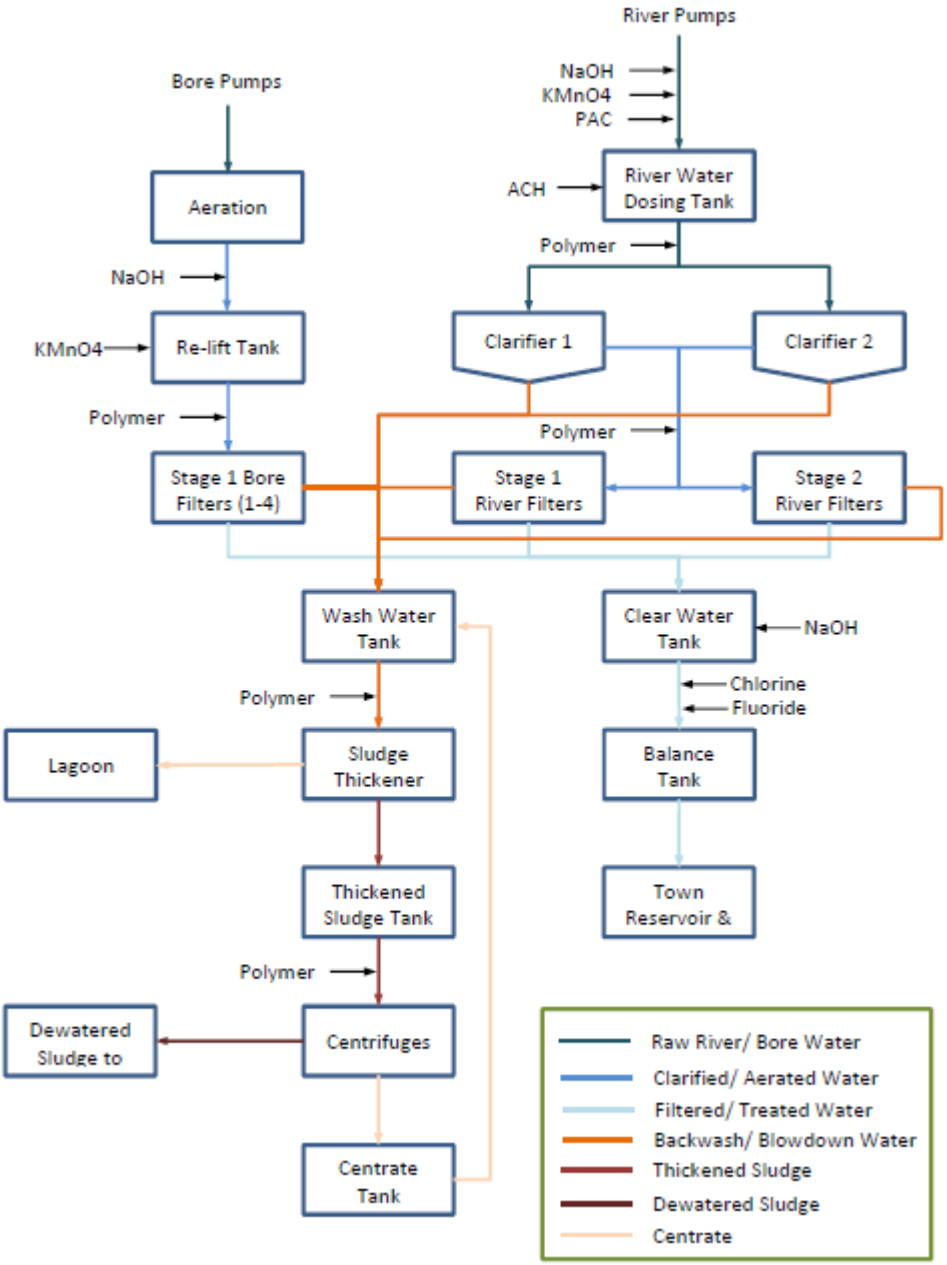
13 Recommendations

The water strategy recommends the following actions:

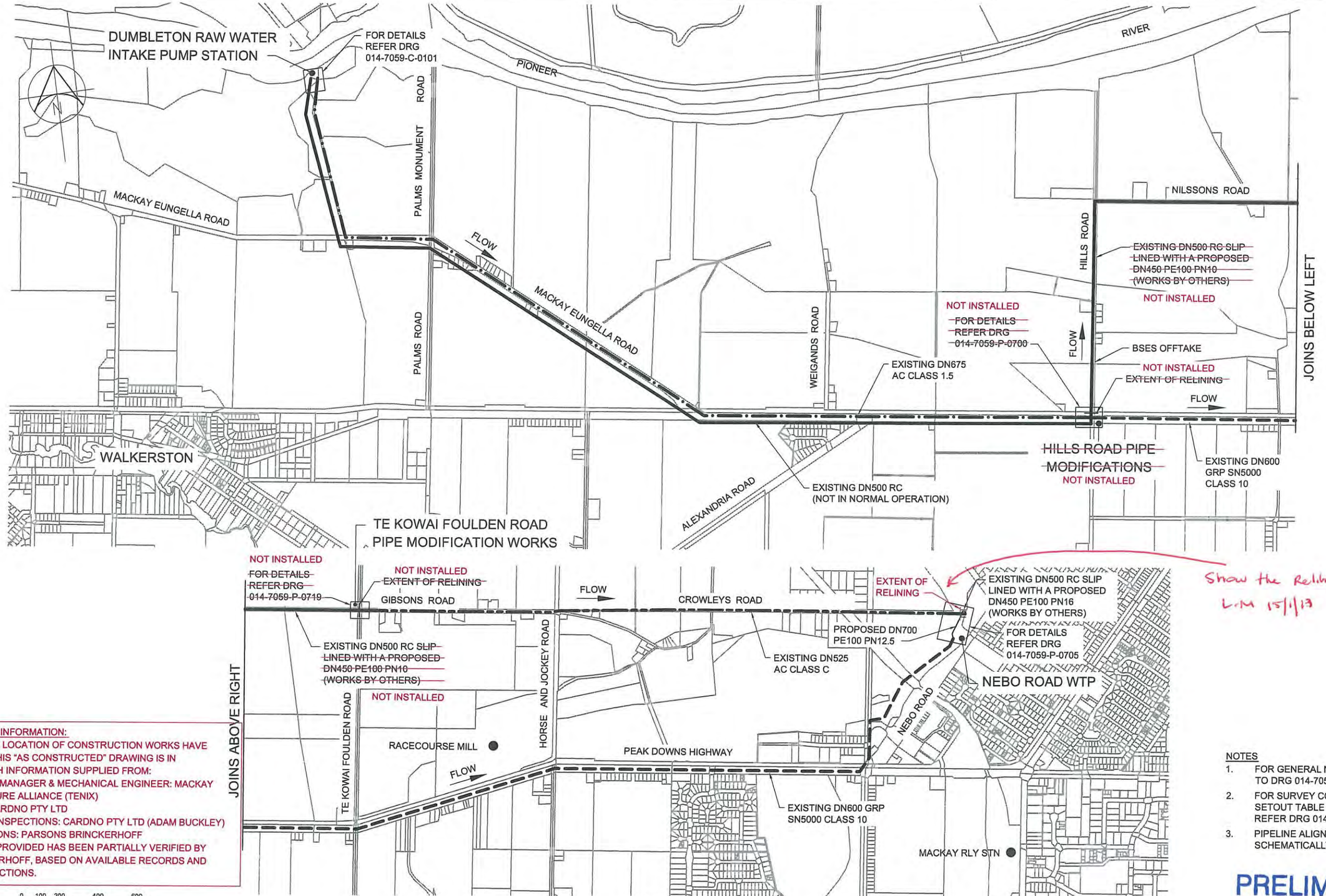
1. Adopt Strategic Option 2A option and capital investment program presented in this water strategy. The option includes the upgrading of the Nebo Road WTP to 90 ML/d in lieu of building a new southern plant. It is noted that there is a key risk to the implementation of Strategic Option 2A in regards to treatment site constraints. The preferred strategy depends on the ability to expand the southern boundary of the WTP site to accommodate an additional sludge tank, sludge thickener and possible clarifier. The reservoir site at Walkerston would be maintained as part of the strategy.
2. Implement the recommendations of the Nebo Road WTP Pinch Point Workshop.
3. Undertake detailed planning studies as soon as possible in the light of adopting Option 2A:
    a. Planning for the upgrade of the Nebo Road WTP to confirm land requirements and availability.
    b. Undertake an energy management investigation of the water supply system operation.
    c. Revise the Nebo Road HLPS configuration in light of upgrading Nebo Road WTP capacity from 75 ML/d to 90 ML/d.
    d. Develop a pressure management plan within the ultimate new Walkerston reservoir zone (South Mackay and Walkerston).
4. Review the upgrade requirements for the Nebo Road HLPS in light of the changed operational requirements of Option 2A.
5. Implement fire flow augmentations as identified in the strategy. Field tests should be undertaken as part of the design to confirm the need and sizing.
6. Implement data analytics to better understand demand characteristics for both residential and non-residential use, as well as to target and reduce system leakage.
7. Undertake specific detailed planning and feasibility studies prior to delivering the capital works identified within this strategic report, to ensure that the preferred and most efficient solutions are refined and delivered at the optimal time. Detailed planning studies will assist in developing more accurate cost estimates.
8. Review the water strategy in 2020.

Appendix A: Key River Water Infrastructure As-Constructed Drawings and Nebo Road WTP Process Flow Diagram

Nebo Road WTP Process Flow Diagram



Key As-Constructed Drawings – Raw Water River Water Intake – Dumbleton Weir



AS CONSTRUCTED INFORMATION:
PLAN, SETOUT AND LOCATION OF CONSTRUCTION WORKS HAVE BEEN AMENDED. THIS "AS CONSTRUCTED" DRAWING IS IN ACCORDANCE WITH INFORMATION SUPPLIED FROM:

1) SITE PROJECT MANAGER & MECHANICAL ENGINEER: MACKAY INFRASTRUCTURE ALLIANCE (TENIX)
2) SURVEYOR: CARDNO PTY LTD
3) STRUCTURAL INSPECTIONS: CARDNO PTY LTD (ADAM BUCKLEY)
4) SITE INSPECTIONS: PARSONS BRINCKERHOFF

THE INFORMATON PROVIDED HAS BEEN PARTIALLY VERIFIED BY PARSONS BRINCKERHOFF, BASED ON AVAILABLE RECORDS AND LIMITED SITE INSPECTIONS.

0 100 200 400 600
Full Size 1:10000 ; Half Reduction 1:20000
SCALE (m)

KEY PLAN
1:10000

NOTES
1. FOR GENERAL NOTES REFER TO DRG 014-7059-P-0012.
2. FOR SURVEY CONTROL, SETOUT TABLE AND LEGEND REFER DRG 014-7059-P-0013
3. PIPELINE ALIGNMENT SHOWN SCHEMATICALLY

PRELIMINARY

AS CONSTRUCTED

EXECUTIVE MANAGER MACKAY WATER: DAVID SEARLE	DATE: 14.04.11
RPEQ APPROVAL: No:	DATE:
W.P. DESIGN MANAGER: TOM ALLAN	DATE: 15.04.11
PROJECT MANAGER: PETER MCLEAN	DATE: 14.04.11
PROJECT APPROVAL	

NOTES: DESIGN NOT TO BE AMENDED WITHOUT REFERENCE TO DESIGN MANAGER / EXECUTIVE MANAGER MACKAY WATER. ALL LEVELS TO AHD.

REV	AMENDMENTS AND REVISIONS	DATE	DRAWN	APPR
1	AS CONSTRUCTED		MN	
0	APPROVED FOR CONSTRUCTION	26.05.11	MN	PRW
B	ISSUE FOR 85% DESIGN DEVELOPMENT REVIEW	24.12.10	MN	
A	ISSUE FOR 70% DOAR WORKSHOP	10.11.10	MN	

SCALE: 1 : 10000	
DESIGN: AH	DATE: 11.10
CHECK: PPH	DATE: 12.10
DRAWN: MN	DATE: 11.10
CHECK: SG	DATE: 12.10
APPROV: PRW	DATE: 05.11

Cardno PB 125 YEARS

Tenix
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BRISBANE . MELBOURNE . PERTH . SYDNEY
AUSTRALIA

Mackay REGIONAL COUNCIL
MACKAY INFRASTRUCTURE ALLIANCE
LEVEL 1 , 38 WELLINGTON STREET
MACKAY QLD 4740

PROJECT: MACKAY INFRASTRUCTURE ALLIANCE

DRAWING TITLE: MIA WORKS PACKAGE No. 014
DUMBLETON RAW WATER INTAKE UPGRADE
KEY PLAN

DESIGN COMPANY: PB	COMPANY CODE:
MIA DRAWING NUMBER:	014-7059-P-0014
MRC DRAWING NUMBER:	A1-19204
REVISION	1

Plotted By: NardellaM Plot Date: 14/01/13 - 13:31 Cad File: J:\A606-WAT\PROJ\2138347A_MACKAY_CAPITAL_WORKS_ALLIANCE_\09_CADD\DRAWINGS\WP014_Dumbleton\014-7059-P-0014-DWG_1.dwg

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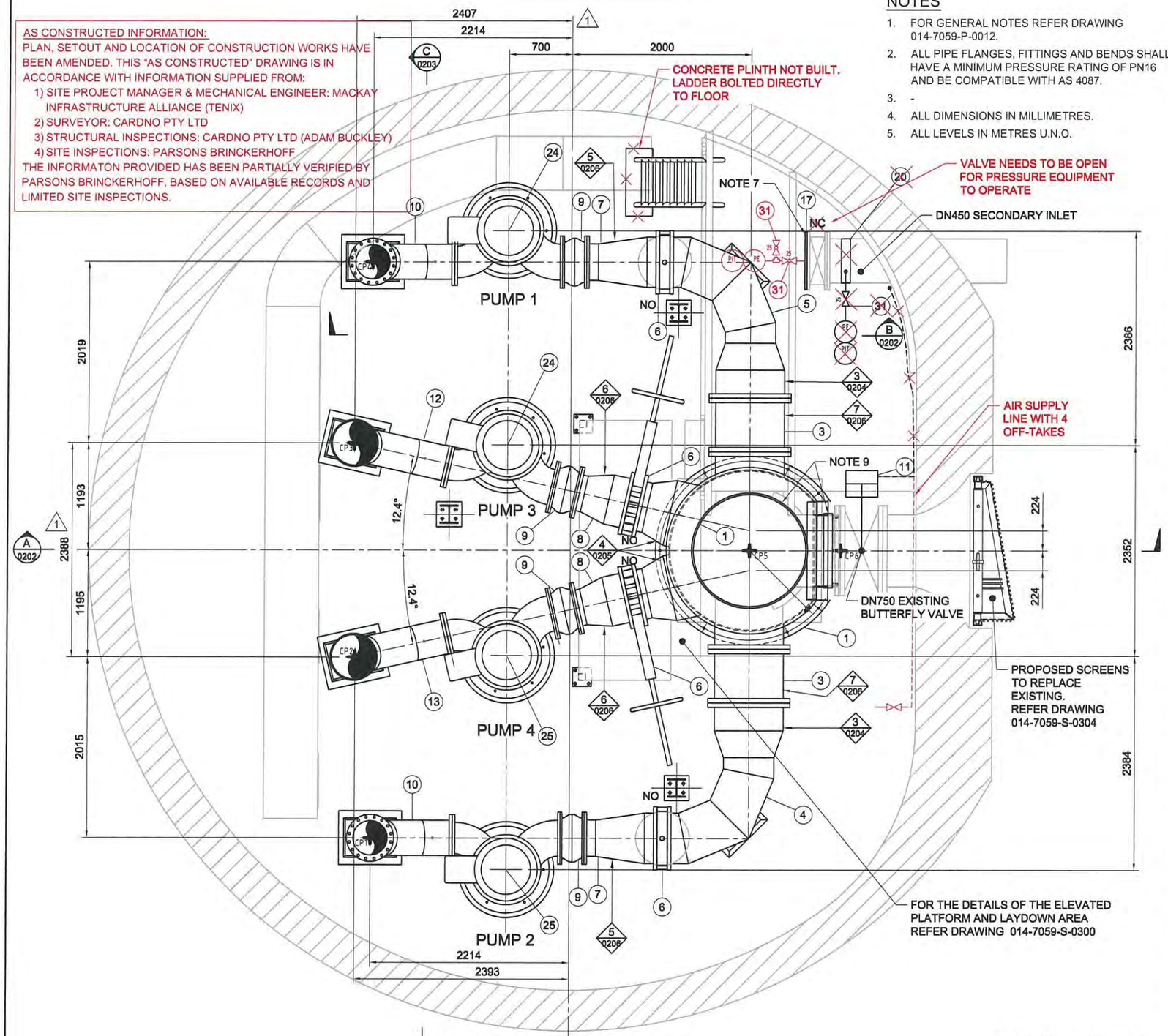


SECTIONAL PLAN OF PUMP WELL
1:25

0 250 500 1000 1500
Full Size 1:25 ; Half Reduction 1:50
SCALE (mm)

NOTES

1. FOR GENERAL NOTES REFER DRAWING 014-7059-P-0012.
2. ALL PIPE FLANGES, FITTINGS AND BENDS SHALL HAVE A MINIMUM PRESSURE RATING OF PN16 AND BE COMPATIBLE WITH AS 4087.
3. -
4. ALL DIMENSIONS IN MILLIMETRES.
5. ALL LEVELS IN METRES U.N.O.
6. FRAMEWORK FOR PUMP SHAFTS (AS PER DRAWING WA1-350B) TO BE REMOVED ONCE PUMP 3 HAS BEEN DECOMMISSIONED.
7. EXISTING TEE AND PLINTH TO BE REMOVED. A DN450 BLANK FLANGE TO BE BOLTED TO EXISTING DN450 VALVE.
8. -
9. ALL SITE CUT MSCL PIPES INTERNAL CEMENT MORTAR LINING TO BE REINSTATED AFTER NEW WELDS HAVE BEEN MADE.
10. ALL EXISTING PUMP PLINTHS TO BE REMOVED. STRUCTURAL DETAILS OF NEW PLINTHS AS PER DRAWING 014-7059-S-0307 & S-0308.
11. ISOLATION TO BE MAINTAINED BETWEEN DIFFERENT MATERIAL TYPES AS PER MRC STANDARD DRAWING A3-04304.
12. STAINLESS STEEL AND MILD STEEL FLANGE SHALL BE ELECTRICALLY ISOLATED TO PREVENT CORROSION. REFER TO MRC STANDARD DRAWING A3-04304.
13. SEQUENCING AND OPERATIONAL REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE SCOPE OF WORKS DOCUMENT (014-7059-Z-0010) AND THE APPROVED CONSTRUCTION METHOLOGY. THE SUB-CONTRACTOR SHALL DESIGN AND CONSTRUCT ANY TEMPORARY SUPPORTS REQUIRED TO ENSURE PIPEWORK IS NOT SUBJECTED TO LOADS DURING CONSTRUCTION.
14. ALL VALVES TO BE PN16.

NO = NORMALLY OPEN
NC = NORMALLY CLOSED

FITTING SCHEDULE

ITEM	DESCRIPTION	MATERIAL	QTY
1	DN1800 SUCTION MANIFOLD, REFER DETAIL 4 DRG P-0205	MSCL	1
2	NOT USED		
3	OD762x14mm FL-FL, PIPE SEGMENT SPECIAL C/W VANES, REFER DETAIL 7 DRG P-0206	316L SS	2
4	OD762x14mm x DN560x10mm (LH) FL-FL, REDUCING ELBOW SPECIAL, REFER DETAIL 3 DRG P-0204	316L SS	1
5	OD762x14mm x DN560x10mm (RH) FL-FL, REDUCING ELBOW SPECIAL, REFER DETAIL 3 DRG P-0204	316L SS	1
6	DN500 KNIFEGATE VALVE, CHALLENGER MODEL 98, LUGGED	316 SS	4
7	OD7620x14mm FL-FL, PIPE SEGMENT SPECIAL C/W VANES, REFER DETAIL 7 DRG P-0206	316L SS	2
8	OD560x10mm x DN406x10mm FL-FL, REDUCER - TYPE 2 C/W VANES, REFER DETAIL 6 DRG P-0206	316L SS	2
9	DN400 FL-FL, EXPANSION JOINT WITH CONTROL / LIMIT RODS	316L SS	4
10	OD390x10mm FL-FL, DUCK FOOT BEND - TYPE 1, REFER DETAIL 1 DRG P-0204	MSCL	2
11	PNEUMATIC ACTUATORS, REFER MIA MECHANICAL, STRUCTURAL AND PIPING TECHNICAL SPECIFICATION (014-7059-C-SC001) SECTION 10 FOR DETAILS.	-	4
12	0D390x10mm FL-FL, DUCK FOOT BEND - TYPE 2, REFER DETAIL 2 DRG P-0204	MSCL	1
13	0D390x10mm FL-FL, DUCK FOOT BEND - TYPE 2, REFER DETAIL 2 DRG P-0204	MSCL	1
14	DN350 THRUST DISMANTLING JOINT, AVK 265 WITH TIE RODS OR SIMILAR APPROVED		4
15	DN350 FLANGE (SLIP-ON TYPE) TO SUIT DISMANTLING JOINT DRILLING	MS	2
16	DN450 x DN350 FL-SP, REDUCER, SP END SHALL BE SUITABLE TO WELD TO EXISTING PIPE	MSCL	2
17	DN450 FL BLANK FLANGE	MS	1
18	DN350 CHECK VALVE, FULL BORE, FL-FL, CHALLENGER DRVG OR SIMILAR APPROVED, CLOSURE IN ≤ 0.1 SEC.		2
19	DN450 CHECK VALVE, FULL BORE, FL-FL, CHALLENGER DRVG OR SIMILAR APPROVED, CLOSURE IN ≤ 0.1 SEC.		2
~~20~~	~~DN450 x DN25 TAPPING BAND~~	~~SS~~	~~1~~
21-23	NOT USED		
24	350 x 400 - 500 SUPER TITAN AND 375 KW MOTOR (CLOCKWISE SHAFT ROTATION)		2
25	350 x 400 - 500 SUPER TITAN AND 375 KW MOTOR (ANTI-CLOCKWISE SHAFT ROTATION)		2
26	DN350 FL-FL, SPOOL, 200 LG	MSCL	2
27	DN450 FL-FL, SPOOL, 200 LG	MSCL	2
28 - 29	NOT USED		
30	DN25 AIR VALVE WITH 1" BSP THREAD		4
31	DN25 BALL VALVE WITH 1" BSP THREAD	SS	~~9~~ 10
32	DN50 BALL VALVE WITH 2" BSP THREAD	SS	~~4~~ 6
33	DN50 MINSUP HOSE COUPLING OR APPROVED EQUIVALENT	SS	4

PRELIMINARY AS CONSTRUCTED

EXECUTIVE MANAGER MACKAY WATER: DAVID SEARLE	DATE: 14.04.11
RPEQ APPROVAL: No:	DATE:
W.P. DESIGN MANAGER: TOM ALLAN	DATE: 15.04.11
PROJECT MANAGER: PETER MCLEAN	DATE: 14.04.11
PROJECT APPROVAL	

NOTES: DESIGN NOT TO BE AMENDED WITHOUT REFERENCE TO DESIGN MANAGER / EXECUTIVE MANAGER MACKAY WATER. ALL LEVELS TO AHD.

REV	AMENDMENTS AND REVISIONS	DATE	DRAWN	APPR
2	AS CONSTRUCTED		MN	
1	MANIFOLD INCREASED TO DN1800	23.02.12	DPD	
0	APPROVED FOR CONSTRUCTION	26.05.11	LB	PRW
B	ISSUE FOR 85% DESIGN DEVELOPMENT REVIEW	04.02.11	LB	
A	ISSUE FOR 70% DOAR WORKSHOP	10.11.10	MM	

SCALE: 1:25	
DESIGN: AH	DATE: 11.10
CHECK: DRK	DATE: 11.10
DRAWN: LB	DATE: 11.10
CHECK: SG	DATE: 12.10
APPROV: PRW	DATE: 05.11

Cardno
PB 125 YEARS
Tenix
TENIX AUSTRALIA PTY LTD
BRISBANE . MELBOURNE . PERTH . SYDNEY
AUSTRALIA

Mackay REGIONAL COUNCIL
MACKAY INFRASTRUCTURE ALLIANCE
LEVEL 1 , 38 WELLINGTON STREET
MACKAY QLD 4740

PROJECT: MACKAY INFRASTRUCTURE ALLIANCE

DRAWING TITLE:
MIA WORKS PACKAGE No. 014
DUMBLETON RAW WATER INTAKE UPGRADE
DUMBLETON PUMP STATION
INTERNAL PIPEWORK GENERAL ARRANGEMENT

DESIGN COMPANY: PB	COMPANY CODE:
MIA DRAWING NUMBER:	014-7059-P-0201
MRC DRAWING NUMBER:	A1-19215
REVISION	2

Plotted By: NardellaM Plot Date: 21/01/13 - 14:59 Cad File: J:\A606-WAT\PROJ\213834?A_MACKAY_CAPITAL_WORKS_ALLIANCE_\09_CADD\DRAWINGS\WP014_Dumbleton\014-7059-P-0201-DWG_2.dwg

TO EMERGENCY SHUTDOWN (ESD) SYSTEM EQUIPMENT AND VENDOR PACKAGE COMPRESSOR SYSTEM

AIR SUPPLY LINES

RL 14.000 WEIR CREST LEVEL (NORMAL OPERATING LEVEL RL 14.000)

RL 13.300 APPROX

CRANE BEAM REFER DRAWING 014-7059-S-0300

RL 12.850 PIPE ℄

RL 12.500 LOW OPERATING LEVEL (FOR INTAKE AT RL 10.600)

RL 11.500 LOW OPERATING LEVEL (FOR INTAKE AT RL 8.350)

EXISTING DN350 SPOOL PIECE

RL 10.600 PIPE ℄

RL 9.990 APPROX

2700 REF.

VENTILATION DUCT REFER DRAWING 014-7059-M-0400

NOTE 3

PUMP 3

RL 8.350 PIPE ℄

RL 6.037 PIPE ℄

RL 5.612 T.O. PLINTH

T.O. PLINTH RL 5.292

DN50 MINSUP COUPLING REMOVED.

TO SUMP

RL 5.000 APPROX

NOTE 5

NOM. 50mm GROUT REFER NOTE 6

NOTE 5

SECTION A 1:25 0201 PUMP 4 SIMILAR

2700 REF.

PUMP 1

NOTE 4

RL 6.037 PIPE ℄

RL 5.612 T.O. PLINTH

RL 5.547 T.O. PLINTH

RL 5.292 T.O. PLINTH

NOTE 5

NOM. 50mm GROUT REFER NOTE 6

NOTE 5

SECTION B 1:25 0201 PUMP 2 SIMILAR

0 250 500 1000 1500
Full Size 1:25 ; Half Reduction 1:50
SCALE (mm)

NOTES

1. FOR GENERAL NOTES REFER DRAWING 014-7059-P-0012.
2. FOR FITTING SCHEDULE AND SPECIFIC PIPEWORK NOTES REFER DRAWING 014-7059-P-0201.
3. REMOVE EXISTING NRV AND TAPER. WELD NEW DN450 x 350 TAPER WITH FLANGED DN350 END TO SUIT DISMANTLING JOINT.
4. REMOVE EXISTING NRV AND TAPER AND WELD NEW DN350 FLANGE TO SUIT DISMANTLING JOINT.
5. ALL EXISTING CONCRETE PUMP PLINTHS TO BE REMOVED. STRUCTURAL DETAILS AT NEW CONCRETE PLINTHS AS PER DRAWING 014-7059-S-0307 & 0308.
6. GROUT UNDER PUMP PLATE SHALL BE HIGH STRENGTH, NON-SHRINK POURABLE GROUT SUCH AS SIKAGROUT-212 HP.

NO = NORMALLY OPEN

NC = NORMALLY CLOSED

AS CONSTRUCTED INFORMATION:
PLAN, SETOUT AND LOCATION OF CONSTRUCTION WORKS HAVE BEEN AMENDED. THIS "AS CONSTRUCTED" DRAWING IS IN ACCORDANCE WITH INFORMATION SUPPLIED FROM:
1) SITE PROJECT MANAGER & MECHANICAL ENGINEER: MACKAY INFRASTRUCTURE ALLIANCE (TENIX)
2) SURVEYOR: CARDNO PTY LTD
3) STRUCTURAL INSPECTIONS: CARDNO PTY LTD (ADAM BUCKLEY)
4) SITE INSPECTIONS: PARSONS BRINCKERHOFF
THE INFORMATON PROVIDED HAS BEEN PARTIALLY VERIFIED BY PARSONS BRINCKERHOFF, BASED ON AVAILABLE RECORDS AND LIMITED SITE INSPECTIONS.

PRELIMINARY

AS CONSTRUCTED

EXECUTIVE MANAGER MACKAY WATER: DAVID SEARLE	DATE: 14.04.11
RPEQ APPROVAL: No:	DATE:
W.P. DESIGN MANAGER: TOM ALLAN	DATE: 15.04.11
PROJECT MANAGER: PETER MCLEAN	DATE: 14.04.11
PROJECT APPROVAL	

NOTES: DESIGN NOT TO BE AMENDED WITHOUT REFERENCE TO DESIGN MANAGER / EXECUTIVE MANAGER MACKAY WATER. ALL LEVELS TO AHD.

REV	AMENDMENTS AND REVISIONS	DATE	DRAWN	APPR
2	AS CONSTRUCTED		MN	
1	MANIFOLD INCREASED TO DN1800	23.02.12	DPD	
0	APPROVED FOR CONSTRUCTION	26.05.11	LB	PRW
B	ISSUE FOR 85% DESIGN DEVELOPMENT REVIEW	04.02.11	LB	
A	ISSUE FOR 70% DOAR WORKSHOP	10.11.10	MM	

SCALE: 1:25	
DESIGN: AH	DATE: 11.10
CHECK: DRK	DATE: 11.10
DRAWN: LB	DATE: 11.10
CHECK: SG	DATE: 12.10
APPROV: PRW	DATE: 05.11

Cardno PB 125 YEARS

Tenix® TENIX AUSTRALIA PTY LTD BRISBANE . MELBOURNE . PERTH . SYDNEY AUSTRALIA

Mackay REGIONAL COUNCIL MACKAY INFRASTRUCTURE ALLIANCE LEVEL 1 , 38 WELLINGTON STREET MACKAY QLD 4740

PROJECT: MACKAY INFRASTRUCTURE ALLIANCE

DRAWING TITLE: MIA WORKS PACKAGE No. 014
DUMBLETON RAW WATER INTAKE UPGRADE
DUMBLETON PUMP STATION
INTERNAL PIPEWORK DETAILS - SHEET 1

DESIGN COMPANY: PB	COMPANY CODE:
MIA DRAWING NUMBER:	014-7059-P-0202
MRC DRAWING NUMBER:	A1-19216
REVISION	2

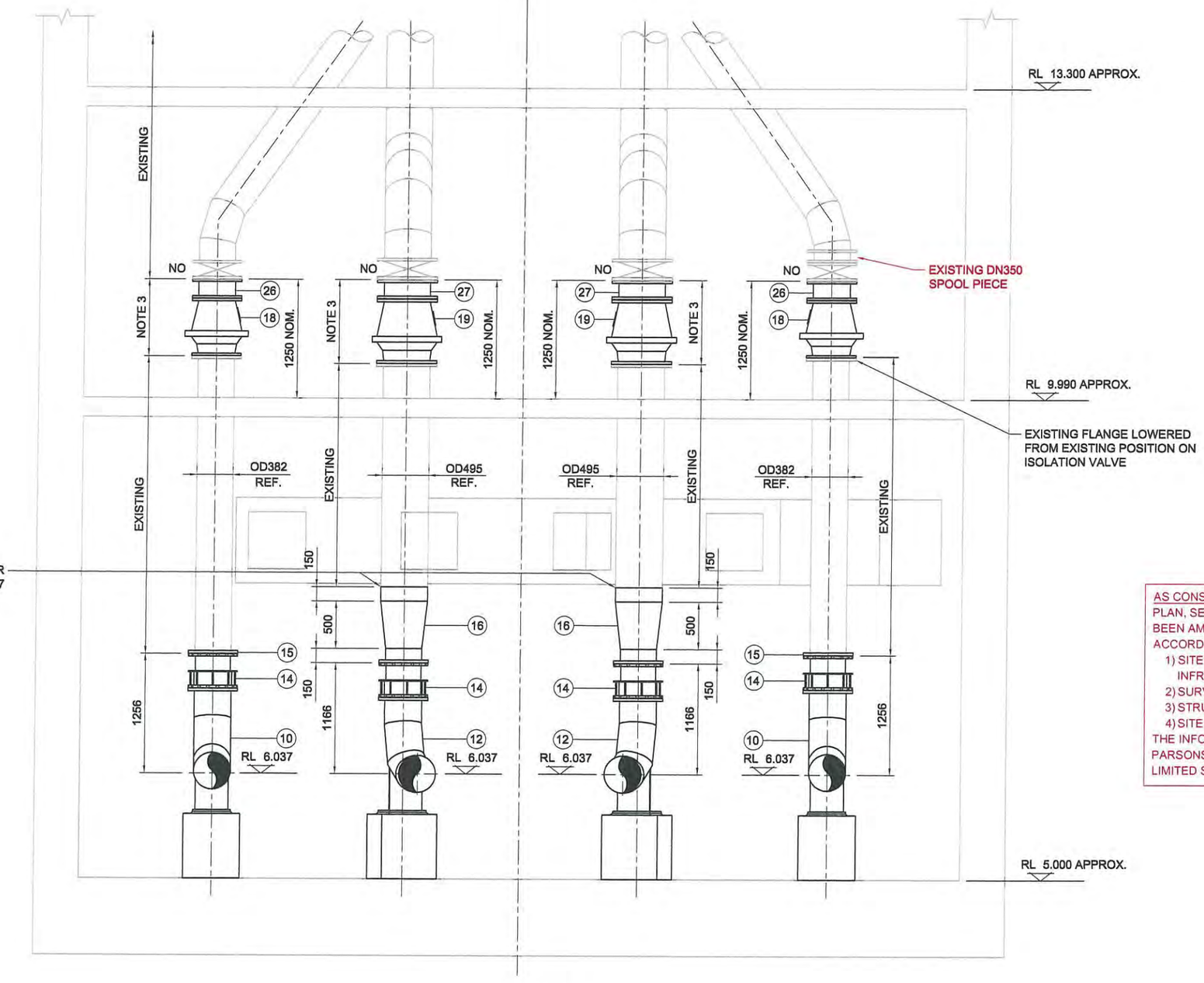
Plotted By: NardellaM Plot Date: 14/01/13 - 07:48 Cad File: J:\A606-WAT\PROJ\2138347A_MACKAY_CAPITAL_WORKS_ALLIANCE_\09_CADD\DRAWINGS\WP014_Dumbleton\014-7059-P-0202-DWG_2.dwg

NOTES

1. FOR GENERAL NOTES REFER DRAWING 014-7059-P-0012.
2. FOR FITTING SCHEDULE AND SPECIFIC PIPEWORK NOTES REFER DRAWING 014-7059-P-0201.
3. LOWER EXISTING PIPE TO FIT NEW CHECK VALVE AND SPOOL PIECE.
4. EXISTING PIPEWORK FROM ISOLATION VALVE AND ABOVE WILL NEED TO BE TEMPORARILY SUPPORTED TO ALLOW NEW WORKS. REFER NOTE 13, DRAWING P-0201.

NO = NORMALLY OPEN

NC = NORMALLY CLOSED



SECTION C 1:25 (0201)

0 250 500 1000 1500
Full Size 1:25 ; Half Reduction 1:50
SCALE (mm)

AS CONSTRUCTED INFORMATION:
PLAN, SETOUT AND LOCATION OF CONSTRUCTION WORKS HAVE BEEN AMENDED. THIS "AS CONSTRUCTED" DRAWING IS IN ACCORDANCE WITH INFORMATION SUPPLIED FROM:
1) SITE PROJECT MANAGER & MECHANICAL ENGINEER: MACKAY INFRASTRUCTURE ALLIANCE (TENIX)
2) SURVEYOR: CARDNO PTY LTD
3) STRUCTURAL INSPECTIONS: CARDNO PTY LTD (ADAM BUCKLEY)
4) SITE INSPECTIONS: PARSONS BRINCKERHOFF
THE INFORMATON PROVIDED HAS BEEN PARTIALLY VERIFIED BY PARSONS BRINCKERHOFF, BASED ON AVAILABLE RECORDS AND LIMITED SITE INSPECTIONS.

PRELIMINARY
AS CONSTRUCTED

EXECUTIVE MANAGER MACKAY WATER: DAVID SEARLE	DATE: 14.04.11
RPEQ APPROVAL: No:	DATE:
W.P. DESIGN MANAGER: TOM ALLAN	DATE: 15.04.11
PROJECT MANAGER: PETER MCLEAN	DATE: 14.04.11
PROJECT APPROVAL	

NOTES: DESIGN NOT TO BE AMENDED WITHOUT REFERENCE TO DESIGN MANAGER / EXECUTIVE MANAGER MACKAY WATER. ALL LEVELS TO AHD.

REV	AMENDMENTS AND REVISIONS	DATE	DRAWN	APPR
2	AS CONSTRUCTED		MN	
1	MANIFOLD INCREASED TO DN1801	23.02.12	DPD	
0	APPROVED FOR CONSTRUCTION	26.05.11	LB	PRW
B	ISSUE FOR 85% DESIGN DEVELOPMENT REVIEW	04.02.11	LB	
A	ISSUE FOR 70% DOAR WORKSHOP	10.11.10	MM	

SCALE:	1 : 25
DESIGN: AH	DATE: 11.10
CHECK: DRK	DATE: 11.10
DRAWN: LB	DATE: 11.10
CHECK: SG	DATE: 12.10
APPROV: PRW	DATE: 05.11

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PB 125 YEARS
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Mackay REGIONAL COUNCIL
MACKAY INFRASTRUCTURE ALLIANCE
LEVEL 1 , 38 WELLINGTON STREET
MACKAY QLD 4740

PROJECT: MACKAY INFRASTRUCTURE ALLIANCE

DRAWING TITLE:
MIA WORKS PACKAGE No. 014
DUMBLETON RAW WATER INTAKE UPGRADE
DUMBLETON PUMP STATION
INTERNAL PIPEWORK DETAILS - SHEET 2

DESIGN COMPANY: PB	COMPANY CODE:
MIA DRAWING NUMBER:	014-7059-P-0203
MRC DRAWING NUMBER:	A1-19217
REVISION	2

Plotted By: NardellaM Plot Date: 14/01/13 - 07:49 Cad File: J:\A606-WAT\PROJ\21383A7A_MACKAY_CAPITAL_WORKS_ALLIANCE_\09_CADD\DRAWINGS\WP014_Dumbleton\014-7059-P-0203-DWG_2.dwg

AS CONSTRUCTED INFORMATION:
PLAN, SETOUT AND LOCATION OF CONSTRUCTION WORKS HAVE BEEN AMENDED. THIS "AS CONSTRUCTED" DRAWING IS IN ACCORDANCE WITH INFORMATION SUPPLIED FROM:
1) SITE PROJECT MANAGER & MECHANICAL ENGINEER: MACKAY INFRASTRUCTURE ALLIANCE (TENIX)
2) SURVEYOR: CARDNO PTY LTD
3) STRUCTURAL INSPECTIONS: CARDNO PTY LTD (ADAM BUCKLEY)
4) SITE INSPECTIONS: PARSONS BRINCKERHOFF
THE INFORMATON PROVIDED HAS BEEN PARTIALLY VERIFIED BY PARSONS BRINCKERHOFF, BASED ON AVAILABLE RECORDS AND LIMITED SITE INSPECTIONS.

EXISTING SWABBING PIT
EXISTING DN150 GMS PIPE
EXISTING DN500 RC PIPE
CONCRETE SURROUND
BOLLARD (11 REQ'D), FOR LOCATIONS AROUND ELECTRICAL PITS REFER DRG 014-7059-E-0805. FOR DETAIL REFER DRG 014-7059-P-0211
A 0211
THRUST BLOCK TB1. REFER DRG 014-7059-P-0211 FOR THRUST BLOCK SCHEDULE
THRUST BLOCK TB2. REFER DRG 014-7059-P-0211 FOR THRUST BLOCK SCHEDULE
THRUST BLOCK TB3. REFER DRG 014-7059-P-0211 FOR THRUST BLOCK SCHEDULE
THRUST BLOCK TB4. REFER DRG 014-7059-P-0211 FOR THRUST BLOCK SCHEDULE
EXISTING DN150 GMS PIPE (TO BE ABANDONED)
EXISTING DN150 AC PIPE (TO BE ABANDONED)
CAUTION UNDERGROUND ELECTRICITY
ELECTRICAL CONDUITS TO BE ABANDONED
DN150 uPVC SN8 STORMWATER DRAIN MIN. GRADE 1%
DN150 SC-SC 45° BEND PVC
DN150 SC-SC 90° BEND PVC
DN150 uPVC DRAIN
ELECTRICAL PIT EP2
2xDN100 ELECTRICAL CONDUITS
WESTERN RAW WATER TRANSFER MAIN (EXISTING OD648 MSCL PIPE)
EASTERN RAW WATER TRANSFER MAIN (EXISTING OD648 MSCL PIPE)
EXISTING OD648 MSCL PIPE
ACCESS TRACK
SUBCONTRACTOR SHALL CUT AND REMOVE EXISTING OD648 MSCL PIPEWORK IN ACCORDANCE WITH WORK METHOD STATEMENT APPROVED BY SUBCONTRACT SUPERINTENDENT.
EXISTING DN750 MSCL PIPE
FLOW METER PIT. FOR DETAIL REFER DRG 014-7059-P-0212
CONCRETE RAMP
DN150 SC-SC 90° BEND PVC
DN150 uPVC DRAIN
ARMCO VEHICULAR GUARDRAIL
ELECTRICAL PIT EP1. FOR DETAILS REFER DRG 014-7059-E-0805
FLOW
NC = NORMALLY CLOSED
NO = NORMALLY OPEN

DETAIL 1 / 1:25 / 0101 ITEM 10
DETAIL 2 / 1:25 ITEM 12
DETAIL 3 / 1:25 ITEM 5
850 DIA x 20mm THICK FLANGE
END TO BE MACHINED SUITABLE FOR DISMANTLING JOINT IN ACCORDANCE WITH MRC STD DWG A3-04310.
OD168x5mm

AS CONSTRUCTED SURVEY NOT PROVIDED BY THE MIA. PB AND THE RPEQ ENGINEER DO NOT WARRANT THE ACCURACY OF THE SITE SETOUT.

CAUTION
SUBCONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS WHEN CUTTING INTO AND REMOVING AC PIPE IN ACCORDANCE WITH THE CODE OF PRACTICE FOR THE SAFE REMOVAL OF ASBESTOS.

NOTES
1. FOR GENERAL NOTES REFER TO DRG 014-7059-P-0012.
2. FOR SURVEY CONTROL, SETOUT TABLE AND LEGEND REFER TO DRG 014-7059-P-0013.
3. FOR FITTING SCHEDULE REFER DRAWING 014-7059-P-0211.
4. FOR BEDDING AND BACKFILL REQUIREMENTS REFER TO MRC STD DRG A3-00835 TYPE 1 CONSTRUCTION.

PRELIMINARY AS CONSTRUCTED

EXECUTIVE MANAGER MACKAY WATER: DAVID SEARLE	DATE: 14.04.11	NOTES: DESIGN NOT TO BE AMENDED WITHOUT REFERENCE TO DESIGN MANAGER / EXECUTIVE MANAGER MACKAY WATER. ALL LEVELS TO AHD.			
RPEQ APPROVAL: No:	DATE:				
W.P. DESIGN MANAGER: TOM ALLAN	DATE: 15.04.11				
PROJECT MANAGER: PETER MCLEAN	DATE: 14.04.11				
		1	AS CONSTRUCTED	MN	
		0	APPROVED FOR CONSTRUCTION	26.05.11	MN PRW
		B	ISSUE FOR 85% DESIGN DEVELOPMENT REVIEW	24.12.10	MN
		A	ISSUE FOR 70% DOAR WORKSHOP	10.11.10	MN
PROJECT APPROVAL		REV	AMENDMENTS AND REVISIONS	DATE	DRAWN APPR

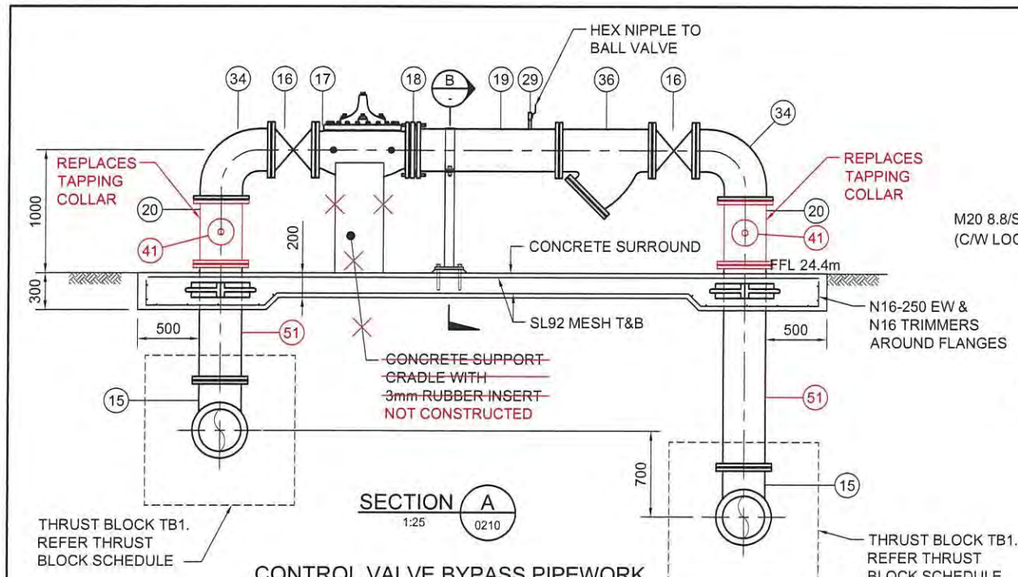
SCALE: 1 : 25
DESIGN: AH DATE: 11.10
CHECK: PPH DATE: 12.10
DRAWN: MN DATE: 11.10
CHECK: SG DATE: 12.10
APPROV: PRW DATE: 05.11

Cardno PB 125 YEARS
Tenix TENIX AUSTRALIA PTY LTD BRISBANE MELBOURNE PERTH SYDNEY AUSTRALIA
Mackay REGIONAL COUNCIL MACKAY INFRASTRUCTURE ALLIANCE LEVEL 1 , 38 WELLINGTON STREET MACKAY QLD 4740

PROJECT: MACKAY INFRASTRUCTURE ALLIANCE
DRAWING TITLE: MIA WORKS PACKAGE No. 014
DUMBLETON RAW WATER INTAKE UPGRADE
DUMBLETON PUMP STATION
EXTERNAL PIPEWORK GENERAL ARRANGEMENT

DESIGN COMPANY: PB | COMPANY CODE:
MIA DRAWING NUMBER: 014-7059-P-0210
MRC DRAWING NUMBER: A1-19221
REVISION: 1

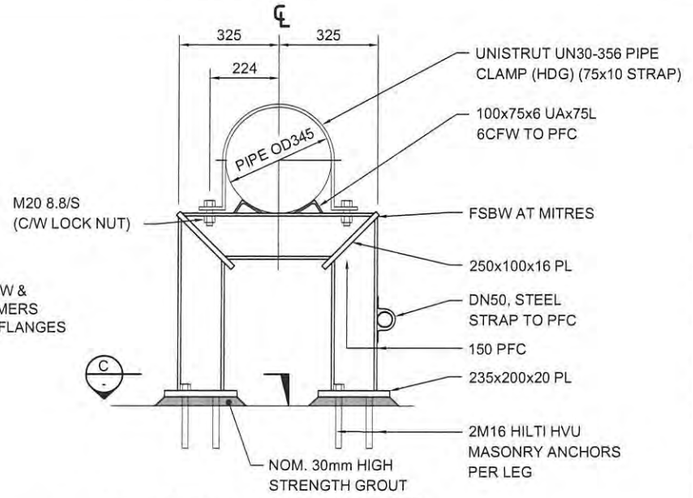
Plotted By: NardellaM Plot Date: 21/01/13 - 14:04 Cad File: J:\A606-WAT\PROJ\2138347A_MACKAY_CAPITAL_WORKS_ALLIANCE_\09_CADD\DRAWINGS\WP014_Dumbleton\014-7059-P-0210-DWG_1.dwg



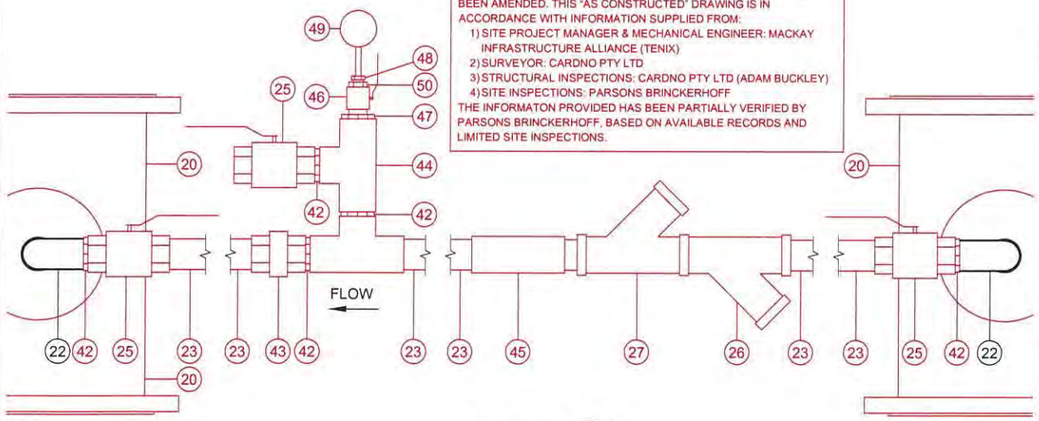
SECTION A 0210 — 1:25

CONTROL VALVE BYPASS PIPEWORK

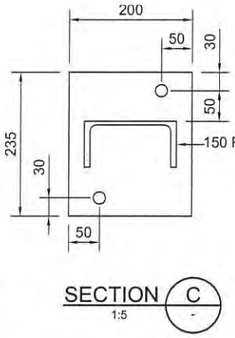
NOTE: PRESSURE REDUCING BYPASS PIPEWORK NOT SHOWN FOR CLARITY



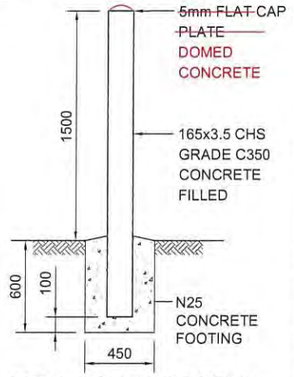
PIPE SUPPORT SECTION B — 1:10



SECTION A 0210 — 1:5



SECTION C — 1:5



TYPICAL BOLLARD DETAIL — 1:20

NOTES

1. FOR GENERAL NOTES REFER TO DRG 014-7059-P-0012
2. FOR SURVEY CONTROL, SETOUT TABLE AND LEGEND REFER TO DRG 014-7059-P-0013.
3. SUBCONTRACTOR SHALL CONFIRM THE OD OF GMS PIPE AND CONFIRM COUPLING IS SUITABLE.
4. PUDDLE FLANGE SHALL BE FACTORY FITTED ONTO PIPE. A MACHINE GROOVE SHALL BE CUT INTO OUTSIDE SURFACE OF THE PIPE AND THE PUDDLE FLANGE MACHINED ACCORDINGLY TO PROVIDE A NOMINAL INTERFERENCE FIT IN ACCORDANCE WITH AS2280.

AS CONSTRUCTED INFORMATION:
PLAN, SETOUT AND LOCATION OF CONSTRUCTION WORKS HAVE BEEN AMENDED. THIS "AS CONSTRUCTED" DRAWING IS IN ACCORDANCE WITH INFORMATION SUPPLIED FROM:
1) SITE PROJECT MANAGER & MECHANICAL ENGINEER: MACKAY INFRASTRUCTURE ALLIANCE (TENIX)
2) SURVEYOR: CARDNO PTY LTD
3) STRUCTURAL INSPECTIONS: CARDNO PTY LTD (ADAM BUCKLEY)
4) SITE INSPECTIONS: PARSONS BRINCKERHOFF
THE INFORMATON PROVIDED HAS BEEN PARTIALLY VERIFIED BY PARSONS BRINCKERHOFF, BASED ON AVAILABLE RECORDS AND LIMITED SITE INSPECTIONS.

FITTING SCHEDULE

ITEM	MATERIAL	MATERIAL	QTY
1	OD648x9.5mm FL-SP C/W THRUST FLANGE (850 DIA x 20mm THICK) (1150 LONG MIN WITH DN600 FLANGE)	MSCL PE COATED	2
2	DN600 ELECTROMAGNETIC FLOW METER		2
3	DN600 NON-THRUST DISMANTLING JOINT TO SUIT ITEM 4.		2
4	OD648x9.5mm FL-SP C/W THRUST FLANGE AND DN150 CONNECTION SPECIAL (REFER DETAIL 3 SIMILAR TO ITEM 5 BUT WITH DN150 CONNECTION ON OTHER SIDE)	MSCL PE COATED	1
5	OD648x9.5mm FL-SP C/W THRUST FLANGE AND DN150 CONNECTION SPECIAL (REFER DETAIL 3)	MSCL PE COATED	1
6	DN600xDN600 FL-FLxFL TEE.	DICL	2
7	DN600 FL-FL SLUICE VALVE (WP SPEC - SP21)	DI FBE COATED	3
8	OD648x6mm FL-SP CONNECTOR (LENGTH TO SUIT)	MSCL PE COATED	2
9	DN600xDN300 FL-FLxFL TEE	DICL	2
10	OD648x9.5mm FL-FL SPECIAL (REFER DETAIL 1)	MSCL PE COATED	1
11	OD648x9.5mm FL-SP (300 LONG WITH DN600 FLANGE)	MSCL PE COATED	1
12	OD648x9.5mm FL-SP SPECIAL (REFER DETAIL 2)	MSCL PE COATED	1
13	DN300 FL-SC CONNECTOR	DICL FBE COATED	4
14	DN300 SP-SP SHORT PIPE ~~(1150 LONG)~~ 865 LONG	DICL FBE COATED	2
15	DN300 FL-FL 90° BEND	DICL FBE COATED	2
16	DN300 FL-FL RESILIENT SEATED GATE VALVE	DI	~~2~~ 4
17	DN300 FL-FL CLA-VAL MODEL 694-01 AUTOMATIC ACTING PRESSURE REDUCING VALVE WITH DOWNSTREAM SURGE PROTECTION (REFER 014-7059-C-SE001 TECHNICAL SPECIFICATION FOR FURTHER DETAILS) OR SIMILAR APPROVED.	DI	1
18	DN300 DISMANTLING JOINT NON-THRUST TYPE	DI	1
19	DN300 FL-SP SHORT PIPE (MIN. 1214 LONG) C/W DN25 THREADED SOCKET FOR BALL VALVE	DICL FBE COATED	1
20	~~DN300 FL-FL SHORT PIPE (LENGTH VARIES) C/W PUDDLE FLANGE AND TAPPING SADDLE TYPE WANG KT4-340T050. (REFER NOTE 4)~~ DN300-DN300xDN100 OFFTAKE	DICL FBE COATED	2
21	WELD COLLAR	MS	5
22	DN50 90° ELBOW	SS	2
23	DN50 PIPE (LENGTH VARIES)	SS	~~5~~ 3
24	NOT USED		
25	DN50 BALL VALVE	SS	2
26	DN50 Y STRAINER	SS	1
27	DN50 PRESSURE REDUCING VALVE. CALEFF 535090 OR SIMILAR APPROVED.	-	1
28	DN150 RESILIENT SEATED GATE VALVE	DI	2
29	DN25 BALL VALVE	SS	1
30	DN150 SC-SC 90° BEND	DICL	~~2~~ 1
31	DN150 SC-SC 45° BEND	DICL	1
32	DN150 SC-SC 22.5° BEND	DICL	2
33	DN150 FL-~~SC~~ SP CONNECTOR	DI	2
34	DN300 FL-FL 90° BEND	DI	2
35	DN150 SP-SP STRAIGHT (LENGTHS VARY)	mPVC PN16	~~7~~ 5
36	DN300 FL-FL STRAINER	DI (WITH SS SCREEN)	1
37	DN150 GIBAULT COUPLING. (SEE NOTE 3)	DI	2
38	DN150 SC-SC SLUICE VALVE	DI	1
39	DN150 FL-FL 90° BEND	DI	1
40	DN150 SP-SC STRAIGHT	DICL	1
41	DN100-DN50 REDUCING FLANGE	DI	2
42	DN50 NIPPLE BSP	SS	7
43	DN50 BARRELL UNION	SS	1
44	DN50 EQUAL TEE	SS	1

FITTING SCHEDULE - CONTINUED

ITEM	MATERIAL	MATERIAL	QTY
45	DN50 SOCKET (BSP)	SS	1
46	DN25 BALL VALVE (BSP)	SS	1
47	DN50-DN25 REDUCING NIPPLE	SS	1
48	¾" - ¼" REDUCING BUSH (BSP)	SS	1
49	¼" 50 mm FACE GUAGE	SS	1
50	1" - ¾" REDUCING BUSH (BSP)	SS	1
51	DN300 FL-FL SHORT PIPE (LENGTH VARIES) WITH PUDDLE FLANGE (REFER NOTE 4)	SS	1

0 50 100 200 300 — Full Size 1:5 ; Half Reduction 1:10 SCALE (mm)
0 100 200 400 600 — Full Size 1:10 ; Half Reduction 1:20 SCALE (mm)
0 0.2 0.4 0.8 1.2 — Full Size 1:20 ; Half Reduction 1:40 SCALE (m)
0 250 500 1000 1500 — Full Size 1:25 ; Half Reduction 1:50 SCALE (mm)

THRUST BLOCK SCHEDULE

ID	DESIGN PRESSURE	MAXIMUM THRUST LOAD	MINIMUM THRUST AREA*
TB1	1600 kPa	147 kN	1.5m²
TB2	1600 kPa	39 kN	0.4m²
TB3	1600 kPa	21kN	0.21m²
TB4	1600 kPa	11kN	0.11m²

* ASSUMED ALLOWABLE BEARING PRESSURE 100 kPa
** REFER MRC STD DRG A3-00836 FOR ADDITIONAL DETAILS

PRELIMINARY
AS CONSTRUCTED

EXECUTIVE MANAGER MACKAY WATER: DAVID SEARLE	DATE: 14.04.11
RPEQ APPROVAL: No:	DATE:
W.P. DESIGN MANAGER: TOM ALLAN	DATE: 15.04.11
PROJECT MANAGER: PETER MCLEAN	DATE: 14.04.11
PROJECT APPROVAL	

NOTES: DESIGN NOT TO BE AMENDED WITHOUT REFERENCE TO DESIGN MANAGER / EXECUTIVE MANAGER MACKAY WATER. ALL LEVELS TO AHD.

REV	AMENDMENTS AND REVISIONS	DATE	DRAWN	APPR
1	AS CONSTRUCTED		MN	
0	APPROVED FOR CONSTRUCTION	26.05.11	MN	PRW
B	ISSUE FOR 85% DESIGN DEVELOPMENT REVIEW	24.12.10	MN	
A	ISSUE FOR 70% DOAR WORKSHOP	10.11.10	MN	

SCALE:	AS SHOWN		
DESIGN: AH	DATE: 11.10		
CHECK: PPH	DATE: 12.10		
DRAWN: MN	DATE: 11.10		
CHECK: SG	DATE: 12.10		
APPROV: PRW	DATE: 05.11		

Cardno — PB 125 YEARS — Tenix® TENIX AUSTRALIA PTY LTD BRISBANE MELBOURNE PERTH SYDNEY AUSTRALIA

Mackay REGIONAL COUNCIL — MACKAY INFRASTRUCTURE ALLIANCE LEVEL 1 , 38 WELLINGTON STREET MACKAY QLD 4740

PROJECT: MACKAY INFRASTRUCTURE ALLIANCE

DRAWING TITLE: MIA WORKS PACKAGE No. 014
DUMBLETON RAW WATER INTAKE UPGRADE
DUMBLETON PUMP STATION
EXTERNAL PIPEWORK DETAILS - SHEET 1

DESIGN COMPANY: PB | COMPANY CODE:
MIA DRAWING NUMBER: 014-7059-P-0211
MRC DRAWING NUMBER: A1-19222
REVISION: 1

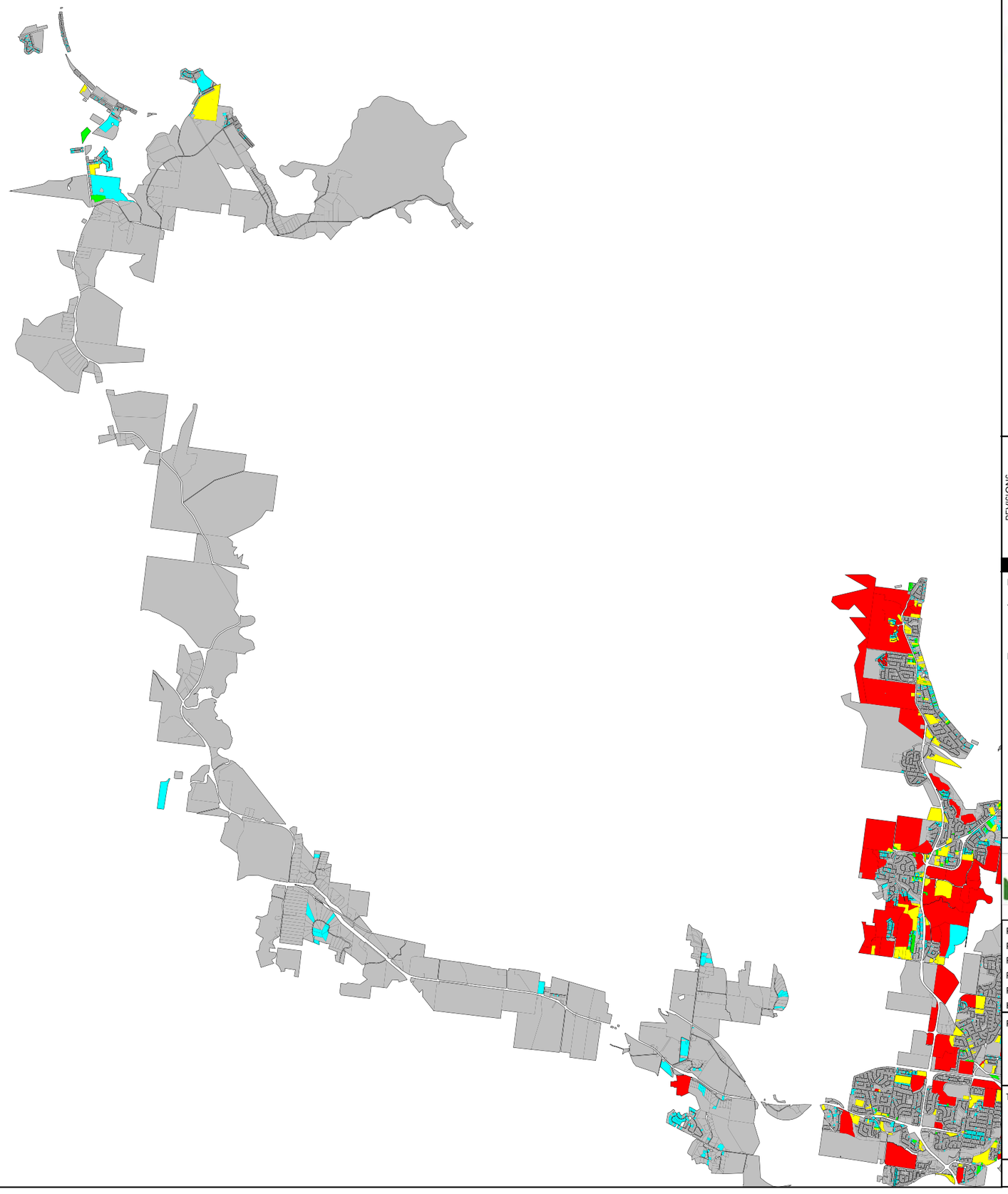
Plotted By: NardellaM Plot Date: 21/01/13 - 09:32 Cad File: J:\A606-WAT\PROJ\21383A7A_MACKAY_CAPITAL_WORKS_ALLIANCE_\09_CADD\DRAWINGS\WP014_Dumbleton\014-7059-P-0211-DWG_1.dwg

Appendix B: Contingency Worksheet

Project Location	Mackay Water Planning			Date:	6/08/2015	
Project Description	Water Strategy					
Task / Activity	Comments		Highly Confident and Reliable	Reasonably Confident and Reliable	Not Confident and Not reliable	Adopted Contingency
Project Scope	Is it well defined? Yes v No ^	Yes ↓ No ↑	1.88%	2.67%	3.57%	1.88%
	Is there room to vary the works?	Yes ↑ No ↓	1.88%	2.67%	3.57%	2.67%
	Are there many options?	Yes ↑ No ↓	1.88%	2.67%	3.57%	2.67%
Risks	Are there significant risks? Political Community , Financial	Yes ↑ No ↓	3.13%	4.00%	5.71%	3.13%
	Has a detailed risk analysis been done?	Yes ↓ No ↑	2.50%	4.00%	5.00%	5.00%
Constructability	Has a constructability review been undertaken?	Yes ↓ No ↑	1.88%	2.67%	3.57%	3.57%
	Is Constructability a problem?	Yes ↑ No ↓	1.88%	2.67%	3.57%	1.88%
Key Dates	Are the project dates known?	Yes ↓ No ↑	0.63%	1.33%	2.14%	1.33%
	Is the project planned for the distant future?	Yes ↑ No ↓	0.63%	1.33%	2.14%	2.14%
Information	Has investigation been undertaken? Geotechnical, Heritage, Technical, Hydraulic	Yes ↓ No ↑	5.63%	8.00%	10.71%	10.71%
Complexity of the project	Is the project complex?	Yes ↑ No ↓	3.13%	4.67%	6.43%	3.13%
			25%	**37%**	**50%**	**38%**
					Adopted Contingency	38%

Notes:
No V denotes that if the answer is No, decrease contingency.
No Λ denotes that if the answer is No, increase contingency.
Yes Λ denotes that if the answer is Yes, increase contingency.
Yes V denotes that if the answer is Yes, decrease contingency.

Appendix C: EP Growth Maps



N
W E
S

LEGEND

	100 to 4,670 Increase in EP	(147)
	10 to 100 Increase in EP	(540)
	5 to 10 Increase in EP	(330)
	0 to 5 Increase in EP	(3153)
	No change	(5792)
	Reduction in EP	(25372)

REVISIONS

REV	DATE	DESCRIPTION	APPD

DATA INFORAMTAION

Aerial / Satellite Imagery

DISCLAIMER

Mackay REGIONAL COUNCIL

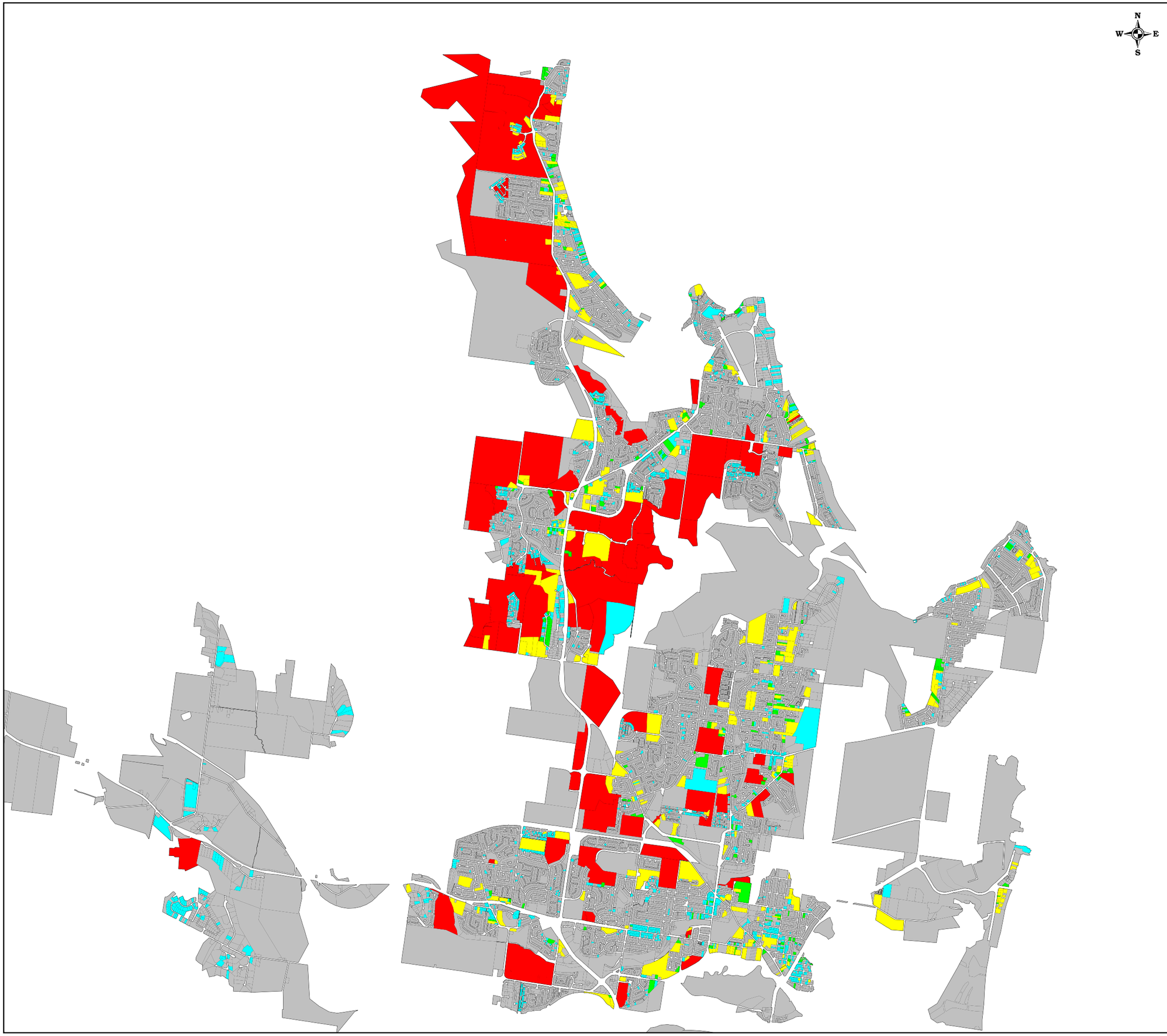
PUBLISHER: PLANNING
PUBLICATION DATE: 21/04/2015
REFERENCE:
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 56
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE

GROWTH 2014-2036 (EP)
SEAFORTH



LEGEND

	100 to 4,670 Increase in EP	(147)
	10 to 100 Increase in EP	(540)
	5 to 10 Increase in EP	(330)
	0 to 5 Increase in EP	(3153)
	No change	(5792)
	Reduction in EP	(25372)

REVISIONS

REV	DATE	DESCRIPTION	APPD

DATA INFORAMTAION

Aerial / Satellite Imagery

DISCLAIMER

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
PUBLICATION DATE: 21/04/2015
REFERENCE: 1
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 56
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE

GROWTH 2014-2036 (EP) NORTH OF PIONEER RIVER

LEGEND

	100 to 4,670 Increase in EP	(147)
	10 to 100 Increase in EP	(540)
	5 to 10 Increase in EP	(330)
	0 to 5 Increase in EP	(3153)
	No change	(5792)
	Reduction in EP	(25372)

REVISIONS

REV	DATE	DESCRIPTION	APPD

DATA INFORAMTAION

Aerial / Satellite Imagery

DISCLAIMER

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
PUBLICATION DATE: 21/04/2015
REFERENCE: 1
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 56
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

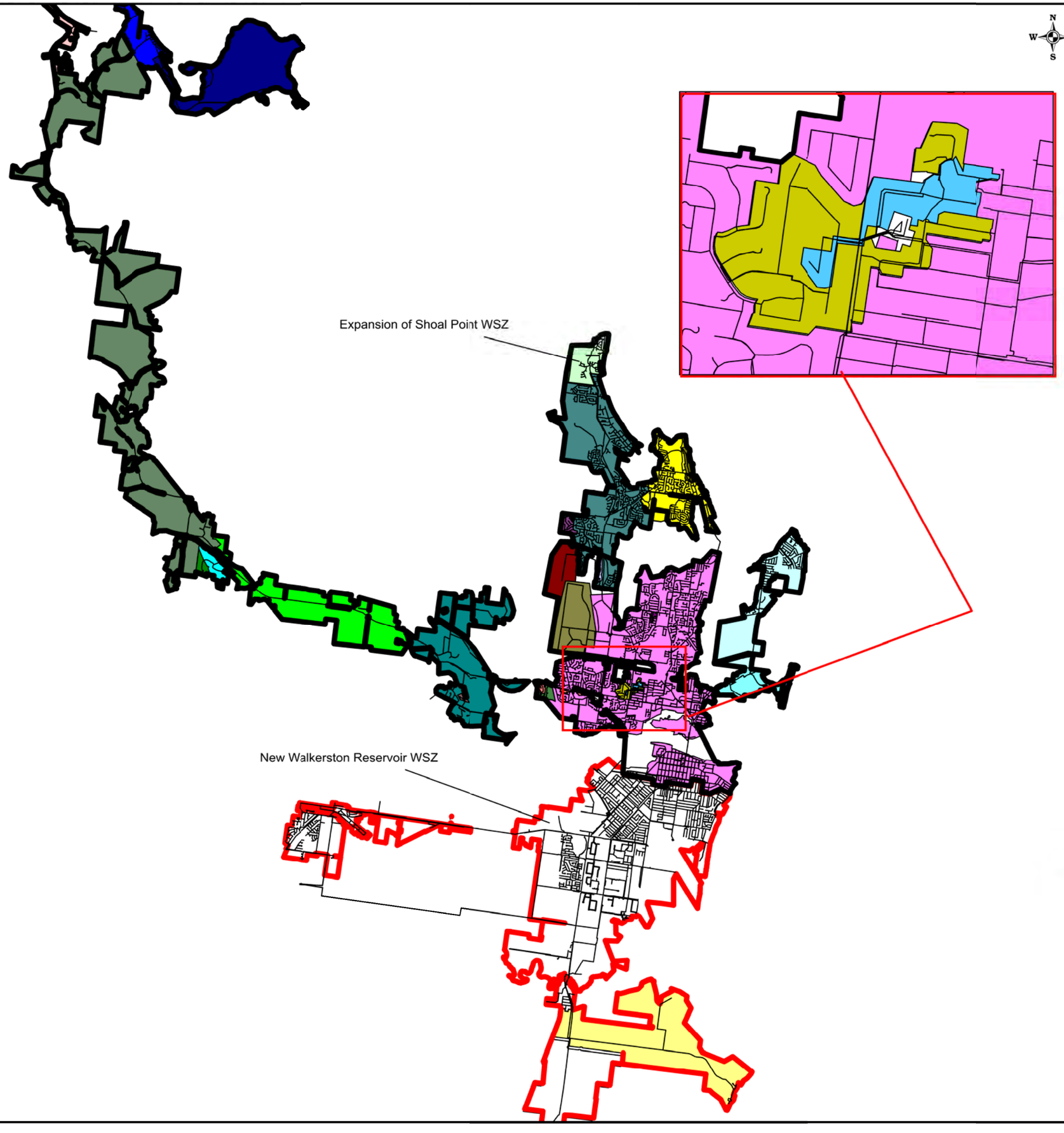
PROJECT

Mackay Water Strategy 83502679

TITLE

GROWTH 2014-2036 (EP)
SOUTH OF THE PIONEER RIVER

Appendix D: Northern and Southern Schemes and Ultimate Pressure Water Supply Zones



LEGEND

- Ultimate Water Mains
- Northern Scheme
- Southern Scheme
- ASHBURTONS RD
- BALL BAY / HALIDAY BAY
- BERRY ST
- BLACKS BEACH
- BRONSON SCRUB
- BOVEYS RD
- BRONSON SCRUB RD
- CAPE HILLSBOROUGH
- CREESE ST
- DOLPHIN HEADS
- FARLEIGH
- GLENELLA PRV
- GREEN ST HLZ
- HARBOUR VILLAGE
- MACKAY LOW LEVEL ZONE
- MCEWENS BEACH
- MT BASSETT
- MT VISTA
- PEPPERMINT GROVE PRV_2
- ILLANGI BOOSTER
- PREMIER GARDENS HZPS
- RICHMOND
- RURAL VIEW
- SEAFORTH
- SHOAL PT
- SHUTTLEWOODS
- SLADE POINT HLZ
- SLADE PT
- SUNSET DR
- THE LEAP BREAK TANK
- NEW WALKERSTON RES ZONE

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
PUBLICATION DATE: 21/04/2015
REFERENCE: 1
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 55
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE

NORTHERN AND SOUTHERN SCHEME WITH ULTIMATE PRESSURE ZONES

Appendix E: Schematics of Strategic Options

Option 1 BAU - Construct Southern WTP and Reservoir at Walkerston

All existing infrastructure has been "greyed out"

Infrastructure Requirements and Timing (based on 1.57% growth rate)

- Construct a new raw water trunk main at 2026 **525** mm.
- De-commission the existing AC/RC raw water main.
- Construct new 16 ML Walkerston Reservoir at 2038
- Construct first trunk main from new Walkertson reservoir to South Mackay at 2038 **675** mm
- Construct new supply main to Walkerston at 2038 **300** mm. Turn off Walkerston WPS and supply Walkerston from the new reservoir.
- Construct 35 ML/d Southern WTP at 2038 with
  - New raw water Main **600** mm
  - New delivery main **675** mm
- Additional Distribution Trunk Main **675** mm at approx 2056
- Separate Northern and Southern Distribution Systems
- Construct Inter-connection pipework at Nebo Road WTP to Southern Scheme network infrastructure to Nebo Road WTP balance tanks. This will allow flexibility to supply Northern Scheme from the Southern Scheme if required. The Southern Scheme can be supplied by the Northern Scheme (NeboRoad WTP) by reverting back to existing system operation

Nebo Rd WTP	Capacity (ML/d)	L/s
Capacity	75	868
Capacity with Sarina	75	868

Nebo Rd HLPS Capacity		ML/d	L/s
Northern Supply	Nebo HLPS	53	608
	Nebo HLPS with Sarina	53	613

New Raw Water Main

diameter	525 mm
diameter with Sarina	**525 mm**
length	11000 m
Year	**2026**

Nebo Road WTP Supplying Northern Scheme (North of the River and Mackay CBD)

Upgrade River Intake Power Supply to 90 ML/d

Dumbleton Weir

PIONEER RIVER

New Raw Water Main — Dumbleton Intake

diameter	525 mm
diameter with Sarina	**600 mm**
length	2500 m
Year	**2038**

Decommission Existing AC/ RC Raw Water Pipe

Nebo Road WTP

Mackay CBD

Southern WTP	Persistance (ML/d)	L/s
Capacity	30	420
Capacity with Sarina	**35**	**450**

Turn off existing Walkerston WPS and supply Walkerston from new reservoir

WTP Supply Boundary

Walkerston Upgrades

diameter	600 mm
diameter with Sarina	**675 mm**
length	6000 m
Year	**2038**

New delivery trunk main

New supply main to Walkerston

diameter	**300 mm**
length	1870 m
year	**2038**

Turn off existing Silangardies Road reservoir and supply Walkerston from new reservoir

diameter	600 mm
diameter with Sarina	**675 mm**
length	9097 m
Year	**2038**

New distribution trunk main

diameter	600 mm
diameter with Sarina	**675 mm**
length	9097 m
Year	**2056**

New distribution trunk main

South Mackay Upgrades

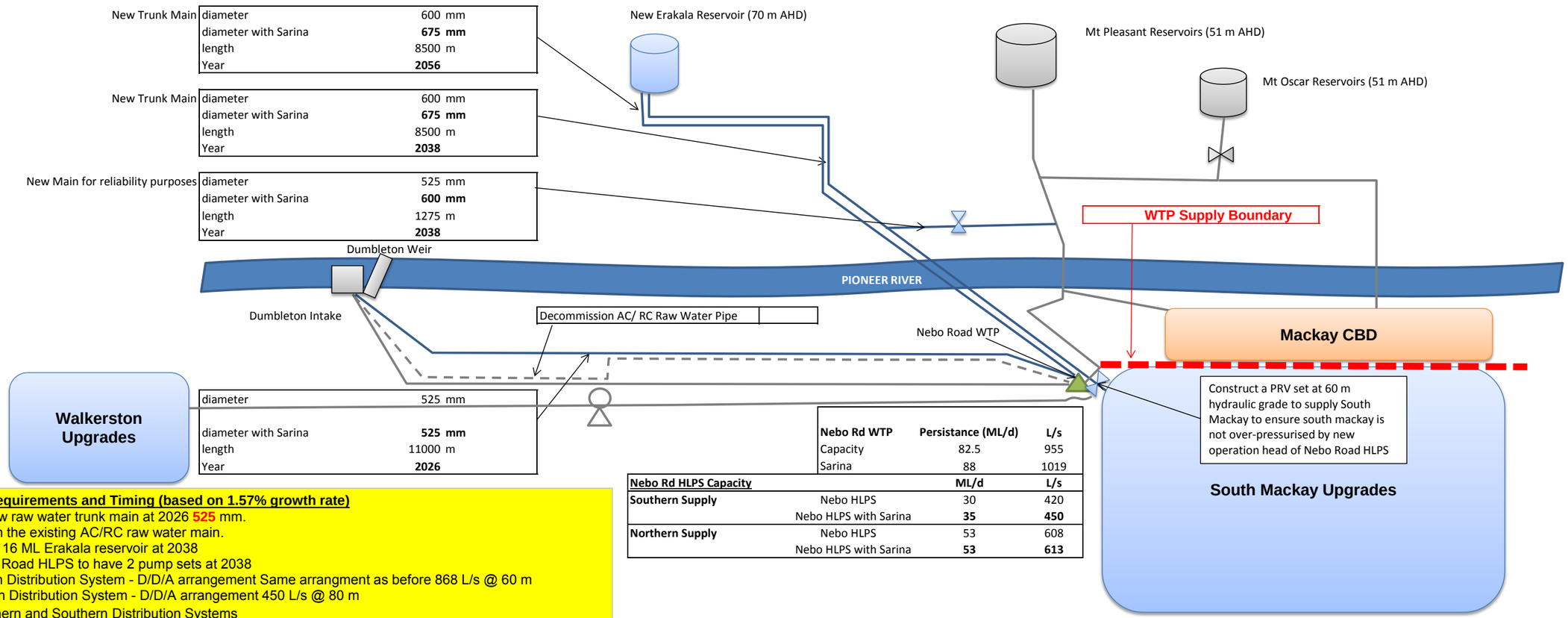
Reservoir	PD (ML)	3*(PD-MDMM) (ML)	Medium Series Timing (2.4%)	Long Term Average Timing (1.57%)
Capacity	33	16	2037	2045
Capacity with Sarina	38	**16**	2031	**2038**

Option 2 Nebo Road WTP Upgrade with Reservoir at Erakala

All existing infrastructure has been "greyed out"

Medium Series Timing (2.4%)	**Long Term Average Timing (1.57%)**
2037	2045
2031	**2038**

Reservoir	**PD (ML)**	**3*(PD-MDMM) (ML)**
Capacity	33	16
Capacity with Sarina	38	**16**



Nebo Rd WTP	**Persistance (ML/d)**	**L/s**
Capacity	82.5	955
Sarina	88	1019

Nebo Rd HLPS Capacity		**ML/d**	**L/s**
Southern Supply	Nebo HLPS	30	420
	Nebo HLPS with Sarina	**35**	**450**
Northern Supply	Nebo HLPS	53	608
	Nebo HLPS with Sarina	**53**	**613**

Infrastructure Requirements and Timing (based on 1.57% growth rate)

- Construct a new raw water trunk main at 2026 **525** mm.
- De-commission the existing AC/RC raw water main.
- Construct New 16 ML Erakala reservoir at 2038
- Upgrade Nebo Road HLPS to have 2 pump sets at 2038
  - Northern Distribution System - D/D/A arrangement Same arrangment as before 868 L/s @ 60 m
  - Southern Distribution System - D/D/A arrangement 450 L/s @ 80 m
- Separate Northern and Southern Distribution Systems
- Construct trunk mains to new reservoir at 2038 **675** mm
- Construct new reliability main with valve at 2038 **600** mm to provide connectivtiy between Northern and Southern Schemes to provide flexibility to transfer water between systems.
- Construct PRV set at 60 m hydraulic grade to supply South Mackay from Nebo Road HLPS
- Upgrade Nebo WTP Capacity to 90 ML/d at 2038 with
  - New technology available to increase WTP capacity from 75 ML/d to 90 ML/d
    - lamella plates, tubesettlers or modification for the use of other technology like DAF, Comag or Actiflo should make it feasible subject to further testing

Option 2A Nebo Road WTP Upgrade with Reservoir at Walkerston

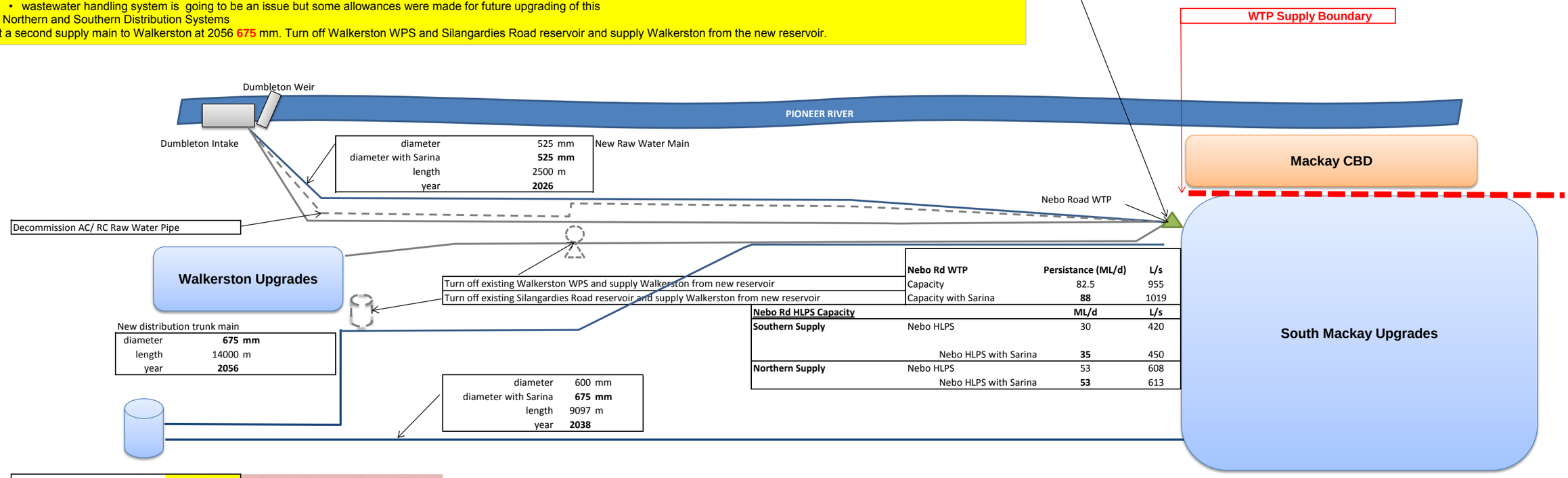
All existing infrastructure has been "greyed out"

Infrastructure Requirements

- Construct a new raw water trunk main at 2026 525 mm.
- De-commission the existing AC/RC raw water main.
- Construct New 16 ML Walkerston reservoir at 2038
- Upgrade Nebo Road HLPS to have 2 pump sets at 2038
  - Northern Distribution System - D/D/A arrangement Same arrangment as before 868 L/s @ 60 m
  - Southern Distribution System - D/D/A arrangement 450 L/s @ 80 m
- Construct trunk main to new reservoir at 2038 **675** mm
- Construct 13 PRVs off the 600 mm diameter southern distribution mian from Nebo Road WTP at specific offtake locations and set at 60 m hydraulic grade to supply South Mackay from Nebo Road HLPS and the new Walkerston reservoir
- Upgrade Nebo WTP Capacity to 90 ML/d at 2038 with
  - New technology available to increase WTP capacity from 75 ML/d to 90 ML/d
    - lamella plates, tubesettlers or modification for the use of other technology like DAF, Comag or Actiflo should make it feasible subject to further testing
    - wastewater handling system is going to be an issue but some allowances were made for future upgrading of this
- Separate Northern and Southern Distribution Systems
- Construct a second supply main to Walkerston at 2056 **675** mm. Turn off Walkerston WPS and Silangardies Road reservoir and supply Walkerston from the new reservoir.

Nebo Rd WTP	Capacity (ML/d)	L/s
Capacity	75	868
Capacity with Sarina	75	868

Nebo Rd HLPS Capacity		ML/d	L/s
Northern Supply	Nebo HLPS	53	608
	Nebo HLPS with Sarina	53	613



Nebo Rd WTP	Persistance (ML/d)	L/s
Capacity	82.5	955
Capacity with Sarina	88	1019

Nebo Rd HLPS Capacity		ML/d	L/s
Southern Supply	Nebo HLPS	30	420
	Nebo HLPS with Sarina	35	450
Northern Supply	Nebo HLPS	53	608
	Nebo HLPS with Sarina	53	613

Reservoir	PD (ML)	(ML)	Timing (2.4%)	Timing (1.57%)
Capacity	33	16	2037	2045
Capacity with Sarina	38	16	2031	2038

Option 3 Construct Northern WTP and Reservoir at Erakala

All existing infrastructure has been "greyed out"

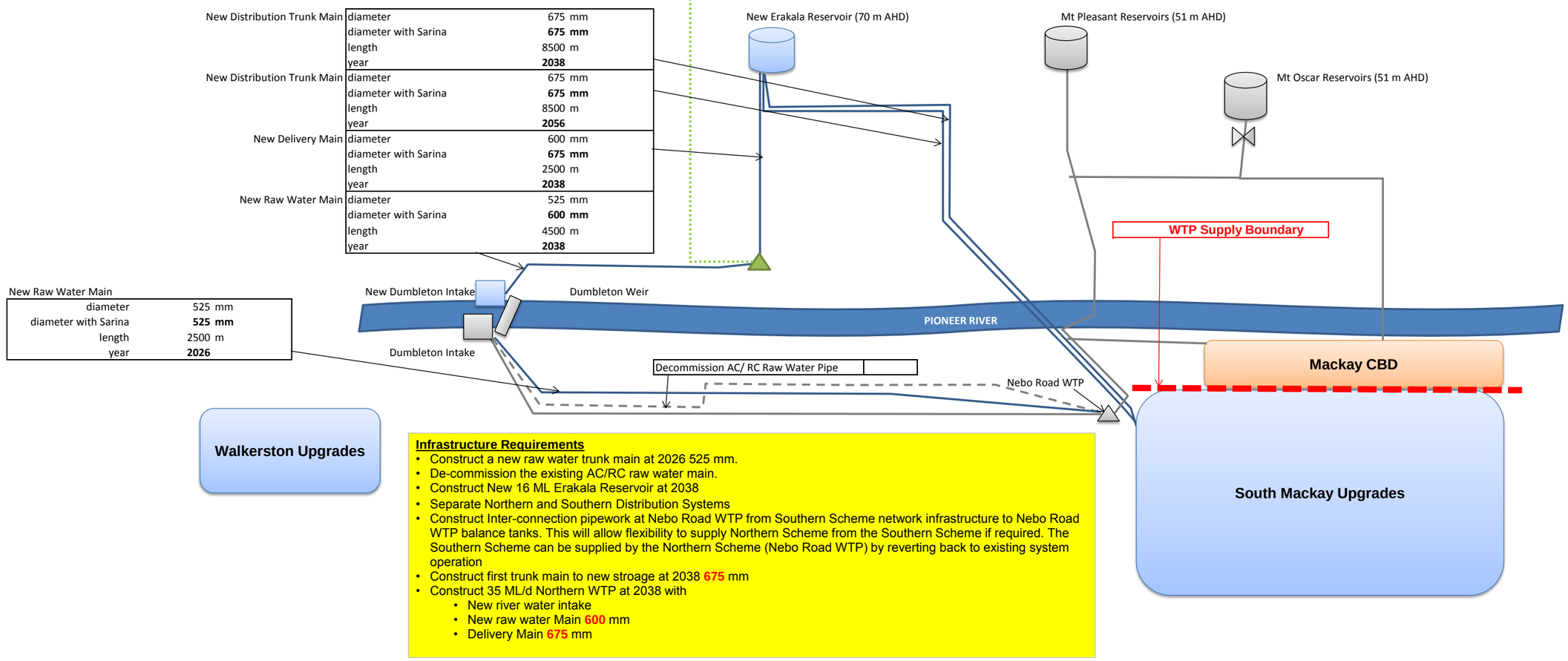
Medium Series Timing (2.4%)	Long Term Average Timing (1.57%)
2037	2045
2031	**2038**

Reservoir	PD (ML)	3*(PD-MDMM) (ML)
Capacity	33	16
Capacity with Sarina	38	**16**

Northern WTP	Persistance (ML/d)	L/s
Capacity	30	420
Capacity with Sarina	**35**	**450**

New Distribution Trunk Main	diameter	675 mm
	diameter with Sarina	**675 mm**
	length	8500 m
	year	**2038**
New Distribution Trunk Main	diameter	675 mm
	diameter with Sarina	**675 mm**
	length	8500 m
	year	**2056**
New Delivery Main	diameter	600 mm
	diameter with Sarina	**675 mm**
	length	2500 m
	year	**2038**
New Raw Water Main	diameter	525 mm
	diameter with Sarina	**600 mm**
	length	4500 m
	year	**2038**

New Raw Water Main	
diameter	525 mm
diameter with Sarina	**525 mm**
length	2500 m
year	**2026**



Infrastructure Requirements

- Construct a new raw water trunk main at 2026 525 mm.
- De-commission the existing AC/RC raw water main.
- Construct New 16 ML Erakala Reservoir at 2038
- Separate Northern and Southern Distribution Systems
- Construct Inter-connection pipework at Nebo Road WTP from Southern Scheme network infrastructure to Nebo Road WTP balance tanks. This will allow flexibility to supply Northern Scheme from the Southern Scheme if required. The Southern Scheme can be supplied by the Northern Scheme (Nebo Road WTP) by reverting back to existing system operation
- Construct first trunk main to new stroage at 2038 **675** mm
- Construct 35 ML/d Northern WTP at 2038 with
  - New river water intake
  - New raw water Main **600** mm
  - Delivery Main **675** mm

Appendix F: Strategic Options Assessment

Whole of Life Costs
Multi-Criteria Assessment

CAPITAL COST

			Capital Cost (Raw Water)	Capital Cost (Treatment)	Capital Cost (Networks)	Total	Average Opex
		Option 1 (BAU - Southern WTP)		$19,232,771	$35,258,000	$92,329,848	$146,820,619	$4,409,548
Discount Rate	5.0%	Option 2 (Nebo Road WTP to Erakala Reservoir)		$17,830,456	$13,968,744	$68,818,380	$100,617,580	$3,993,548
		Option 2A (Nebo Road WTP to Walkerston Reservoir)		$17,830,456	$13,968,744	$88,896,726	$120,695,926	$3,993,548
		Option 3 (Northern WTP)		$29,708,257	$35,258,000	$82,545,493	$147,511,750	$4,409,548
Cost Year	2015							
End Year	2065							

	Raw Water								Treatment								Networks							
	Option 1		Option 2		Option 2A		Option 3		Option 1		Option 2		Option 2A		Option 3		Option 1		Option 2		Option 2A		Option 3	
Year	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX	Capital	OPEX
2015		$512,000		$512,000		$512,000		$512,000		$2,609,895		$2,609,895		$2,609,895		$2,609,895								
2016		$519,845		$519,845		$519,845		$519,845		$2,637,627		$2,637,627		$2,637,627		$2,637,627								
2017		$527,690		$527,690		$527,690		$527,690		$2,665,360		$2,665,360		$2,665,360		$2,665,360								
2018		$535,536		$535,536		$535,536		$535,536		$2,693,092		$2,693,092		$2,693,092		$2,693,092								
2019		$543,381		$543,381		$543,381		$543,381		$2,720,825		$2,720,825		$2,720,825		$2,720,825								
2020		$551,226		$551,226		$551,226		$551,226		$2,748,557		$2,748,557		$2,748,557		$2,748,557								
2021		$559,071		$559,071		$559,071		$559,071		$2,776,290		$2,776,290		$2,776,290		$2,776,290								
2022		$566,917		$566,917		$566,917		$566,917		$2,804,022		$2,804,022		$2,804,022		$2,804,022								
2023		$574,762		$574,762		$574,762		$574,762		$2,831,755		$2,831,755		$2,831,755		$2,831,755								
2024		$582,607		$582,607		$582,607		$582,607		$2,859,487		$2,859,487		$2,859,487		$2,859,487								
2025		$590,452		$590,452		$590,452		$590,452		$2,887,220		$2,887,220		$2,887,220		$2,887,220								
2026	$17,830,456	$598,297	$17,830,456	$598,297	$17,830,456	$598,297	$18,384,457	$598,297		$2,914,952		$2,914,952		$2,914,952		$2,914,952								
2027		$606,143		$606,143		$606,143		$606,143		$2,942,684		$2,942,684		$2,942,684		$2,942,684								
2028		$613,988		$613,988		$613,988		$613,988		$2,970,417		$2,970,417		$2,970,417		$2,970,417								
2029		$621,833		$621,833		$621,833		$621,833		$2,998,149		$2,998,149		$2,998,149		$2,998,149								
2030		$629,678		$629,678		$629,678		$629,678		$3,025,882		$3,025,882		$3,025,882		$3,025,882								
2031		$637,523		$637,523		$637,523		$637,523		$3,053,614		$3,053,614		$3,053,614		$3,053,614								
2032		$645,369		$645,369		$645,369		$645,369		$3,081,347		$3,081,347		$3,081,347		$3,081,347								
2033		$653,214		$653,214		$653,214		$653,214		$3,109,079		$3,109,079		$3,109,079		$3,109,079								
2034		$661,059		$661,059		$661,059		$661,059		$3,136,812		$3,136,812		$3,136,812		$3,136,812								
2035		$668,904		$668,904		$668,904		$668,904		$3,164,544		$3,164,544		$3,164,544		$3,164,544								
2036		$676,750		$676,750		$676,750		$676,750		$3,192,276		$3,192,276		$3,192,276		$3,192,276								
2037		$684,595		$684,595		$684,595		$684,595		$3,220,009		$3,220,009		$3,220,009		$3,220,009								
2038	$1,402,315	$692,440		$692,440		$692,440	$11,323,800	$692,440	$35,258,000	$3,247,741	$13,968,744	$3,247,741	$13,968,744	$3,247,741	$35,258,000	$3,247,741	$61,585,927		$37,872,304		$42,361,867		$53,132,780	
2039		$700,285		$700,285		$700,285		$700,285		$4,075,474		$3,275,474		$3,275,474		$4,075,474								
2040		$708,130		$708,130		$708,130		$708,130		$4,103,206		$3,303,206		$3,303,206		$4,103,206								
2041		$715,976		$715,976		$715,976		$715,976		$4,130,939		$3,330,939		$3,330,939		$4,130,939								
2042		$723,821		$723,821		$723,821		$723,821		$4,158,671		$3,358,671		$3,358,671		$4,158,671								
2043		$731,666		$731,666		$731,666		$731,666		$4,186,404		$3,386,404		$3,386,404		$4,186,404								
2044		$739,511		$739,511		$739,511		$739,511		$4,214,136		$3,414,136		$3,414,136		$4,214,136								
2045		$747,356		$747,356		$747,356		$747,356		$4,241,869		$3,441,869		$3,441,869		$4,241,869								
2046		$755,202		$755,202		$755,202		$755,202		$4,269,601		$3,469,601		$3,469,601		$4,269,601				$2,042,189				$2,042,189	
2047		$763,047		$763,047		$763,047		$763,047		$4,297,333		$3,497,333		$3,497,333		$4,297,333								
2048		$770,892		$770,892		$770,892		$770,892		$4,325,066		$3,525,066		$3,525,066		$4,325,066								
2049		$778,737		$778,737		$778,737		$778,737		$4,352,798		$3,552,798		$3,552,798		$4,352,798								
2050		$786,583		$786,583		$786,583		$786,583		$4,380,531		$3,580,531		$3,580,531		$4,380,531								
2051		$794,428		$794,428		$794,428		$794,428		$4,408,263		$3,608,263		$3,608,263		$4,408,263								
2052		$802,273		$802,273		$802,273		$802,273		$4,435,996		$3,635,996		$3,635,996		$4,435,996								
2053		$810,118		$810,118		$810,118		$810,118		$4,463,728		$3,663,728		$3,663,728		$4,463,728								
2054		$817,963		$817,963		$817,963		$817,963		$4,491,461		$3,691,461		$3,691,461		$4,491,461								
2055		$825,809		$825,809		$825,809		$825,809		$4,519,193		$3,719,193		$3,719,193		$4,519,193								
2056		$833,654		$833,654		$833,654		$833,654		$4,546,926		$3,746,926		$3,746,926		$4,546,926	$30,743,922		$28,903,887		$46,534,859		$27,370,524	
2057		$841,499		$841,499		$841,499		$841,499		$4,574,658		$3,774,658		$3,774,658		$4,574,658								
2058		$849,344		$849,344		$849,344		$849,344		$4,602,390		$3,802,390		$3,802,390		$4,602,390								
2059		$857,189		$857,189		$857,189		$857,189		$4,630,123		$3,830,123		$3,830,123		$4,630,123								
2060		$865,035		$865,035		$865,035		$865,035		$4,657,855		$3,857,855		$3,857,855		$4,657,855								
2061		$872,880		$872,880		$872,880		$872,880		$4,685,588		$3,885,588		$3,885,588		$4,685,588								
2062		$880,725		$880,725		$880,725		$880,725		$4,713,320		$3,913,320		$3,913,320		$4,713,320								
2063		$888,570		$888,570		$888,570		$888,570		$4,741,053		$3,941,053		$3,941,053		$4,741,053								
2064		$896,416		$896,416		$896,416		$896,416		$4,768,785		$3,968,785		$3,968,785		$4,768,785								
2065		$906,654		$906,654		$906,654		$906,654		$4,804,979		$4,004,979		$4,004,979		$4,804,979								

NPV

	WHOLE OF LIFE CAPEX (2065)	WHOLE OF LIFE OPEX (2065)	TOTAL WHOLE OF LIFE (2065)
Option 1 (BAU - Southern WTP)	$46,570,342	$74,466,868	$121,037,210
Option 2 (Nebo Road WTP to Erakala Reservoir)	$31,663,236	$70,652,987	$102,316,223
Option 2A (Nebo Road WTP to Walkerston Reservoir)	$35,060,039	$70,652,987	$105,713,026
Option 3 (Northern WTP)	$47,365,961	$74,466,868	$121,832,829

NPV

		Option 1					Option 2						Option 2A						Option 3					
Capital Cost	Year	OPEX	Total	Discounted Capex	Discounted Opex	Total Discounted	Capital Cost	OPEX	Total	Discounted Capex	Discounted Opex	Total Discounted	Capital Cost	OPEX	Total	Discounted Capex	Discounted Opex	Total Discounted	Capital Cost	OPEX	Total	Discounted Capex	Discounted Opex	Total Discounted
$0	2015	$3,121,895	$3,121,895	$0	$3,121,895	$3,121,895	$0	$3,121,895	$3,121,895	$0	$3,121,895	$3,121,895	$0	$3,121,895	$3,121,895	$0	$3,121,895	$3,121,895	$0	$3,121,895	$3,121,895	$0	$3,121,895	$3,121,895
$0	2016	$3,157,473	$3,157,473	$0	$3,007,117	$3,007,117	$0	$3,157,473	$3,157,473	$0	$3,007,117	$3,007,117	$0	$3,157,473	$3,157,473	$0	$3,007,117	$3,007,117	$0	$3,157,473	$3,157,473	$0	$3,007,117	$3,007,117
$0	2017	$3,193,050	$3,193,050	$0	$2,896,191	$2,896,191	$0	$3,193,050	$3,193,050	$0	$2,896,191	$2,896,191	$0	$3,193,050	$3,193,050	$0	$2,896,191	$2,896,191	$0	$3,193,050	$3,193,050	$0	$2,896,191	$2,896,191
$0	2018	$3,228,628	$3,228,628	$0	$2,789,010	$2,789,010	$0	$3,228,628	$3,228,628	$0	$2,789,010	$2,789,010	$0	$3,228,628	$3,228,628	$0	$2,789,010	$2,789,010	$0	$3,228,628	$3,228,628	$0	$2,789,010	$2,789,010
$0	2019	$3,264,206	$3,264,206	$0	$2,685,470	$2,685,470	$0	$3,264,206	$3,264,206	$0	$2,685,470	$2,685,470	$0	$3,264,206	$3,264,206	$0	$2,685,470	$2,685,470	$0	$3,264,206	$3,264,206	$0	$2,685,470	$2,685,470
$0	2020	$3,299,783	$3,299,783	$0	$2,585,467	$2,585,467	$0	$3,299,783	$3,299,783	$0	$2,585,467	$2,585,467	$0	$3,299,783	$3,299,783	$0	$2,585,467	$2,585,467	$0	$3,299,783	$3,299,783	$0	$2,585,467	$2,585,467
$0	2021	$3,335,361	$3,335,361	$0	$2,488,898	$2,488,898	$0	$3,335,361	$3,335,361	$0	$2,488,898	$2,488,898	$0	$3,335,361	$3,335,361	$0	$2,488,898	$2,488,898	$0	$3,335,361	$3,335,361	$0	$2,488,898	$2,488,898
$0	2022	$3,370,939	$3,370,939	$0	$2,395,663	$2,395,663	$0	$3,370,939	$3,370,939	$0	$2,395,663	$2,395,663	$0	$3,370,939	$3,370,939	$0	$2,395,663	$2,395,663	$0	$3,370,939	$3,370,939	$0	$2,395,663	$2,395,663
$0	2023	$3,406,516	$3,406,516	$0	$2,305,664	$2,305,664	$0	$3,406,516	$3,406,516	$0	$2,305,664	$2,305,664	$0	$3,406,516	$3,406,516	$0	$2,305,664	$2,305,664	$0	$3,406,516	$3,406,516	$0	$2,305,664	$2,305,664
$0	2024	$3,442,094	$3,442,094	$0	$2,218,804	$2,218,804	$0	$3,442,094	$3,442,094	$0	$2,218,804	$2,218,804	$0	$3,442,094	$3,442,094	$0	$2,218,804	$2,218,804	$0	$3,442,094	$3,442,094	$0	$2,218,804	$2,218,804
$0	2025	$3,477,672	$3,477,672	$0	$2,134,989	$2,134,989	$0	$3,477,672	$3,477,672	$0	$2,134,989	$2,134,989	$0	$3,477,672	$3,477,672	$0	$2,134,989	$2,134,989	$0	$3,477,672	$3,477,672	$0	$2,134,989	$2,134,989
$17,830,456	2026	$3,513,249	$21,343,705	$10,425,098	$2,054,124	$12,479,222	$17,830,456	$3,513,249	$21,343,705	$10,425,098	$2,054,124	$12,479,222	$17,830,456	$3,513,249	$21,343,705	$10,425,098	$2,054,124	$12,479,222	$18,384,457	$3,513,249	$21,897,706	$10,749,011	$2,054,124	$12,803,135
$0	2027	$3,548,827	$3,548,827	$0	$1,976,120	$1,976,120	$0	$3,548,827	$3,548,827	$0	$1,976,120	$1,976,120	$0	$3,548,827	$3,548,827	$0	$1,976,120	$1,976,120	$0	$3,548,827	$3,548,827	$0	$1,976,120	$1,976,120
$0	2028	$3,584,405	$3,584,405	$0	$1,900,886	$1,900,886	$0	$3,584,405	$3,584,405	$0	$1,900,886	$1,900,886	$0	$3,584,405	$3,584,405	$0	$1,900,886	$1,900,886	$0	$3,584,405	$3,584,405	$0	$1,900,886	$1,900,886
$0	2029	$3,619,982	$3,619,982	$0	$1,828,337	$1,828,337	$0	$3,619,982	$3,619,982	$0	$1,828,337	$1,828,337	$0	$3,619,982	$3,619,982	$0	$1,828,337	$1,828,337	$0	$3,619,982	$3,619,982	$0	$1,828,337	$1,828,337
$0	2030	$3,655,560	$3,655,560	$0	$1,758,387	$1,758,387	$0	$3,655,560	$3,655,560	$0	$1,758,387	$1,758,387	$0	$3,655,560	$3,655,560	$0	$1,758,387	$1,758,387	$0	$3,655,560	$3,655,560	$0	$1,758,387	$1,758,387
$0	2031	$3,691,138	$3,691,138	$0	$1,690,953	$1,690,953	$0	$3,691,138	$3,691,138	$0	$1,690,953	$1,690,953	$0	$3,691,138	$3,691,138	$0	$1,690,953	$1,690,953	$0	$3,691,138	$3,691,138	$0	$1,690,953	$1,690,953
$0	2032	$3,726,715	$3,726,715	$0	$1,625,954	$1,625,954	$0	$3,726,715	$3,726,715	$0	$1,625,954	$1,625,954	$0	$3,726,715	$3,726,715	$0	$1,625,954	$1,625,954	$0	$3,726,715	$3,726,715	$0	$1,625,954	$1,625,954
$0	2033	$3,762,293	$3,762,293	$0	$1,563,310	$1,563,310	$0	$3,762,293	$3,762,293	$0	$1,563,310	$1,563,310	$0	$3,762,293	$3,762,293	$0	$1,563,310	$1,563,310	$0	$3,762,293	$3,762,293	$0	$1,563,310	$1,563,310
$0	2034	$3,797,871	$3,797,871	$0	$1,502,946	$1,502,946	$0	$3,797,871	$3,797,871	$0	$1,502,946	$1,502,946	$0	$3,797,871	$3,797,871	$0	$1,502,946	$1,502,946	$0	$3,797,871	$3,797,871	$0	$1,502,946	$1,502,946
$0	2035	$3,833,448	$3,833,448	$0	$1,444,786	$1,444,786	$0	$3,833,448	$3,833,448	$0	$1,444,786	$1,444,786	$0	$3,833,448	$3,833,448	$0	$1,444,786	$1,444,786	$0	$3,833,448	$3,833,448	$0	$1,444,786	$1,444,786
$0	2036	$3,869,026	$3,869,026	$0	$1,388,757	$1,388,757	$0	$3,869,026	$3,869,026	$0	$1,388,757	$1,388,757	$0	$3,869,026	$3,869,026	$0	$1,388,757	$1,388,757	$0	$3,869,026	$3,869,026	$0	$1,388,757	$1,388,757
$0	2037	$3,904,604	$3,904,604	$0	$1,334,788	$1,334,788	$0	$3,904,604	$3,904,604	$0	$1,334,788	$1,334,788	$0	$3,904,604	$3,904,604	$0	$1,334,788	$1,334,788	$0	$3,904,604	$3,904,604	$0	$1,334,788	$1,334,788
$98,246,242	2038	$3,940,181	$102,186,423	$31,986,157	$1,282,810	$33,268,967	$51,841,048	$3,940,181	$55,781,230	$16,877,958	$1,282,810	$18,160,768	$56,330,611	$3,940,181	$60,270,792	$18,339,631	$1,282,810	$19,622,441	$99,714,580	$3,940,181	$103,654,761	$32,464,206	$1,282,810	$33,747,016
$0	2039	$4,775,759	$4,775,759	$0	$1,480,810	$1,480,810	$0	$3,975,759	$3,975,759	$0	$1,232,755	$1,232,755	$0	$3,975,759	$3,975,759	$0	$1,232,755	$1,232,755	$0	$4,775,759	$4,775,759	$0	$1,480,810	$1,480,810
$0	2040	$4,811,337	$4,811,337	$0	$1,420,801	$1,420,801	$0	$4,011,337	$4,011,337	$0	$1,184,559	$1,184,559	$0	$4,011,337	$4,011,337	$0	$1,184,559	$1,184,559	$0	$4,811,337	$4,811,337	$0	$1,420,801	$1,420,801
$0	2041	$4,846,914	$4,846,914	$0	$1,363,150	$1,363,150	$0	$4,046,914	$4,046,914	$0	$1,138,157	$1,138,157	$0	$4,046,914	$4,046,914	$0	$1,138,157	$1,138,157	$0	$4,846,914	$4,846,914	$0	$1,363,150	$1,363,150
$0	2042	$4,882,492	$4,882,492	$0	$1,307,767	$1,307,767	$0	$4,082,492	$4,082,492	$0	$1,093,489	$1,093,489	$0	$4,082,492	$4,082,492	$0	$1,093,489	$1,093,489	$0	$4,882,492	$4,882,492	$0	$1,307,767	$1,307,767
$0	2043	$4,918,070	$4,918,070	$0	$1,254,568	$1,254,568	$0	$4,118,070	$4,118,070	$0	$1,050,493	$1,050,493	$0	$4,118,070	$4,118,070	$0	$1,050,493	$1,050,493	$0	$4,918,070	$4,918,070	$0	$1,254,568	$1,254,568
$0	2044	$4,953,647	$4,953,647	$0	$1,203,470	$1,203,470	$0	$4,153,647	$4,153,647	$0	$1,009,113	$1,009,113	$0	$4,153,647	$4,153,647	$0	$1,009,113	$1,009,113	$0	$4,953,647	$4,953,647	$0	$1,203,470	$1,203,470
$0	2045	$4,989,225	$4,989,225	$0	$1,154,394	$1,154,394	$0	$4,189,225	$4,189,225	$0	$969,292	$969,292	$0	$4,189,225	$4,189,225	$0	$969,292	$969,292	$0	$4,989,225	$4,989,225	$0	$1,154,394	$1,154,394
$0	2046	$5,024,803	$5,024,803	$0	$1,107,263	$1,107,263	$2,042,189	$4,224,803	$6,266,992	$450,016	$930,975	$1,380,991	$0	$4,224,803	$4,224,803	$0	$930,975	$930,975	$2,042,189	$5,024,803	$7,066,992	$450,016	$1,107,263	$1,557,279
$0	2047	$5,060,380	$5,060,380	$0	$1,062,003	$1,062,003	$0	$4,260,380	$4,260,380	$0	$894,110	$894,110	$0	$4,260,380	$4,260,380	$0	$894,110	$894,110	$0	$5,060,380	$5,060,380	$0	$1,062,003	$1,062,003
$0	2048	$5,095,958	$5,095,958	$0	$1,018,542	$1,018,542	$0	$4,295,958	$4,295,958	$0	$858,644	$858,644	$0	$4,295,958	$4,295,958	$0	$858,644	$858,644	$0	$5,095,958	$5,095,958	$0	$1,018,542	$1,018,542
$0	2049	$5,131,536	$5,131,536	$0	$976,812	$976,812	$0	$4,331,536	$4,331,536	$0	$824,529	$824,529	$0	$4,331,536	$4,331,536	$0	$824,529	$824,529	$0	$5,131,536	$5,131,536	$0	$976,812	$976,812
$0	2050	$5,167,113	$5,167,113	$0	$936,747	$936,747	$0	$4,367,113	$4,367,113	$0	$791,715	$791,715	$0	$4,367,113	$4,367,113	$0	$791,715	$791,715	$0	$5,167,113	$5,167,113	$0	$936,747	$936,747
$0	2051	$5,202,691	$5,202,691	$0	$898,283	$898,283	$0	$4,402,691	$4,402,691	$0	$760,157	$760,157	$0	$4,402,691	$4,402,691	$0	$760,157	$760,157	$0	$5,202,691	$5,202,691	$0	$898,283	$898,283
$0	2052	$5,238,269	$5,238,269	$0	$861,358	$861,358	$0	$4,438,269	$4,438,269	$0	$729,810	$729,810	$0	$4,438,269	$4,438,269	$0	$729,810	$729,810	$0	$5,238,269	$5,238,269	$0	$861,358	$861,358
$0	2053	$5,273,846	$5,273,846	$0	$825,913	$825,913	$0	$4,473,846	$4,473,846	$0	$700,628	$700,628	$0	$4,473,846	$4,473,846	$0	$700,628	$700,628	$0	$5,273,846	$5,273,846	$0	$825,913	$825,913
$0	2054	$5,309,424	$5,309,424	$0	$791,890	$791,890	$0	$4,509,424	$4,509,424	$0	$672,571	$672,571	$0	$4,509,424	$4,509,424	$0	$672,571	$672,571	$0	$5,309,424	$5,309,424	$0	$791,890	$791,890
$0	2055	$5,345,002	$5,345,002	$0	$759,234	$759,234	$0	$4,545,002	$4,545,002	$0	$645,598	$645,598	$0	$4,545,002	$4,545,002	$0	$645,598	$645,598	$0	$5,345,002	$5,345,002	$0	$759,234	$759,234
$30,743,922	2056	$5,380,579	$36,124,501	$4,159,087	$727,893	$4,886,980	$28,903,887	$4,580,579	$33,484,466	$3,910,164	$619,668	$4,529,832	$46,534,859	$4,580,579	$51,115,439	$6,295,310	$619,668	$6,914,978	$27,370,524	$5,380,579	$32,751,103	$3,702,728	$727,893	$4,430,622
$0	2057	$5,416,157	$5,416,157	$0	$697,816	$697,816	$0	$4,616,157	$4,616,157	$0	$594,744	$594,744	$0	$4,616,157	$4,616,157	$0	$594,744	$594,744	$0	$5,416,157	$5,416,157	$0	$697,816	$697,816
$0	2058	$5,451,735	$5,451,735	$0	$668,952	$668,952	$0	$4,651,735	$4,651,735	$0	$570,788	$570,788	$0	$4,651,735	$4,651,735	$0	$570,788	$570,788	$0	$5,451,735	$5,451,735	$0	$668,952	$668,952
$0	2059	$5,487,312	$5,487,312	$0	$641,255	$641,255	$0	$4,687,312	$4,687,312	$0	$547,766	$547,766	$0	$4,687,312	$4,687,312	$0	$547,766	$547,766	$0	$5,487,312	$5,487,312	$0	$641,255	$641,255
$0	2060	$5,522,890	$5,522,890	$0	$614,678	$614,678	$0	$4,722,890	$4,722,890	$0	$525,641	$525,641	$0	$4,722,890	$4,722,890	$0	$525,641	$525,641	$0	$5,522,890	$5,522,890	$0	$614,678	$614,678
$0	2061	$5,558,468	$5,558,468	$0	$589,179	$589,179	$0	$4,758,468	$4,758,468	$0	$504,382	$504,382	$0	$4,758,468	$4,758,468	$0	$504,382	$504,382	$0	$5,558,468	$5,558,468	$0	$589,179	$589,179
$0	2062	$5,594,045	$5,594,045	$0	$564,714	$564,714	$0	$4,794,045	$4,794,045	$0	$483,955	$483,955	$0	$4,794,045	$4,794,045	$0	$483,955	$483,955	$0	$5,594,045	$5,594,045	$0	$564,714	$564,714
$0	2063	$5,629,623	$5,629,623	$0	$541,244	$541,244	$0	$4,829,623	$4,829,623	$0	$464,330	$464,330	$0	$4,829,623	$4,829,623	$0	$464,330	$464,330	$0	$5,629,623	$5,629,623	$0	$541,244	$541,244
$0	2064	$5,665,201	$5,665,201	$0	$518,728	$518,728	$0	$4,865,201	$4,865,201	$0	$445,477	$445,477	$0	$4,865,201	$4,865,201	$0	$445,477	$445,477	$0	$5,665,201	$5,665,201	$0	$518,728	$518,728
$0	2065	$5,711,634	$5,711,634	$0	$498,076	$498,076	$0	$4,911,634	$4,911,634	$0	$428,313	$428,313	$0	$4,911,634	$4,911,634	$0	$428,313	$428,313	$0	$5,711,634	$5,711,634	$0	$498,076	$498,076

Option 1 and 3

Year	AD (ML/d) Mackay Northern Scheme	Mackay Southern Scheme	AD (ML/d) Mackay	Sarina	Total AD	Nebo Road WTP Labour	Consumables	Power	Maintenance	Treatment OPEX	River Intake Raw Water OPEX
2015	22.3	11.4	33.7	2.6	36.4	$ 800,000	$566,600	$637,000	$606,295	$2,609,895	$512,000
2016	22.7	11.6	34.3	2.7	36.9	$ 800,000	$575,282	$646,761	$615,585	$2,637,627	$519,845
2017	23.0	11.8	34.8	2.7	37.5	$ 800,000	$583,964	$656,521	$624,875	$2,665,360	$527,690
2018	23.3	11.9	35.3	2.8	38.1	$ 800,000	$592,646	$666,282	$634,165	$2,693,092	$535,536
2019	23.7	12.1	35.8	2.8	38.6	$ 800,000	$601,327	$676,042	$643,455	$2,720,825	$543,381
2020	24.0	12.3	36.3	2.9	39.2	$ 800,000	$610,009	$685,803	$652,745	$2,748,557	$551,226
2021	24.4	12.5	36.8	2.9	39.7	$ 800,000	$618,691	$695,563	$662,035	$2,776,290	$559,071
2022	24.7	12.6	37.3	2.9	40.3	$ 800,000	$627,373	$705,324	$671,325	$2,804,022	$566,917
2023	25.1	12.8	37.9	3.0	40.8	$ 800,000	$636,055	$715,084	$680,616	$2,831,755	$574,762
2024	25.4	13.0	38.4	3.0	41.4	$ 800,000	$644,737	$724,845	$689,906	$2,859,487	$582,607
2025	25.7	13.2	38.9	3.1	42.0	$ 800,000	$653,418	$734,606	$699,196	$2,887,220	$590,452
2026	26.1	13.3	39.4	3.1	42.5	$ 800,000	$662,100	$744,366	$708,486	$2,914,952	$598,297
2027	26.4	13.5	39.9	3.1	43.1	$ 800,000	$670,782	$754,127	$717,776	$2,942,684	$606,143
2028	26.8	13.7	40.4	3.2	43.6	$ 800,000	$679,464	$763,887	$727,066	$2,970,417	$613,988
2029	27.1	13.9	41.0	3.2	44.2	$ 800,000	$688,146	$773,648	$736,356	$2,998,149	$621,833
2030	27.4	14.0	41.5	3.3	44.7	$ 800,000	$696,828	$783,408	$745,646	$3,025,882	$629,678
2031	27.8	14.2	42.0	3.3	45.3	$ 800,000	$705,509	$793,169	$754,936	$3,053,614	$637,523
2032	28.1	14.4	42.5	3.3	45.9	$ 800,000	$714,191	$802,929	$764,226	$3,081,347	$645,369
2033	28.5	14.6	43.0	3.4	46.4	$ 800,000	$722,873	$812,690	$773,516	$3,109,079	$653,214
2034	28.8	14.7	43.5	3.4	47.0	$ 800,000	$731,555	$822,450	$782,806	$3,136,812	$661,059
2035	29.1	14.9	44.1	3.5	47.5	$ 800,000	$740,237	$832,211	$792,096	$3,164,544	$668,904
2036	29.5	15.1	44.6	3.5	48.1	$ 800,000	$748,919	$841,972	$801,386	$3,192,276	$676,750
2037	29.8	15.3	45.1	3.6	48.6	$ 800,000	$757,600	$851,732	$810,676	$3,220,009	$684,595
2038	30.2	15.4	45.6	3.6	49.2	$ 800,000	$766,282	$861,493	$819,967	$3,247,741	$692,440
2039	30.5	15.6	46.1	3.6	49.8	$ 800,000	$475,233	$534,281	$508,527	$2,318,040	$429,437
2040	30.9	15.8	46.6	3.7	50.3	$ 800,000	$480,549	$540,258	$514,216	$2,335,023	$434,242
2041	31.2	16.0	47.1	3.7	50.9	$ 800,000	$485,866	$546,235	$519,905	$2,352,005	$439,046
2042	31.5	16.1	47.7	3.8	51.4	$ 800,000	$491,182	$552,212	$525,594	$2,368,988	$443,850
2043	31.9	16.3	48.2	3.8	52.0	$ 800,000	$496,499	$558,189	$531,283	$2,385,970	$448,654
2044	32.2	16.5	48.7	3.8	52.5	$ 800,000	$501,815	$564,166	$536,971	$2,402,952	$453,458
2045	32.6	16.7	49.2	3.9	53.1	$ 800,000	$507,132	$570,143	$542,660	$2,419,935	$458,262
2046	32.9	16.8	49.7	3.9	53.7	$ 800,000	$512,448	$576,120	$548,349	$2,436,917	$463,066
2047	33.2	17.0	50.2	4.0	54.2	$ 800,000	$517,765	$582,097	$554,038	$2,453,900	$467,871
2048	33.6	17.2	50.8	4.0	54.8	$ 800,000	$523,081	$588,074	$559,727	$2,470,882	$472,675
2049	33.9	17.4	51.3	4.1	55.3	$ 800,000	$528,398	$594,051	$565,416	$2,487,865	$477,479
2050	34.3	17.5	51.8	4.1	55.9	$ 800,000	$533,714	$600,028	$571,105	$2,504,847	$482,283
2051	34.6	17.7	52.3	4.1	56.4	$ 800,000	$539,030	$606,005	$576,794	$2,521,829	$487,087
2052	34.9	17.9	52.8	4.2	57.0	$ 800,000	$544,347	$611,982	$582,483	$2,538,812	$491,891
2053	35.3	18.0	53.3	4.2	57.6	$ 800,000	$549,663	$617,959	$588,172	$2,555,794	$496,695
2054	35.6	18.2	53.9	4.3	58.1	$ 800,000	$554,980	$623,936	$593,861	$2,572,777	$501,500
2055	36.0	18.4	54.4	4.3	58.7	$ 800,000	$560,296	$629,913	$599,550	$2,589,759	$506,304
2056	36.3	18.6	54.9	4.3	59.2	$ 800,000	$565,613	$635,890	$605,239	$2,606,742	$511,108
2057	36.7	18.7	55.4	4.4	59.8	$ 800,000	$570,929	$641,867	$610,928	$2,623,724	$515,912
2058	37.0	18.9	55.9	4.4	60.3	$ 800,000	$576,246	$647,844	$616,616	$2,640,706	$520,716
2059	37.3	19.1	56.4	4.5	60.9	$ 800,000	$581,562	$653,821	$622,305	$2,657,689	$525,520
2060	37.7	19.3	57.0	4.5	61.5	$ 800,000	$586,879	$659,798	$627,994	$2,674,671	$530,325
2061	38.0	19.4	57.5	4.6	62.0	$ 800,000	$592,195	$665,775	$633,683	$2,691,654	$535,129
2062	38.4	19.6	58.0	4.6	62.6	$ 800,000	$597,512	$671,752	$639,372	$2,708,636	$539,933
2063	38.7	19.8	58.5	4.6	63.1	$ 800,000	$602,828	$677,729	$645,061	$2,725,619	$544,737
2064	39.0	20.0	59.0	4.7	63.7	$ 800,000	$608,145	$683,706	$650,750	$2,742,601	$549,541
2065	39.4	20.3	59.7	4.7	64.4	$ 800,000	$613,672	$689,920	$656,665	$2,760,257	$554,536

Year	New WTP Labour	Consumables	Power	Maintenance	Treatment OPEX	River Intake Raw Water OPEX	Total WTP OPEX	Total Raw Water OPEX
2015	$800,000	$566,600	$637,000	$606,295	$2,609,895	$512,000		
2016								
2017								
2018								
2019								
2020								
2021								
2022								
2023								
2024								
2025								
2026								
2027								
2028								
2029								
2030								
2031								
2032								
2033								
2034								
2035								
2036								
2037								
2038								
2039	$ 800,000	$299,731	$336,973	$320,730	$ 1,757,434	$270,848	$4,075,474	
2040	$ 800,000	$303,096	$340,756	$324,331	$ 1,768,184	$273,889	$4,103,256	
2041	$ 800,000	$306,462	$344,540	$327,932	$ 1,778,934	$276,930	$4,130,939	
2042	$ 800,000	$309,827	$348,323	$331,533	$ 1,789,684	$279,971	$4,158,671	
2043	$ 800,000	$313,193	$352,107	$335,134	$ 1,800,434	$283,012	$4,186,404	
2044	$ 800,000	$316,558	$355,890	$338,735	$ 1,811,184	$286,053	$4,214,136	
2045	$ 800,000	$319,923	$359,674	$342,337	$ 1,821,934	$289,094	$4,241,869	
2046	$ 800,000	$323,289	$363,457	$345,938	$ 1,832,684	$292,135	$4,269,601	
2047	$ 800,000	$326,654	$367,241	$349,539	$ 1,843,434	$295,176	$4,297,333	
2048	$ 800,000	$330,019	$371,024	$353,140	$ 1,854,184	$298,217	$4,325,066	
2049	$ 800,000	$333,385	$374,808	$356,741	$ 1,864,934	$301,258	$4,352,798	
2050	$ 800,000	$336,750	$378,591	$360,342	$ 1,875,684	$304,299	$4,380,531	
2051	$ 800,000	$340,116	$382,375	$363,943	$ 1,886,434	$307,341	$4,408,263	
2052	$ 800,000	$343,481	$386,158	$367,545	$ 1,897,184	$310,382	$4,435,996	
2053	$ 800,000	$346,846	$389,942	$371,146	$ 1,907,934	$313,423	$4,463,728	
2054	$ 800,000	$350,212	$393,725	$374,747	$ 1,918,684	$316,464	$4,491,461	
2055	$ 800,000	$353,577	$397,509	$378,348	$ 1,929,434	$319,505	$4,519,193	
2056	$ 800,000	$356,942	$401,292	$381,949	$ 1,940,184	$322,546	$4,546,926	
2057	$ 800,000	$360,308	$405,076	$385,550	$ 1,950,934	$325,587	$4,574,658	
2058	$ 800,000	$363,673	$408,859	$389,151	$ 1,961,684	$328,628	$4,602,390	
2059	$ 800,000	$367,038	$412,643	$392,753	$ 1,972,434	$331,669	$4,630,123	
2060	$ 800,000	$370,404	$416,427	$396,354	$ 1,983,184	$334,710	$4,657,855	
2061	$ 800,000	$373,769	$420,210	$399,955	$ 1,993,934	$337,751	$4,685,588	
2062	$ 800,000	$377,135	$423,994	$403,556	$ 2,004,684	$340,792	$4,713,320	
2063	$ 800,000	$380,500	$427,777	$407,157	$ 2,015,434	$343,833	$4,741,053	
2064	$ 800,000	$383,865	$431,561	$410,758	$ 2,026,184	$346,874	$4,768,785	
2065	$ 800,000	$389,669	$438,085	$416,968	$ 2,044,722	$352,119	$4,804,979	

Option 2 and 2A

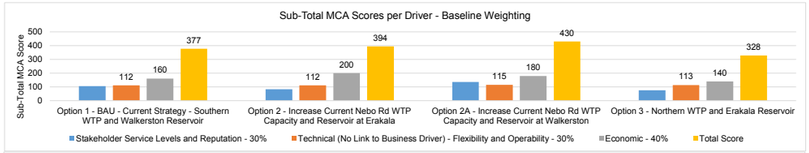
Year	AD (ML/d) Mackay	Sarina	Total AD	Labour	WTP Consumables	Power ($)	Maintenance ($)	Total Treatment OPEX ($)	River Intake Power and Maintenance ($)	Total Raw Water OPEX ($)
2015	33.7	2.6	36.4	$ 800,000	$566,600	$637,000	$606,295	$2,609,895	$512,000	$512,000
2016	34.3	2.7	36.9	$ 800,000	$575,282	$646,761	$615,585	$2,637,627	$519,845	$519,845
2017	34.8	2.7	37.5	$ 800,000	$583,964	$656,521	$624,875	$2,665,360	$527,690	$527,690
2018	35.3	2.8	38.1	$ 800,000	$592,646	$666,282	$634,165	$2,693,092	$535,536	$535,536
2019	35.8	2.8	38.6	$ 800,000	$601,327	$676,042	$643,455	$2,720,825	$543,381	$543,381
2020	36.3	2.9	39.2	$ 800,000	$610,009	$685,803	$652,745	$2,748,557	$551,226	$551,226
2021	36.9	2.9	39.7	$ 800,000	$618,691	$695,563	$662,035	$2,776,290	$559,071	$559,071
2022	37.4	2.9	40.3	$ 800,000	$627,373	$705,324	$671,325	$2,804,022	$566,917	$566,917
2023	37.9	3.0	40.8	$ 800,000	$636,055	$715,084	$680,616	$2,831,755	$574,762	$574,762
2024	38.4	3.0	41.4	$ 800,000	$644,737	$724,845	$689,906	$2,859,487	$582,607	$582,607
2025	39.0	3.1	42.0	$ 800,000	$653,418	$734,606	$699,196	$2,887,220	$590,452	$590,452
2026	39.5	3.1	42.5	$ 800,000	$662,100	$744,366	$708,486	$2,914,952	$598,297	$598,297
2027	40.0	3.1	43.1	$ 800,000	$670,782	$754,127	$717,776	$2,942,684	$606,143	$606,143
2028	40.5	3.2	43.6	$ 800,000	$679,464	$763,887	$727,066	$2,970,417	$613,988	$613,988
2029	41.0	3.2	44.2	$ 800,000	$688,146	$773,648	$736,356	$2,998,149	$621,833	$621,833
2030	41.6	3.3	44.7	$ 800,000	$696,828	$783,408	$745,646	$3,025,882	$629,678	$629,678
2031	42.1	3.3	45.3	$ 800,000	$705,509	$793,169	$754,936	$3,053,614	$637,523	$637,523
2032	42.6	3.3	45.9	$ 800,000	$714,191	$802,929	$764,226	$3,081,347	$645,369	$645,369
2033	43.1	3.4	46.4	$ 800,000	$722,873	$812,690	$773,516	$3,109,079	$653,214	$653,214
2034	43.6	3.4	47.0	$ 800,000	$731,555	$822,450	$782,806	$3,136,812	$661,059	$661,059
2035	44.2	3.5	47.5	$ 800,000	$740,237	$832,211	$792,096	$3,164,544	$668,904	$668,904
2036	44.7	3.5	48.1	$ 800,000	$748,919	$841,972	$801,386	$3,192,276	$676,750	$676,750
2037	45.2	3.6	48.6	$ 800,000	$757,600	$851,732	$810,676	$3,220,009	$684,595	$684,595
2038	45.7	3.6	49.2	$ 800,000	$766,282	$861,493	$819,967	$3,247,741	$692,440	$692,440
2039	46.3	3.6	49.8	$ 800,000	$774,964	$871,253	$829,257	$3,275,474	$700,285	$700,285
2040	46.8	3.7	50.3	$ 800,000	$783,646	$881,014	$838,547	$3,303,206	$708,130	$708,130
2041	47.3	3.7	50.9	$ 800,000	$792,328	$890,774	$847,837	$3,330,939	$715,976	$715,976
2042	47.8	3.8	51.4	$ 800,000	$801,010	$900,535	$857,127	$3,358,671	$723,821	$723,821
2043	48.3	3.8	52.0	$ 800,000	$809,691	$910,295	$866,417	$3,386,404	$731,666	$731,666
2044	48.9	3.8	52.5	$ 800,000	$818,373	$920,056	$875,707	$3,414,136	$739,511	$739,511
2045	49.4	3.9	53.1	$ 800,000	$827,055	$929,817	$884,997	$3,441,869	$747,356	$747,356
2046	49.9	3.9	53.7	$ 800,000	$835,737	$939,577	$894,287	$3,469,601	$755,202	$755,202
2047	50.4	4.0	54.2	$ 800,000	$844,419	$949,338	$903,577	$3,497,333	$763,047	$763,047
2048	51.0	4.0	54.8	$ 800,000	$853,101	$959,098	$912,867	$3,525,066	$770,892	$770,892
2049	51.5	4.1	55.3	$ 800,000	$861,782	$968,859	$922,157	$3,552,798	$778,737	$778,737
2050	52.0	4.1	55.9	$ 800,000	$870,464	$978,619	$931,447	$3,580,531	$786,583	$786,583
2051	52.5	4.1	56.4	$ 800,000	$879,146	$988,380	$940,737	$3,608,263	$794,428	$794,428
2052	53.0	4.2	57.0	$ 800,000	$887,828	$998,140	$950,028	$3,635,996	$802,273	$802,273
2053	53.6	4.2	57.6	$ 800,000	$896,510	$1,007,901	$959,318	$3,663,728	$810,118	$810,118
2054	54.1	4.3	58.1	$ 800,000	$905,192	$1,017,661	$968,608	$3,691,461	$817,963	$817,963
2055	54.6	4.3	58.7	$ 800,000	$913,873	$1,027,422	$977,898	$3,719,193	$825,809	$825,809
2056	55.1	4.3	59.2	$ 800,000	$922,555	$1,037,183	$987,188	$3,746,926	$833,654	$833,654
2057	55.6	4.4	59.8	$ 800,000	$931,237	$1,046,943	$996,478	$3,774,658	$841,499	$841,499
2058	56.2	4.4	60.3	$ 800,000	$939,919	$1,056,704	$1,005,768	$3,802,390	$849,344	$849,344
2059	56.7	4.5	60.9	$ 800,000	$948,601	$1,066,464	$1,015,058	$3,830,123	$857,189	$857,189
2060	57.2	4.5	61.5	$ 800,000	$957,283	$1,076,225	$1,024,348	$3,857,855	$865,035	$865,035
2061	57.7	4.6	62.0	$ 800,000	$965,964	$1,085,985	$1,033,638	$3,885,588	$872,880	$872,880
2062	58.3	4.6	62.6	$ 800,000	$974,646	$1,095,746	$1,042,928	$3,913,320	$880,725	$880,725
2063	58.8	4.6	63.1	$ 800,000	$983,328	$1,105,506	$1,052,218	$3,941,053	$888,570	$888,570
2064	59.3	4.7	63.7	$ 800,000	$992,010	$1,115,267	$1,061,508	$3,968,785	$896,416	$896,416
2065	60.3	4.7	64.4	$ 800,000	$1,003,341	$1,128,006	$1,073,633	$4,004,979	$906,554	$906,554

Year	Northern S	Southern Scheme
2015	21.97829	11.24038
2016	22.31963	11.41495
2017	22.66096	11.58952
2018	23.0023	11.76409
2019	23.34364	11.93866
2020	23.68498	12.11323
2021	24.02631	12.2878
2022	24.36765	12.46237
2023	24.70899	12.63694
2024	25.05032	12.81151
2025	25.39166	12.98608
2026	25.733	13.16065
2027	26.07433	13.33522
2028	26.41567	13.50979
2029	26.75701	13.68436
2030	27.09834	13.85893
2031	27.43968	14.0335
2032	27.78102	14.20807
2033	28.12235	14.38264
2034	28.46369	14.55721
2035	28.80503	14.73178
2036	29.14636	14.90635
2037	29.4877	15.08092
2038	29.82904	15.25549
2039	30.17037	15.43006
2040	30.51171	15.60463
2041	30.85305	15.7792
2042	31.19438	15.95377
2043	31.53572	16.12834
2044	31.87706	16.30292
2045	32.21839	16.47749
2046	32.55973	16.65206
2047	32.90107	16.82663
2048	33.24241	17.0012
2049	33.58374	17.17577
2050	33.92508	17.35034
2051	34.26642	17.52491
2052	34.60775	17.69948
2053	34.94909	17.87405
2054	35.29043	18.04862
2055	35.63176	18.22319
2056	35.9731	18.39776
2057	36.31444	18.57233
2058	36.65577	18.7469
2059	36.99711	18.92147
2060	37.33845	19.09604
2061	37.67978	19.27061
2062	38.02112	19.44518
2063	38.36246	19.61975
2064	38.70379	19.79432
2065	39.04513	19.96889

MCA Baseline	Stakeholder Service Levels and Reputation	Environment	Technical (No Link to Business Driver) - Flexibility and Operability	Technical (No Link to Business Driver) - Constructability	Economic	Non Cost Score	Total Score
Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir	30%	No Criteria Weighted	30%	No Criteria Weighted	40%	217	377
Option 2 - Increase Current Nebo Rd WTP Capacity and Reservoir at Erakala						194	394
Option 2A - Increase Current Nebo Rd WTP Capacity and Reservoir at Walkerston						**250**	**430**
Option 3 - Northern WTP and Erakala Reservoir						188	328

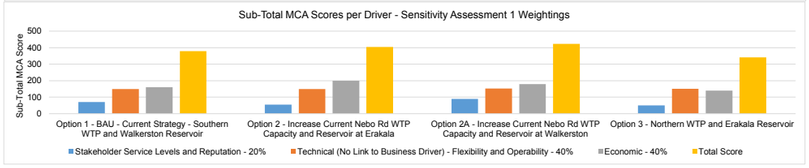
Sub-Totals Scores of Business Drivers

Stakeholder Service Levels and Reputation - 30%	Technical (No Link to Business Driver) - Flexibility and Operability - 30%	Economic - 40%
105	112	160
83	112	200
135	115	180
75	113	140



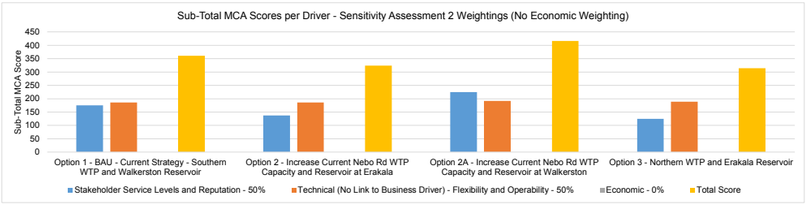
MCA Sensitivity 1	Stakeholder Service Levels and Reputation	Environment	Technical (No Link to Business Driver) - Flexibility and Operability	Technical (No Link to Business Driver) - Constructability	Economic	Non Cost Score	Total Score
Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir	20%	No Criteria Weighted	40%	No Criteria Weighted	40%	219	379
Option 2 - Increase Current Nebo Rd WTP Capacity and Reservoir at Erakala						204	404
Option 2A - Increase Current Nebo Rd WTP Capacity and Reservoir at Walkerston						**243**	**423**
Option 3 - Northern WTP and Erakala Reservoir						201	341

Stakeholder Service Levels and Reputation - 20%	Technical (No Link to Business Driver) - Flexibility and Operability - 40%	Economic - 40%
70	149	160
55	149	200
90	153	180
50	151	140



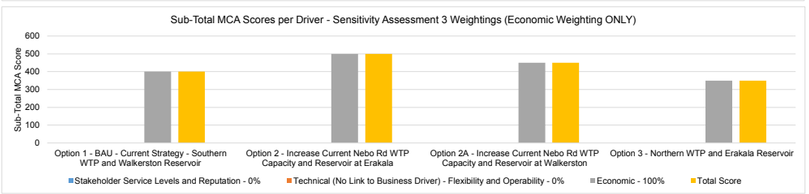
MCA Sensitivity 2	Stakeholder Service Levels and Reputation	Environment	Technical (No Link to Business Driver) - Flexibility and Operability	Technical (No Link to Business Driver) - Constructability	Economic	Non Cost Score	Total Score
Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir	50%	No Criteria Weighted	50%	No Criteria Weighted	0%	361	361
Option 2 - Increase Current Nebo Rd WTP Capacity and Reservoir at Erakala						324	324
Option 2A - Increase Current Nebo Rd WTP Capacity and Reservoir at Walkerston						**417**	**417**
Option 3 - Northern WTP and Erakala Reservoir						314	314

Stakeholder Service Levels and Reputation - 50%	Technical (No Link to Business Driver) - Flexibility and Operability - 50%	Economic - 0%
175	186	0
138	186	0
225	192	0
125	189	0



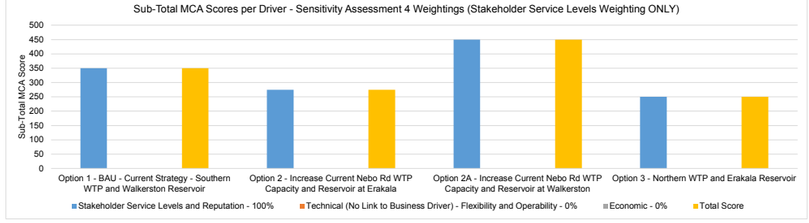
MCA Sensitivity 3	Stakeholder Service Levels and Reputation	Environment	Technical (No Link to Business Driver) - Flexibility and Operability	Technical (No Link to Business Driver) - Constructability	Economic	Non Cost Score	Total Score
Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir	0%	No Criteria Weighted	0%	No Criteria Weighted	100%	0	400
Option 2 - Increase Current Nebo Rd WTP Capacity and Reservoir at Erakala						0	**500**
Option 2A - Increase Current Nebo Rd WTP Capacity and Reservoir at Walkerston						0	450
Option 3 - Northern WTP and Erakala Reservoir						0	350

Stakeholder Service Levels and Reputation - 0%	Technical (No Link to Business Driver) - Flexibility and Operability - 0%	Economic - 100%
0	0	400
0	0	500
0	0	450
0	0	350



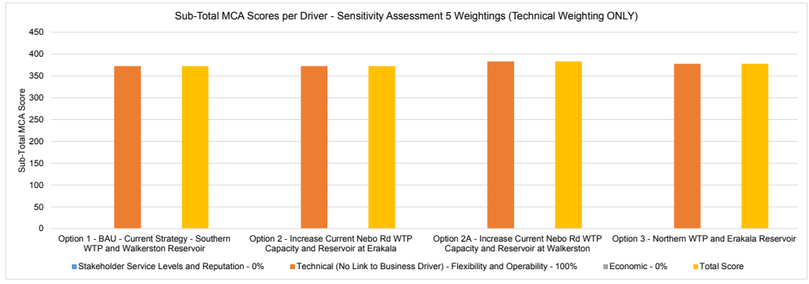
MCA Sensitivity 4	Stakeholder Service Levels and Reputation	Environment	Technical (No Link to Business Driver) - Flexibility and Operability	Technical (No Link to Business Driver) - Constructability	Economic	Non Cost Score	Total Score
Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir	100%	No Criteria Weighted	0%	No Criteria Weighted	0%	350	350
Option 2 - Increase Current Nebo Rd WTP Capacity and Reservoir at Erakala						275	275
Option 2A - Increase Current Nebo Rd WTP Capacity and Reservoir at Walkerston						**450**	**450**
Option 3 - Northern WTP and Erakala Reservoir						250	250

Stakeholder Service Levels and Reputation - 100%	Technical (No Link to Business Driver) - Flexibility and Operability - 0%	Economic - 0%
350	0	0
275	0	0
450	0	0
250	0	0



MCA Sensitivity 5	Stakeholder Service Levels and Reputation	Environment	Technical (No Link to Business Driver) - Flexibility and Operability	Technical (No Link to Business Driver) - Constructability	Economic	Non Cost Score	Total Score
Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir	0%	No Criteria Weighted	100%	No Criteria Weighted	0%	372	372
Option 2 - Increase Current Nebo Rd WTP Capacity and Reservoir at Erakala						372	372
Option 2A - Increase Current Nebo Rd WTP Capacity and Reservoir at Walkerston						**383**	**383**
Option 3 - Northern WTP and Erakala Reservoir						378	378

Stakeholder Service Levels and Reputation - 0%	Technical (No Link to Business Driver) - Flexibility and Operability - 100%	Economic - 0%
0	372	0
0	372	0
0	383	0
0	378	0



MWS Business Drivers		Technical (Flexibility/ Operability/ Constructability)	Environment	Stakeholder Service Levels and Reputation	Economic
Desired Stakeholder Outcomes		Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	Strategy mitigates risks and allows compliance with environmental approvals	No construction on Heritage land	Strategy has no impact on the reasonable escalation of future rate prices
		Easily maintainable	Ecosystem is protected through construction, commissioning and operation phases	Public accept strategy	Least whole of life costs
		Positive impact on water age/ water quality		Infrastructure is visually ameniable and blends into existing and natural surroudings	
		Operation is simple		Minimal/ No disruption during construction	
		Maximises the utilisation of assets		Appropriate management of traffic disruption during construction	
		Network has sufficient redundancy to service customers		Construction through existing easements as well as "ease of approval" for new easements	
		Additional infrastructure can be easily constructed within soils		No loss of cropping land	
		Minimal / no regulatory issues and licensing permits required		No impact on land values	
		Land ownership and access issues.			
		Use of innovative technology			
Impact Rating	**Points**	**Technical (Flexibility/ Operability/ Constructability)**	**Environment**	**Stakeholder Service Levels and Reputation**	**Economic**
Unacceptable	0	Solution will not meet stakeholder techincal outcomes	Solution does not meet desired stakeholder outcomes	Public discontent highly likely. Exposes community to unneccesary and unacceptable risks.	Other Options in Comparison to Lowest Cost Option
Very High	1	Solution may not meet the desired stakeholder techincal outcome because of significant issues to address and manage	Significant environmental impacts exist that may be managed. Potential for non-compliance with regulatory licence	Meets most stakeholders levels of service. Prolonged and significant adjustment required to community behaviour	Other Options in Comparison to Lowest Cost Option
High	2	Solution can meet the desired stakeholder technical outcome however major issues to address and manage	Significant environmental impacts that exist that may be managed.	Meets most stakeholders levels of service. Significant adjustment required to community behaviour	Other Options in Comparison to Lowest Cost Option
Moderate	3	Solution will meet the desired stakeholder outcome with minor issues to address and manage	Minor environmental impacts exist that could be managed.	Meets stakeholder and community outcomes with minor issues	Other Options in Comparison to Lowest Cost Option
Normal	4	Solution will meet the desired stakeholder outcome	Effective management can result in neutral impacts to environment	Meets stakeholder and community outcomes	Other Options in Comparison to Lowest Cost Option
Low	5	Solution will meet the desired stakeholder outcome with added technical benefits	Solution will meet the desired stakeholder outcome with added environmental benefits	Meets stakeholder and community outcomes with additional community beenfits	Lowest Cost Option

MCA Baseline

Note: Items denoted as a ***"Key Strategic Decision"*** *(highlighted green) was used in the Water Strategy Options MCA.*
Items denoted ***"Issue/ Risk"*** *is highlighted for documentation purposes only and are to be considered in revisions to the Water Stratgey in the future.*

									Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir			Option 2 - Increase Current Nebo Rd WTP Capacity and Erakala Reservoir			Option 2A - Increase Current Nebo Rd WTP Capacity and Walkerston Reservoir			Option 3 - Northern WTP and Erakala Reservoir			
Key Strategic Decision Or Issue/ Risk	**Stakeholder**	**Desired Stakeholder Outcomes**	**Criteria**	**Weighting**	**Connection to MWS Business Drivers**	**Sub-criteria**	**Weighting**	**Weighting x 100**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Comments**
Issue/ Risk	**Regulator - DEHP**	No construction on Heritage land	**Social/Cultural**			Heritage land issues			No construction on heritage land meeting stakeholder objectives			Potential heritage issues adjoinng the southern boundary of the existing WTP site which may impact on the upgrading of the waste water system.			Potential heritage issues adjoining the southern boundary of the existing WTP site which may impact on the upgrading of the waste water system.			No construction on heritage land meeting stakeholder objectives			
Key Strategic Decision	**MRC and Public**	Mackay Regional Council and Public accept strategy	**Social/Cultural**			Acceptance of Strategy	0.5	15	Southern WTP preferred site to be constructed adjacent to existing cemetery which could potetnially lead to localised public disapproval. This option is MRC's preferred option from previous Strategic Plan with a number of planning projects completed since 2010 based on the BAU Strategic Option.	4	60	Public is likely to accept strategy. Contingency trunk main planned along Heaths Road which may cause some localised disapproval from commercial customers. MRC likely to accept strategy as it aligns with with existing system with prposed trunk infrastructure not in line with current planning .	3.5	52.5	Public is likley to accept strategy. MRC likely to accept strategy as it aligns with with existing system and location of proposed trunk infrastructure is in line with previous planning works conducted under BAU strategic option.	5	75	Public is likley to accept strategy however for MRC this is a major change in direction from previous preferred Strategic Option (constructing a new WTP and trunk infrastructure on southern side of Pioneer River)	3	45	
Issue/ Risk	**Public**	Infrastructure is visually amenable and blends into existing and natural surroundings	**Social/Cultural**			Visual Amenity			Trunk infrastructure will have little impact on visual amenity including new reservoir. Southern WTP has potential image corridor issues to address			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and local impacts of visual amenity where new reservoir will be visible from Sugarshed road			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and location of the new Walkerston Reservoir			Trunk infrastructure other will have little impact on visual amenity with exception of local impacts of visual amenity where new reservoir will be visible from Sugarshed road			
Issue/ Risk	**Public**	Minimal/ No disruption to public during construction	**Social/Cultural**	**30%**	**Stakeholder Service Levels and Reputation**	Disruption to the community during construction			Delivery trunk main crosses major transport route. Will likely be underbored. Southern WTP to be constructed on northern side of Peak Downs Highway which will have impact on speed limits disrupting time of travel to those working in the mines as well as living past Walkerston. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site as well as along Mackay Bypass Road via the new Base Hospital bridge and along Heaths and Sugarshed Roads. Heaths Road has a number of commercial sites which likely cause disruption.			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits.			Localised manageable disruption to residents situated on Aprile Court, Mallia Road, Sugarshed Road, Ridolfis Road, Barclays Road and small portion of Maraju-Yakapari Road			
Key Strategic Decision	**Mackay Regional Council / Farmers / Public**	Construction through existing easements as well as "ease of approval" for new easements	**Social/Cultural**			Easement and land acquisition requirements	0.5	15	Easements and infrastructure locations and routes well defined however require to acquire land opposite existing cemetery	3	45	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road. Potential for easement issues along Heath's Road.	2	30	Trunk main from South Mackay and Walkerston Reservoir has well defined locations and routes. No land acquisition required with the exception of potentially acquiring someland to the south for waste water system	4	60	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road.	2	30	
Issue/ Risk	**Regulator - DEHP**	Strategy mitigates risks and allows compliance with environmental approvals	**Environmental**	**0%**	**Environment**	DEHP and other approvals/risks			No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			New reservoir site at Walkerston already acquired and No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	3.3	New WTP is near Walkerston and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	13.3	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	13.3	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	13.3	New WTP is on the northern side of the Pioneer River at Dumbleton Weir and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as the WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	13.3	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	3.3	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Walkerston reservoir to South Mackay . Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred.	4	13.3	New proposed Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in the southern area of mackay. One 675 mm trunk main has been costed from the new reservoir to south mackay. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	11.7	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. One 675 mm main has been costed from the new Walkerston reservoir to South Mackay with supply from nebo Road WTP. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred. This option aslo allows to continue with the construction of the Southern WTP (BAU option) in the future.	4.5	15.0	New WTP is near Dumbleton Weir and new Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Erakala reservoir to the Mackay urban area. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	11.7	
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	3.3	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	10.0	One WTP will require same level of maintenance as current status quo	4	13.3	One WTP will require same level of maintenance as current status quo	4	13.3	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	10.0	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	3.3	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	13.3	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the nebo Road HLPS is required would requried to maintained and checked regularly. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	11.7	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	11.7	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	13.3	
Issue/ Risk	**Mackay Water Services**	Positive impact on water age/ water quality	**Flexibility and Operability**	**30%**	***Technical (No Link to Business Driver)***	Water Quality			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains toWalkerston reservoir to ensure positive impact on water quality.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Erakala reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positvi impact on water quality as dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Walkerston reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positive impact on water quality as a dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains to storages to ensure positive impact on water quality.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	3.3	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	10	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	11.7	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	11.7	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	10.0	

Key Strategic Decision	**Mackay Water Services**	**Network Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	3.3	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Operation is simple with gravity feed from Walkerston reservoir to south mackay and inter-connection back into Nebo Road WTP balance tanks so as to be able to shut down the Nebo Road WTP if requried and supply from the Southern WTP. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage.	4	13.3	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the Nebo Road HLPS is required increasing complexity of system.	3	10.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage off the existing 600 mm trunk main (7 PRVS required). Increased complexity to system however pressure management is required on the southern system anyway	4	13.3	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management in South Mackay to manage potential bursts and increase in leakage.	4	13.3
Key Strategic Decision	**Mackay Water Services**	Maximises the utilisation of existing assets	**Flexibility and Operability**			Asset utilisation of existing assets	0.11	3.3	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	8.3	Maximises utilisation of existing WTP and network assets.	4	13.3	Maximises utilisation of existing WTP and network assets.	4	13.3	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	8.3
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	3.3	Two WTPs available to supply Mackay Urban area and increases reliability.	5	16.7	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	10.0	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	10.0	Two WTPs available to supply Mackay Urban area and increases reliability.	5	16.7
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	3.3	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Road WTP balance tanks from the Walkerston reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	4	13.3	One trunk main from Erakala reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. Reliability main is proposed on Heaths Road so that if the tunk main from Erakala reservoir is compromised, supply from Mt Pleasant can be maintained.	5	16.7	One trunk main fromWalkerston reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. If the runk main from Walkerston reservoir to south mackay is compromised the Nebo Road WTP HLPS could supply south mackay from Mt Pleasant (revert back to existing system operation)	4	13.3	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Rado WTP balance tanks from the Erakala reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	5	16.7
Issue/ Risk	**Mackay Water Services**	Additional infrastructure can be easily constructed within soils	**Constructability**			Geotechnical			Potential for rock to be encountered around the southern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site		
Issue/ Risk	**Mackay Regional Council**	Minimal / no regulatory issues and licensing permits required	**Constructability**	**0%**	*Technical (No Link to Business Driver)*	Regulatory issues- licensing/permits			no known regulatory issues			no known regulatory issues			no known regulatory issues			no known regulatory issues		
Issue/ Risk	**Mackay Regional Council**	Land ownership and access issues.	**Constructability**			Land ownership issues and access.			No known land ownership and access issues			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road		
Key Strategic Decision	**Mackay Regional Council**	Least whole of life costs	**Economic (Whole Life Cost)**	**40%**	**Economic**	Whole life cycle cost (NPV)	1	40	Second highest whole of life cost	4	160	Lowest whole of life cost	5	200	Second lowest whole of life cost	4.5	180	Highest whole of life cost	3.5	140
				100%			**Total**	**100**		Non-Cost Score	**217**		Non-Cost Score	**194**		Non-Cost Score	**250**		Non-Cost Score	**188**
										Total Score	**377**		Total Score	**394**		Total Score	**430**		Total Score	**328**

MCA Sensitivity 1

Note: Items denoted as a ***"Key Strategic Decision"*** *(highlighted green) was used in the Water Strategy Options MCA.*
Items denoted ***"Issue/ Risk"*** *is highlighted for documentation purposes only and are to be considered in revisions to the Water Stratgey in the future.*

									Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir			Option 2 - Increase Current Nebo Rd WTP Capacity and Erakala Reservoir			Option 2A - Increase Current Nebo Rd WTP Capacity and Walkerston Reservoir			Option 3 - Northern WTP and Erakala Reservoir			
Key Strategic Decision Or Issue/ Risk	**Stakeholder**	**Desired Stakeholder Outcomes**	**Criteria**	**Weighting**	**Connection to MWS Business Drivers**	**Sub-criteria**	**Weighting**	**Weighting x 100**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Comments**
Issue/ Risk	**Regulator - DEHP**	No construction on Heritage land	**Social/Cultural**			Heritage land issues			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			
Key Strategic Decision	**MRC and Public**	Mackay Regional Council and Public accept strategy	**Social/Cultural**			Acceptance of Strategy	0.5	10	Southern WTP preferred site to be constructed adjacent to existing cemetery which could potetnially lead to localised public disapproval. This option is MRC's preferred option from previous Strategic Plan with a number of planning projects completed since 2010 based on the BAU Strategic Option.	4	40	Public is likely to accept strategy. Contingency trunk main planned along Heaths Road which may cause some localised disapproval from commercial customers. MRC likely to accept strategy as it aligns with with existing system with proposed trunk infrastructure not in line with current planning .	3.5	35	Public is likely to accept strategy. MRC likely to accept strategy as it aligns with with existing system and location of proposed trunk infrastructure is in line with previous planning works conducted under BAU strategic option.	5	50	Public is likley to accept strategy however for MRC this is a major change in direction from previous preferred Strategic Option (constructing a new WTP and trunk infrastructure on southern side of Pioneer River)	3	30	
Issue/ Risk	**Public**	Infrastructure is visually amenable and blends into existing and natural surroundings	**Social/Cultural**			Visual Amenity			Trunk infrastructure will have little impact on visual amenity including new reservoir. Southern WTP has potential image corridor issues to address			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and local impacts of visual amenity where new reservoir will be visible from Sugarshed road			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and location of the new Walkerston Reservoir			Trunk infrastructure other will have little impact on visual amenity with exception of local impacts of visual amenity where new reservoir will be visible from Sugarshed road			
Issue/ Risk	**Public**	Minimal/ No disruption to public during construction	**Social/Cultural**	**20%**	**Stakeholder Service Levels and Reputation**	Disruption to the community during construction			Delivery trunk main crosses major transport route. Will likely be underbored. Southern WTP to be constructed on northern side of Peak Downs Highway which will have impact on speed limits disrupting time of travel to those working in the mines as well as living past Walkerston. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site as well as along Mackay Bypass Road via the new Base Hospital bridge and along Heaths and Sugarshed Roads. Heaths Road has a number of commercial sites which likely cause disruption.			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits.			Localised manageable disruption to residents situated on Aprile Court, Mallia Road, Sugarshed Road, Ridolfis Road, Barclays Road and small portion of Maraju-Yakapari Road			
Key Strategic Decision	**Mackay Regional Council / Farmers / Public**	Construction through existing easements as well as "ease of approval" for new easements	**Social/Cultural**			Easement requirements	0.5	10	Easements and infrastructure locations and routes well defined	3	30	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road. Potential for easement issues along Health's Road.	2	20	Trunk main from South Mackay and Walkerston Reservoir has well defined locations and routes.	4	40	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road.	2	20	
Issue/ Risk	**Regulator - DEHP**	Strategy mitigates risks and allows compliance with environmental approvals	**Environmental**	**0%**	**Environment**	DEHP and other approvals/risks			No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			New reservoir site at Walkerston already acquired and No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	4.4	New WTP is near Walkerston and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	17.8	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	17.8	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	17.8	New WTP is on the northern side of the Pioneer River at Dumbleton Weir and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as the WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	17.8	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	4.4	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Walkerston reservoir to South Mackay . Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred.	4	17.8	New proposed Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in the southern area of mackay. One 675 mm trunk main has been costed from the new reservoir to south mackay. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	15.6	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. One 675 mm main has been costed from the new Walkerston reservoir to South Mackay with supply from nebo Road WTP. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred. This option aslo allows to continue with the construction of the Southern WTP (BAU option) in the future.	4.5	20.0	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Erakala reservoir to the Mackay urban area. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	15.6	
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	4.4	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	13.3	One WTP will require same level of maintenance as current status quo	4	17.8	One WTP will require same level of maintenance as current status quo	4	17.8	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	13.3	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	4.4	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	17.8	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the nebo Road HLPS is required would requried to maintained and checked regularly. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	15.6	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	15.6	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	17.8	
Issue/ Risk	**Mackay Water Services**	Positive impact on water age/ water quality	**Flexibility and Operability**	**40%**	***Technical (No Link to Business Driver)***	Water Quality			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains toWalkerston reservoir to ensure positive impact on water quality.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Erakala reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positv impact on water quality as dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Walkerston reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positive impact on water quality as a dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains to storages to ensure positive impact on water quality.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	4.4	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	13.33333333	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	15.6	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	15.6	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	13.3	

Key Strategic Decision	**Mackay Water Services**	**Network Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	4.4	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Operation is simple with gravity feed from Walkerston reservoir to south mackay and inter-connection back into Nebo Road WTP balance tanks so as to be able to shut down the Nebo Road WTP if requried and supply from the Southern WTP. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage.	4	17.8	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unacceptable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the Nebo Road HLPS is required increasing complexity of system.	3	13.3	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unacceptable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage off the existing 600 mm trunk main (7 PRVS required). Increased complexity to system however pressure management is required on the southern system anyway	4	17.8	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management in South Mackay to manage potential bursts and increase in leakage.	4	17.8
Key Strategic Decision	**Mackay Water Services**	Maximises the utilisation of existing assets	**Flexibility and Operability**			Asset utilisation of existing assets	0.11	4.4	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	11.1	Maximises utilisation of existing WTP and network assets.	4	17.8	Maximises utilisation of existing WTP and network assets.	4	17.8	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	11.1
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	4.4	Two WTPs available to supply Mackay Urban area and increases reliability.	5	22.2	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	13.3	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	13.3	Two WTPs available to supply Mackay Urban area and increases reliability.	5	22.2
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	4.4	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Road WTP balance tanks from the Walkerston reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	4	17.8	One trunk main from Erakala reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. Reliability main is proposed on Heaths Road so that if the tunk main from Erakala reservoir is compromised, supply from Mt Pleasant can be maintained.	5	22.2	One trunk main fromWalkerston reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. If the runk main from Walkerston reservoir to south mackay is compromised the Nebo Road WTP HLPS could supply south mackay from Mt Pleasant (revert back to existing system operation)	4	17.8	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Rado WTP balance tanks from the Erakala reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	5	22.2
Issue/ Risk	**Mackay Water Services**	Additional infrastructure can be easily constructed within soils	**Constructability**			Geotechnical			Potential for rock to be encountered around the southern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site		
Issue/ Risk	**Mackay Regional Council**	Minimal / no regulatory issues and licensing permits required	**Constructability**	**0%**	*Technical (No Link to Business Driver)*	Regulatory issues- licensing/permits			no known regulatory issues			no known regulatory issues			no known regulatory issues			no known regulatory issues		
Issue/ Risk	**Mackay Regional Council**	Land ownership and access issues.	**Constructability**			Land ownership issues and access.			No known land ownership and access issues			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road		
Key Strategic Decision	**Mackay Regional Council**	Least whole of life costs	**Economic (Whole Life Cost)**	**40%**	**Economic**	Whole life cycle cost (NPV)	1	40	Second highest whole of life cost	4	160	Lowest whole of life cost	5	200	Second lowest whole of life cost	4.5	180	Highest whole of life cost	3.5	140
				100%			**Total**	**100**		Non-Cost Score	**219**		Non-Cost Score	**204**		Non-Cost Score	**243**		Non-Cost Score	**201**
										Total Score	**379**		Total Score	**404**		Total Score	**423**		Total Score	**341**

MCA Sensitivity 2

Note: Items denoted as a ***"Key Strategic Decision"*** *(highlighted green) was used in the Water Strategy Options MCA.*
Items denoted ***"Issue/ Risk"*** *is highlighted for documentation purposes only and are to be considered in revisions to the Water Stratgey in the future.*

									Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir			Option 2 - Increase Current Nebo Rd WTP Capacity and Erakala Reservoir			Option 2A - Increase Current Nebo Rd WTP Capacity and Walkerston Reservoir			Option 3 - Northern WTP and Erakala Reservoir			
Key Strategic Decision Or Issue/ Risk	**Stakeholder**	**Desired Stakeholder Outcomes**	**Criteria**	**Weighting**	**Connection to MWS Business Drivers**	**Sub-criteria**	**Weighting**	**Weighting x 100**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Comments**
Issue/ Risk	**Regulator - DEHP**	No construction on Heritage land	**Social/Cultural**			Heritage land issues			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			
Key Strategic Decision	**MRC and Public**	Mackay Regional Council and Public accept strategy	**Social/Cultural**			Acceptance of Strategy	0.5	25	Southern WTP preferred site to be constructed adjacent to existing cemetery which could potetnially lead to localised public disapproval. This option is MRC's preferred option from previous Strategic Plan with a number of planning projects completed since 2010 based on the BAU Strategic Option.	4	100	Public is likely to accept strategy. Contingency trunk main planned along Heaths Road which may cause some localised disapproval from commercial customers. MRC likely to accept strategy as it aligns with with existing system with proposed trunk infrastructure not in line with current planning .	3.5	87.5	Public is likely to accept strategy. MRC likely to accept strategy as it aligns with with existing system and location of proposed trunk infrastructure is in line with previous planning works conducted under BAU strategic option.	5	125	Public is likley to accept strategy however for MRC this is a major change in direction from previous preferred Strategic Option (constructing a new WTP and trunk infrastructure on southern side of Pioneer River)	3	75	
Issue/ Risk	**Public**	Infrastructure is visually amenable and blends into existing and natural surroundings	**Social/Cultural**			Visual Amenity			Trunk infrastructure will have little impact on visual amenity including new reservoir. Southern WTP has potential image corridor issues to address			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and local impacts of visual amenity where new reservoir will be visible from Sugarshed road			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and location of the new Walkerston Reservoir			Trunk infrastructure other will have little impact on visual amenity with exception of local impacts of visual amenity where new reservoir will be visible from Sugarshed road			
Issue/ Risk	**Public**	Minimal/ No disruption to public during construction	**Social/Cultural**	**50%**	**Stakeholder Service Levels and Reputation**	Disruption to the community during construction			Delivery trunk main crosses major transport route. Will likely be underbored. Southern WTP to be constructed on northern side of Peak Downs Highway which will have impact on speed limits disrupting time of travel to those working in the mines as well as living past Walkerston. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site as well as along Mackay Bypass Road via the new Base Hospital bridge and along Heaths and Sugarshed Roads. Heaths Road has a number of commercial sites which likely cause disruption.			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits.			Localised manageable disruption to residents situated on Aprile Court, Mallia Road, Sugarshed Road, Ridolfis Road, Barclays Road and small portion of Maraju-Yakapari Road			
Key Strategic Decision	**Mackay Regional Council / Farmers / Public**	Construction through existing easements as well as "ease of approval" for new easements	**Social/Cultural**			Easement requirements	0.5	25	Easements and infrastructure locations and routes well defined	3	75	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road. Potential for easement issues along Health's Road.	2	50	Trunk main from South Mackay and Walkerston Reservoir has well defined locations and routes.	4	100	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road.	2	50	
Issue/ Risk	**Regulator - DEHP**	Strategy mitigates risks and allows compliance with environmental approvals	**Environmental**	**0%**	**Environment**	DEHP and other approvals/risks			No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			New reservoir site at Walkerston already acquired and No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	5.6	New WTP is near Walkerston and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	22.2	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	22.2	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	22.2	New WTP is on the northern side of the Pioneer River at Dumbleton Weir and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as the WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	22.2	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	5.6	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Walkerston reservoir to South Mackay . Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred.	4	22.2	New proposed Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in the southern area of mackay. One 675 mm trunk main has been costed from the new reservoir to south mackay. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	19.4	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. One 675 mm main has been costed from the new Walkerston reservoir to South Mackay with supply from nebo Road WTP. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred. This option aslo allows to continue with the construction of the Southern WTP (BAU option) in the future.	4.5	25.0	New WTP is near Dumbleton Weir and new Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Erakala reservoir to the Mackay urban area. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	19.4	
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	5.6	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	16.7	One WTP will require same level of maintenance as current status quo	4	22.2	One WTP will require same level of maintenance as current status quo	4	22.2	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	16.7	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	5.6	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	22.2	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the nebo Road HLPS is required would requried to maintained and checked regularly. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	19.4	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	19.4	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	22.2	
Issue/ Risk	**Mackay Water Services**	Positive impact on water age/ water quality	**Flexibility and Operability**	**50%**	***Technical (No Link to Business Driver)***	Water Quality			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains toWalkerston reservoir to ensure positive impact on water quality.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Erakala reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positv impact on water quality as dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Walkerston reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positive impact on water quality as a dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains to storages to ensure positive impact on water quality.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	5.6	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	16.66666667	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	19.4	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	19.4	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	16.7	

Key Strategic Decision	**Mackay Water Services**	**Network Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	5.6	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Operation is simple with gravity feed from Walkerston reservoir to south mackay and inter-connection back into Nebo Road WTP balance tanks so as to be able to shut down the Nebo Road WTP if requried and supply from the Southern WTP. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage.	4	22.2	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the Nebo Road HLPS is required increasing complexity of system.	3	16.7	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage off the existing 600 mm trunk main (7 PRVS required). Increased complexity to system however pressure management is required on the southern system anyway	4	22.2	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management in South Mackay to manage potential bursts and increase in leakage.	4	22.2
Key Strategic Decision	**Mackay Water Services**	Maximises the utilisation of existing assets	**Flexibility and Operability**			Asset utilisation of existing assets	0.11	5.6	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	13.9	Maximises utilisation of existing WTP and network assets.	4	22.2	Maximises utilisation of existing WTP and network assets.	4	22.2	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	13.9
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	5.6	Two WTPs available to supply Mackay Urban area and increases reliability.	5	27.8	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	16.7	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	16.7	Two WTPs available to supply Mackay Urban area and increases reliability.	5	27.8
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	5.6	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Road WTP balance tanks from the Walkerston reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	4	22.2	One trunk main from Erakala reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. Reliability main is proposed on Heaths Road so that if the tunk main from Erakala reservoir is compromised, supply from Mt Pleasant can be maintained.	5	27.8	One trunk main fromWalkerston reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. If the runk main from Walkerston reservoir to south mackay is compromised the Nebo Road WTP HLPS could supply south mackay from Mt Pleasant (revert back to existing system operation)	4	22.2	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Rado WTP balance tanks from the Erakala reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	5	27.8
Issue/ Risk	**Mackay Water Services**	Additional infrastructure can be easily constructed within soils	**Constructability**	0%	*Technical (No Link to Business Driver)*	Geotechnical			Potential for rock to be encountered around the southern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site		
Issue/ Risk	**Mackay Regional Council**	Minimal / no regulatory issues and licensing permits required	**Constructability**			Regulatory issues- licensing/permits			no known regulatory issues			no known regulatory issues			no known regulatory issues			no known regulatory issues		
Issue/ Risk	**Mackay Regional Council**	Land ownership and access issues.	**Constructability**			Land ownership issues and access.			No known land ownership and access issues			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road		
Key Strategic Decision	**Mackay Regional Council**	Least whole of life costs	**Economic (Whole Life Cost)**	0%	**Economic**	Whole life cycle cost (NPV)	1	0	Second highest whole of life cost	4	0	Lowest whole of life cost	5	0	Second lowest whole of life cost	4.5	0	Highest whole of life cost	3.5	0
				100%			**Total**	**100**		Non-Cost Score	**361**		Non-Cost Score	**324**		Non-Cost Score	**417**		Non-Cost Score	**314**
										Total Score	**361**		Total Score	**324**		Total Score	**417**		Total Score	**314**

MCA Sensitivity 3

Note: Items denoted as a ***"Key Strategic Decision"*** *(highlighted green) was used in the Water Strategy Options MCA.*
Items denoted ***"Issue/ Risk"*** *is highlighted for documentation purposes only and are to be considered in revisions to the Water Stratgey in the future.*

									Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir			Option 2 - Increase Current Nebo Rd WTP Capacity and Erakala Reservoir			Option 2A - Increase Current Nebo Rd WTP Capacity and Walkerston Reservoir			Option 3 - Northern WTP and Erakala Reservoir			
Key Strategic Decision Or Issue/ Risk	**Stakeholder**	**Desired Stakeholder Outcomes**	**Criteria**	**Weighting**	**Connection to MWS Business Drivers**	**Sub-criteria**	**Weighting**	**Weighting x 100**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Comments**
Issue/ Risk	**Regulator - DEHP**	No construction on Heritage land	**Social/Cultural**			Heritage land issues			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			
Key Strategic Decision	**MRC and Public**	Mackay Regional Council and Public accept strategy	**Social/Cultural**			Acceptance of Strategy	0.5	0	Southern WTP preferred site to be constructed adjacent to existing cemetery which could potetnially lead to localised public disapproval. This option is MRC's preferred option from previous Strategic Plan with a number of planning projects completed since 2010 based on the BAU Strategic Option.	4	0	Public is likely to accept strategy. Contingency trunk main planned along Heaths Road which may cause some localised disapproval from commercial customers. MRC likely to accept strategy as it aligns with with existing system with proposed trunk infrastructure not in line with current planning .	3.5	0	Public is likely to accept strategy. MRC likely to accept strategy as it aligns with with existing system and location of proposed trunk infrastructure is in line with previous planning works conducted under BAU strategic option.	5	0	Public is likley to accept strategy however for MRC this is a major change in direction from previous preferred Strategic Option (constructing a new WTP and trunk infrastructure on southern side of Pioneer River)	3	0	
Issue/ Risk	**Public**	Infrastructure is visually amenable and blends into existing and natural surroundings	**Social/Cultural**			Visual Amenity			Trunk infrastructure will have little impact on visual amenity including new reservoir. Southern WTP has potential image corridor issues to address			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and local impacts of visual amenity where new reservoir will be visible from Sugarshed road			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and location of the new Walkerston Reservoir			Trunk infrastructure other will have little impact on visual amenity with exception of local impacts of visual amenity where new reservoir will be visible from Sugarshed road			
Issue/ Risk	**Public**	Minimal/ No disruption to public during construction	**Social/Cultural**	**0%**	**Stakeholder Service Levels and Reputation**	Disruption to the community during construction			Delivery trunk main crosses major transport route. Will likely be underbored. Southern WTP to be constructed on northern side of Peak Downs Highway which will have impact on speed limits disrupting time of travel to those working in the mines as well as living past Walkerston. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site as well as along Mackay Bypass Road via the new Base Hospital bridge and along Heaths and Sugarshed Roads. Heaths Road has a number of commercial sites which likely cause disruption.			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits.			Localised manageable disruption to residents situated on Aprile Court, Mallia Road, Sugarshed Road, Ridolfis Road, Barclays Road and small portion of Maraju-Yakapari Road			
Key Strategic Decision	**Mackay Regional Council / Farmers / Public**	Construction through existing easements as well as "ease of approval" for new easements	**Social/Cultural**			Easement requirements	0.5	0	Easements and infrastructure locations and routes well defined	3	0	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road. Potential for easement issues along Health's Road.	2	0	Trunk main from South Mackay and Walkerston Reservoir has well defined locations and routes.	4	0	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road.	2	0	
Issue/ Risk	**Regulator - DEHP**	Strategy mitigates risks and allows compliance with environmental approvals	**Environmental**	**0%**	**Environment**	DEHP and other approvals/risks			No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			New reservoir site at Walkerston already acquired and No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	0.0	New WTP is near Walkerston and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	0.0	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	0.0	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	0.0	New WTP is on the northern side of the Pioneer River at Dumbleton Weir and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as the WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	0.0	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	0.0	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Walkerston reservoir to South Mackay . Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred.	4	0.0	New proposed Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in the southern area of mackay. One 675 mm trunk main has been costed from the new reservoir to south mackay. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	0.0	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. One 675 mm main has been costed from the new Walkerston reservoir to South Mackay with supply from nebo Road WTP. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred. This option aslo allows to continue with the construction of the Southern WTP (BAU option) in the future.	4.5	0.0	New WTP is near Dumbleton Weir and new Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Erakala reservoir to the Mackay urban area. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	0.0	
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	0.0	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	0.0	One WTP will require same level of maintenance as current status quo	4	0.0	One WTP will require same level of maintenance as current status quo	4	0.0	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	0.0	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	0.0	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	0.0	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the nebo Road HLPS is required would requried to maintained and checked regularly. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	0.0	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	0.0	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	0.0	
Issue/ Risk	**Mackay Water Services**	Positive impact on water age/ water quality	**Flexibility and Operability**	**0%**	***Technical (No Link to Business Driver)***	Water Quality			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains toWalkerston reservoir to ensure positive impact on water quality.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Erakala reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positv impact on water quality as dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Walkerston reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positive impact on water quality as a dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains to storages to ensure positive impact on water quality.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	0.0	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	0	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	0.0	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	0.0	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	0.0	

Key Strategic Decision	**Mackay Water Services**	**Network Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	0.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Operation is simple with gravity feed from Walkerston reservoir to south mackay and inter-connection back into Nebo Road WTP balance tanks so as to be able to shut down the Nebo Road WTP if requried and supply from the Southern WTP. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage.	4	0.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the Nebo Road HLPS is required increasing complexity of system.	3	0.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage off the existing 600 mm trunk main (7 PRVS required). Increased complexity to system however pressure management is required on the southern system anyway	4	0.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management in South Mackay to manage potential bursts and increase in leakage.	4	0.0
Key Strategic Decision	**Mackay Water Services**	Maximises the utilisation of existing assets	**Flexibility and Operability**			Asset utilisation of existing assets	0.11	0.0	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	0.0	Maximises utilisation of existing WTP and network assets.	4	0.0	Maximises utilisation of existing WTP and network assets.	4	0.0	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	0.0
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	0.0	Two WTPs available to supply Mackay Urban area and increases reliability.	5	0.0	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	0.0	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	0.0	Two WTPs available to supply Mackay Urban area and increases reliability.	5	0.0
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	0.0	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Road WTP balance tanks from the Walkerston reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	4	0.0	One trunk main from Erakala reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. Reliability main is proposed on Heaths Road so that if the tunk main from Erakala reservoir is compromised, supply from Mt Pleasant can be maintained.	5	0.0	One trunk main fromWalkerston reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. If the runk main from Walkerston reservoir to south mackay is compromised the Nebo Road WTP HLPS could supply south mackay from Mt Pleasant (revert back to existing system operation)	4	0.0	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Rado WTP balance tanks from the Erakala reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	5	0.0
Issue/ Risk	**Mackay Water Services**	Additional infrastructure can be easily constructed within soils	**Constructability**			Geotechnical			Potential for rock to be encountered around the southern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site		
Issue/ Risk	**Mackay Regional Council**	Minimal / no regulatory issues and licensing permits required	**Constructability**	**0%**	*Technical (No Link to Business Driver)*	Regulatory issues-licensing/permits			no known regulatory issues			no known regulatory issues			no known regulatory issues			no known regulatory issues		
Issue/ Risk	**Mackay Regional Council**	Land ownership and access issues.	**Constructability**			Land ownership issues and access.			No known land ownership and access issues			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road		
Key Strategic Decision	**Mackay Regional Council**	Least whole of life costs	**Economic (Whole Life Cost)**	**100%**	**Economic**	Whole life cycle cost (NPV)	1	100	Second highest whole of life cost	4	400	Lowest whole of life cost	5	500	Second lowest whole of life cost	4.5	450	Highest whole of life cost	3.5	350
				100%			**Total**	**100**		Non-Cost Score	**0**		Non-Cost Score	**0**		Non-Cost Score	**0**		Non-Cost Score	**0**
										Total Score	**400**		Total Score	**500**		Total Score	**450**		Total Score	**350**

MCA Sensitivity 4

Note: Items denoted as a ***"Key Strategic Decision"*** *(highlighted green) was used in the Water Strategy Options MCA.*
Items denoted ***"Issue/ Risk"*** *is highlighted for documentation purposes only and are to be considered in revisions to the Water Stratgey in the future.*

									Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir			Option 2 - Increase Current Nebo Rd WTP Capacity and Erakala Reservoir			Option 2A - Increase Current Nebo Rd WTP Capacity and Walkerston Reservoir			Option 3 - Northern WTP and Erakala Reservoir			
Key Strategic Decision Or Issue/ Risk	**Stakeholder**	**Desired Stakeholder Outcomes**	**Criteria**	**Weighting**	**Connection to MWS Business Drivers**	**Sub-criteria**	**Weighting**	**Weighting x 100**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Comments**
Issue/ Risk	**Regulator - DEHP**	No construction on Heritage land	**Social/Cultural**			Heritage land issues			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			
Key Strategic Decision	**MRC and Public**	Mackay Regional Council and Public accept strategy	**Social/Cultural**			Acceptance of Strategy	0.5	50	Southern WTP preferred site to be constructed adjacent to existing cemetery which could potetnially lead to localised public disapproval. This option is MRC's preferred option from previous Strategic Plan with a number of planning projects completed since 2010 based on the BAU Strategic Option.	4	200	Public is likely to accept strategy. Contingency trunk main planned along Heaths Road which may cause some localised disapproval from commercial customers. MRC likely to accept strategy as it aligns with with existing system with proposed trunk infrastructure not in line with current planning .	3.5	175	Public is likely to accept strategy. MRC likely to accept strategy as it aligns with with existing system and location of proposed trunk infrastructure is in line with previous planning works conducted under BAU strategic option.	5	250	Public is likley to accept strategy however for MRC this is a major change in direction from previous preferred Strategic Option (constructing a new WTP and trunk infrastructure on southern side of Pioneer River)	3	150	
Issue/ Risk	**Public**	Infrastructure is visually amenable and blends into existing and natural surroundings	**Social/Cultural**			Visual Amenity			Trunk infrastructure will have little impact on visual amenity including new reservoir. Southern WTP has potential image corridor issues to address			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and local impacts of visual amenity where new reservoir will be visible from Sugarshed road			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and location of the new Walkerston Reservoir			Trunk infrastructure other will have little impact on visual amenity with exception of local impacts of visual amenity where new reservoir will be visible from Sugarshed road			
Issue/ Risk	**Public**	Minimal/ No disruption to public during construction	**Social/Cultural**	**100%**	**Stakeholder Service Levels and Reputation**	Disruption to the community during construction			Delivery trunk main crosses major transport route. Will likely be underbored. Southern WTP to be constructed on northern side of Peak Downs Highway which will have impact on speed limits disrupting time of travel to those working in the mines as well as living past Walkerston. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site as well as along Mackay Bypass Road via the new Base Hospital bridge and along Heaths and Sugarshed Roads. Heaths Road has a number of commercial sites which likely cause disruption.			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits.			Localised manageable disruption to residents situated on Aprile Court, Mallia Road, Sugarshed Road, Ridolfis Road, Barclays Road and small portion of Maraju-Yakapari Road			
Key Strategic Decision	**Mackay Regional Council / Farmers / Public**	Construction through existing easements as well as "ease of approval" for new easements	**Social/Cultural**			Easement requirements	0.5	50	Easements and infrastructure locations and routes well defined	3	150	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road. Potential for easement issues along Health's Road.	2	100	Trunk main from South Mackay and Walkerston Reservoir has well defined locations and routes.	4	200	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road.	2	100	
Issue/ Risk	**Regulator - DEHP**	Strategy mitigates risks and allows compliance with environmental approvals	**Environmental**	**0%**	**Environment**	DEHP and other approvals/risks			No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			New reservoir site at Walkerston already acquired and No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	0.0	New WTP is near Walkerston and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	0.0	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	0.0	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	0.0	New WTP is on the northern side of the Pioneer River at Dumbleton Weir and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as the WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	0.0	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	0.0	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Walkerston reservoir to South Mackay . Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred.	4	0.0	New proposed Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in the southern area of mackay. One 675 mm trunk main has been costed from the new reservoir to south mackay. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	0.0	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. One 675 mm main has been costed from the new Walkerston reservoir to South Mackay with supply from nebo Road WTP. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred. This option aslo allows to continue with the construction of the Southern WTP (BAU option) in the future.	4.5	0.0	New WTP is near Dumbleton Weir and new Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Erakala reservoir to the Mackay urban area. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	0.0	
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	0.0	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	0.0	One WTP will require same level of maintenance as current status quo	4	0.0	One WTP will require same level of maintenance as current status quo	4	0.0	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	0.0	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	0.0	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	0.0	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the nebo Road HLPS is required would requried to maintained and checked regularly. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	0.0	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	0.0	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	0.0	
Issue/ Risk	**Mackay Water Services**	Positive impact on water age/ water quality	**Flexibility and Operability**	**0%**	***Technical (No Link to Business Driver)***	Water Quality			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains toWalkerston reservoir to ensure positive impact on water quality.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Erakala reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positv impact on water quality as dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Walkerston reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positive impact on water quality as a dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains to storages to ensure positive impact on water quality.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	0.0	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	0	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	0.0	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	0.0	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	0.0	

Key Strategic Decision	**Mackay Water Services**	**Network Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	0.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Operation is simple with gravity feed from Walkerston reservoir to south mackay and inter-connection back into Nebo Road WTP balance tanks so as to be able to shut down the Nebo Road WTP if requried and supply from the Southern WTP. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage.	4	0.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the Nebo Road HLPS is required increasing complexity of system.	3	0.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage off the existing 600 mm trunk main (7 PRVS required). Increased complexity to system however pressure management is required on the southern system anyway	4	0.0	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management in South Mackay to manage potential bursts and increase in leakage.	4	0.0
Key Strategic Decision	**Mackay Water Services**	Maximises the utilisation of existing assets	**Flexibility and Operability**			Asset utilisation of existing assets	0.11	0.0	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	0.0	Maximises utilisation of existing WTP and network assets.	4	0.0	Maximises utilisation of existing WTP and network assets.	4	0.0	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	0.0
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	0.0	Two WTPs available to supply Mackay Urban area and increases reliability.	5	0.0	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	0.0	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	0.0	Two WTPs available to supply Mackay Urban area and increases reliability.	5	0.0
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	0.0	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Road WTP balance tanks from the Walkerston reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	4	0.0	One trunk main from Erakala reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. Reliability main is proposed on Heaths Road so that if the tunk main from Erakala reservoir is compromised, supply from Mt Pleasant can be maintained.	5	0.0	One trunk main fromWalkerston reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. If the runk main from Walkerston reservoir to south mackay is compromised the Nebo Road WTP HLPS could supply south mackay from Mt Pleasant (revert back to existing system operation)	4	0.0	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Rado WTP balance tanks from the Erakala reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	5	0.0
Issue/ Risk	**Mackay Water Services**	Additional infrastructure can be easily constructed within soils	**Constructability**			Geotechnical			Potential for rock to be encountered around the southern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site		
Issue/ Risk	**Mackay Regional Council**	Minimal / no regulatory issues and licensing permits required	**Constructability**	**0%**	*Technical (No Link to Business Driver)*	Regulatory issues-licensing/permits			no known regulatory issues			no known regulatory issues			no known regulatory issues			no known regulatory issues		
Issue/ Risk	**Mackay Regional Council**	Land ownership and access issues.	**Constructability**			Land ownership issues and access.			No known land ownership and access issues			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road		
Key Strategic Decision	**Mackay Regional Council**	Least whole of life costs	**Economic (Whole Life Cost)**	**0%**	**Economic**	Whole life cycle cost (NPV)	1	0	Second highest whole of life cost	4	0	Lowest whole of life cost	5	0	Second lowest whole of life cost	4.5	0	Highest whole of life cost	3.5	0
				100%			**Total**	**100**		Non-Cost Score	**350**		Non-Cost Score	**275**		Non-Cost Score	**450**		Non-Cost Score	**250**
										Total Score	**350**		Total Score	**275**		Total Score	**450**		Total Score	**250**

MCA Sensitivity 5

Note: Items denoted as a ***"Key Strategic Decision"*** *(highlighted green) was used in the Water Strategy Options MCA.*
Items denoted ***"Issue/ Risk"*** *is highlighted for documentation purposes only and are to be considered in revisions to the Water Stratgey in the future.*

									Option 1 - BAU - Current Strategy - Southern WTP and Walkerston Reservoir			Option 2 - Increase Current Nebo Rd WTP Capacity and Erakala Reservoir			Option 2A - Increase Current Nebo Rd WTP Capacity and Walkerston Reservoir			Option 3 - Northern WTP and Erakala Reservoir			
Key Strategic Decision Or Issue/ Risk	**Stakeholder**	**Desired Stakeholder Outcomes**	**Criteria**	**Weighting**	**Connection to MWS Business Drivers**	**Sub-criteria**	**Weighting**	**Weighting x 100**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Stakeholder Outcomes**	**Score**	**Weighted Score**	**Comments**
Issue/ Risk	**Regulator - DEHP**	No construction on Heritage land	**Social/Cultural**			Heritage land issues			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			No construction on heritage land meeting stakeholder objectives			
Key Strategic Decision	**MRC and Public**	Mackay Regional Council and Public accept strategy	**Social/Cultural**			Acceptance of Strategy	0.5	0	Southern WTP preferred site to be constructed adjacent to existing cemetery which could potetnially lead to localised public disapproval. This option is MRC's preferred option from previous Strategic Plan with a number of planning projects completed since 2010 based on the BAU Strategic Option.	4	0	Public is likely to accept strategy. Contingency trunk main planned along Heaths Road which may cause some localised disapproval from commercial customers. MRC likely to accept strategy as it aligns with with existing system with proposed trunk infrastructure not in line with current planning .	3.5	0	Public is likely to accept strategy. MRC likely to accept strategy as it aligns with with existing system and location of proposed trunk infrastructure is in line with previous planning works conducted under BAU strategic option.	5	0	Public is likley to accept strategy however for MRC this is a major change in direction from previous preferred Strategic Option (constructing a new WTP and trunk infrastructure on southern side of Pioneer River)	3	0	
Issue/ Risk	**Public**	Infrastructure is visually amenable and blends into existing and natural surroundings	**Social/Cultural**			Visual Amenity			Trunk infrastructure will have little impact on visual amenity including new reservoir. Southern WTP has potential image corridor issues to address			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and local impacts of visual amenity where new reservoir will be visible from Sugarshed road			Little/ no change to visual amenity other than in the construction/ upgrade phase of the project at the Nebo Road WTP and location of the new Walkerston Reservoir			Trunk infrastructure other will have little impact on visual amenity with exception of local impacts of visual amenity where new reservoir will be visible from Sugarshed road			
Issue/ Risk	**Public**	Minimal/ No disruption to public during construction	**Social/Cultural**	**0%**	**Stakeholder Service Levels and Reputation**	Disruption to the community during construction			Delivery trunk main crosses major transport route. Will likely be underbored. Southern WTP to be constructed on northern side of Peak Downs Highway which will have impact on speed limits disrupting time of travel to those working in the mines as well as living past Walkerston. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site as well as along Mackay Bypass Road via the new Base Hospital bridge and along Heaths and Sugarshed Roads. Heaths Road has a number of commercial sites which likely cause disruption.			Due to existing site being on Nebo Road there will be some disruption to Mackay residents surrounding the Nebo Road WTP site. Potential disruption to Mackay Ring Road along Stockroute Road increasing travel time from reduction in speed limits.			Localised manageable disruption to residents situated on Aprile Court, Mallia Road, Sugarshed Road, Ridolfis Road, Barclays Road and small portion of Maraju-Yakapari Road			
Key Strategic Decision	**Mackay Regional Council / Farmers / Public**	Construction through existing easements as well as "ease of approval" for new easements	**Social/Cultural**			Easement requirements	0.5	0	Easements and infrastructure locations and routes well defined	3	0	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road. Potential for easement issues along Health's Road.	2	0	Trunk main from South Mackay and Walkerston Reservoir has well defined locations and routes.	4	0	Construction generally along local roads and could be integrated with Ergon power easements if required (this has been completed in SEQ). New Base Hospital Bridge allows for one additional water or sewer trunk infrastructure. Potential for signifacnt easement issues (dealing with TMR) along Mackay Bypass Road from Sugarshed Road to Nebo Road.	2	0	
Issue/ Risk	**Regulator - DEHP**	Strategy mitigates risks and allows compliance with environmental approvals	**Environmental**	**0%**	**Environment**	DEHP and other approvals/risks			No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			New reservoir site at Walkerston already acquired and No known issues with environmental approvals			New reservoir site at Erakala may have some environmental approval issues as it adjacent to vegetation which contains endangered regional ecosystem.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	11.1	New WTP is near Walkerston and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	44.4	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	44.4	WTP upgrade allows for flexibility in growth rates north and south of the river by upgrading the existing WTP. No staging of the WTP will be considered as the existing WTP will be increased from 75 ML/d to 90 ML/d. The capacity upgrade allows for supplying Sarina.	4	44.4	New WTP is on the northern side of the Pioneer River at Dumbleton Weir and allows for growth in Ooralea. When constructed the WTP will be constructed at 35 ML/d (no staging) as the WTP boundary will be set with minimal growth going forwards. This allows load to be taken off the Nebo Road WTP to service the signifacnt growth occuring in the Northern Scheme. Thus, allows for spatial growth north and south of the river. The new WTP allows for supplying Sarina.	4	44.4	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Allows for sensibility and flexibility in servicing growth and considers for staging of infrastructure where required	**Flexibility and Operability**			Ability to flexibly service growth - staging, strategy change	0.11	11.1	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Walkerston reservoir to South Mackay . Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred.	4	44.4	New proposed Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in the southern area of mackay. One 675 mm trunk main has been costed from the new reservoir to south mackay. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	38.9	New proposed Walkerston reservoir is approximately 15 kms from South Mackay and allows for growth in Ooralea. One 675 mm main has been costed from the new Walkerston reservoir to South Mackay with supply from nebo Road WTP. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option provides an increased starting head to reduce the design head of the booster pump to supply Sarina when required. and allows any boosting requirements to be deferred. This option aslo allows to continue with the construction of the Southern WTP (BAU option) in the future.	4.5	50.0	New WTP is near Dumbleton Weir and new Erakala reservoir is approximately 8.5 kms from South Mackay and allows for growth in Ooralea. Staging of two 675 mm mains has been costed from the new Erakala reservoir to the Mackay urban area. Supply to Sarina has been considered in the sizing of trunk infrastructure. Under Ultimate demand Sarina supply will be required to be boosted due to the distance between Mackay and Alligator Creek. This option is not likely to provide an increased starting head to reduce the design head of the booster pump to Sarina .	3.5	38.9	
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	11.1	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	33.3	One WTP will require same level of maintenance as current status quo	4	44.4	One WTP will require same level of maintenance as current status quo	4	44.4	Two WTP's will require increase of operations and maintenance staff and will increase maintenance requriements.	3	33.3	
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Easily maintainable	**Flexibility and Operability**			Ease of maintenance	0.11	11.1	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	44.4	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the nebo Road HLPS is required would requried to maintained and checked regularly. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	38.9	Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south. Less trunk main infrastructure required then Option 1 and 3 which means less maintenance on trunk mains.	3.5	38.9	Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage. Maintenance would be based on pressure management requirements in the south.	4	44.4	
Issue/ Risk	**Mackay Water Services**	Positive impact on water age/ water quality	**Flexibility and Operability**	**100%**	***Technical (No Link to Business Driver)***	Water Quality			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains toWalkerston reservoir to ensure positive impact on water quality.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Erakala reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positvi impact on water quality as dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced reservoir volumes required. In addition, combined inlet/ outlet main to Walkerston reservoir which could lead to a floating reservoir. However changed operation at Nebo Road WTP will allow for pumping to new reservoir and back feeding into South Mackay due to the available increased head of the reservoir. Won't have as positive impact on water quality as a dedicated inlet/ outlet approach.			Strategy allows for WTP production to mitigate against peak month persistent demands with reduced storage volumes required. In addition, separate inlet/ outlet mains to storages to ensure positive impact on water quality.			
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	11.1	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	33.33333333	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	38.9	One WTP will require same level of operation as current status quo with some minor changes to operational logistics cush as Southern and Northern Schemes HLPS operation	3.5	38.9	Two WTP's will require increase of operations and maintenance staff and will increaseoperational logistic requierements.	3	33.3	

Key Strategic Decision	**Mackay Water Services**	**Network Component -** Operation is simple	**Flexibility and Operability**			Ease of operation	0.11	11.1	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Operation is simple with gravity feed from Walkerston reservoir to south mackay and inter-connection back into Nebo Road WTP balance tanks so as to be able to shut down the Nebo Road WTP if requried and supply from the Southern WTP. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Walkerston reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management to manage potential bursts and increase in leakage.	4	44.4	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Erakala Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. A large PRV situated on the southern network feed downstream of the Nebo Road HLPS is required increasing complexity of system.	3	33.3	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on an integrated pumping/ reservoir supply arragement from Nebo Road WTP to Walkerston Reservoir. This means pumping head requirements will increase maximum network pressures close to or above 80 m which is unaccetpable and likley to cause increase levels of leakage , pipe bursts and issues to hot water systems. Pressure management to manage potential bursts and increase in leakage off the existing 600 mm trunk main (7 PRVS required). Increased complexity to system however pressure management is required on the southern system anyway	4	44.4	All options allow for disaggregation of Northern Scheme from Southern Scheme with inter-connection between schemes for contingency purposes. Network infrastructure is based on a dedicated feed/ distribution approach thus customers will typically see stable pressures based on the new Erakala reservoir level. However the head will be higher (increased from 50 m to 70 m) which will require some level of pressure management in South Mackay to manage potential bursts and increase in leakage.	4	44.4
Key Strategic Decision	**Mackay Water Services**	Maximises the utilisation of existing assets	**Flexibility and Operability**			Asset utilisation of existing assets	0.11	11.1	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	27.8	Maximises utilisation of existing WTP and network assets.	4	44.4	Maximises utilisation of existing WTP and network assets.	4	44.4	When new WTP comes online, Nebo Road WTP asset utilisation will reduce from 75 ML/d in peak periods to 53 ML/d peak periods. 45 ML/d AD reduces to 30 ML/d AD. Similar demand to what is seen in 2015.	2.5	27.8
Key Strategic Decision	**Mackay Water Services**	**Treatment Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	11.1	Two WTPs available to supply Mackay Urban area and increases reliability.	5	55.6	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	33.3	One WTP supplying Mackay Urban area which does not allow for long shut down periods. Contingency supply is the Nebo Road bores which can supply under limited demand conditions.	3	33.3	Two WTPs available to supply Mackay Urban area and increases reliability.	5	55.6
Key Strategic Decision	**Mackay Water Services**	**Network Component -** Network has sufficient redundancy to service customers	**Flexibility and Operability**			Resilience for emergencies	0.11	11.1	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Road WTP balance tanks from the Walkerston reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	4	44.4	One trunk main from Erakala reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. Reliability main is proposed on Heaths Road so that if the tunk main from Erakala reservoir is compromised, supply from Mt Pleasant can be maintained.	5	55.6	One trunk main fromWalkerston reservoir to South Mackay which reduces reliability due to the location of reservoir compared to location of demand. If the runk main from Walkerston reservoir to south mackay is compromised the Nebo Road WTP HLPS could supply south mackay from Mt Pleasant (revert back to existing system operation)	4	44.4	Trunk infrastucture allows for 2 staged trunk mains from Walkerston reservoir to South Mackay which increases reliability of supply. If Nebo Road WTP requires to be shut down the network can supply from a contingency main proposed to feed into Nebo Rado WTP balance tanks from the Erakala reservoir. If Southern WTP requires to be shut down the system can be reverted back to existing system operation.	5	55.6
Issue/ Risk	**Mackay Water Services**	Additional infrastructure can be easily constructed within soils	**Constructability**			Geotechnical			Potential for rock to be encountered around the southern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site			Potential for rock to be encountered around the northern reservoir location site		
Issue/ Risk	**Mackay Regional Council**	Minimal / no regulatory issues and licensing permits required	**Constructability**	**0%**	*Technical (No Link to Business Driver)*	Regulatory issues- licensing/permits			no known regulatory issues			no known regulatory issues			no known regulatory issues			no known regulatory issues		
Issue/ Risk	**Mackay Regional Council**	Land ownership and access issues.	**Constructability**			Land ownership issues and access.			No known land ownership and access issues			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road			Possible land issues if Main Roads easements are required - Mackay By-Pass Road		
Key Strategic Decision	**Mackay Regional Council**	Least whole of life costs	**Economic (Whole Life Cost)**	**0%**	**Economic**	Whole life cycle cost (NPV)	1	0	Second highest whole of life cost	4	0	Lowest whole of life cost	5	0	Second lowest whole of life cost	4.5	0	Highest whole of life cost	3.5	0
				100%			**Total**	**100**		Non-Cost Score	**372**		Non-Cost Score	**372**		Non-Cost Score	**383**		Non-Cost Score	**378**
										Total Score	**372**		Total Score	**372**		Total Score	**383**		Total Score	**378**

Appendix G: Strategic Options Capital Costs

Strategic Option 1 Capital Costs

Asset ID	Asset Type	Description	Length (m)	Diameter (mm)	Unit Rate	Soil Type	Land Use	Adjustment Factor	Year Required	Base Infrastructure Cost ($)	Incorporating Soil & LanduseType Factor Cost ($)	Regional Factor (5%) ($)	Contingency Cost ($)	Cost 2011 ($)	Cost 2015 ($)
													38%		107%
Raw Water															
Option_1_RW_001	Raw Water Main	Dumbleton Weir to Nebo Road WTP	11,000	525	$1,303.00	Good Soil	Rural	0.81	2026	$14,333,000	$11,609,730.00	$580,487	$4,411,697	$16,601,914	$17,830,456
Option_1_RW_002	Raw Water Main	Dumbleton Weir to Southern WTP	750	600	$1,503	Good Soil	Rural	0.81	2038	$1,127,250	$913,073	$45,654	$346,968	$1,305,694	$1,402,315
Water Treatment															
Asset ID	**Asset Type**				**Unit Rate**	**Soil Type**	**Land Use**	**Adjustment Factor**	**Year Required**	**Base Infrastructure Cost ($)**	**Incorporating Soil & LanduseType Factor Cost ($)**	**Regional Factor (5%) ($)**	**Contingency Cost ($)**	**Cost 2013 ($)**	**Cost 2015 ($)**
Option_1_Southern_WTP	Water Treatment Plant	35 ML Capacity. Cost based on Clarifier + Rapid Gravity Filter WTP. Includes civil and elctrical site establishment works.							2038	2038	$34,000,000			$34,000,000	$35,258,000
Trunk Mains															
Option_1_TM_001	Potable Water Main	Southern WTP to Walkerston Reservoir	6,000	675	$2,496	Good Soil	Rural	0.81	2038	$14,976,000	$12,130,560	$606,528	$4,609,613	$17,346,701	$18,630,357
Option_1_TM_002	Potable Water Main	Walkerston Reservoir to Ooralea #1	7,100	675	$2,496	Good Soil	Rural	0.8	2038	$17,721,600	$14,177,280	$708,864	$5,387,366	$20,273,510	$21,773,750
			2,000		$2,496	Hard Rock	Rural	1.17	2038	$4,992,000	$5,840,640	$292,032	$2,219,443	$8,352,115	$8,970,172
Option_1_TM_003	Potable Water Main	Walkerston Reservoir to Ooralea #2	7,100	675	$2,496	Good Soil	Rural	0.8	2056	$17,721,600	$14,177,280	$708,864	$5,387,366	$20,273,510	$21,773,750
			2,000		$2,496	Hard Rock	Rural	1.17	2056	$4,992,000	$5,840,640	$292,032	$2,219,443	$8,352,115	$8,970,172
Option_1_TM_004	Potable Water Main	Walkerston Reservoir to Walkerston	1,500	300	$518	Good Soil	Rural	0.85	2038	$777,000	$660,450	$33,023	$250,971	$944,444	$1,014,332
Option_1_TM_005	Potable Water Main	Stockroute Rd (west)	1,630	600	$1,503	Good Soil	Rural	0.81	2038	$2,449,890	$1,984,411	$99,221	$754,076	$2,837,708	$3,047,698
Option_1_TM_006	Potable Water Main	Stockroute Rd (east)	620	600	$1,503	Good Soil	Rural	0.85	2038	$931,860	$792,081	$39,604	$300,991	$1,132,676	$1,216,494
Option_1_TM_007	Potable Water Main	Connors Road	620	600	$1,503	Good Soil	Rural	0.85	2038	$931,860	$792,081	$39,604	$300,991	$1,132,676	$1,216,494
Option_1_TM_008	Potable Water Main	Reliability Main at Nebo Road WTP	130	600	$1,503	Good Soil	Urban	1.89	2038	$195,390	$369,287	$9,770	$140,329	$519,386	$557,820
Option_1_Reliability_Valve	Control Valve	Control Valve at Nebo Road WTP to allow Southern WTP to feed Nebo Road WTP Balance Tanks	500						2038	$28,614	$28,614	$1,431	$10,873	$40,918	$43,946
Storage															
Asset ID	**Asset Type**				**Unit Rate**	**Soil Type**	**Land Use**	**Adjustment Factor**	**Year Required**	**Base Infrastructure Cost ($)**	**Incorporating Soil & LanduseType Factor Cost ($)**	**Regional Factor (5%) ($)**	**Contingency Cost ($)**	**Cost 2011 ($)**	**Cost 2015 ($)**
Option_1_Walkerston_Res	Reservoir	16 ML Reservoir at Walkerston							2038	$3,330,380	$3,330,380	$166,519	$1,265,544	$4,762,443	$5,114,864
Total														$137,875,809	$146,820,619

Strategic Option 2 Capital Costs

Asset ID	Asset Type	Description	Length (m)	Diameter (mm)	Unit Rate	Soil Type	Land Use	Adjustment Factor	Year Required	Base Infrastructure Cost ($)	Incorporating Soil & LanduseType Factor Cost ($)	Regional Factor (5%) ($)	Contingency Cost ($)	Cost 2011 ($)	Cost 2015 ($)
													38%		107%
Raw Water															
Option_2_RW_001	Raw Water Main	Dumbleton Weir to Nebo Road WTP	11,000	525	$1,303.00	Good Soil	Rural	0.81	2026	$14,333,000	$11,609,730.00	$580,487	$4,411,697	$16,601,914	$17,830,456
Water Treatment															
Asset ID	**Asset Type**								**Year Required**	**Base Infrastructure Cost ($)**	**Incorporating Soil & LanduseType Factor Cost ($)**	**Regional Factor (5%) ($)**	**Contingency Cost ($)**	**Cost 2013 ($)**	**Cost 2015 ($)**
Option_2_Nebo_WTP_Upgrade	Water Treatment Plant	Upgrade Nebo Road WTP from 75 ML/d up to 90 ML/d . Cost based on upgrades to clarifiers, chemical dosing systems and pumps, sludge mgt facilities and SCADA/ PLC modification. Costs based on CityWater Technologies Estimates.							2038	$10,732,636	$10,732,636		$1,610,071.00	$12,342,707	$12,342,707
Option_2_HLPS_Upgrade	Pump to Northern Erakala Reservoir	Reconfiguration of Nebo Road HLPS so that pumps can transfer water to Erakala Reservoir	375 kW						2038	$1,058,742	$1,058,742.00	$52,937	$402,321.96	$1,514,001	$1,626,037
Option_2_TM_004	Potable Water Main	Connection main from Option_2_TM_009 to existing 600 and 300 diameter mains at Nebo Road WTP	95	675	$2,496.00	Good Soil	Urban	2.16	2038	$237,120	$512,179	$25,609	$194,628	$732,416	$786,615
Option_2_PRV	Pressure Reducing Valve	PRV dowsntream of Nebo Road HLPS serving southern Mackay	500						2038	$52,000	$52,000	$2,600	$19,760	$74,360	$79,863
Trunk Mains															
Option_2_TM_005	Potable Water Main	Connors Road	620	300	$518.00	Good Soil	Rural	0.85	2046	$321,160	$272,986.00	$13,649	$103,735	$390,370	$419,257
Option_2_TM_006	Potable Water Main	Stockroute Rd	2,400	300	$518.00	Good Soil	Rural	0.85	2046	$1,243,200	$1,056,720.00	$52,836	$401,554	$1,511,110	$1,622,932
Option_2_TM_009	Potable Water Main	Erakala Reservoir to South Mackay #1	6,500	675	$2,496.00	Good Soil	Rural	0.8	2038	$16,224,000	$12,979,200.00	$648,960	$4,932,096	$18,560,256	$19,933,715
			2,000	675	$2,496.00	Hard Rock	Rural	1.17	2038	$4,992,000	$5,840,640.00	$292,032	$2,219,443	$8,352,115	$8,970,172
Option_2_TM_010	Potable Water Main	Erakala Reservoir to South Mackay #2	6,500	675	$2,496.00	Good Soil	Rural	0.8	2056	$16,224,000	$12,979,200.00	$648,960	$4,932,096	$18,560,256	$19,933,715
			2,000	675	$2,496.00	Hard Rock	Rural	1.17	2056	$4,992,000	$5,840,640.00	$292,032	$2,219,443	$8,352,115	$8,970,172
Option_2_TM_012	Potable Water Main	Reliability Main (Heaths Road)	1,275	600	$1,503.00	Good Soil	Urban	1	2038	$1,916,325	$1,916,325.00	$95,816	$728,204	$2,740,345	$2,943,130
Option 2_Reliability_Valve	Control Valve	Control valve on Heath's Road Reliability Main	500						2038	$28,614	$28,614	$1,431	$10,873	$40,918	$43,946
Storage															
Asset ID	**Asset Type**				**Unit Rate**	**Soil Type**	**Land Use**	**Adjustment Factor**	**Year Required**	**Base Infrastructure Cost ($)**	**Incorporating Soil & LanduseType Factor Cost ($)**	**Regional Factor (5%) ($)**	**Contingency Cost ($)**	**Cost 2011 ($)**	**Cost 2015 ($)**
Option_2_Northern_Res	Reservoir	16 ML Reservoir at Erakala							2038	$3,330,380	$3,330,379.80	$166,519	$1,265,544	$4,762,443	$5,114,864
Total														$94,535,326	$100,617,580

Strategic Option 2A Capital Costs

Asset ID	Asse Type	Description	Length (m)	Diameter (mm)	Unit Rate	Soil Type	Land Use	Adjustment Factor	Year Required	Base Infrastructure Cost ($)	Incorporating Soil & LanduseType Factor Cost ($)	Regional Factor (5%) ($)	Contingency Cost ($)	Cost 2011 ($)	Cost 2015 ($)
													38%		107%
Raw Water															
Option_2A_RW_001	Raw Water Main	Dumbleton Weir to Nebo Road WTP	11,000	525	$1,303	Soft Rock	Good Soil	0.81	2026	$14,333,000	$11,609,730	$580,487	$4,411,697	$16,601,914	$17,830,456
Water Treatment															
Asset ID	**Asse Type**	**Description**	**kW**						**Year Required**	**Base Infrastructure Cost ($)**	**Incorporating Soil & LanduseType Factor Cost ($)**	**Regional Factor (5%) ($)**	**Contingency Cost ($)**	**Cost 2011 ($)**	**Cost 2015 ($)**
Option_2A_Nebo_WTP_Upgrade	Water Treatment Plant	Upgrade Nebo Road WTP from 75 ML/d up to 90 ML/d . Cost based on upgrades to clarifiers, chemical dosing systems and pumps, sludge mgt facilities and SCADA/ PLC modification. Costs based on CityWater Technologies Estimates.							2038	$10,732,636	$10,732,636		$1,610,071.00	$12,342,707	$12,342,707
Option_2A_HLPS_Upgrade	Pump toWalkerston Reservoir	Reconfiguration of Nebo Road HLPS so that pumps can transfer water to Walkerston Reservoir	375.00						2038	$1,058,742	$1,058,742	$52,937	$402,322	$1,514,001	$1,626,037.14
Trunk Mains															
Option_2A_TM_001	Potable Water Main	Walkerston Reservoir to Ooralea #1	7,100	675	$2,496	Good Soil	Rural	0.81	2038	$17,721,600	$14,354,496	$717,725	$5,454,708	$20,526,929	$22,045,922
			2,000		$2,496	Hard Rock	Rural	1.17	2038	$4,992,000	$5,840,640	$292,032	$2,219,443	$8,352,115	$8,970,172
Option_2A_TM_002	Potable Water Main	Stockroute Rd (west)	1,630	600	$1,503	Good Soil	Rural	0.81	2038	$2,449,890	$1,984,411	$122,495	$754,076	$2,860,982	$3,072,694
Option_2A_TM_003	Potable Water Main	Stockroute Rd (east)	820	600	$1,503	Good Soil	Rural	0.81	2038	$1,232,460	$998,293	$61,623	$379,351	$1,439,267	$1,545,773
Option_2A_TM_004	Potable Water Main	Connors Rd	620	600	$1,503	Good Soil	Rural	0.81	2038	$931,860	$754,807	$46,593	$286,827	$1,088,226	$1,168,755
Option_2A_TM_005	Potable Water Main	Paradise Street to Walkerston Reservoir #2	12,000	675	$2,496	Good Soil	Rural	0.81	2056	$29,952,000	$24,261,120	$1,497,600	$9,219,226	$34,977,946	$37,566,314
			2,000		$2,496	Hard Rock	Rural	1.17	2056	$4,992,000	$5,840,640	$249,600	$2,219,443	$8,309,683	$8,924,600
Option_2A_TM_006	Potable Water Main	Nebo Road WTP Outlet Main	30	600	$1,503	Good Soil	Urban	2.88	2038	$45,090	$129,859	$2,255	$49,346	$181,460	$194,888
Option_2A_Control_Valve	Control Valve	600	500			Good Soil	Urban	1	2056	$28,614	$28,614	$1,431	$10,873	$40,918	$43,946
Option_2A_PRV-1	Pressure Reducing Valve	385	300			Good Soil	Urban	1	2038	$28,441	$28,441	$1,422	$10,807	$40,670	$43,680
Option_2A_PRV-2	Pressure Reducing Valve	480	450			Good Soil	Urban	1	2038	$42,198	$42,198	$2,110	$16,035	$60,343	$64,809
Option_2A_PRV-3	Pressure Reducing Valve	157	100			Good Soil	Urban	1	2038	$4,086	$4,086	$204	$1,553	$5,843	$6,275
Option_2A_PRV-4	Pressure Reducing Valve	152	100			Good Soil	Urban	1	2038	$4,086	$4,086	$204	$1,553	$5,843	$6,275
Option_2A_PRV-5	Pressure Reducing Valve	160	100			Good Soil	Urban	1	2038	$4,086	$4,086	$204	$1,553	$5,843	$6,275
Option_2A_PRV-6	Pressure Reducing Valve	210	150			Good Soil	Urban	1	2038	$5,541	$5,541	$277	$2,105	$7,923	$8,509
Option_2A_PRV-6A	Pressure Reducing Valve	210	150			Good Soil	Urban	1	2038	$5,541	$5,541	$277	$2,105	$7,923	$8,509
Option_2A_PRV-7	Pressure Reducing Valve	210	150			Good Soil	Urban	1	2038	$5,541	$5,541	$277	$2,105	$7,923	$8,509
Option_2A_PRV-8	Pressure Reducing Valve	317	250			Good Soil	Urban	1	2038	$19,845	$19,845	$992	$7,541	$28,379	$30,479
Option_2A_PRV-9	Pressure Reducing Valve	186	150			Good Soil	Urban	1	2038	$5,541	$5,541	$277	$2,105	$7,923	$8,509
Option_2A_PRV-10	Pressure Reducing Valve	259	250			Good Soil	Urban	1	2038	$19,845	$19,845	$992	$7,541	$28,379	$30,479
Option_2A_PRV-11A	Pressure Reducing Valve	150	100			Good Soil	Urban	1	2038	$4,086	$4,086	$204	$1,553	$5,843	$6,275
Option_2A_PRV-11B	Pressure Reducing Valve	250	200			Good Soil	Urban	1	2038	$13,164	$13,164	$658	$5,002	$18,825	$20,218
Storage															
Asset ID	**Asse Type**	**Description**			**Unit Rate**	**Soil Type**	**Land Use**	**Adjustment Factor**	**Year Required**	**Base Infrastructure Cost ($)**	**Incorporating Soil & LanduseType Factor Cost ($)**	**Regional Factor (5%) ($)**	**Contingency Cost ($)**	**Cost 2011 ($)**	**Cost 2015 ($)**
Option_2A_Walkerston_Res	Reservoir	16 ML Reservoir at Walkerston							2038	$3,330,380	$3,330,380	$166,519	$1,265,544	$4,762,443	$5,114,864
Total														$113,230,248	$120,695,926

Strategic Option 3 Capital Costs

Asset ID	Asset Type	Description	Length (m)	Diameter (mm)	Unit Rate	Soil Type	Land Use	Adjustment Factor	Year Required	Base Infrastructure Cost ($)	Incorporating Soil & LanduseType Factor Cost ($)	Regional Factor (5%) ($)	Contingency Cost ($)	Cost 2011 ($)	Cost 2015 ($)
													38%		107%
Raw Water															
Option_3_RW_001	Potable Water Main	Dumbleton Weir to Nebo Road WTP	11,000	525	$1,303	Good Soil	Rural	0.81	2026	$14,333,000	$11,609,730	$580,487	$4,411,697	$16,601,914	$17,830,456
Option_3_RW_002	Raw Water Main	Dumbleton Weir to Northern WTP	300	600	$1,503	Good Soil	Rural	0.8	2038	$450,900	$360,720	$18,036	$137,074	$515,830	$554,001
Option_3_Northern_River_Intake	River Water Intake Pump	River Water Intake at 35 ML Capacity.	150						2038	$10,158,800.00	$10,158,800.00		$1,165,000	$11,323,800	$11,323,800
Water Treatment															
Asset ID	**Asset Type**	**Description**			**Unit Rate**	**Soil Type**	**Land Use**	**Adjustment Factor**	**Year Required**	**Base Infrastructure Cost ($)**	**Incorporating Soil & LanduseType Factor Cost ($)**	**Regional Factor (5%) ($)**	**Contingency Cost ($)**	**Cost 2013 ($)**	**Cost 2015 ($)**
Option_3_Northern_WTP	Water Treatment Plant	35 ML Capacity. Cost based on Clarifier + Rapid Gravity Filter WTP. Includes civil and elctrical site establishment works.							2038	$34,000,000.00				$34,000,000	$35,258,000
Trunk Mains															
Option_3_TM_003	Potable Water Main	Connection main from Option_3_TM_008 to existing 600 and 300 diameter mains at Nebo Road WTP	75	675	$2,496	Good Soil	Urban	2.16	2038	$187,200	$404,352	$20,218	$153,654	$578,223	$621,012
Option_3_TM_004	Potable Water Main	Reliability Main at Nebo Road WTP	140	600	$1,503	Good Soil	Urban	1.89	2038	$210,420	$397,694	$10,521	$151,124	$559,338	$600,729
Option_3_Reliability_Valve	Control Valve	Control Valve at Nebo Road WTP to allow Northern WTP to feed Nebo Road WTP Balance Tanks	500						2038	$28,614	$28,614	$1,431	$10,873	$40,918	$43,946
Option_3_TM_007	Potable Water Main	Northern WTP to Erakala Reservoir	6,320	675	$2,496	Good Soil	Rural	0.8	2038	$15,774,720	$12,619,776	$630,989	$4,795,515	$18,046,280	$19,381,704
Option_3_TM_008	Potable Water Main	Erakala Reservoir to South Mackay #1	6,000	675	$2,496	Good Soil	Rural	0.8	2038	$14,976,000	$11,980,800	$599,040	$4,552,704	$17,132,544	$18,400,352
			2,000	675	$2,496	Hard Rock	Rural	1.17	2038	$4,992,000	$5,840,640	$292,032	$2,219,443	$8,352,115	$8,970,172
Option_3_TM_009	Potable Water Main	Erakala Reservoir to South Mackay #2	6,000	675	$2,496	Good Soil	Rural	0.8	2056	$14,976,000	$11,980,800	$599,040	$4,552,704	$17,132,544	$18,400,352
			2,000	675	$2,496	Hard Rock	Rural	1.17	2056	$4,992,000	$5,840,640	$292,032	$2,219,443	$8,352,115	$8,970,172
Option_3_TM_005	Potable Water Main	Connors Road	620	300	$518	Good Soil	Rural	0.85	2046	$321,160	$272,986	$13,649	$103,735	$390,370	$419,257
Option_3_TM_006	Potable Water Main	Stockroute Rd	2,400	300	$518	Good Soil	Rural	0.85	2046	$1,243,200	$1,056,720	$52,836	$401,554	$1,511,110	$1,622,932
Storage															
Asset ID	**Asset Type**	**Description**			**Unit Rate**	**Soil Type**	**Land Use**	**Adjustment Factor**	**Year Required**	**Base Infrastructure Cost ($)**	**Incorporating Soil & LanduseType Factor Cost ($)**	**Regional Factor (5%) ($)**	**Contingency Cost ($)**	**Cost 2011 ($)**	**Cost 2015 ($)**
Option_3_Northern_Res	Reservoir	16 ML Reservoir at Erakala							2038	$3,330,380	$3,330,379.80	$166,519	$1,265,544	$4,762,443	$5,114,864
Total														$139,299,544	$147,511,749

Appendix H: Desired Standards of Service

Mackay Water Strategy – Adopted Standards of Service

<table>
<tr><th>No</th><th>Parameter</th><th>Mackay Water Strategy Proposed Service Standards</th></tr>
<tr><td colspan="2">A. Drinking Water – Conventional (Single Supply Zone)</td><td></td></tr>
<tr><td>A1</td><td>Average Day Demand (AD) per EP, excluding NRW (Note: EP/ET conversion rate provided in separate tables from Water Service Provider)</td><td>240 L/EP/d</td></tr>
<tr><td>A2</td><td>Estimated Non-Revenue Water (NRW)</td><td>16% (40 L/EP/d)</td></tr>
<tr><td>A3</td><td>Peaking Factors

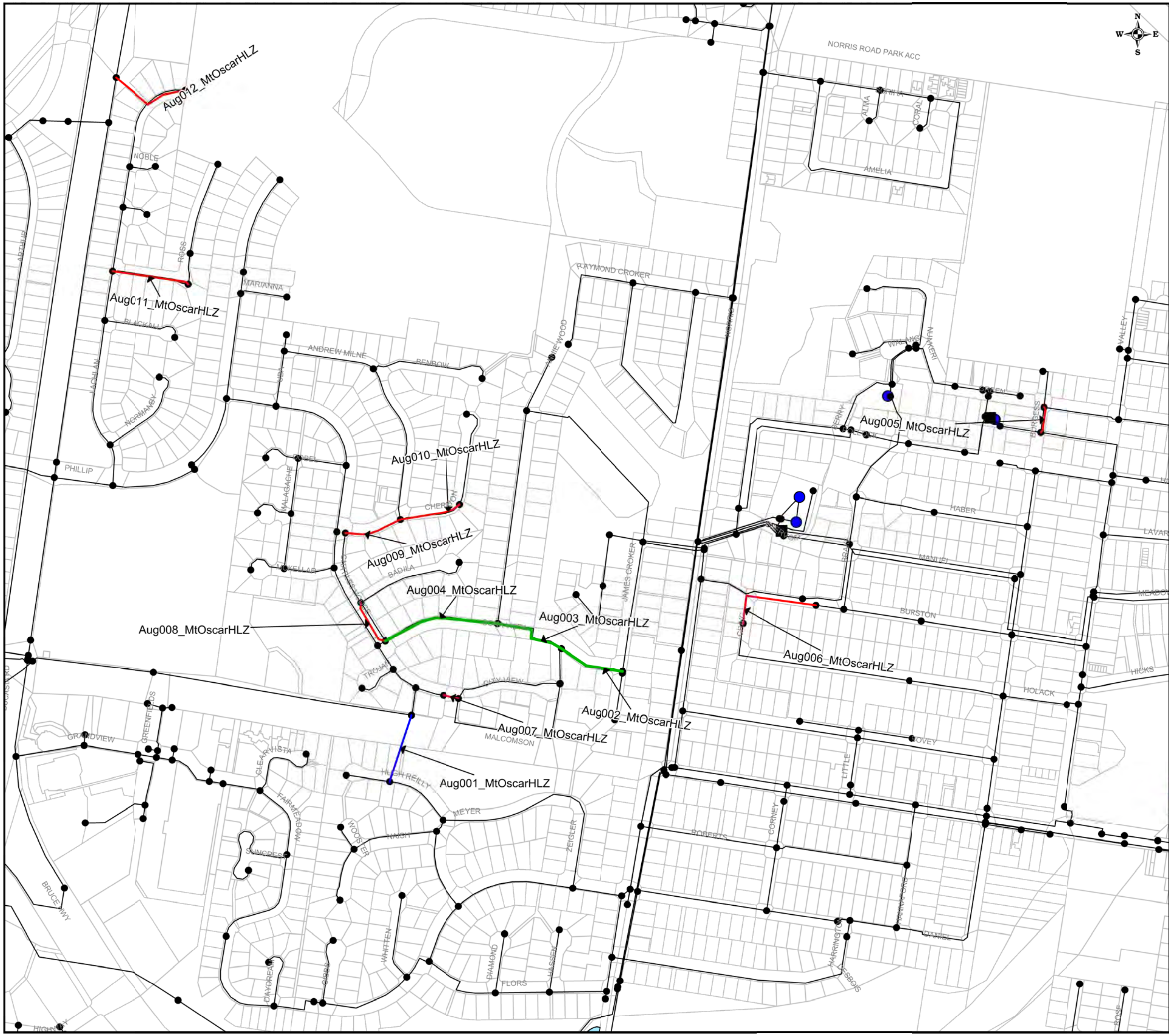
MDMM/AD

PD/AD

PH/AD</td><td>
<table>
<tr><th></th><th colspan="2">Residential</th><th colspan="4">Non-Residential</th></tr>
<tr><th>Factor</th><th>Single Family Residential - Detached (SFR)</th><th>Multi-Family Residential - Attached (MFR)</th><th>Commercial</th><th>Industry</th><th>Public</th><th>Open Space (incl. sport and rec)</th></tr>
<tr><td>MDMM:AD</td><td>1.55</td><td>1.25</td><td>1.3</td><td>1.3</td><td>1.3</td><td>1.25</td></tr>
<tr><td>PD:AD</td><td>1.85</td><td>1.51</td><td>1.6</td><td>1.6</td><td>1.6</td><td>1.55</td></tr>
<tr><td>PH:AD</td><td>4.33</td><td>3.57</td><td>3.09</td><td>3.09</td><td>3.09</td><td>2.40</td></tr>
</table>
</td></tr>
<tr><td rowspan="4">A4</td><td>Pressure
minimum SERVICE pressure (at PH on PD with Reservoirs at MOL) with no flow through service, Urban and Rural
Normal operating conditions</td><td>22m at the property boundary and allowing pressure to drop to a minimum 18 m for 2 hours under peak hour conditions on a peak day</td></tr>
<tr><td>In areas defined by the SP, properties requiring domestic private boosters</td><td>12m at the property boundary</td></tr>
<tr><td>Maximum SERVICE Pressure</td><td>80 m</td></tr>
<tr><td>Emergency fire operating conditions (Minimum Residual Mains Pressures)</td><td>12m min in the main at the flowing hydrant.
6m elsewhere in mains that have customer connections
Positive pressure throughout</td></tr>
<tr><td rowspan="2">A5</td><td>Fire Fighting
Rural and Small Communities
(Definitions as per Glossary)</td><td>.Rural Residential only: 7.5L/s for 2 hours
Rural Commercial/Industrial: 15L/s for 2 hours</td></tr>
<tr><td>Urban</td><td>15L/s for 2 hours for residential and 30L/s for 4 hours for commercial & industrial and achieving 12 m at hydrant (for Rural Residential to be advised),</td></tr>
<tr><td></td><td>Background Demand</td><td>Res (Detached/Multistorey); highest f 2/3 PH or AD
Commercial/Industrial: PH demand (between 10am and 4pm) (single fire event only)</td></tr>
<tr><td rowspan="2">A6</td><td rowspan="2">Reservoir storage[1]—operational capacity
(Min Operating Storage – four consecutive hours of demand)</td><td>Ground Level Reservoir:
3 x (PD - MDMM) for spare capcity assessment and Persistance Analysis for major trunk reservoirs</td></tr>
<tr><td>Elevated Reservoirs:
Not an acceptable solution.</td></tr>
<tr><td rowspan="3">A7</td><td>Reservoir Pump Servicing Requirements</td><td>MDMM in 20 hours</td></tr>
<tr><td>Ground level reservoir – Duty Pump</td><td rowspan="2">Booster Pumps - Greater of PH or Peak Instantaneous Flow + fire flow</td></tr>
<tr><td>Elevated reservoir – Duty Pump</td></tr>
<tr><td>A8</td><td>Standby pump capacity</td><td>Match largest single pump unit capacity</td></tr>
<tr><td>A8</td><td>Pipeline Capacity Requirements</td><td>Transport: MDMM in 20 hours
Reticulation Mains; Maintain pressure for Peak Hour and fire flow performance</td></tr>
<tr><td rowspan="3">A9</td><td>Pipe Friction Losses

Hazen Williams Friction Factors
Based on the preferred material types outlined in the SEQ Water Supply Code (as amended). Any variation from these material types needs to be subject to further investigation.</td><td><= 300mm, C=110
<300mm-600mm, C=120
>600 = 130</td></tr>
<tr><td>Maximum Allowable Headloss (PH) (m/km)</td><td>Don't use
Don't use</td></tr>
<tr><td>Maximum allowable velocity</td><td>As a guideline 2.5 m/s for peak hour.
As a guideline 4 m/s for fire flow.</td></tr>
</table>

Appendix I: Mount Oscar HLZ Augmentations Map



LEGEND

Mt Oscar HLZ Pipe Augmentations

- 100 mm
- 150 mm
- 225 mm

Current Network

- Pipes
- Pump Station
- Reservoir

THIS DRAWING IS CONFIDENTIAL AND SHALL BE USED FOR THE PURPOSES OF THIS PROJECT

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
PUBLICATION DATE: 21/04/2015
REFERENCE:
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 55
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE Figure I1

Pipe Augmentations for Mt Oscar High Level Zone

Appendix J: Greenfield Infrastructure Map

LEGEND

Ultimate Network
- Pipes
- Pump Station
- Reservoir

Greenfield Augmentations
- 2016 Developer
- 2021 Developer
- 2021 MWS
- 2026 Developer

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
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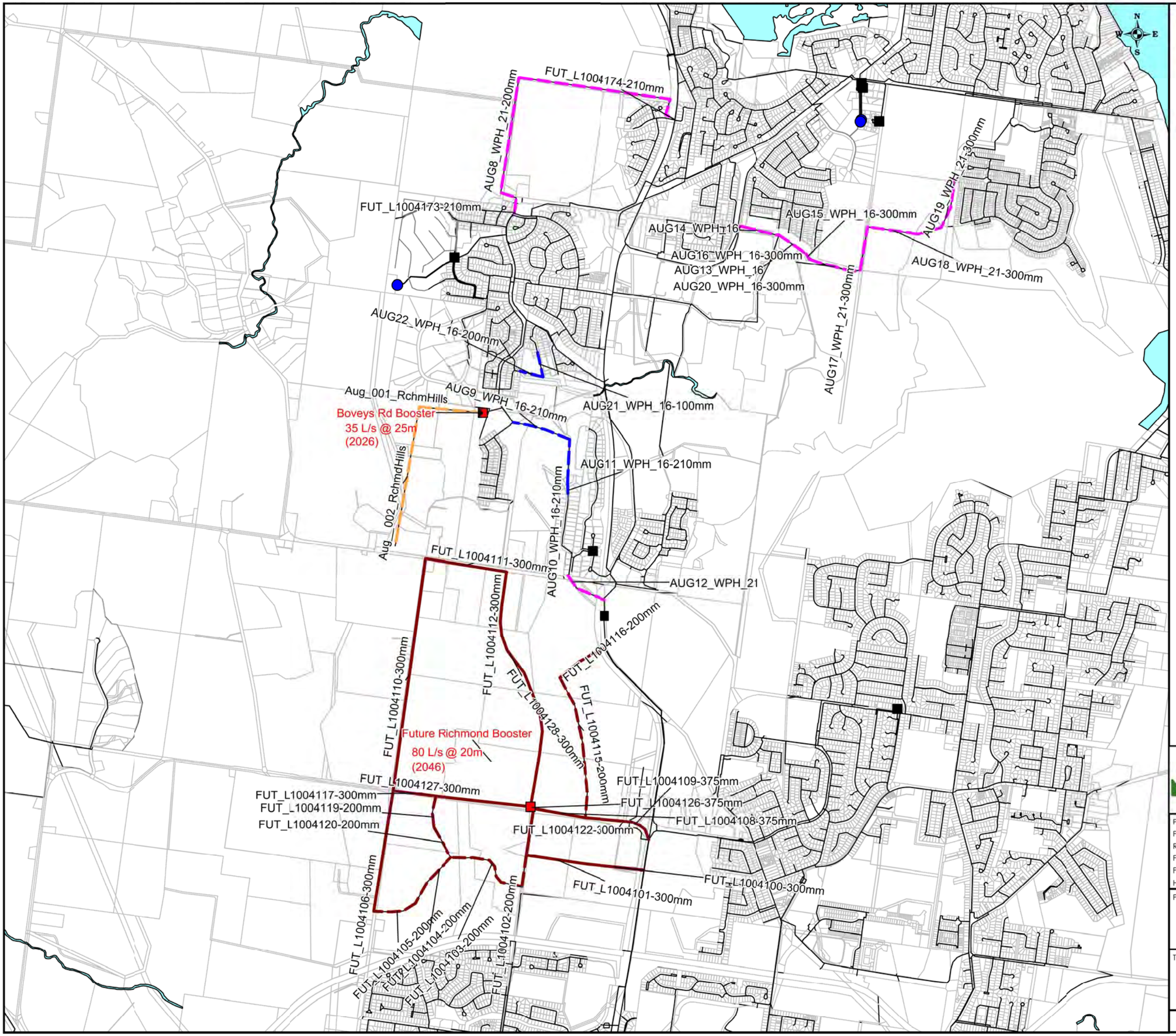
REFERENCE: 1
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 56
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE

Figure J1 Greenfield Augmentations: Ooralea



LEGEND

Ultimate Network
- Pipe
- Pump Station
- Reservoir

Greenfield Network
- 2016 Developer
- 2021 Developer
- 2021 MWS
- 2026 Developer
- 2046 Developer
- 2046 MWS

Greenfield Pump Station

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
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FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 56
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE

Figure J2 Greenfield Augmentations: Richmond, Rural View and Balcks Beach

LEGEND

Ultimate Network
- Pipes
- Pump Station
- Reservoir

Greenfield Network
- 2016 Developer
- 2021 Developer
- 2021 MWS
- 2026 Developer
- 2026 MWS
- 2046 Developer
- 2046 MWS
- New Pump
- New Reservoir
- New Valve
- Boundary Valve

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
PUBLICATION DATE: 16/03/2015
REFERENCE: 1
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 56
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE

Figure J3 Greenfield Augmentations: Shoal Point

Appendix K: Fireflow Results

Seaforth, Ball Bay,
Halliday Bay, Cape Hillsborough

Shoal Point, Blacks Beach,
Rural View

Andergrove, Beaconsfield,
Slade Point, Mackay Harbour

Bonson Scrub High Level Zone

Farleigh, The Leap

Creese St PS Booster

Harbour Village Booster Pump

Sunset Drive High Level Zone

Mount Pleasant, Glenella,
North Mackay

Walkerston

Mackay CBD,
South Mackay

Bakers Creek,
McEwens Beach

LEGEND

Current Network
- Pipes
- Pump Station
- Reservoir

Fire Flow Type (other than Residential)
- Commercial Fireflow
- Rural Residential Fireflow

Fireflow Residual Pressure
- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
PUBLICATION DATE: 21/04/2015
REFERENCE: 1
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 55
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE

Fireflow Performance Results Overview Map

Bakers Creek Treatment Plant:

TEMPLES
FAIRWAY
DRURY
MAIN
COOKS
CONNORS
STOCKROUTE
BROADSOUND
INDUSTROPLEX
MERCHANT
CROUCHS
PRATTIS
PATTINSONS
HAMILTON
WALZ
HOLMES
MOORELAND
LEMBERGS
PETERSENS
MCEWENS BEACH
CROUCHS
FENNERS
FENNERS ACCESS
BRUCE HWY

N
W E
S

LEGEND

Fireflow Residual Pressure

- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Fire Flow Type (other than Residential)

- Commercial Fireflow
- Rural Residential Fireflow

Current Network

- Pipes
- Pump Station
- Reservoir

Mackay REGIONAL COUNCIL

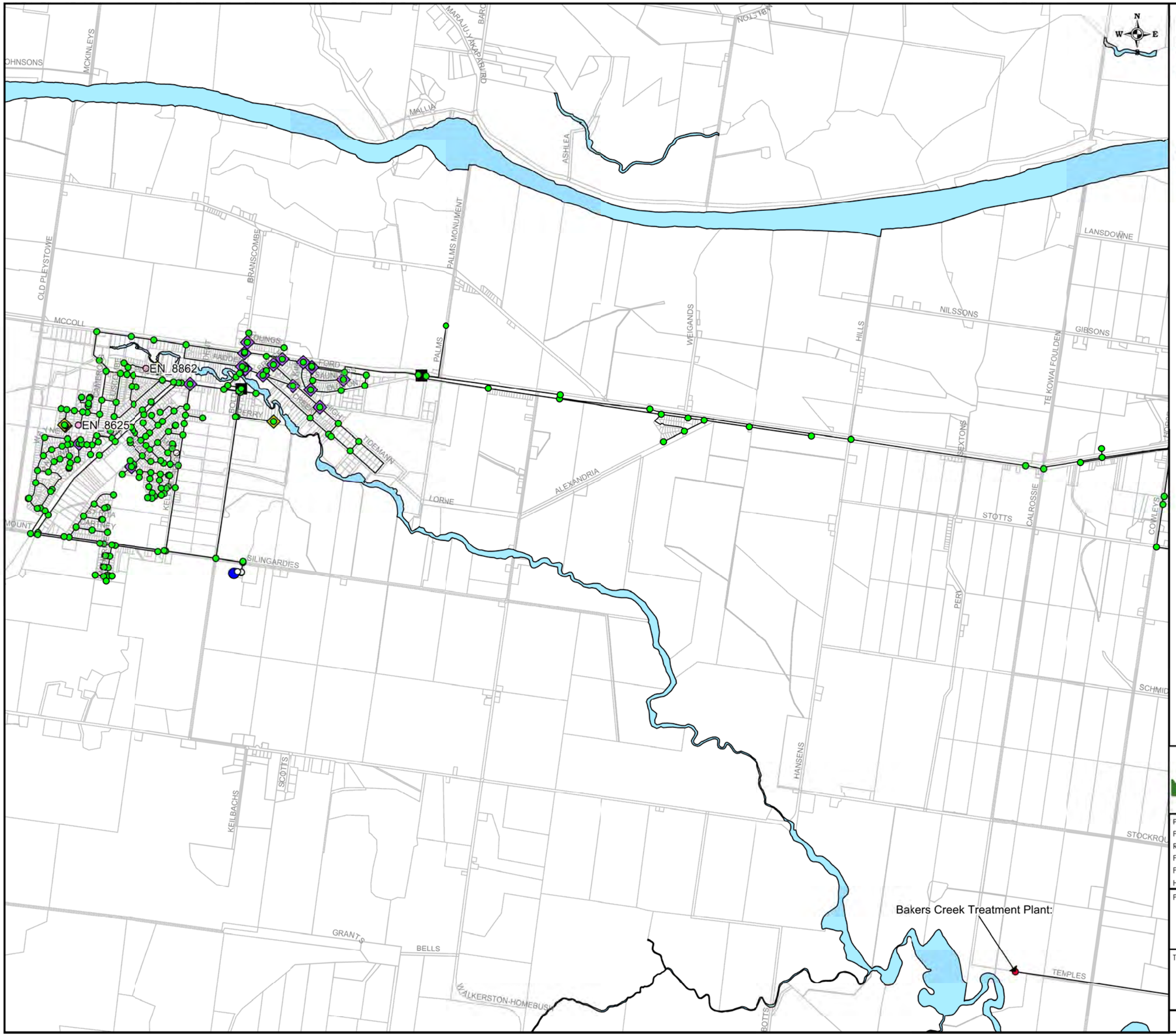
PUBLISHER: PLANNING
PUBLICATION DATE: 21/04/2015
REFERENCE: 1
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 55
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE

Fireflow Performance Results Bakers Creek, McEwen's Beach



LEGEND

Fireflow Residual Pressure

- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Fire Flow Type (other than Residential)

- Commercial Fireflow
- Rural Residential Fireflow

Current Network

- Pipes
- Pump Station
- Reservoir

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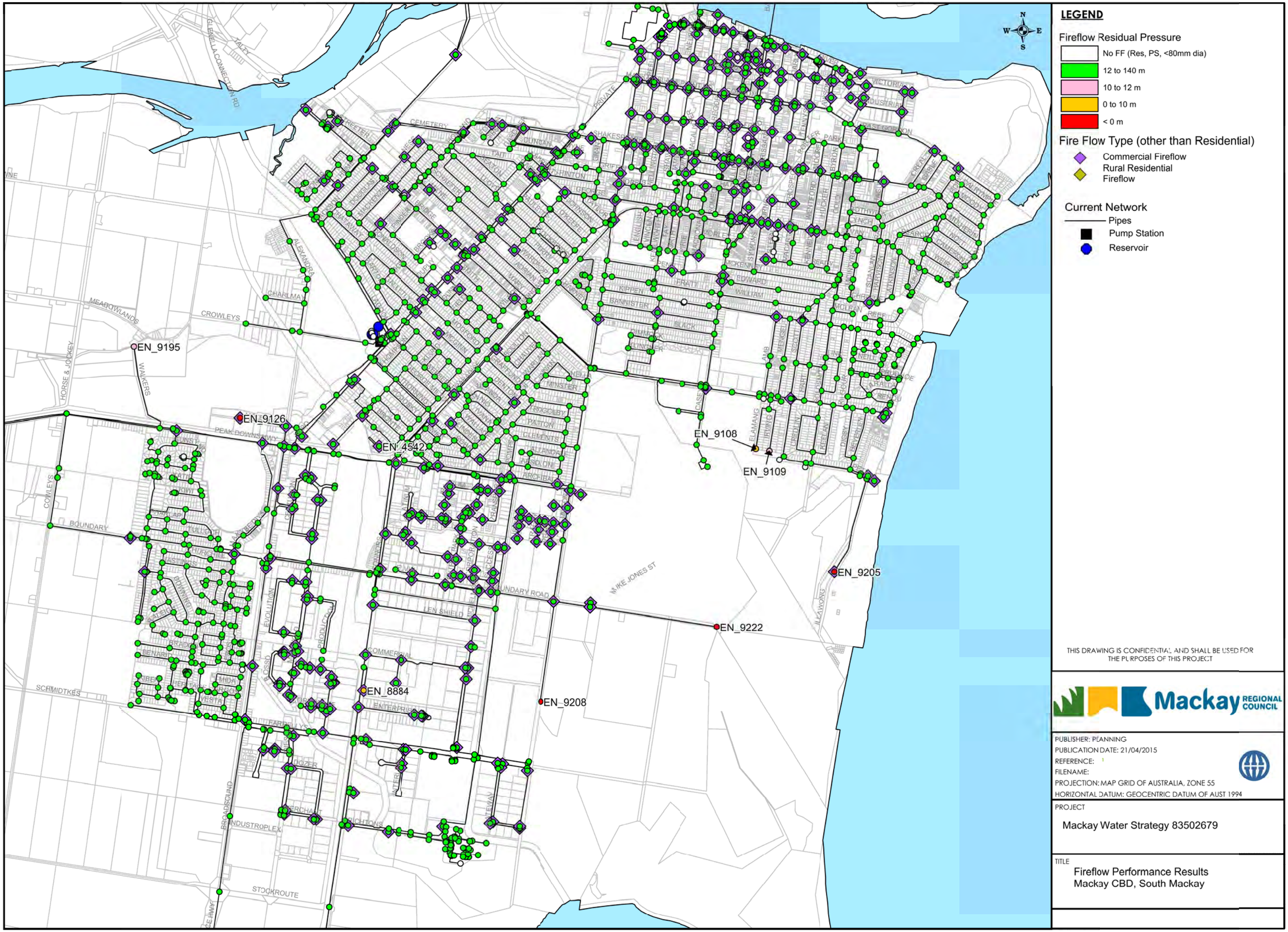
PROJECT

Mackay Water Strategy 83502679

TITLE

Fireflow Performance Results
Walkerston



LEGEND

Fireflow Residual Pressure

- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Fire Flow Type (other than Residential)

- Commercial Fireflow
- Rural Residential Fireflow

Current Network

- Pipes
- Pump Station
- Reservoir

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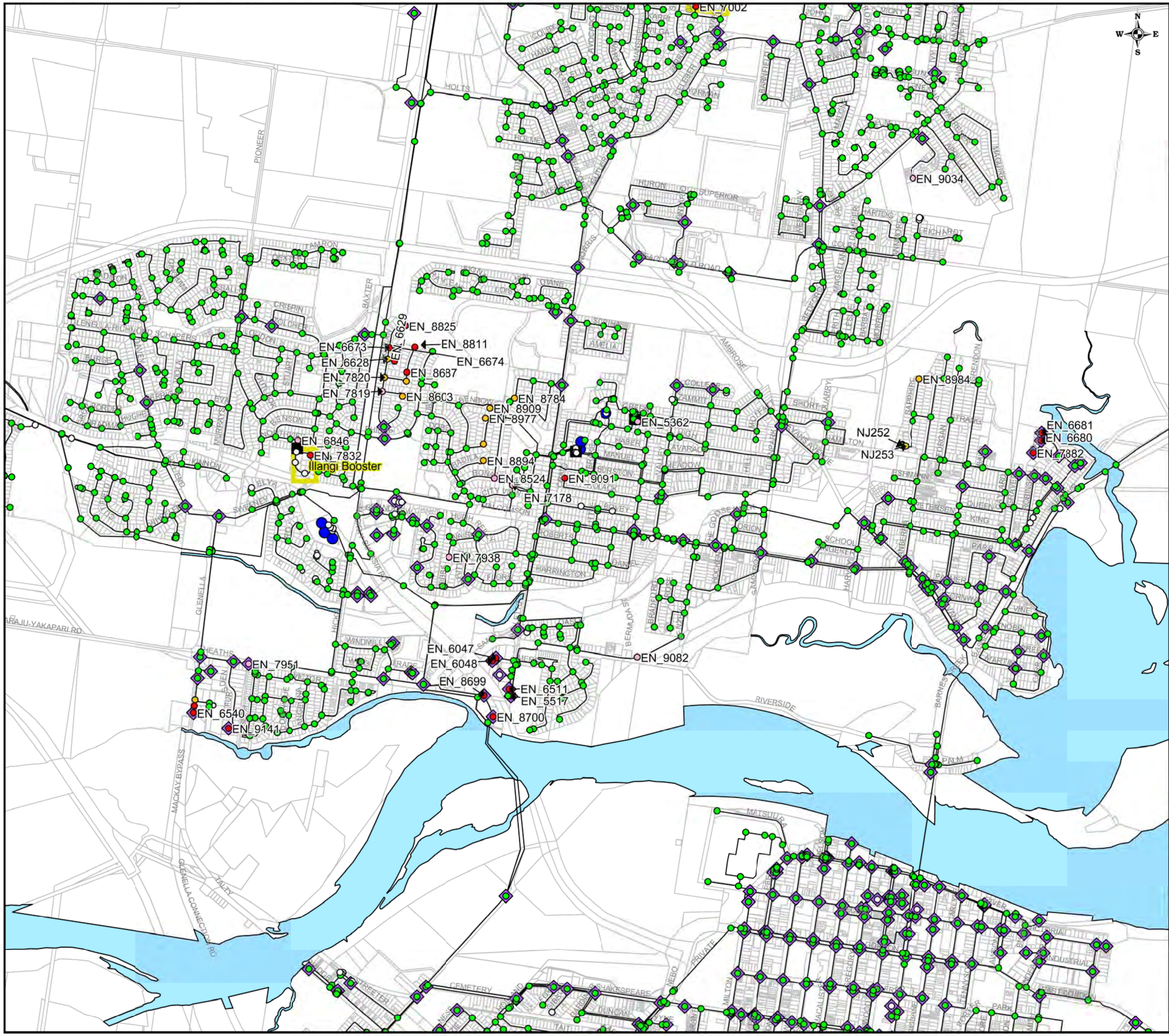
PROJECT

Mackay Water Strategy 83502679

TITLE

Fireflow Performance Results
Mackay CBD, South Mackay



LEGEND

Fireflow Residual Pressure

- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Fire Flow Type (other than Residential)

- Commercial Fireflow
- Rural Residential Fireflow

Current Network

- Pipes
- Pump Station
- Reservoir

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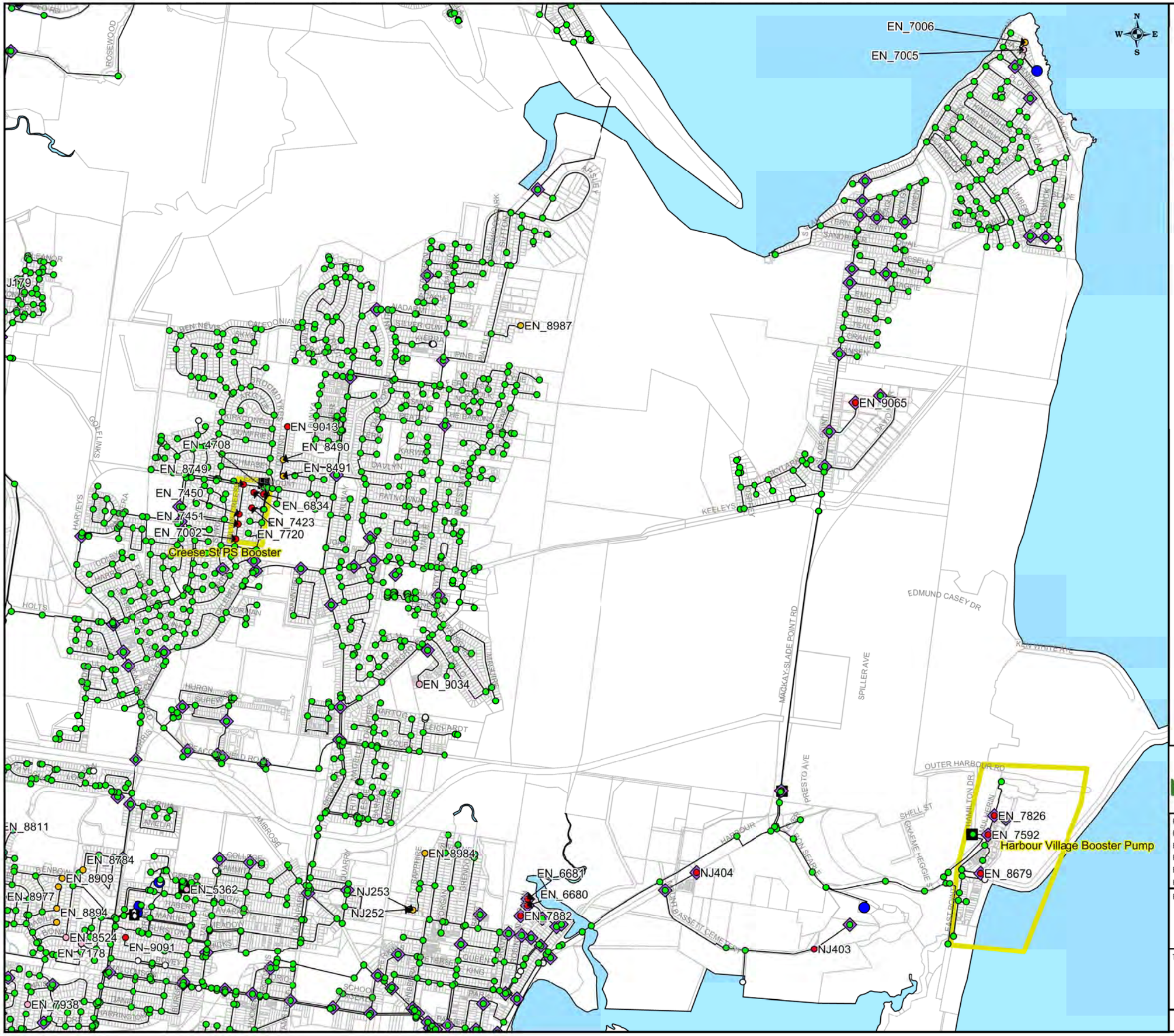
PROJECT

Mackay Water Strategy 83502679

TITLE

Fireflow Performance Results
Mount Pleasant, Glenella, North Mackay



LEGEND

Fireflow Residual Pressure

- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Fire Flow Type (other than Residential)

- Commercial Fireflow
- Rural Residential Fireflow

Current Network

- Pipes
- Pump Station
- Reservoir

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PROJECT

Mackay Water Strategy 83502679

TITLE

Fireflow Performance Results Andergrove, Beaconsfield, Salde Point and Mackay Harbour

EN_7658

EN_5371

EN_5040

EN_6160

NB10

EN_8855

EN_8987

NJ179

ORPHANAGE

BARCOO

WANDELLS

GEISLERS RD

BUCASIA DUMP

WALLMANS

KERRDALE

GLENELLA-RICHMOND

DAWSON

BOWES

WOODWARD

LYNETTE

GULLERTIE

GOLFLINKS

LEGEND

Fireflow Residual Pressure

- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Fire Flow Type (other than Residential)

- Commercial Fireflow
- Rural Residential Fireflow

Current Network

- Pipes
- Pump Station
- Reservoir

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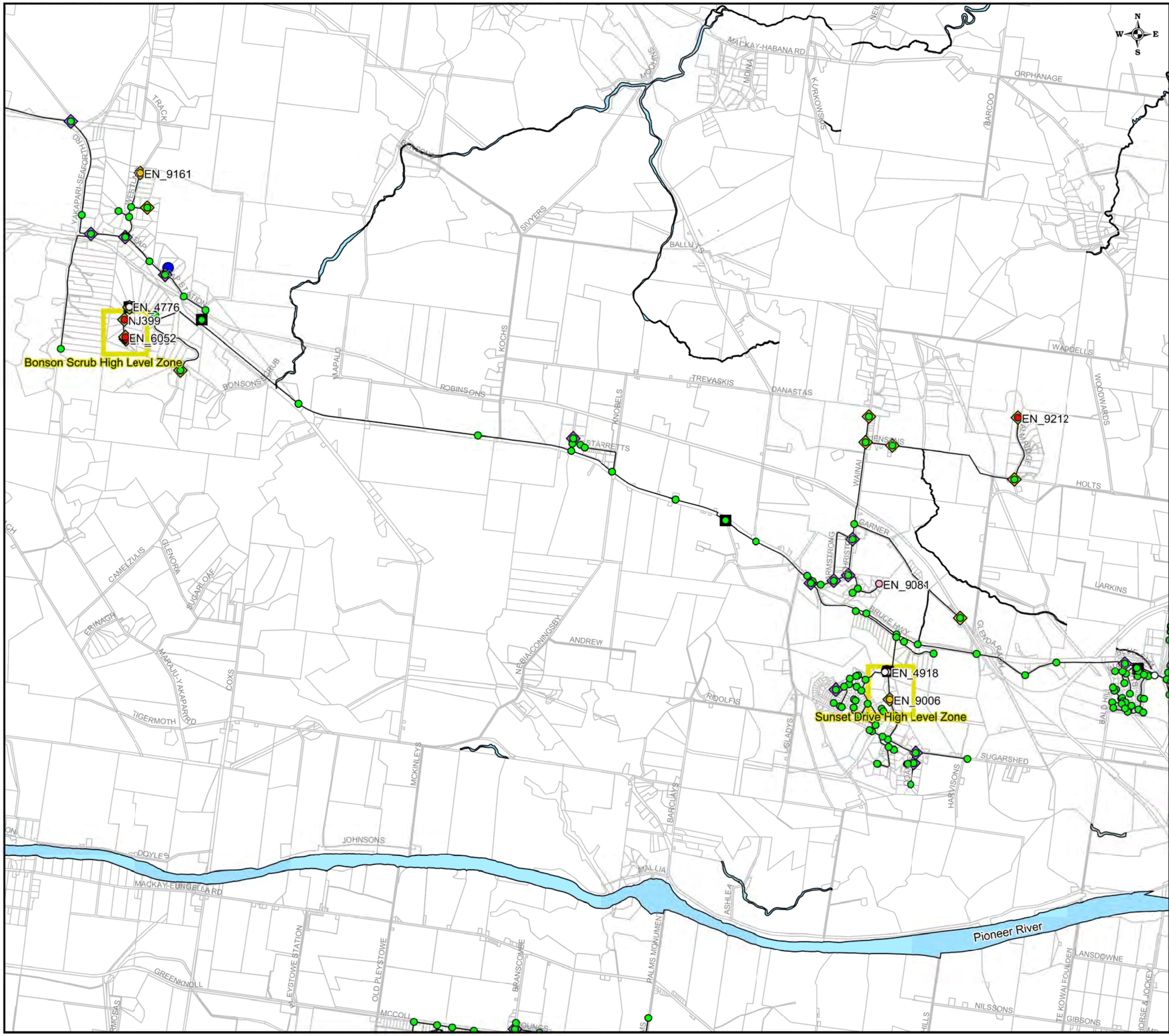
PROJECT

Mackay Water Strategy 83502679

TITLE

Fireflow Performance Results
Shoal Point and Blacks Beach



LEGEND

Fireflow Residual Pressure

- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Fire Flow Type (other than Residential)

- Commercial Fireflow
- Rural Residential Fireflow

Current Network

- Pipes
- Pump Station
- Reservoir

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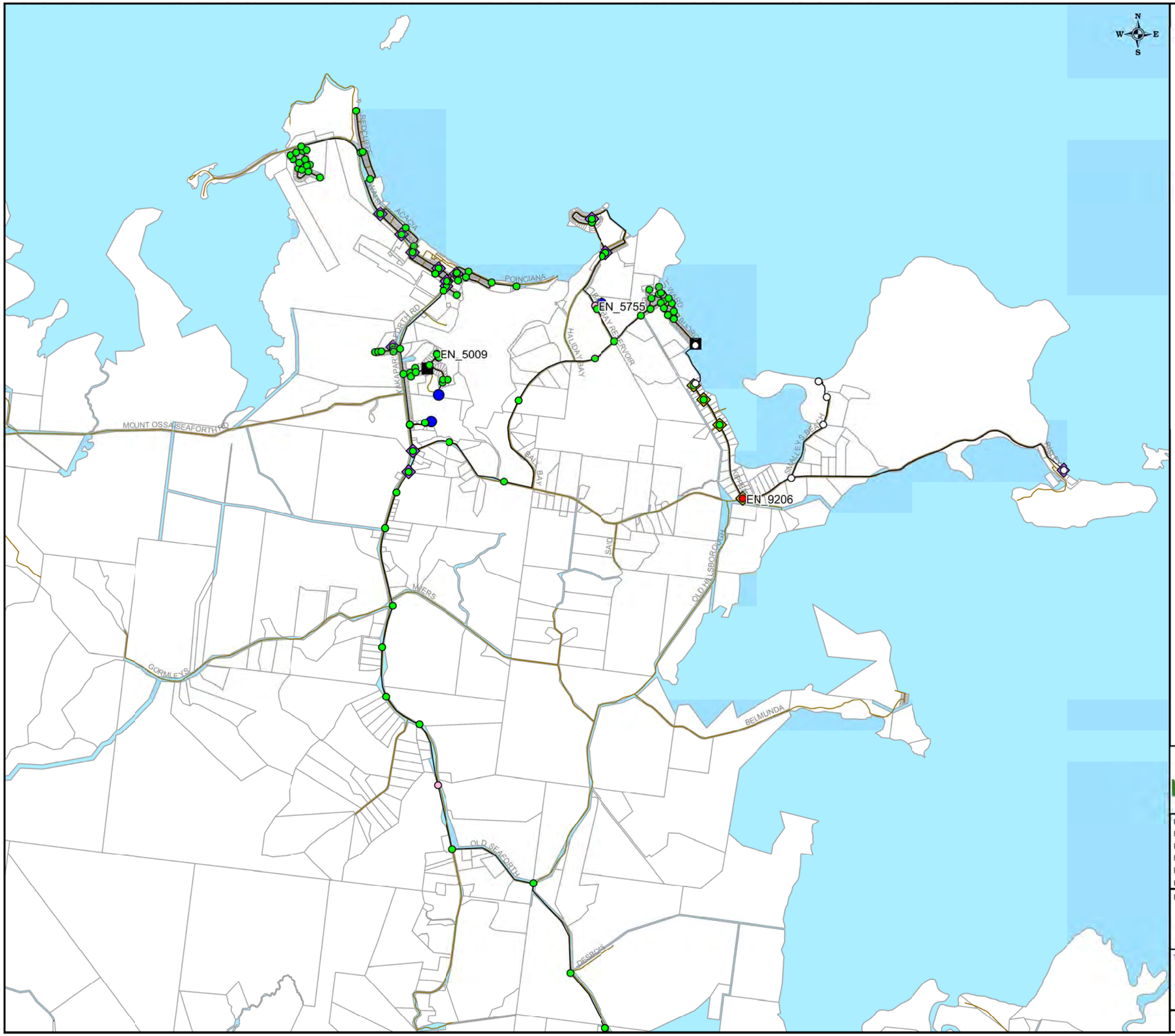
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy

TITLE

Fireflow Performance Results
Farleigh, The Leap



LEGEND

Fireflow Residual Pressure

- No FF (Res, PS, <80mm dia)
- 12 to 140 m
- 10 to 12 m
- 0 to 10 m
- < 0 m

Fire Flow Type (other than Residential)

- Commercial Fireflow
- Rural Residential Fireflow

Current Network

- Pipes
- Pump Station
- Reservoir

Mackay REGIONAL COUNCIL

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PROJECT

Mackay Water Strategy 83502679

TITLE Fireflow Performance Results Seaforth, Ball Bay , Halliday Bay, Cape Hillsborough

Fire Flow Results based on MWS Standards

Label	Location	Fire Flow Category	Comment
EN_4708	Eaglemount Rd, ANDERGROVE	Residential	Creese St PS Fire Booster Exists however not in hydraulic model
EN_4776	Ian Reddacliff Dr, THE LEAP	Residential	Bonson Scrub High Level Zone
EN_4808	Reservoir Rd, NORTH MACKAY	Residential	Refer Risk Assessment
EN_5080	Morehead Drive, RURAL VIEW	Residential	Refer Risk Assessment
EN_5517	Willetts Rd, MOUNT PLEASANT	Non-residential	Refer Risk Assessment
EN_6047	Discovery Lane, MOUNT PLEASANT	Non-residential	Refer Risk Assessment
EN_6048	Discovery Lane, MOUNT PLEASANT	Non-residential	Refer Risk Assessment
EN_6051	Ian Reddacliff Dr, THE LEAP	Rural Residential	Bronson Scrub High Level Zone
EN_6052	Ian Reddacliff Dr, THE LEAP	Rural Residential	Bronson Scrub High Level Zone
EN_6373	Mackay Bypass Rd, GLENELLA	Non-residential	Refer Risk Assessment
EN_6374	Mackay Bypass Rd, GLENELLA	Non-residential	Refer Risk Assessment
EN_6511	Willetts Rd, MOUNT PLEASANT	Non-residential	Refer Risk Assessment
EN_6540	Glenella Connection Rd, FOULDEN	Non-residential	Refer Risk Assessment
EN_6628	Lachlan St, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_6629	Shepherd Cr, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_6673	Lachlan St, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_6674	Noble Cr, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_6680	Shinn St, NORTH MACKAY	Non-residential	Refer Risk Assessment
EN_6681	Shinn St, NORTH MACKAY	Non-residential	Refer Risk Assessment
EN_6834	Lyn Ct, BEACONSFIELD	Residential	Creese St PS Fire Booster Exists however not in hydraulic model
EN_7002	Galvin St, BEACONSFIELD	Residential	Creese St PS Fire Booster Exists however not in hydraulic model
EN_7006	Albatross St, SLADE POINT	Residential	Refer Risk Assessment

Label	Location	Fire Flow Category	Comment
EN_7423	Lyn Ct, BEACONSFIELD	Residential	Creese St PS Fire Booster Exists however not in hydraulic model
EN_7450	Creese St, BEACONSFIELD	Residential	Creese St PS Fire Booster Exists however not in hydraulic model
EN_7451	Galvin St, BEACONSFIELD	Residential	Creese St PS Fire Booster Exists however not in hydraulic model
EN_7592	Mulherin Dr, MACKAY HARBOUR	Non-residential	Harbour Village PS Fire Booster Exists however not in hydraulic model
EN_7658	Homestead Bay Av, BUCASIA	Non-residential	Refer Risk Assessment
EN_7720	Dell Ct, BEACONSFIELD	Residential	Creese St PS Fire Booster Exists however not in hydraulic model
EN_7820	Lachlan St, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone
EN_7826	Mulherin Dr, MACKAY HARBOUR	Non-residential	Harbour Village PS Fire Booster Exists however not in hydraulic model
EN_7832	Illalangi Estate (Private), MOUNT PLEASANT	Residential	Illangi PS Fire Booster Exists however not in hydraulic model
EN_7882	Shinn St, NORTH MACKAY	Non-residential	Refer Risk Assessment
EN_8490	Newton St, ANDERGROVE	Residential	Refer Risk Assessment
EN_8491	Domino Cr, ANDERGROVE	Residential	Refer Risk Assessment
EN_8603	Blackall Ct, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_8679	Breakwater Access Road, MACKAY HARBOUR	Non-residential	Harbour Village PS Fire Booster Exists however not in hydraulic model
EN_8687	Ross St, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_8699	Kay Ct, MOUNT PLEASANT	Non-residential	Refer Risk Assessment
EN_8700	Kay Ct, MOUNT PLEASANT	Non-residential	Refer Risk Assessment
EN_8749	Eaglemount Rd, ANDERGROVE	Residential	Creese St PS Fire Booster Exists however not in hydraulic model
EN_8784	Annie Wood Av, MOUNT PLEASANT	Residential	Refer Risk Assessment

Label	Location	Fire Flow Category	Comment
EN_8811	Ross St, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_8825	Lachlan St, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_8884	Connors Road, PAGET	Non-residential	Refer Risk Assessment
EN_8894	Badila Ct, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_8909	Benbow Ct, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_8977	Cheribon Av, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_8984	Sapphire Ct, NORTH MACKAY	Residential	Refer Risk Assessment
EN_8987	Forest Ct, ANDERGROVE	Residential	Refer Risk Assessment
EN_9006	Sunset Dr, ERAKALA	Rural Residential	Refer Risk Assessment
EN_9013	Domino Cr, ANDERGROVE	Residential	Refer Risk Assessment
EN_9065	Lester Hansen St, SLADE POINT	Non-residential	Refer Risk Assessment
EN_9091	Craig St, NORTH MACKAY	Residential	Fixed by Mount Oscar High Level Zone Augmentations
EN_9108	Elamang St, SOUTH MACKAY	Non-residential	Refer Risk Assessment
EN_9126	Mclennan St, OORALEA	Non-residential	Zoned Rural, no fireflow required
EN_9139	Ian Reddacliff Dr, THE LEAP	Rural Residential	Refer Risk Assessment
EN_9141	Fursden St, GLENELLA	Non-residential	Refer Risk Assessment
EN_9161	Westlake Dr, THE LEAP	Rural Residential	Refer Risk Assessment
EN_9205	Illawong Dr, SOUTH MACKAY	Non-residential	Refer Risk Assessment
EN_9206	Kippen Dr, BALL BAY	Rural Residential	Cape Hillsborough: run with model bypassed pump and fire flow is achieved
EN_9208	Milton St, PAGET	Non-residential	Refer Risk Assessment
EN_9212	Palm Ridge Dr, RICHMOND	Rural Residential	Refer Risk Assessment
EN_9222	Boundary Road East, PAGET	Residential	Refer Risk Assessment

Label	Location	Fire Flow Category	Comment
EN_9237	Temples Lane, TE KOWAI	Residential	Baker's Creek Treatment Plant. Assumes that recycled water onsite can be used for fire fighting
NJ252	Sapphire Ct, NORTH MACKAY	Residential	Refer Risk Assessment
NJ253	Sapphire Ct, NORTH MACKAY	Residential	Refer Risk Assessment
NJ399	Ian Reddacliff Dr, THE LEAP	Rural Residential	Bonson Scrub High Level Zone Booster
NJ403	Mount Bassett Cemetery Rd, MACKAY HARBOUR	Non-residential	Refer Risk Assessment
NJ404	Mackay-Slade Point Rd, MACKAY HARBOUR	Non-residential	Refer Risk Assessment
NJ_46464	Ross St, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentation
NJ_47592	Cheribon Av, MOUNT PLEASANT	Residential	Fixed by Mount Oscar High Level Zone Augmentation
EN_4542	Paget St, WEST MACKAY	Non-residential	Marginal Failure, No Augmentation Recommended
EN_4918	Bruce Hwy, FARLEIGH	Residential	Marginal Failure, No Augmentation Recommended
EN_5009	Harrison Ct, SEAFORTH	Non-residential	Marginal Failure, No Augmentation Recommended
EN_5040	Beach Rd, DOLPHIN HEADS	Residential	Marginal Failure, No Augmentation Recommended
EN_5041	Beach Rd, DOLPHIN HEADS	Residential	Marginal Failure, No Augmentation Recommended
EN_5362	Green St, NORTH MACKAY	Residential	Marginal Failure, No Augmentation Recommended
EN_5371	Eimeo Esp, EIMEO	Non-residential	Marginal Failure, No Augmentation Recommended
EN_5755	Ball Bay Reservoir Rd, HALIDAY BAY	Residential	Marginal Failure, No Augmentation Recommended
EN_6160	Dolphin Dr, BUCASIA	Non-residential	Marginal Failure, No Augmentation Recommended
EN_6846	Northview Tce, MOUNT PLEASANT	Residential	Marginal Failure, No Augmentation Recommended
EN_7005	Albatross St, SLADE POINT	Residential	Marginal Failure, No Augmentation Recommended
EN_7178	Bona Vista Dr, MOUNT PLEASANT	Residential	Marginal Failure, No Augmentation Recommended
EN_7819	Blackall Ct, MOUNT PLEASANT	Residential	Marginal Failure, No Augmentation Recommended

Label	Location	Fire Flow Category	Comment
EN_7938	Naish Av, MOUNT PLEASANT	Residential	Marginal Failure, No Augmentation Recommended
EN_7951	Heaths Rd, GLENELLA	Non-residential	Marginal Failure, No Augmentation Recommended
EN_8524	Bona Vista Dr, MOUNT PLEASANT	Residential	Marginal Failure, No Augmentation Recommended
EN_8625	Etwell Ct, WALKERSTON	Residential	Marginal Failure, No Augmentation Recommended
EN_8855	Blacks Beach Rd, BLACKS BEACH	Non-residential	Marginal Failure, No Augmentation Recommended
EN_8862	Stoddart Pl, WALKERSTON	Residential	Marginal Failure, No Augmentation Recommended
EN_9034	Lorraine Ct, ANDERGROVE	Residential	Marginal Failure, No Augmentation Recommended
EN_9081	Refalo Dr, FARLEIGH	Residential	Marginal Failure, No Augmentation Recommended
EN_9082	Sams Rd, NORTH MACKAY	Non-residential	Marginal Failure, No Augmentation Recommended
EN_9109	Irving St, SOUTH MACKAY	Residential	Marginal Failure, No Augmentation Recommended
EN_9195	Walkers Rd, RACECOURSE	Residential	Marginal Failure, No Augmentation Recommended
NJ32	Beach Rd, DOLPHIN HEADS	Residential	Marginal Failure, No Augmentation Recommended
NJ179	Camellen St, BEACONSFIELD	Non-residential	Marginal Failure, No Augmentation Recommended
NB10	Bourke St, BLACKS BEACH	Non-residential	Marginal Failure, No Augmentation Recommended

Appendix L: Fireflow Risk Assessment

Fire Flow Risk Assessment

LEGEND

Meets AS2419

Marginal Residual Failure - No Augmentation Recommended

Residual Failure - Augmentation Recommended

Model ID	Location	Category of Fire fighting demand	Number of Hydrants Required at 10 L/s each	Total Fire Flow Required (L/s)	Residual Pressure at Total Fire Flow Required (m)	Assessment	Proposed Action/ Augmentation Name
EN_5517	Willetts Rd, MOUNT PLEASANT	Non-residential	2	20	18.4	Marginal failure based on AS2419	Recommend no augmentation
EN_6047	Discovery Lane, MOUNT PLEASANT	Non-residential	2	20	18.5	Marginal failure based on AS2419	Recommend no augmentation
EN_6047	Discovery Lane, MOUNT PLEASANT	Non-residential	2	20	18.5	Marginal failure based on AS2419	Recommend no augmentation
EN_6048	Discovery Lane, MOUNT PLEASANT	Non-residential	2	20	18.3	Marginal failure based on AS2419	Recommend no augmentation
EN_6373	Mackay Bypass Rd, GLENELLA	Non-residential	2	20	23.2	Meets AS2419	Recommend no augmentation
EN_6374	Mackay Bypass Rd, GLENELLA	Non-residential	2	20	19.7	Marginal failure based on AS2419	Recommend no augmentation
EN_6511	Willetts Rd, MOUNT PLEASANT	Non-residential	2	20	18.4	Marginal failure based on AS2419	Recommend no augmentation
EN_6540	Glenella Connection Rd, FOULDEN	Non-residential	2	20	15.5	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are actually fire	Augmentation ID Aug001_FF_MWS

Model ID	Location	Category of Fire fighting demand	Number of Hydrants Required at 10 L/s each	Total Fire Flow Required (L/s)	Residual Pressure at Total Fire Flow Required (m)	Assessment	Proposed Action/ Augmentation Name
						sprinkler systems in these industrial sites that would require these pressures.	
EN_6680	Shinn St, NORTH MACKAY	Non-residential	2	20	16	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug002_FF_MWS
EN_6681	Shinn St, NORTH MACKAY	Non-residential	2	20	13	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug002_FF_MWS
EN_7006	Albatross St, SLADE POINT	Residential	2	20	-8.1	Pressures indicated that an augmentation may be required to meet residential fire flows. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug003_FF_MWS
EN_7658	Homestead Bay Avenue BUCASIA QLD 4750	Non-residential	2	20	18.6	Marginal failure based on AS2419	Recommend no augmentation

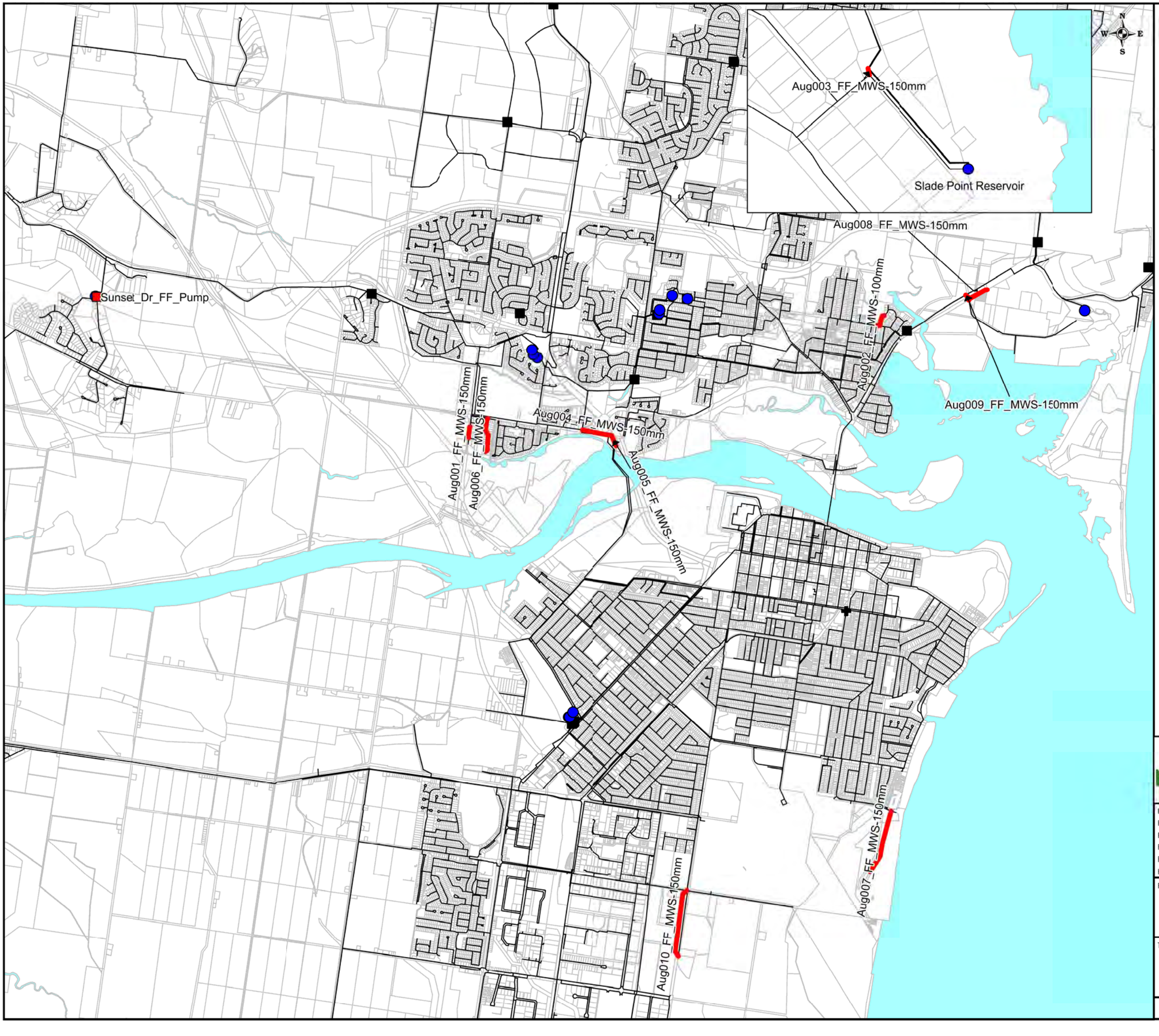
Model ID	Location	Category of Fire fighting demand	Number of Hydrants Required at 10 L/s each	Total Fire Flow Required (L/s)	Residual Pressure at Total Fire Flow Required (m)	Assessment	Proposed Action/ Augmentation Name
EN_7882	Shinn St, NORTH MACKAY	Non-residential	2	20	9.4	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug002_FF_MWS
EN_8490	Newton St, ANDERGROVE	Residential	1	10	23.1	Meets AS2419	Recommend no augmentation
EN_8491	Domino Cr, ANDERGROVE	Residential	1	10	19.9	Marginal failure based on AS2419	Recommend no augmentation
EN_8699	Kay Ct, MOUNT PLEASANT	Non-residential	2	20	5.1	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug004_FF_MWS
EN_8700	Kay Ct, MOUNT PLEASANT	Non-residential	2	20	-5.2	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug005_FF_MWS
EN_8784	Annie Wood Av, MOUNT PLEASANT	Residential	1	10	20.9	Meets AS2419	Recommend no augmentation
EN_8884	Connors Road, PAGET	Non-residential	2	20	25.2	Meets AS2419	Recommend no augmentation

Model ID	Location	Category of Fire fighting demand	Number of Hydrants Required at 10 L/s each	Total Fire Flow Required (L/s)	Residual Pressure at Total Fire Flow Required (m)	Assessment	Proposed Action/ Augmentation Name
EN_8984	Sapphire Ct, NORTH MACKAY	Residential	1	20	24.5	Meets AS2419	Recommend no augmentation
EN_8987	Forest Ct, ANDERGROVE	Residential	1	20	24	Meets AS2419	Recommend no augmentation
EN_9006	Sunset Dr, ERAKALA	Rural Residential	1	10	2.2	It is recommended that a fireflow pump be installed at the Sunset Drive pump station, to cope with supplying rural residential fire flows to high elevation properties.	Augmentation ID Sunset_Dr_FF_Pump
EN_9013	Domino Cr, ANDERGROVE	Residential	1	10	19.7	Marginal failure based on AS2419	
EN_9065	Lester Hansen St, SLADE POINT	Non-residential	2	20	22.8	Meets AS2419	Recommend no augmentation
EN_9108	Elamang St, SOUTH MACKAY	Residential	1	10	25.9	Meets AS2419	Recommend no augmentation
EN_9141	Fursden Street GLENELLA	Non-residential	2	20	-10.7	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug006_FF_MWS
EN_9161	Westlake Dr, THE LEAP	Rural Residential	1	7.5	<0	Can achieve 6.4 L/s at 12m pressure	Recommend no augmentation

Model ID	Location	Category of Fire fighting demand	Number of Hydrants Required at 10 L/s each	Total Fire Flow Required (L/s)	Residual Pressure at Total Fire Flow Required (m)	Assessment	Proposed Action/ Augmentation Name
EN_9205	Illawong Dr, SOUTH MACKAY	Non-residential	2	20	-45.1	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug007_FF_MWS
EN_9206	Kippen Dr, BALL BAY	Rural Residential	1	7.5	<0	Can achieve 6.7 L/s at 12 m pressure	Recommend no augmentation
EN_9208	Milton Street PAGET (Brothers Leagues Club?)	Non-residential	2	20	-36.4	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug010_FF_MWS
EN_9212	Palm Ridge Dr, RICHMOND	Rural Residential	1	7.5	<0	Can achieve 5.4 L/s at 12 m pressure	Recommend no augmentation
EN_9222	Boundary Road East PAGET	Residential	1	10	19.1	Marginal failure based on AS2419	Recommend no augmentation
NJ252	Sapphire Ct, NORTH MACKAY	Residential	1	10	24.8	Meets AS2419	Recommend no augmentation
NJ253	Sapphire Ct, NORTH MACKAY	Residential	1	10	25.2	Meets AS2419	Recommend no augmentation

Model ID	Location	Category of Fire fighting demand	Number of Hydrants Required at 10 L/s each	Total Fire Flow Required (L/s)	Residual Pressure at Total Fire Flow Required (m)	Assessment	Proposed Action/ Augmentation Name
NJ403	Mount Bassett Cemetery Rd, MACKAY H	Non-residential	1	10	21.4	Meets AS2419	Recommend no augmentation
NJ404	Mackay Slade Point Road, MACKAY HARBOUR	Non-residential	2	20	3.3	Pressures indicated that an augmentation may be required. Prior to undertaking an augmentation, an audit should be carried out on the site to determine if there are fire sprinkler systems in these industrial sites that would trigger augmentation.	Augmentation ID Aug008_FF_MWS and Aug009_FF_MWS

Appendix M: Fireflow Augmentation Infrastructure Maps



LEGEND

Ultimate Network

- Pipes
- Pump Station
- Reservoir

Fire Flow Augmentations from Risk Assess

- Fire Flow Pipe Augmentation
- Fire Flow Pump Augmentation

Mackay REGIONAL COUNCIL

PUBLISHER: PLANNING
PUBLICATION DATE: 21/04/2015
REFERENCE: 1
FILENAME:
PROJECTION: MAP GRID OF AUSTRALIA, ZONE 56
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

PROJECT

Mackay Water Strategy 83502679

TITLE Figure M1

Fire Flow Augmentations based on Risk Assessment

Appendix N: Nebo Road HPS Upgrade Costs to 75 ML/s and Nebo Road Bores Upgrade Costs

Nebo High Lift Pump Station Upgrade Costs taken from Nebo Road HLPS Planning Project (TR-055)

Table 5-4: Preferred Option Costs Estimates

Item	Description	Item Elements	Timing	Cost	Total Cost (inc Contingency 39 %, Design 10%)
1	Install Pressure Transducers/Gauges	≠ Install Pressure Transducers ≠ Analogue Gauges on suction and discharge mains ≠ SCADA connections to discharge Pressure transducers	2015/16	$25,000	**$35,000**
2	Internal Pump Inspections Pumps 2*, 3, 4, 5 and 6	Internal Condition Assessment will include: ≠ Check bearing wear ≠ Impeller shroud thickness ≠ visual inspection of the impellor condition (looking for cracks/ defects/ wear) ≠ Seals inspection (depending on the setup), ≠ shaft play measurement ≠ internal casing inspection ≠ Non-return valve inspection internal condition ≠ General pipework internal condition and internal diameters Any minor pipework, gauges and valves that require renewal following the outcomes of the internal condition assessment will form part of Item 2's scope.	2015/16	$38,000	**$58,000**
3	Pump Testing	≠ Individual and combination pump testing as described in this report	2015/16	$15,000	**$20,000**
4	Pump No.4 Replacement (430 L/sec @ 45m)	≠ Pump/Motor ≠ Pipework ≠ Valving and Fittings ≠ Installation Pump No. 4 motor on pump No.3 ≠ Day works, commissioning & Testing	2017/18^{+}	$175,000	**$265,000**
5	Pump 5 Replacement (430 L/sec @ 45m)	≠ Pump/Motor ≠ Pipework ≠ Valving and Fittings ≠ Day works, commissioning & testing	2017/18^{+}	$170,000	**$260,000**
6	Pump 6 Replacement (430 L/sec @ 45m)	≠ Pump/Motor ≠ Pipework ≠ Valving and Fittings	2017/18^{+}	$180,000	**$260,000**

		≠ Day works, commissioning & testing			
7	Pump 2, 3 Replacements (175 L/sec @ 45m)	≠ Pumps and motors ≠ Pipework ≠ Valving and Fittings ≠ Day works, commissioning & testing	2017/18+	$225,000	**$250,000**
Total Estimated Cost				**$790,000**	**$1,055,000**

*** Please note pump 2 internal condition assessment has already been completed late FY14/15. The decision to replace pump 2 in 2017/18 will be made once the pump performance assessment is completed which requires the installation of pressure transducers on the suction and discharge sides of the pump (Item 1).**

+ This timing is based on the requirement to renew the pumps following the outcomes of the internal condition assessment as per the Business Case BC15-19 Water Pump Station Renewals. Therefore timing of the pump renewals will be dependent on the outcomes of the SCA and pump performance outcomes.

Nebo Road Bores Upgrade Costs taken from Nebo Road Bores Planning Project (PPB-026)

Nebo Road Bore Replacement Cost Estimate (with Submersibles)

Bore	Recommended Pump Curve	Power (kW)	Estimated Replacement Cost	Flow Control Valve	Water Level and Pressure Transducer Monitoring	Bore Rehabilitation Costs	Switchboard and Telemetry	Total Estimated Replacement Cost	Overheads (10%)	Sub-Total	Contingency (40%)	Total Estimated Cost ($)
1	Grundfos SP95-4-B	14.5	$17,400	$2,300	$5,500	$20,000	$0	$45,200	$4,500	$49,700	$19,900	$69,600
2	Grundfos SP95-3-B	10.5	$16,400	$2,300	$5,500	$20,000	$0	$44,200	$4,400	$48,600	$19,400	$68,000
3	Grundfos SP95-4	16.5	$19,400	$2,300	$5,500		$0	$27,200	$2,700	$29,900	$12,000	$41,900
5	Grundfos SP95-3-B	10.5	$16,400	$2,300	$5,500		$0	$24,200	$2,400	$26,600	$10,600	$37,200
6	Grundfos SP95-4-B	14.5	$17,400	$2,300	$5,500	$20,000	$0	$45,200	$4,500	$49,700	$19,900	$69,600
7	Grundfos SP95-4-B	14.5	$17,400	$2,300	$5,500	$20,000	$0	$45,200	$4,500	$49,700	$19,900	$69,600
8	Grundfos SP95-3-BB	9	$15,400	$2,300	$5,500		$0	$23,200	$2,300	$25,500	$10,200	$35,700
4 (NEW LOCATION)	Grundfos SP95-3-BB	9	$15,400	$2,300	$5,500	$20,000	$30,000	$73,200	$7,300	$80,500	$32,200	$112,700
		Total	**$135,200**	**$18,400**	**$44,000**	**$100,000**	**$30,000**	**$327,600**	**$32,600**	**$360,200**	**$144,100**	**$504,300**

Nebo Road Bore Replacement Cost Estimate (with Shaft Driven Pumps)

Bore	Recommended Pump Curve	Power (kW)	Estimated Replacement Cost	Flow Control Valve	Water Level and Pressure Transducer Monitoring	Bore Rehabilitation Costs	Switchboard and Telemetry	Total Estimated Replacement Cost	Overheads (10%)	Sub-Total	Contingency (40%)	Total Estimated Cost ($)
1	Pomona 3 Stage 7MC-B	21	$20,600	$2,300	$5,500		$0	$28,400	$2,800	$31,200	$12,500	$43,700
2	Pomona 3 Stage 7MC-B	21	$20,600	$2,300	$5,500	$20,000	$0	$48,400	$4,800	$53,200	$21,300	$74,500
3	Pomona 3 Stage 7MC-B	18.5	$20,600	$2,300	$5,500		$0	$28,400	$2,800	$31,200	$12,500	$43,700
5	Pomona 3 Stage 7MC-B	18.5	$20,600	$2,300	$5,500		$0	$28,400	$2,800	$31,200	$12,500	$43,700
6	Pomona 3 Stage 7MC-B	21	$20,600	$2,300	$5,500		$0	$28,400	$2,800	$31,200	$12,500	$43,700
7	Pomona 3 Stage 7MC-B	21	$20,600	$2,300	$5,500		$0	$28,400	$2,800	$31,200	$12,500	$43,700
8	Pomona 3 Stage 7MC-B	18.5	$20,600	$2,300	$5,500	$20,000	$0	$48,400	$4,800	$53,200	$21,300	$74,500
4 (NEW LOCATION)	Pomona 3 Stage 7MC-B	21	$20,600	$2,300	$5,500	$20,000	$30,000	$78,400	$7,800	$86,200	$34,500	$120,700
		Total	**$164,800**	**$18,400**	**$44,000**	**$60,000**	**$30,000**	**$317,200**	**$31,400**	**$348,600**	**$139,600**	**$488,200**

Nebo Road Bore Maintenance Cost Estimate

Bore	Shed Maintenance	Cleaning and Painting of Discharge Pipework	Caps for Monitoring Bores	Signage for Monitoring Bores	Monitoring Bore Rehabilitation	New Monitoring Bore	Total
1	$5,500	$3,100	$20	$100			$8,720
2	$5,500	$3,100		$100			$8,700
3	$5,500	$3,100	$20	$100			$8,720
5	$5,500	$3,100		$100			$8,700
6	$5,500	$3,100	$20	$100	$2,000		$10,720
7	$5,500	$3,100		$100		$5,000	$13,700
8	$5,500	$3,100		$100			$8,700
Total	**$38,500**	**$21,700**	**$60**	**$700**	**$2,000**	**$5,000**	**$67,960**

Costing for the Water Level and Pressure Transducer Monitoring Data Loggers:

Approx. $2,741 per bore – Thermo Fisher pricing:

- This is for vented data loggers – Vented Leveltroll 500.
- The unit is $1,661 and the vented cable is $225 plus $16.5 per m. Given you will have to run the cable from the bore to the shed also (worked out at 50m per bore) so adjust as necessary if you have accurate distances between bores and sheds.
- Need to find out if the current telemetry system has a power connection port where this will be hard wired to, 12-24V? If so then the battery life of the loggers is not an issue as it'll have a constant power feed and the battery will be a redundant backup until required, it automatically kicks in to log as programmed in the event of power failure. (providing the telemetry is on all the time given the intermittent pumping of these bores?)

Otherwise the battery life on the units is approximately 5-7 years (when used hourly or less), and longer if logging less frequently.

Appendix O: Overall Capital Investment Program

Mackay Water Strategy - Overall Capital Investment Program

** Includes Base Unit Rate, Adjustment Factor (for size, land use and soil type), Length Scale Factors, Regional Factor (5%), Contingency Rate at 38% and Indexation from 2011 to 2015 (7%)*

Asset Type	Infrastructure Requirement	Asset ID	Location/ Description	Year Required	Size	Unit	Quantity	Unit	Adjusted Unit Rate*	per Unit	Total Cost	Figure Reference and Location
Water Main	Fire Flow Augmentation	Aug001_FF_MWS	Glenella Connection Road, Foulden	2016	150	mm	126	m	$462	/ m	$58,090	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug002_FF_MWS	Shinn Street, North Mackay	2016	150	mm	168	m	$440	/ m	$73,828	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug003_FF_MWS	Albatross Street, Slade Point	2016	150	mm	6	m	$704	/ m	$4,124	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug004_FF_MWS	Kay Court, Mount Pleasant	2016	150	mm	348	m	$440	/ m	$153,057	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug005_FF_MWS	Kay Court, Mount Pleasant	2016	150	mm	129	m	$462	/ m	$59,660	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug006_FF_MWS	Fursden Street, Glenella	2016	150	mm	410	m	$440	/ m	$180,345	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug007_FF_MWS	Illawong Drive, South Mackay	2016	150	mm	735	m	$440	/ m	$323,220	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug008_FF_MWS	Mackay Slade Point Road, Mackay Harbour	2016	150	mm	243	m	$440	/ m	$107,036	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug009_FF_MWS	Mackay Slade Point Road, Mackay Harbour	2016	150	mm	72	m	$528	/ m	$37,844	Figure M1, Appendix M
Water Main	Fire Flow Augmentation	Aug010_FF_MWS	Milton Street Paget	2016	150	mm	780	m	$440	/ m	$343,079	Figure M1, Appendix M
Pump	Fire Flow Augmentation	Sunset_Dr_FF_Pump	Sunset Drive, Erakala	2016	0.9	kW	1				$38,434	Figure M1, Appendix M
Water Main	Mt Oscar HLZ Augmentation	Aug012_MtOscarHLZ	Connection main from Lachlan Street to Mackay Bucasia Road	2016	150	mm	132	m	$464	/ m	$61,412	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug011_MtOscarHLZ	Ross Street, Mt Pleasant	2016	150	mm	125	m	$464	/ m	$57,850	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug010_MtOscarHLZ	Cheribon Avenue, Mt Oscar	2016	150	mm	100	m	$464	/ m	$46,406	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug009_MtOscarHLZ	Cheribon Avenue, Mt Oscar	2016	150	mm	93	m	$531	/ m	$49,129	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug008_MtOscarHLZ	Charles Hodge Avenue, Mt Oscar	2016	150	mm	77	m	$531	/ m	$41,109	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug007_MtOscarHLZ	City View Court, Mt Oscar	2016	150	mm	25	m	$708	/ m	$17,926	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug006_MtOscarHLZ	Corner of Craig Street and Burston Steet, Mt Oscar	2016	150	mm	157	m	$442	/ m	$69,656	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug005_MtOscarHLZ	Burgess Street, Mt Oscar	2016	150	mm	43	m	$708	/ m	$30,417	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug004_MtOscarHLZ	Bona Vista Drive, Mt Oscar	2016	225	mm	189	m	$613	/ m	$115,965	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug003_MtOscarHLZ	Bona Vista Drive, Mt Oscar	2016	225	mm	121	m	$643	/ m	$77,887	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug002_MtOscarHLZ	Bona Vista Drive, Mt Oscar	2016	225	mm	108	m	$643	/ m	$69,304	Figure I1, Appendix I
Water Main	Mt Oscar HLZ Augmentation	Aug001_MtOscarHLZ	Servicing highly elevated properties on Hugh Reilly Court, Mt Pleasant	2016	100	mm	112	m	$371	/ m	$41,359	Figure I1, Appendix I
Pump Station	Nebo Road HLPS Upgrade	See Detail in Appendix N	Staged replacement/upgrade of Pumps 4, 5 and 6 to 430 L/s each and replacement of Pump 2 and 3 with 175 L/s pumps to provide an instantaneous capacity of 1,035 L/s and back up capacity for the jockey (175 L/s) pump	2015-2018							$1,055,000	Refer TR-055 Nebo Road High Lift Pumps Report (MWH, 2014)
Bores	Nebo Road Bores Upgrade	See Detail in Appendix N	Undertake immediate specified maintenance on the bore sheds, painting of pipework and monitoring bores at an estimated cost of $67,200 Replace the shaft driven pumps over time (as they fail) with submersible pumps and to drill a replacement for Bore 4 is $504,300	2015-2019							$572,300	Refer PPB-026 Nebo Road Bores Report (2014)
Valve	Greenfield - Shoal Point	New_Shoal_Pt_Valve	At Shoal Point Reservoir	2023	250	mm	1				$30,479	Figure J3, Appendix J
Water Main	Greenfield - Shoal Point	AUG1_WPH_23	Trunk Main supplying into new Shoal Point Reservoir	2023	300	mm	175	m	$676	/ m	$118,596	Figure J3, Appendix J
Reservoir	Greenfield - Shoal Point	New_Shoal_Pt_Res	New Shoal Point Reservoir	2023	2	ML	1				$1,689,402	Figure J3, Appendix J
Pump Station	Greenfield - Richmond Hills	Bovey's Road	Booster pump station to service highly elevated areas in Richmond Hills	2026	10.5	kW	1				$197,016	Figure J3, Appendix J
Pump Station	Greenfield - Shoal Point	Shoal Point	Booster pump station to service highly elevated areas in Shoal Point	2026	5	kW	1				$150,531	Figure J3, Appendix J
Raw Water Main	Strategic - Option 2A	Option_2A_RW_001	Dumbleton Weir to Nebo Road WTP	2026	525	mm	11,000	m	$1,621	/ m	$17,830,456	Figure 8-4, p75 of Strategy
Water Treatment Plant	Nebo Road WTP Upgrade	See Detail in Appendix Q	Chemical Dosing Systems Upgrade (chlorine). The upgrade will achieve both 75 and 90 ML/d.	2030							$187,697	Refer Item 1 Table 4-1 in Appendix Q
Water Treatment Plant	Nebo Road WTP Upgrade	See Detail in Appendix Q	Chemical Dosing Pumps Upgrade (ACH, Polymer Bores and Polymer River). The upgrade will achive both 75 and 90 ML/d.	2030							$137,241	Refer Item 2 Refer Table 4-1 in Appendix Q
Water Treatment Plant	Nebo Road WTP Upgrade	See Detail in Appendix Q	Installation of 2 shallow depth clarifiers with tube settlers to achieve 90 ML/d. This will limit the requirement to install an additional clarifier outside the exitsing WTP boundary.	2030							$8,876,639	Refer Item 3C Refer Table 4-2 in Appendix Q
Water Treatment Plant	Nebo Road WTP Upgrade	See Detail in Appendix Q	Upgrade sludge management facilities to achieve 90 ML/d. includes additional sludge thickener, thickened sludge tank and centrifuge.	2030							$3,753,600	Refer Item 4 Refer Table 4-3 in Appendix Q
Water Treatment Plant	Nebo Road WTP Upgrade	See Detail in Appendix Q	modification or integration of the SCADA/PLC of Stage 1 and 2 River Filters to with Stage 1 Bore Filters. The upgrade will achive both 75 and 90 ML/d.	2030							$25,476	Refer Item 5 Refer Table 4-1 in Appendix Q
Raw Water Intake	Upgrade Power	Details of Upgrade and Cost Estimate to be Confirmed. A nominal $1 M has been included for the power and pump recoiifguration works.	Upgrade power and reconfigure pump arranegement to achieve duty/ duty/ duty/ standby arrangement	2032							$1,000,000	Figure 8-4, p75 of Strategy
Water Main	Strategic - Option 2A	Option_2A_TM_001	Walkerston Reservoir to Ooralea #1 Trunk Main	2038	675	mm	9,100	m	$3,408	/ m	$31,016,094	Figure 8-4, p75 of Strategy
Water Main	Strategic - Option 2A	Option_2A_TM_002	Stockroute Road (west) Trunk Main	2038	600	mm	1,630	m	$1,885	/ m	$3,072,694	Figure 8-4, p75 of Strategy
Water Main	Strategic - Option 2A	Option_2A_TM_003	Stockroute Road (east) Trunk Main	2038	600	mm	820	m	$1,885	/ m	$1,545,773	Figure 8-4, p75 of Strategy
Water Main	Strategic - Option 2A	Option_2A_TM_004	Connors Road Trunk Main	2038	600	mm	620	m	$1,885	/ m	$1,168,755	Figure 8-4, p75 of Strategy
Water Main	Strategic - Option 2A	Option_2A_TM_006	Nebo Road WTP Outlet Trunk Main	2038	600	mm	30	m	$6,496	/ m	$194,888	Figure 8-4, p75 of Strategy
Reservoir	Strategic - Option 2A	Option_2A_Walkerston_Res	Walkerston Reservoir	2038	16	ML	1				$5,114,864	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-1	Pressure Reducing Valve on Paradise Street	2038	300	mm	1				$43,680	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-2	Pressure Reducing Valve on Paradise Street	2038	450	mm	1				$64,809	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-3	Pressure Reducing Valve on Archibald Street	2038	100	mm	1				$6,275	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-4	Pressure Reducing Valve on Archibald Street	2038	100	mm	1				$6,275	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-5	Pressure Reducing Valve on Titanium Drive	2038	100	mm	1				$6,275	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-6	Pressure Reducing Valve on Boundary Road	2038	150	mm	1				$8,509	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-6A	Pressure Reducing Valve on Boundary Road	2038	150	mm	1				$8,509	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-7	Pressure Reducing Valve between Boundary Road and Len Shield Street	2038	150	mm	1				$8,509	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-8	Pressure Reducing Valve on corner of Crichtons Road and Connors Road	2038	250	mm	1				$30,479	Figure 8-4, p75 of Strategy

Mackay Water Strategy - Overall Capital Investment Program

** Includes Base Unit Rate, Adjustment Factor (for size, land use and soil type), Length Scale Factors, Regional Factor (5%), Contingency Rate at 38% and Indexation from 2011 to 2015 (7%)*

Asset Type	Infrastructure Requirement	Asset ID	Location/ Description	Year Required	Size	Unit	Quantity	Unit	Adjusted Unit Rate*	per Unit	Total Cost	Figure Reference and Location
Valve	Strategic - Option 2A	Option_2A_PRV-9	Pressure Reducing Valve on corner of Stockroute Road and Broadsound Road	2038	150	mm	1				$8,509	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_PRV-10	Pressure Reducing Valve on corner of Stockroute Road and Cowleys Road	2038	250	mm	1				$30,479	Figure 8-4, p75 of Strategy
Valve	Strategic - Option 2A	Option_2A_Control_Valve	Pressure Reducing Valve on corner of Paradise Street and Archibald Street	2038	500	mm	1				$43,946	Figure 8-4, p75 of Strategy
Pump Station	Strategic - Option 2A	Option_2A_HLPS_Upgrade	Nebo Road High Lift Pump Station Reconfiguration	2038	375	kW	1				$1,626,037	Figure 8-4, p75 of Strategy
Water Main	Greenfield - Ooralea	FUT_L1004190	Ooralea growth area water main	2046	300	mm	1,221	m	$676	/ m	$825,667	Figure J1, Appendix J
Water Main	Greenfield - Ooralea	FUT_L1004191	Ooralea growth area water main	2046	300	mm	1,227	m	$676	/ m	$829,724	Figure J1, Appendix J
Water Main	Greenfield - Ooralea	FUT_L1004192	Ooralea growth area water main	2046	300	mm	787	m	$676	/ m	$532,186	Figure J1, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004100	Richmond growth area water main	2046	300	mm	414	m	$676	/ m	$280,226	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004101	Richmond growth area water main	2046	300	mm	416	m	$676	/ m	$281,335	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004106	Richmond growth area water main	2046	300	mm	852	m	$676	/ m	$575,877	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004108	Richmond growth area water main	2046	375	mm	364	m	$1,180	/ m	$429,884	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004109	Richmond growth area water main	2046	375	mm	515	m	$1,180	/ m	$607,894	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004110	Richmond growth area water main	2046	300	mm	1,636	m	$676	/ m	$1,106,055	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004111	Richmond growth area water main	2046	300	mm	576	m	$676	/ m	$389,470	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004112	Richmond growth area water main	2046	300	mm	558	m	$676	/ m	$377,088	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004117	Richmond growth area water main	2046	300	mm	299	m	$676	/ m	$202,028	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004122	Richmond growth area water main	2046	300	mm	330	m	$676	/ m	$223,444	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004126	Richmond growth area water main	2046	375	mm	24	m	$1,888	/ m	$45,449	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004127	Richmond growth area water main	2046	300	mm	665	m	$676	/ m	$449,397	Figure J2, Appendix J
Water Main	Greenfield - Richmond	FUT_L1004128	Richmond growth area water main	2046	300	mm	1,157	m	$676	/ m	$782,111	Figure J2, Appendix J
Pump Station	Greenfield - Richmond	Richmond Booster	Richmond growth area water main	2046	18	kW	1				$339,640	Figure J2, Appendix J
Water Main	Strategic - Option 2A	Option_2A_TM_005	Paradise Street to Walkerston Reservoir #2 Trunk Main	2056	675	mm	14,000	m	$3,321	/ m	$46,490,913	Figure 8-4, p75 of Strategy
										Total	**$136,455,315**	

Appendix P: Nebo Road Pinch Point Meeting Minutes

ISSUES PAPER

NEBO RD WTP PINCH POINTS Meeting Minutes

for Mackay Regional Council

12 October 2015

DOCUMENT ISSUE RECORD

ISSUE DATE	REVISION	ISSUE	ISSUED TO	PREPARED BY	APPROVED BY
27/08/2015	A	Draft	Kylie Rogers	MMC	BAM
03/09/2015	B	Post workshop	Kylie Rogers	BAM	BAM
09/09/2015	C	Post Workshop	Janice Wilson/Roger Crozier	SMH	KR
12/10/2015	D	Post Workshop	Kylie Rogers	MMC	BAM

Mackay Regional Council (MRC) organised a workshop on 1st September, 2015 to determine the "pinch points" that may restrict current capacity of Nebo Rd WTP or limit future upgrade options. This paper summarises key technical issues from that workshop.

Workshop attendees were:

- Bruce Murray, Citywater [Facilitator]
- David Brooker (part)
- Linda Pearson (MWS)
- Stuart Boyd (MWS)
- Kylie Rogers (MWS)
- Sunnie Hollenbeck (MWS)
- Russell Lenz (MWS)
- Janice Wilson (MWS)
- Don Pidsley (MWS)
- Laura Burbidge (MWS)
- Roger Crozier (MWH)

- Andy Findlay (MWH)

The following meeting minutes have tasks broken down into maintenance tasks and assigned tasks. The purpose of this is to acknowledge the issues that were raised with maintaining the WTP, but to distinguish tasks that are related to the pinch points of the WTP meeting the desired output to Mackay.

NOTE: No assessment on the capacity of the pipework within Nebo Rd WTP was done during this pinch point workshop.

1 Design Envelopes

1.1 Previous Design

Nebo Rd WTP was recently upgraded, with completion in 2012. The WTP was designed based on:

- 99 percentile river water turbidity of 41.5 NTU, true colour of 88.5 HU, total iron 0.9 mg/L & total manganese 0.7 mg/L (water quality analysis 2003-2008).
- 99 percentile bore water turbidity of 2 NTU, true colour of 2 HU and total iron 2 mg/L
- WTP capable of 75 ML/d throughput, either as all river water or combination of river and bore in which case the plant must retain the capability of using up to 21 ML/day bore water.
- Plant capacity is to be met by 24 hour operation, but functions requiring the presence of operators need to be performed during two full 8-hour shifts. Any functions required to operate outside of these hours need to function automatically without operator intervention.
- The conversion factors of 1 NTU=1.5 mg/L solids and 1 HU(true colour)=0.2 mg/L solids are used for solids loading estimation
- ACH comes out of solution as coagulation occurs, the precipitate being 89% of the dosed mass.
- 50 mg/L ACH dosage (as ACH) was used for sludge calculations.
- About 4 ML of Clearwater to backwash all filters.

Based on conversations during the start of the workshop there are numerous soft engineering targets that WWS needs to implement and use to guide the further development of the hard engineering tasks required for the pinch points. Some of these include changing the culture of the Mackay Region based on water usage—there have been great strides in this area with the roll out of the MyH2O and teaching the customers about managing their own water usage; additionally, there needs to be an understanding of managing the peaks within the systems by putting restrictions on water usage. Finally, there needs to be an understanding of events that cause the river water quality to be poor and how that correlates to the demand of our customers (e.g. a large wet weather event will cause the turbidity of the water to be poor; however, there will be less of a demand to produce water for the network).This is an example list and not an exhaustive list of the soft engineering targets and hard engineering tasks that MWS has review.

1.2 Updated Evaluation

Raw water quality has changed significantly since previous design and 99 percentile raw water turbidity & colour increased to 124 NTU & 262 HU respectively (water quality analysis 1997-2015).

	Previous Design data 99 %ile Water Quality Analysis '03-'08*	**Updated data 99 %ile** Water Quality Analysis '97-'15	**Updated data 95 %ile**	**Updated data 90 %ile**
Turbidity (NTU)	41.5	124	53	29
Colour (HU)	88.5	262	92	56

*Used in the design in 2012

The WTP after evaluation was reconsidered based on:

- 99 percentile river water turbidity of 124 NTU, true colour of 262 HU (water quality analysis 2003-2008).
- 99 percentile bore water turbidity of 2 NTU, true colour of 2 HU
- WTP capable of 75 ML/d throughput, either as all river water or combination of river and bore in which case the plant must retain the capability of using up to 12 ML/day bore water.
- Plant capacity is to be met by 24 hour operation, but functions requiring the presence of operators need to be performed during two full 8-hour shifts. Any functions required to operate outside of these hours need to function automatically without operator intervention
- The conversion factors of 1 NTU=1.5 mg/L solids and 1 HU(true colour)=0.2 mg/L solids are used for solids loading estimation
- ACH comes out of solution as coagulation occurs, the precipitate being 89% of the dosed mass.
- 50 mg/L ACH dosage (as ACH) was used for sludge calculations.
- 75 kL of Clearwater required to backwash one x single cell filter and 150 kL of Clearwater required to backwash one x dual cells filter. 1.2 ML/day of Clearwater required to backwash all filters.
- Main focus of this workshop is to achieve 75 ML/d production of Treated Water. Secondary focus is 90 ML/d production of Treated Water.

Plant Inflow (ML/d)	**Output (ML/d)**	**h/day Operation**	**Plant Inflow (L/s)**	**Output (L/s)**
77.2	75.2	24	894	870

92.2	90	24	1067	1042

Task 1: Design Envelopes to be further developed/ confirmed for design purposes for sizing the equipment for costing to achieve 75 ML/d WTP production capacity. Resource implications need to be identified and review during the design stage (SB w/ LP)

2 Bore Water Allocations and treatment

Bore water is only to be used as an emergency supply. It is treated by manganese oxidation and filtration and disinfection with low log removal for Giardia and Cryptosporidium even though there is high pathogen risk as per treatment's input into the meeting. Additional treatment is preferred.

There is currently little understanding or data of the bore water quality.

Current bore water allocation is "0" ML per annum for 7 out of 8 bores with 1 bore having an allocation of 390 ML. An application for additional allocation has been approved for a total of 250 ML for the 7 bores with no allocation up to the 30 June 2016. 7 out of 8 bores are available for a maximum capacity of 12 ML/day (i.e.25 days to meet 300 ML/yr. bore water allocation)

Maintenance task 1: Maintain bore water access for backup as per the Nebo Road Bores report PPB-026

Task 2A: Confirm existing bore water allocations (SB)

Task 2B: Investigate possible renegotiations of future water allocations based on aquifer (DP)

Task 3A: Perform tests in bore water quality to understand treatment requirements. (SB)

Task 3B: Analyze treatment options based on legislative requirements, capital costs, and operational costs. (LP)

Task 4: Understand network demand and operation through network configuration strategy (DP)

3 Raw Water Pump Station

Four raw water pumps installed at the raw water pump station. They need to run in pairs with operators selectable from the following configurations:

Pump Pair 1: Pump 2 (PD10127) + Pump 1 (PD10130)
Pump Pair 2: Pump 4 (PD10128) + Pump 3 (PD10129)
Pump Pair 3: Pump 4 (PD10128) + Pump 1 (PD10130)
Pump Pair 4: Pump 2 (PD10127) + Pump 3 (PD10129)

This pump configuration is due to a limitation with the pump power supply arrangements at Dumbleton. The pumps will be able to run any combination of pump configurations unrestricted and may operate as Duty/Duty/Duty/Standby to meet higher level flow rate requirements when the power supply transformers are upgraded in future.

Since pump no 4 has excessive vibration issues, only 3 pumps (2 pairs, 2-1 & 2-3) are available. Pump no 1 and 3 are in acceptable condition with early symptoms of friction and/or flow induced vibration also visible on Pump no 1 and early stage rotating looseness visible on pump no 3. Symptoms of

early stage bearing fault also visible on pump NDE bearing of Pump no 2 (Briefing Note-Dumbleton Weir River Water Pumps, 2nd September 2015 by Janice Wilson).

The maximum pumping rate (@100% pump speed) recorded from the flow test conducted on 24/6/2013 was 807 L/s (@ pump station flowmeter) and 785 L/s (@ WTP inlet flowmeter). That is equivalent to 62.2 ML/d @ 22h/day operation and 67.8 ML/d @ 24h/day operation. The operating pressure recorded at maximum pump rate was 8.5-9 Bar.

With the minimum flow of 300 L/s, the existing raw water pumps turndown ratio is 2.5:1. Operators prefer 5:1 at least.

The capacity of new flowmeters at the RWPS is suitable for 92.2 ML/d inflow. New water flowmeters have issues such as biological growth, huge discrepancies in totalised flow readings compared to plant inlet flowmeter and no flowmeter bypass line for flowmeter maintenance.

Maintenance task 2: Carry out calibrated vibration analysis on the pumps and pipework.

Previous business decisions (2014) based on risk the backup generators are not required.

Task 5A: Investigate upgrade power supply arrangements with Ergon at pump station (to be able to run any combination of pump configurations unrestricted) to meet 75 ML/d & 90 ML/d WTP outputs (KR with input from ID & Ken Martin)

Task 5B: Review assumptions used in BC14-03 to determine the risk with backup generation to verify if these are still valid. (KR)

4 Raw Water Mains

Two approximately 11 km long mains connect the pump station and the WTP. The diameter of the old main varies 500-525 mm, Reinforced Concrete pipe & Asbestos Cement (AC) pipe and the new main varies 600-675 mm, Asbestos Cement (AC) pipe & Glass Reinforced Plastic (GRP) pipe. The pipe diameters are optimum for 350 L/s flow (old main) and 600 L/s flow (new main).

Leaks occur above 240 L/s in old main and this requires about $100,000 per annum maintenance program to repair the leaks.

Currently, 72.6 ML/d inflow (600+240 L/s) which is equivalent to about 71 ML/d plant output is possible without patching the old main. **Assuming no off takes before plant.**

Re-lining of old main required to meet 75 ML/d output.

90 ML/d plant output requires replacing the old main with larger diameter pipes.

Since typical AC pipe service life is 50-70 years depending on pipe condition and working environment, the old main is nearing the end of its useful service life.

Task 6: locating/condition assessment of the terminal valves just before the WTP is also required. (DP)

Task 7: Perform pipe performance assessment and failure likelihood. Also, have a better understanding of what failure will look like (DP)

Task 8: Perform a risk assessment & management plan in event of main (new main) failure (DP)

Task 9: Understand number and volume of current and future of offtake/ commitments from Raw Water Main which will affect delivery capacity (DP)

5 River Water Dosing Tank

The capacity of existing flowmeters at the RWDT inlet (DN750) is suitable for 92.2 ML/d inflow.

CFD report (18/12/2009) states 12.5 min detention time at 79.2 ML/d. Detention time for 92.2 ML/d is 10.7 min. Target minimum contact time is 10 min for manganese oxidation with potassium permanganate.

Ideal PAC contact time for removal of tastes and odours and algal toxins is 10 to 60 minutes depending on the compound. Some herbicides have been detected in the catchment at various levels and Atrazine has been found to be difficult to remove with the current PAC (PS1000).

10 min contact time was used for jar testing to investigate the atrazine removal with different type of Powdered Activated Carbon (PAC) products. No significant reduction in Atrazine was found based on City Water's analysis.

Task 10: Investigate Atrazine removal and possible jar testing with different PAC products @ 20 & 30 min contact times or with oxidants (SB)

6 Clarifiers

Type : Upflow sludge blanket but it has always been operated as settlers without sludge blanket.

Quantity : Two

Shape : Square

Depth : 5m

Settling area of each clarifier : (17.55m x 17.55 m) - (6 m x 6m central well) = 272 m^2

Total settling area of 2 clarifiers : 2 X 272 = 544 m^2

Plant Inflow (L/s)	Plant Inflow (ML/d)	Surface Loading Rate (m/h)**
300	23.8	2
350	27.7	2.3
400	31.7	2.6
450	35.6	3.0
500	39.6	3.3
550	43.6	3.6
600	47.5	4.0
650	51.5	4.3
700	55.4	4.6
750	59.4	5.0
800	63.4	5.3
850	67.3	5.6
900	71.3	6.0
950	*75.2*	*6.3*
975	77.2	6.5

1000	79.2	6.6
1050	83.2	6.9
1100	87.1	7.3
1150	91.1	7.6
1164	*92.2*	*7.7*
** Two clarifiers online		

Following table presents the typical surface loading rates for different clarification systems

Clarifier Type	**Typical Surface Loading Rate (m/h)**
Sedimentation	0.7-1.5
Simple upflow (Nebo Rd WTP Clarifiers)	1.3-1.9
Up flow with solids contact (sludge recirculation)	1.5-4
Shallow depth settlers with lamella plates or tube settlers (based on clarifier area)	4-8
DAF	6-12
Enhanced settling – Actiflo, Comag, Sirofloc	15-60

Although operators have decreased the plant inflow to 320-350L/s during poor raw water quality events, it was difficult to achieve clarified water quality of <5 NTU consistently with correct coagulant dosage. Clarifiers require upgrade to handle high flow.

The existing clarifiers can operate at about 60 ML/d with good quality raw water but are limited to about 30 ML/d with poor raw water quality. They can sometimes be operated at higher rates with additional loading placed on to the filters. Alternative polymers may assist.

Task 11: Cost options to maximize the surface loading rate of the clarifiers to meet 75 ML/d & 90 ML/d outputs with various qualities of raw water. (KR)

7 Filters

The following table presents the design maximum filtration rates of the filters

	Type	Number of filters	Area of a filter (m^2)	Filtration rate (m/h)
River stage 1	Single cell	4	24.5	12-15
River stage 2	Dual cells	4	49	12
Bore filters	Single cell	4	24.5	12-15

Basis: 91.7 ML/d, 22h/day operation, Inflow 1158L/s

4 x Dual & 8 x Single filters online, No backwash						
	No	**Area (m2)**	**Total Area (m2)**	**m/h**	**m3/h**	**L/s**
Single cell	8	24.5	196	10.7	2097.2	583
Dual cells	4	49.0	196	10.7	2097.2	583
Total as Single	16		392		4194.4	1165
During one dual cells filter backwash						
Single cell	8	24.5	196	12	2352.0	653
Dual cells	3	49.0	147	12	1764.0	490
Total as Single	14		343		4116	1143
During one single cell filter backwash						
Single cell	7	24.5	171.5	11.4	1955.1	543
Dual cells	4	49.0	196	11.4	2234.4	621
Total as Single	15		367.5		4189.5	1164

Basis: 76.8 ML/d, 22h/day operation, Inflow 970L/s

4 x Dual & 6 x Single filters online, No backwash						
	No	Area (m2)	Total Area (m2)	m/h	m3/h	L/s
Single cell	6	24.5	147	10.2	1499.4	417
Dual cells	4	49.0	196	10.2	1999.2	555
Total as Single	14		343		3498.6	972
During one dual cells filter backwash						
Single cell	6	24.5	147	11.9	1749.3	486
Dual cells	3	49.0	147	11.9	1749.3	486
Total as Single	12		294		3498.6	972
During one single cell filter backwash						
Single cell	5	24.5	122.5	11	1347.5	374
Dual cells	4	49.0	196	11	2156.0	599
Total as Single	13		318.5		3503.5	973

Bore filters need to be used for river water to meet 75 ML/d & 90 ML/d output.
Operators report significant media loss in Filter 12 due to the holes (erosion of filling agent) between concrete launders and the drain channel walls. The filter media clogged up the centrifuge feed pumps. It has huge impact on the operation of the centrifuges. Operator needs to clean out the centrifuge feed pumps on a regular basis. Impact on changing procedures of backwashes also has reduced impact of filter media on centrifuges – not exclusively from Filter 12
Level sensors in some filters also need to be replaced.

Maintenance task 3: Carry out filter repair on Filter 12 and check filter media loss in the filters and top up if required Replace level sensors. City water to provide work that has been done to date.

Maintenance task 4: Ensure filters are cleaned on their required schedule.

Task 12: Investigate modifications required to upgrade bore filters for river water (SCADA modifications) (KR)

8 Balance Tanks

The filters supply the filtered water to the Clearwater Tank below the filters, situated below the WTP control building. The filtered water is then gravity-fed to three in ground balance tanks (2 x 2.25 ML, 1 x 4.5 ML) on site.

No issues with the balance tanks.

Maintenance task 5: Balance tank cleaning to be carried out using divers to maintain water quality and to monitor the condition of the structure. And determine how often the divers are required.

9 Disinfection and Fluoridation

9.1 Disinfection

Two x 10 kg/h duty/ standby chlorinators are used at WTP. 2 * 920 kg drums are online (Duty/Standby) with automatic changeover from empty to full drum. The existing chlorine drum room can accommodate Four 920 kg drums. Orica replace empty drums every 14 days. Total quantity to be stored at an average feed rate calculated at 90 ML/d * 2.75 kg/ML, one 920 kg drum will give up to 3.7 days' supply. Four 920 drums will give enough time for replacement of the empty drums without requiring additional spare drums.

The chlorine demand of the plant is 2-3.5 kg/ML filtered water depending on the quality of the filtered water.

Required maximum chlorine dose rate for 75 ML/d output:

3.5 kg/ML * 75 ML/d *1/22 = 11.9 kg/h

Required maximum chlorine dose rate for 90 ML/d output:

3.5 kg/ML * 90 ML/d *1/22 = 14.3 kg/h

The motive water for the chlorinators is supplied from the service water. Reliability for this critical disinfection could be further safeguarded by having dedicated duty/ standby booster pumps.

Periodically during the wet season high chlorine demand water has been produced.

Evoqua are conducting an audit on the chlorination system 14 September.

Task 13: In addition to the Evoqua audit obtain costs for two x 15 kg/h Duty/Standby chlorinators require for 75 ML/d & 90 ML/d outputs. Consider additional chlorinator to top up the residual chlorine at the outlet of the HL pump station. Investigate requirement for Duty/Standby Booster pumps (JW)

9.2 Fluoride Dosing System

The fluoride system has had several problems. Please see attached B6974 Mackay Regional Council-Fluoride System Report for a detailed overview of issues.

Evoqua are conducting an audit on the fluoridation system shortly.

Task 14: As part of Evoqua audit check suitability of system and fluoride screw feeder for 75 ML/d & 90 ML/d outputs and determine any upgrades required (JW)

10 Chemical Dosing Systems

10.1 ACH Dosing System

Basis:

Maximum dosage: 60 mg/L as ACH

ACH concentration: 40%

Sp gr: 1.33

Capacity of existing ACH pumps: 375 L/h ea

Required maximum ACH dose rate for 75 ML/d output:

(60 mg/L * 77.2 ML/d *1000g/kg)/ (400g/L*1.33*22) = 396 L/h

Required maximum ACH dose rate for 90 ML/d output:

(60 mg/L * 92.2 ML/d *1000g/kg)/ (400g/L*1.33*22) = 473 L/h

The pumps should be located outside at lower level to maximise usage of existing storage.

Task 35: Costing for ACH dosing pumps require upgrade to meet 75 ML/d & 90 ML/d outputs and should be located outside at lower level. (KR)

10.2 Clarifier Poly Dosing System

Basis:

Maximum dosage: 0.2 mg/L

Batch poly concentration: 0.1%

Sp gr: 1.05

Capacity of existing poly dosing pumps: 940 L/h ea

Required maximum poly dose rate for 75 ML/d output:

(0.2 mg/L * 77.2 ML/d *1000g/kg)/ (1g/L*1.05*22) = 668 L/h

Required maximum poly dose rate for 90 ML/d output:

(0.2 mg/L * 92.2 ML/d *1000g/kg)/ (1g/L*1.05*22) = 798 L/h

Poly pumps are OK for 75 ML/d & 90 ML/d outputs.

10.3 Potassium Permanganate

10.3.1 River Water Potassium Permanganate Dosing System

Basis:

Maximum dosage: 2.05 mg/L

Potassium Permanganate ($KMnO_4$)solution concentration: 2.5%

Sp gr: 1.0

Capacity of existing river water $KMnO_4$ pumps: 375 L/h ea

Required maximum caustic dose rate for 75 ML/d output:

(2.05 mg/L * 77.2 ML/d *1000g/kg)/ (25g/L*1.0*22) = 288 L/h

Required maximum caustic dose rate for 90 ML/d output:

(2.05 mg/L * 92.2 ML/d *1000g/kg)/ (25g/L*1.0*22) = 343 L/h

Existing Pot Perm pumps: 375 L/h ea. They are OK for 75 ML/d & 90 ML/d outputs.

10.3.2 Bore Water Potassium Permanganate Dosing System

Basis:

Maximum dosage: 4.12 mg/L

Potassium Permanganate ($KMnO_4$)solution concentration: 2.5%

Sp gr: 1.0

Capacity of existing river water $KMnO_4$ pumps: 540-648 L/h ea

Required maximum caustic dose rate for 12 ML/d output:

(4.12 mg/L * 12 ML/d *1000g/kg)/ (25g/L*1.0*22) = 90 L/h

Existing Bore Pot Perm pumps are OK for 12 ML/d outputs.

10.4 PAC

Basis:

Minimum dosage: 5 mg/L

Maximum dosage: 50 mg/L

Maximum output of the PAC feeder @ 63Hz: 329 kg/h

Required maximum PAC dose rate for 75 ML/d output:

(50 mg/L * 77.2 ML/d)/ (22h) = 175 kg/h

Required maximum PAC dose rate for 90 ML/d output:

(50 mg/L * 92.2 ML/d)/ (22h) = 210 kg/h

PAC system is OK for 75 ML/d & 90 ML/d outputs.

Operator reported PAC system tripped at high range dosing.

Maintenance task 6: System needs to be run regularly and cause for trips investigated

10.5 Caustic

10.5.1 Bore Water Caustic Dosing System

Basis:

Maximum dosage: 51.9 mg/L

Caustic concentration: 50%

Sp gr: 1.52 @20°C

Capacity of existing bore water caustic pumps: 150 L/h ea

Required maximum caustic dose rate for 12 ML/d output:

(51.9 mg/L * 12 ML/d *1000g/kg)/ (500g/L*1.52*22) = 37 L/h

Bore Water Caustic pumps can handle up to 48 ML/d output.

10.5.2 River Water Caustic Dosing System

Basis:

Maximum dosage: 51.9 mg/L

Caustic concentration: 50%

Sp gr: 1.52@20°C

Capacity of existing river water caustic pumps: 375 L/h ea

Required maximum caustic dose rate for 75 ML/d output:

(51.9 mg/L * 77.2 ML/d *1000g/kg)/ (500g/L*1.52*22) = 240 L/h

Required maximum caustic dose rate for 90 ML/d output:

(51.9 mg/L * 92.2 ML/d *1000g/kg)/ (500g/L*1.52*22) = 286 L/h

River Water Caustic pumps are OK for 75 ML/d & 90 ML/d outputs.

10.5.3 Clear Water Caustic Dosing System

Basis:

Maximum dosage: 51.9 mg/L

Caustic concentration: 50%

Sp gr: 1.52 @20°C

Capacity of existing clear water caustic pumps: 375 L/h ea

Required maximum caustic dose rate for 75 ML/d output:

(51.9 mg/L * 75 ML/d *1000g/kg)/ (500g/L*1.52*22) = 233 L/h

Required maximum caustic dose rate for 90 ML/d output:

(51.9 mg/L * 90 ML/d *1000g/kg)/ (500g/L*1.52*22) = 279 L/h

Clear Water Caustic pumps are OK for 75 ML/d & 90 ML/d outputs.

10.6 Filter Aid Poly Dosing Systems

Basis:

Maximum dosage: 0.15 mg/L

Batch poly concentration: 0.1%

Sp gr: 1.05

Maximum flow to dual filters during 90 ML/d output: 621 L/s (See Section 7 Filters)

Maximum flow to single filter during 90 ML/d output: 653 L/s (See Section 7 Filters)

	No of Pumps	**Capacity (L/h)**
River stage 1 dosing system	2	150

River stage 2 dosing system	2	375
Bore filters dosing system	2	150

Required maximum F/A poly dose rate to dual filters @ 90 ML/d output:

(0.15 mg/L * 621L/s *3600 s/h)/ (1g/L*1.05*1000mg/g) = 319 L/h

Required maximum F/A poly dose rate to single filters @ 90 ML/d output:

(0.15 mg/L * 653L/s *3600 s/h)/ (1g/L*1.05*1000mg/g) = 336 L/h

Operator comment from workshop was that batching takes a long time and cannot keep with dosing. This is current situation.

Task 46: Costing for Upgrade F/A pumps for River stage 1 and Bore filters (KR)

10.7 Sludge Thickener Poly Dosing System

Basis:

Design inflow to thickener: 65 L/s, 5.61 ML/d* (1.67 m/h)

Maximum dosage: 5 mg/L

Batch poly concentration: 0.25% (Design: 0.1-0.5%)

Sp gr: 1.05

Capacity of existing poly dosing pumps: 940 L/h ea

* Calculated inflow to thickener @ 75 ML/d output is2.52 ML/d & 90 ML/d output is 2.76 ML/d

The sludge thickener poly batching system has a preparation capacity of 1040L/h at aging time of 60 min.

Required maximum poly dose rate

(5 mg/L * 65L/s *3600 s/h)/ (2.5g/L*1.05*1000mg/g) = 446 L/h

Operator comment from workshop was that batching takes a long time and cannot keep with dosing. This system requires norminal water flow of 2000-3000 L/h @3 bar during batch preparation. If the water flow is lower than the recommended range, batching takes longer than normal and cannot keep up with the withdrawal rate (dosing rate).

Sludge thickener poly system is OK for 75 ML/d & 90 ML/d outputs

10.8 Centrifuge Poly Dosing System

Basis:

Batch poly concentration: 0.1-0.5% (Supplier recommend 0.25%)

The poly batching system can process 66kg of poly powder in 12 h @ 0.25%, 2200 L/h. 10kg of poly requires for 1T of solids. With existing poly batching system, WTP can process 6.6T of solids in 12h.

Since 90ML/d output generates 27T/day solids and 75 ML/d output generates 22.6T/day solids, WTP requires larger poly dosing system. (Note solids loading are based on 99%ile WQ data)

Operator comment from workshop was that batching takes a long time and cannot keep with dosing. This is current situation.

Task 17: Costing for 75ML/Day Requirement of larger batching system (KR)

11 High Lift Pumps

Treated water is pumping from 3 x onsite balance tanks (total volume of 8.8 ML) to town.

Pump	Capacity (L/s)	Actual Max Output (L/s)	Status	Issues
HL 1	630	540	In Operation	Cavitation. Doesn't appear to be acceptable as an emergency backup. Vibrating even at lower speeds and appears to be deteriorating.
HL 2	130		In Operation	None
HL 3	150		In Operation	None
HL 4	240		In Operation	Motor size incorrect, should be 150 kW
HL 5	370	360	In Operation	Small leak at pump gland.
HL6	340		In Operation	None

HL 3, 4 & 6 being evaluated. Condition assessment has been done on HL 2 & 5. Combination of HL 4, 5 & 6 could achieve the flow of 870L/s. However this combination has not been tested yet.

Additional connectivity may be required to deliver 90 ML/d output to the town reservoirs & to improve water pressure management.

Water supply to part of South Mackay is directly fed from the HL pump station. HL2 or HL3 needed to run at 70-80L/s flow continuously during plant shutdown.

New flowmeter will be installed on 300 mm main this year.

Task 18: Carry out testing out HL pump combinations to determine the maximum achievable output (RC)

Task 19: Further investigation required for the additional storage tank to supply South Mackay (RC)

12 Delivery/Demand

The observed peak day demand between 2010 and 2014 was 57 ML/d. For 2013 and the first half of 2014 observed peak flow was around 50 ML/d.

The minimum demand that can be tolerated is 170 L/s for a period of three days which would leave the reservoirs at 30 %. Maximum flow would then be required for some time. The bores can deliver 150 L/s some river water is always required.

Task 20: Summarize demand requirements from Cardnos and MWH work as part of Network strategy. (DP)

13 Waste Washwater Tank

The washwater tank receives the filter backwash and clarifier blowdown water as well as the centrifuge centrate and area washdown water. This water is pumped across to the sludge thickener using 3 (Duty/Duty/Standby) submersible pumps. The capacity of the tank is 458 kL.

It has been designed to receive following flows;

- Filter backwash- max 3.9 ML/d at intermittent 315 L/s
- Clarifier blowdown purge – possible 18 cones at 6 minutes per cone, ie 175 kL per day at 27L/s blowdown flowrate
- centrate return – 209 kL/d at intermittent 15 L/s
- Rain water including 100-year storm event, expect 43 mm per hour over the washwater tank area for an 8-hour event.

Type of Waste	**Original Design 75 ML/d**	**Updated**	
		75 ML/d	**90 ML/d**
Filter Backwash (ML/d)	3.9	1.2	1.2
Clarifier Blowdown (ML/d)	0.175	0.567	0.672
Centrate Return (ML/d)	0.209	0.707	0.844
Rainwater (ML/d)	0.04	0.04	0.04
Total (ML/d)	**4.324**	**2.514**	**2.756**

Actual filter backwash water generation to backwash all filters (1.2 ML/d) are significantly lower than the design value. So theoretically enough capacity available. More filters to be backwashed in future but still only one at a time. Additional capacity downstream will assist.

Maintenance task 6: Install additional mixer for better mixing

14 Sludge Thickener

Currently supernatant from the sludge thicker is discharged to the lagoon. Supernatant quality is reportedly well within the discharge limit. Option of pumping supernatant back to head of WTP could be considered but not required at this stage. No flowmeter on the supernatant discharge pipe line is an issue.

Diameter: 13.5 m

Stilling well diameter: 2m

Working surface area: 140 m^2

Maximum design inflow: 65 L/s (1.67m/h)

Design loading rate for underflow sludge: 2-6 kg/m^2/h (6720-20,160 kg/d)

Calculated loading for 75ML/d output: 22,610.6 kg/d

Calculated loading for 90ML/d output: 27,076.6 kg/d

Maintenance task 7: Requirement raised is to empty the tank and check the rake operation. Provide better access to the launder for maintenance cleaning.

Task 21: For increased plant throughput and higher solids a second thickener would be required though space restricted. Re-investigate options based on refined design envelope. Provide a cost estimate on this requirement (P&S) NOTE: Requires having design envelope-Task 1 to be complete (SB)

15 Thickened Sludge Tank

Working capacity: 150 m^3

Calculated thickened sludge volume: 773.4 m^3 (90 ML/d output), 645.8 m^3 (75 ML/d output)

Task 22: For increased plant throughput and higher solids a second thickened sludge tank would be required though space restricted. Re-investigate options based on refined design envelope. Provide a cost estimate on this requirement (POC: P&S) NOTE: Requires to have design envelope-Task 1 to be complete (SB)

16 Centrifuges

At base 3% solid loading centrifuges were capable of handling up to 313 kg/h at hydraulic capacity of 10.5m^3/h. The cake solid concentration was >18 % and centrate quality less than 0.06%.

2 centrifuges * 313 kg/h * 12h/day = 7.5 T/d

2 centrifuges * 313 kg/h * 22h/day = 13.8 T/d

Task 23: Calculate size/spacing requirements of centrifuge required (POC: Treatment) ***NOTE: Requires to have design envelope-Task 1 to be complete (SB)***

Task 24: Provide cost estimate based on task 23 while considering compatibility of equipment if additional centrifuge added for critical spares **(LP)**

17 Additional issues

- Monitoring – largely satisfactory but seem improvements needed in flow metering and further development of coagulant feedback control systems.
- Power – review Emergency procedures UPS and emergency generator back-up – probably (*Task 6 is reviewing)
- PLC maintenance – modify code for additional ACH flexibility in dosing into River Dosing Tank. New hot back-up PLC to be installed.
- Data management – several improvements needed including flow balancing and operator log sheets, complete IMS by reviewing operating procedures to understand/locate any gaps.
- Telemetry Improvements: Dumbleton RWPS link to WTP required. Also need to consider links from bores to WTP and upgrade proposal as a part of task 26.
- SCADA New CLEAR SCADA system proposed – Exporting and archiving of data needs to be resolved. Currently data older than three months is lost.
- Documentation-Review and Update Old reports, PIDs, Tenix work as ex, O&M manual)
- Potential constraints / issues with future land acquisition requirements and DTMR upgrades on surrounding roads. P&S to consider in future planning in task 27.

Maintenance Task 8: Data Management: Review operating procedures and log sheets/flow sheets to find any informational gaps that need to be addressed

Task 25: Install/maintain flow monitors to provide accurate flow balance from Dumbleton Weir to output into network to include the supernatant (Treatment). To co-ordinate with ID Flow Balance project to ensure no rework (SB w/ID & P&S)

Task 26: Telemetry Improvements required. Treatment to advise P&S on requirements for telemetry (KR)

Task 27: Future planning needs to identify potential constraints/issues with future land acquisition requirements and DTMR upgrades to surrounding roads (LP)

18 Final Commentary

This was a very successful workshop highlighting areas that were previously known and showcasing areas that were assumed to not have an issue with capacity. Based on the outcomes of the meeting

there were 27 pinch point tasks and 8 maintenance tasks that need to be address. The primary pinch points for meeting the 75ML/day desired requirement for the future water strategy are:

- **Raw Water Pump Station**
- **Raw Water Mains Capacity**
- **Clarifiers Capacity**
- **Chemical Dosing System**
- **Waste Water System**

Pinch Point Task Register

Task No	Task Description	PM
1	Design Envelopes to be further developed/ confirmed for design purposes for sizing the equipment for costing to achieve 75 ML/d WTP production capacity. Resource implications need to be identified and review during the design stage	SP
2A	Confirm existing bore water allocations	SB
2B	Investigate possible renegotiations of future water allocations based on aquifer	DP
3A	Perform tests in bore water quality to understand treatment requirements	SB
3B	Analyse treatment options based on legislative requirements, capital costs, and operational costs	LP
4	Understand network demand and operation through network configuration strategy	DP
5A	Investigate upgrade power supply arrangements with Ergon at pump station (to be able to run any combination of pump configurations unrestricted) to meet 75 ML/d & 90 ML/d WTP outputs	KR
5B	Review assumptions used in BC14-03 to determine the risk with backup generation to verify if these are still valid	KR
6	locating/condition assessment of the terminal valves just before the WTP is also required	DP
7	Perform pipe performance assessment and failure likelihood. Also, have a better understanding of what failure will look like	DP
8	Perform a risk assessment & management plan in event of main (new main) failure	DP
9	Understand number and volume of current and future of offtake/ commitments from Raw Water Main which will affect delivery capacity	DP
10	Investigate Atrazine removal and possible jar testing with different PAC products @ 20 & 30 min contact times or with oxidants	SB
11	Cost options to maximize the surface loading rate of the clarifiers to meet 75 ML/d & 90 ML/d outputs with various qualities of raw water	KR
12	Investigate modifications required to upgrade bore filters for river water (SCADA modifications)	KR
13	In addition to the Evoqua audit obtain costs for two x 15 kg/h Duty/Standby chlorinators require for 75 ML/d & 90 ML/d outputs. Consider additional chlorinator to top up the residual chlorine at the outlet of the HL pump station. Investigate requirement for Duty/Standby Booster pumps	JW
14	As part of Evoqua audit check suitability of system and fluoride screw feeder for 75 ML/d & 90 ML/d outputs and determine any upgrades required	JW
15	Costing for ACH dosing pumps require upgrade to meet 75 ML/d & 90 ML/d outputs and should be located outside at lower level	KR
16	Costing for Upgrade F/A pumps for River stage 1 and Bore filters	KR
17	Costing for 75ML/Day Requirement of larger batching system	KR
18	Carry out testing out HL pump combinations to determine the maximum achievable output	RC
19	Further investigation required for the additional storage tank to supply South Mackay	RC
20	Summarize demand requirements from Cardnos and MWH work as part of Network strategy	DP
21	For increased plant throughput and higher solids a second thickener would be required though space restricted. Re-investigate options based on refined design envelope. Provide a cost estimate on this requirement	KR

22	For increased plant throughput and higher solids a second thickened sludge tank would be required though space restricted. Re-investigate options based on refined design envelope. Provide a cost estimate on this requirement	KR
23	Calculate size/spacing requirements of centrifuge required	SB
24	Provide cost estimate based on task 23 while considering compatibility of equipment if additional centrifuge added for critical spares	LP
25	Install/maintain flow monitors to provide accurate flow balance from Dumbleton Weir to output into network to include the supernatant	SB w/ ID
26	Telemetry Improvements required. Treatment to advise P&S on requirements for telemetry	KR
27	Future planning needs to identify potential constraints/issues with future land acquisition requirements and DTMR upgrades to surrounding roads	LP

Maintenance Task Register

Mnx Task No	Task Description
1	Maintain bore water access for backup as per the Nebo Road Bores report PPB-026
2	Carry out calibrated vibration analysis on the pumps and pipework
3	Carry out filter repair on Filter 12 and check filter media loss in the filters and top up if required Replace level sensors. City water to provide work that has been done to date
4	Ensure filters are cleaned on their required schedule
5	Balance tank cleaning to be carried out using divers to maintain water quality and to monitor the condition of the structure. And determine how often the divers are required
6	Install additional mixer for better mixing
7	Requirement raised is to empty the tank and check the rake operation. Provide better access to the launder for maintenance cleaning
8	Data Management: Review operating procedures and log sheets/flow sheets to find any informational gaps that need to be addressed

Appendix Q: Nebo Road WTP Upgrade Options and Cost Estimation Paper, City Water Technology

COST ESTIMATION PAPER

Nebo Road WTP Upgrade Options & Cost Estimation

for Mackay Regional Council

28 January 2016

DOCUMENT ISSUE RECORD

ISSUE DATE	REVISION	ISSUE	ISSUED TO	PREPARED BY	APPROVED BY
18/01/2016	A	Internal Review	BAM	JC	-
20/01/2016	B	Draft	MRC	JC	MMC
28/01/2016	C	Final	MRC	JC	BAM

1 Introduction

Nebo Road Water Treatment Plant (WTP) is a conventional water treatment plant with the treatment processes of oxidation, coagulation/flocculation, clarification, filtration, chlorine disinfection and fluoridation.

Nebo Rd WTP's capacity is restricted to 60 ML/d based on good raw water quality and 30 ML/d based on poor raw water quality, under 24 hr/d operation. Mackay Regional Council are seeking to upgrade the capacity and quality of water produced by Nebo Road WTP.

City Water Technology (CWT; Bruce Murray) facilitated a workshop with Mackay Regional Council (MRC) on the 1st of September, 2015, to determine the "Pinch Points" that may restrict current capacity at Nebo Road WTP or limit future upgrade options.

1.1 Purpose of Report

This report summarises cost estimations for several items identified as pinch points in *Nebo Rd WTP Pinch Point Meeting Minutes*, issued on the 12 October 2015 to MRC. The items costed in this report, which requires upgrade, or installation includes:

1. Chemical dosing systems including:
    a. Upgrade of chlorine dosing system
    b. Installation of polymer dosing system prior to Centrifuges
2. Chemical dosing pumps including:
    a. ACH dosing pumps
    b. Polymer dosing pumps prior to:
        i. Stage 1 Bore Water Filters
        ii. Stage 1 River Water Filters
3. Upgrades of clarification capacity including:
    a. Upgrades to existing Clarifiers 1 and 2 (part of option 1) and install additional clarifier
    b. Installation of additional clarifier(s) (part of option 1)
    c. Replacement of existing Clarifiers (option 2)
4. Upgrade of Waste Water System including:
    a. Installing an additional sludge thickener
    b. Installing an additional thickened sludge tank
    c. Installing an additional centrifuge
5. Modifying and integrating SCADA/PLC of Stage 1 and 2 River Filters with Stage 1 Bore Filters

The above items are numbered accordingly and coloured blue in Figure 1-1.

The boundaries of Nebo Rd WTP are highlighted in blue as shown in Figure 1-2.

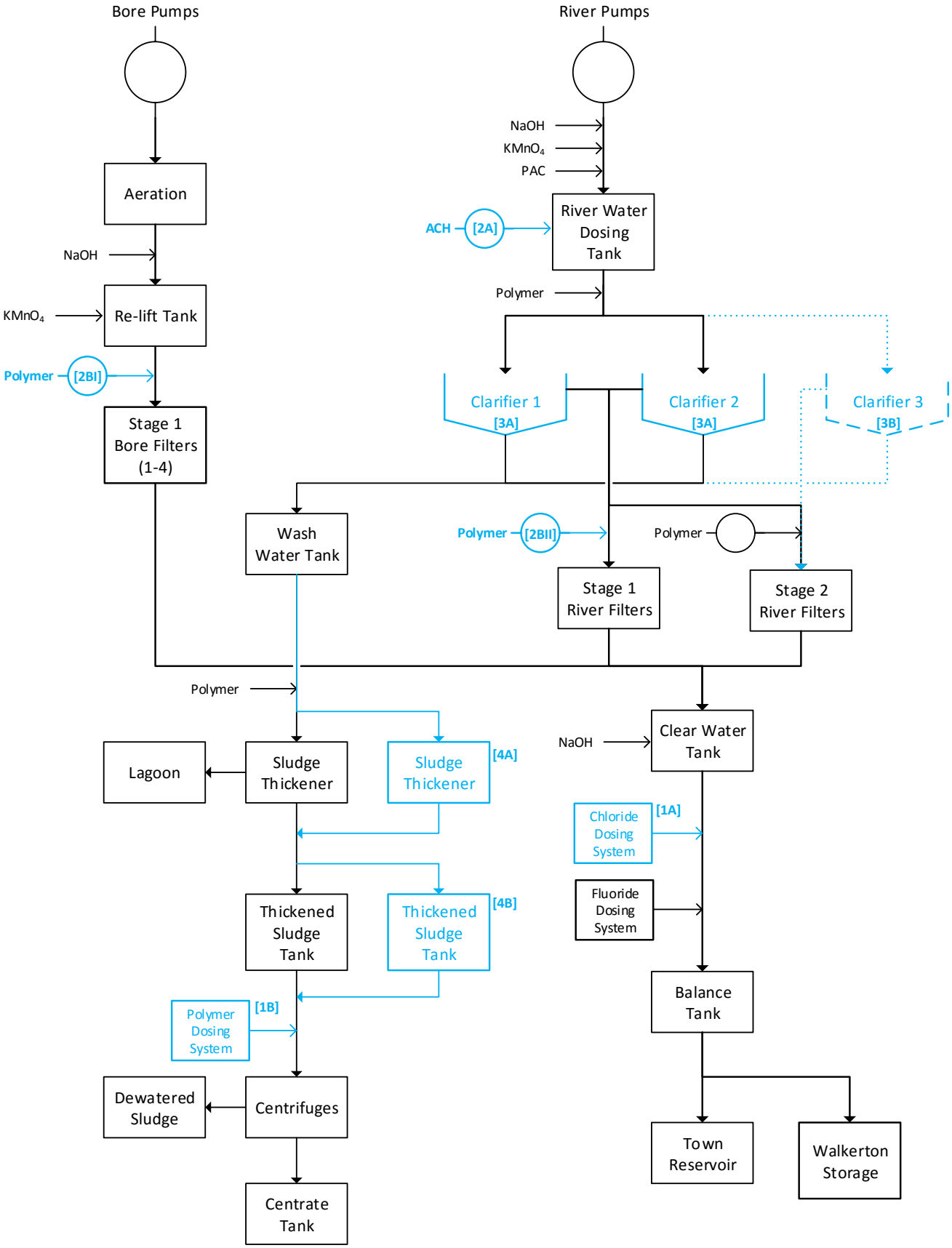


Figure 1-1 Nebo Road WTP Process Flow Diagram

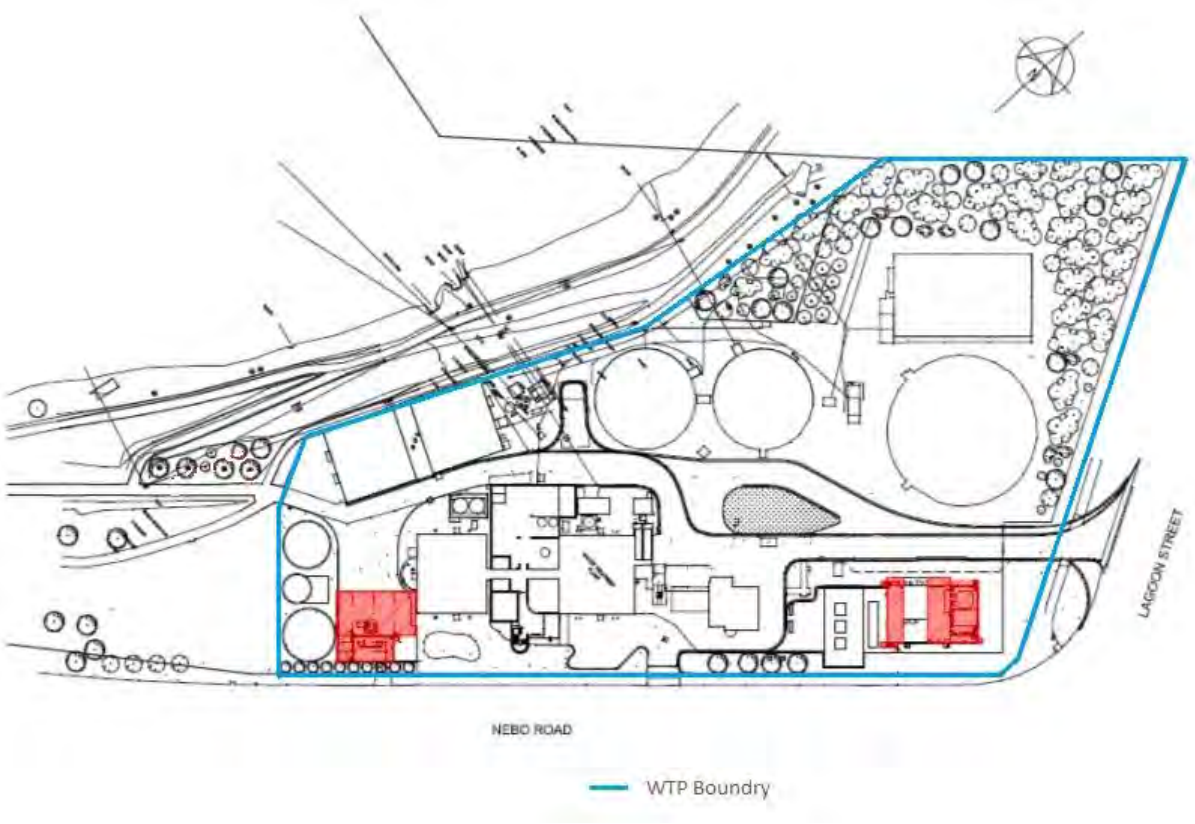


Figure 1-2 Plan View of Nebo Rd WTP

2 Basis of Cost Estimations

This section summarises the design basis for cost estimations.

2.1 Capacity

The upgraded Nebo Road WTP must be capable of 75 ML/d throughput, either as river water or a combination of river and bore in which case the plant must retain the capability of using up to 21 ML/d of bore water.

MRC is also investigating options to upgrade capacity to 90 ML/d to support future demand.

All items (1-11) have been costed on the basis of 75 ML/d and 90 ML/d output with consideration given for existing process capacity and operating 22-24 h/d.

2.2 Chemical Dosing Systems

Table 2-1 summarises the chlorine dose rate and pumping requirements on the basis of an upper chlorine demand of 3.5 kg/ML of filtered water.

Table 2-1 Chemical dosing requirements

Item	Dosing system	Required dose rate for:		Capacity (kg/h) required for	
		75 ML	90 ML	75 ML	90 ML
[1A]	Chlorine	11.9 kg/h	14.3 kg/h	15 kg/h x 2 (duty/standby)	

Nebo Rd WTP Pinch Point Meeting Minutes report states the requirement of new batching system capable to supply enough poly solution to handle the solids generated from the 75 ML/d production as shown in Table 2-2.

The existing centrifuge poly batching and dosing systems are suitably sized for the existing centrifuges (target solids loading rate is 281 kg/h x 2 = 562 kg/h). In order to handle the solids loading generated from 75 ML/d plant production (i.e. 22 ton/d of solids), poly batching & dosing systems as well as the capacity of the centrifuges need to be upgraded.

Supplier estimation for the centrifuge polymer batching system is based on the solids generated from the 75 ML/d production and the batch polymer concentration of 0.1 – 0.5%. Upgrade of Centrifuges and dosing pumps has not been included in this report.

Table 2-2 Estimated solids generation

Item	Capacity basis (ML/d)	Solids loading (kg/d)
[1B]	**75**	22,611
[1B]	**90**	27,077

2.3 Chemical Dosing Pumps

Table 2-3 lists the basis for calculations and requirement determined in *MPP880-01D Nebo Rd Pinch Point* report for new ACH dosing [1a] and Filter aid (F/A)polymer dosing pumps.

Table 2-3 Chemical dosing system requirements

Item	Pump	Max. dose rate (mg/L)	Product purity (%)	Product Specific gravity	Capacity of existing pumps (ea.)	Capacity required for 75 ML/d	Capacity required for 90 ML/d
[2A]	ACH pumps	60	40	1.33	375L/h x 2 (Standby/duty)	396 L/h x 2 (duty/ standby)	473 L/h x 2 (duty/standby)
[2BI]	F/A Polymer pumps (Bores)	0.15	0.1	1.05	150 L/h x 2 (duty/standby)	N/A	168 L/h x 2 (duty/standby)
[2BII]	F/A Polymer pumps (River Stage 1)	0.15	0.1	1.05	150 L/h x 2 (duty/standby)	N/A	168 L/h x 2 (duty/standby)

For filter aid polymer dosing for bores and stage 1 river filters, instead of upgrading the dosing pumps (Item No: 2BI & 2BII), we recommend changing the batch polymer solution concentration from 0.1% to 0.15%. By doing so, require max dose rate will be decreased from 168 L/h to 112 L/h.

Table 2-4 Current Polymer Dosing Pump Capacity

Item	Pump	No. of pumps	Capacity per pump (L/s)
[2BI]	Bore Filters Polymer dosing pumps	2	150
[2BII]	Stage 1 River Filter polymer dosing pumps	2	150
-	Stage 2 River Filter polymer dosing pumps	2	375
		Total capacity	**675**

Therefore, if the polymer pumping systems were integrated to have a common polymer dosing line to the inlets of the Bore and River filters, excess pumping capacity would be available.

2.4 Clarifiers

The existing clarifiers are upflow sludge blanket clarifiers with a total combined surface area of 544 m^2. The typical surface loading rate for this type of clarifier is 1.3-1.9 m/h.

The existing clarifiers can operate at about 60 ML/d with good quality raw water but are limited to 30 ML/d with poor raw water quality.

The existing clarifiers; Clarifiers 1 and 2, require tube settlers to increase their capacity to 50 ML/d with poor raw water quality and an additional clarifier is required to meet the target 75-90 ML/d capacity.

Alternatively, MRC may opt to replace the existing clarifiers; Clarifier 1 and 2, with new clarifiers of appropriate capacity and functional specification.

Several cost options were considered for upgrading of the clarification process:

- Option 1: Upgrading existing clarifiers 1 and 2 (item [3A]) and installing a third (item [3B]):
    - In circular arrangement [3BI]
    - In rectangular or square arrangements (Item [3BII])
- Options 2: Replacing Clarifier 1 and 2 with new clarifiers (item [3C])
    - In circular arrangements [3CI]
    - In rectangular or square arrangements [3CII]

2.5 Sludge Facilities

2.5.1 Sludge Thickener

An additional Sludge Thickener is required to handle increased solids loading associated with 75-90 ML/d upgrade in capacity. *Nebo Rd WTP Pinch Point Meeting Minutes* report states the following requirements for a new Sludge Thickener as shown in Table 2-5.

Table 2-5 Solids loading for Sludge Thickener

Item	Capacity basis (ML/d)	Solids loading (kg/d)
[4A]	**75**	22,611

2.5.2 Thickened Sludge Tank

An additional Thickened Sludge Tank is required to handle increased solids loading associated with the 75-90 ML/d upgrade in capacity. *Nebo Rd WTP Pinch Point Meeting Minutes* report states the following requirements for a new Thickened Sludge Tank as shown in Table 2-6.

Table 2-6 Volume Requirement for New Thickened Sludge Tank

Item	Capacity basis (ML/d)	Volume (m^3)
[4B]	**75**	645.8

2.5.3 Centrifuge

An additional Centrifuge may be required to handle increased solids loading associated with the 75-90 ML/d upgrade in capacity. An additional centrifuge has been added to both options in upgrade capacity, to be conservative. The need for the additional centrifuge depends on future solids loads.

2.5.4 Land requirements

The acquisition of additional land is an important criterion in the selection of an option. Figure 2-1 is a plan drawing showing the perimeter of the existing plant (blue line), existing facilities that require upgrade and proposed sites for upgrades.

Note that the future infrastructure is not within the boundaries of Nebo Rd WTP. For the clarifier upgrade, to avoid the requirement of land acquisition, MRC may opt to build an additional clarifier atop the aeration basin (item 2B) or replace existing clarifiers (item [3C]).

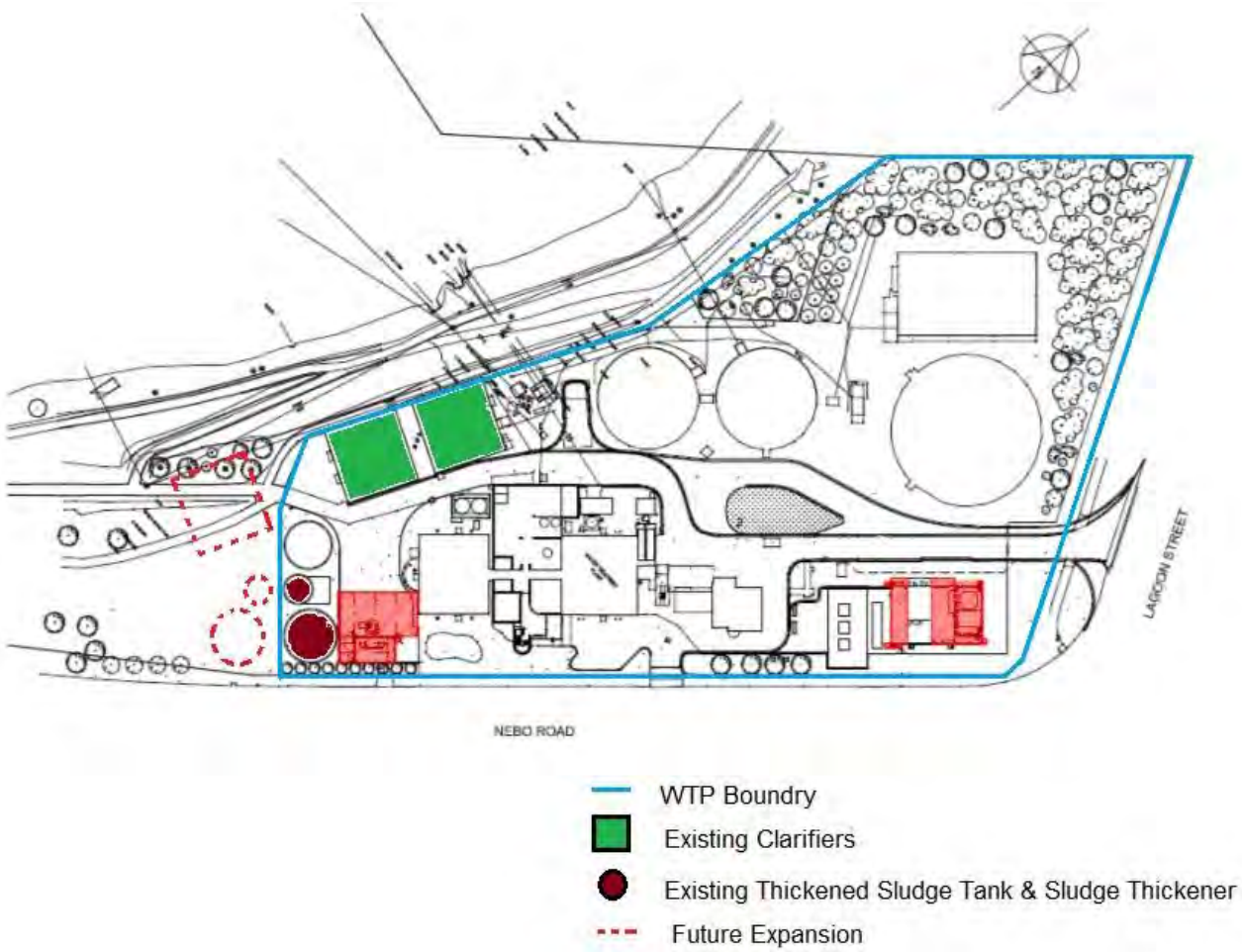


Figure 2-1 Plan Drawing of Nebo Rd WTP with Future Expansion Requirements.

2.6 SCADA/PLC Modification for Bore Filters

The Stage 1 Bore Filters consist of four single cell filters, which are controlled independent of the River Water Filter's upstream treatment train. Reconfiguration and modification of the existing SCADA/PLC is required to integrate Bore Water Filter control with the Stage 1 and 2 Filter control.

3 Cost Estimations

All cost estimations exclude Goods and Services Tax (GST).

Land purchase costs (if required) are excluded.

3.1 Chemical Dosing Systems

The following cost estimations for the chemical dosing system upgrades (items [1A] and [1B]) were developed. The costs are approximately the same for 75 and 90 ML/d.

Table 3-1 Cost Estimations for Chemical Dosing Systems

Item	Component	Inclusions	Exclusions	Cost (ex. GST)
[1]	Chemical Dosing Systems Upgrades			
[1A]	Chlorine gas dosing	- 15 kg/h Chlorinator including new positioner - New injector panel including new rotameter, actuated valves, check valves and press gauges - Installation and commissioning - Standard and general arrangement drawings - Piping and Instrumentation Drawings - Operations manual	- Dosing lines and fittings from supply to injection points - Integration with SCADA and electricals - Booster pumps	$40,000
[1B]	Centrifuge polymer batching system	- 350 kg hopper - 200 kg/hr vacuum loader - Fully automatic three-chamber preparation system for polyelectrolyte solutions in the adjusted concentration - Three-chamber PPH tank with chambers for preparation, ripening and dosing; - Preparation and ripening chamber with electric agitators	- Installation, delivery and offloading - Commissioning - Dosing lines and fittings from supply to existing dosing pumps - Engineering and administrative costs	$53,000

Item	Component	Inclusions	Exclusions	Cost (ex. GST)
		- Dosing chamber optionally with an electric agitator - Dry material feeding system - Ultrasonic sensor for continuous level control with programmable cut-off points min./max./dry run/overflow - Water apparatus with shut-off valve, solenoid valve (24 VDC), pressure reducing valve and contact water meter - Jet mixer for dry polymer - Yard piping - Site preparation and landscaping - Site electricals and controls - Standard and general arrangement drawings - Piping and Instrumentation Drawings - Operations manual		
	Other direct costs	- Piping (10%)		$9,300
		- Site preparation (5%)		$4,650
		- Electricals and controls (20%)		$18,600
			TOTAL DIRECT COSTS	$125,550
			INDIRECT COSTS (30% of direct, inc. engineering & supervision)	$37,665
			CONTINGENCY (15% of direct + indirect costs)	$24,482
			TOTAL COST (ex. GST)	**$187,697**

3.2 Dosing Pumps

The following cost estimations for the dosing pumps (items [2A] and [2B]) were developed. The costs are approximately the same for 75 and 90 ML/d.

Table 3-2 Cost Estimations for Dosing Pumps

[2]	Chemical Dosing Pumps Upgrades			
[2A]	ACH dosing pumps	- 2 pumps (duty/standby) pumps - Operations manual - Pulsation damper	- Installation and delivery - Pipework and fittings - PLC code modification	$28,000
[2B]	Polymer dosing pumps[1]	- 2 pumps (duty/standby) pumps - Operations manual	- Installation and delivery - Pipework and fittings - Integration with SCADA/PLC and electrical	$40,000
	Other direct costs	- Yard piping (at 10%)		$6,800
		- Site preparation and landscaping (5%)		$3,400
		- Site electricals and controls - SCADA/PLC and electrical integration (20%)		$13,600
			TOTAL DIRECT COSTS (ex. GST)	$91,800
			INDIRECT COSTS (30 % of direct, inc. engineering & administrative; ex. GST)	$27,540
			CONTINGENCY (15% of direct + indirect costs; ex. GST)	$17,901
			TOTAL COST (ex. GST)	**$137,241**

[1] The polymer pumps have been costed for convenience, however, as mentioned in Section 2.3, increasing the polymer dosing concentration from 0.1 to 0.15% reduces the pumping requirement, and therefore, the pumps do not require upgrade.

3.3 Clarifier Upgrade Options

Cost estimations for several clarifier upgrade options (items [3A], [3B] and [3C]) were developed. Note: Land acquisition costs to accommodate additional facilities have not been included in this report. Table 3-3 lists the direct and non-direct costs considered for cost estimating.

Table 3-3 Summary of Direct and Non-direct Cost Estimates Options

Item	Upgrade – Option	Direct cost inclusions	Non-direct cost inclusions
[3A]	Retrofit existing clarifiers with tube settlers – part of Option 1	- General and skilled labour - Equipment - Support structures - Tube settlers and material - Removal of current infrastructure - Removal and reinstallation of launders - Standard and general arrangement drawings - Floor modifications and scaffolding	- Rubbish removal - Modifications to ensure continual operation during refurbishment - Augmentations to site for access - Commissioning
[3B]	Install an additional clarifier	- General and skilled labour - Equipment - Earthworks (1 m in ground) - Reinforced concrete for floor, walls, panels and concrete for blinding - Scrapers - Scaffold hire - Staircase and walkways - Support structures (lateral and longitudinal) - Lamella/ tube settlers - Installation of settlers and supports - Standard and general arrangement drawings - Piping and Instrumentation Drawings - Operations manual	- Civil works integration of with existing infrastructure - Site preparation including ground levelling - Civil works integration with existing infrastructure - Commissioning - SCADA/PLC and electrical integration
[3C]	Replace existing clarifiers	- General and skilled labour - Equipment - Earthworks (1 m in ground)	- Civil works integration of with existing infrastructure - Site preparation including ground levelling - Civil works integration with existing infrastructure

Item	Upgrade – Option	Direct cost inclusions	Non-direct cost inclusions
		- Reinforced concrete for floor, walls, panels and concrete for blinding - Scrapers - Scaffold hire - Staircase and walkways - Support structures (lateral and longitudinal) - Lamella/ tube settlers - Installation of settlers and supports - Standard and general arrangement drawings - Piping and Instrumentation Drawings - Operations manual	- Commissioning - SCADA/PLC and electrical integration

3.3.1 Retrofit of Existing Clarifiers with Tube Settlers

The following cost estimations for retrofitting the existing clarifiers with tube settlers (item [3A]) was developed.

Table 3-4 Cost Estimations for Installing Tube Settlers in Existing Clarifiers (Item [3B])

Parameter	Value
Total combined surface area of existing clarifiers (m^2)	544
Cost estimations for refurbishment and tube settler installation ($/$m^2$)	$6,000
TOTAL DIRECT & INDIRECT COSTS	$3,264,000
CONTINGENCY (15% of direct + indirect costs)	$489,600
TOTAL COST (ex. GST)	**$3,753,600**

3.3.2 Adding an Additional Clarifier (item [3B])

The following cost estimations for adding an additional clarifier (item [3B]) were developed.

Two types of clarifiers are considered here; a simple upflow clarifier (such as those currently installed at Nebo Rd WTP) and a shallow depth clarifier with tube settlers. Two geometric arrangements are also considered for each type of clarifier; circular and rectangular/square.

Table 3-5 Dimensions and Cost Estimations for Installation of an Additional Clarifier (Item [3B])

Capacity (ML/d)	75		90	
Type	**Simple upflow**	**Shallow depth with tube settlers**	**Simple Upflow**	**Shallow depth with tube settlers**
Dimensions				
Surface area (m^2)	801	260	1,282	417
Diameter (circular arrangement; m)	31.9	18.2	40.4	23.0
Rectangular dimensions (m)[2]	23.1 x 34.7	13.2 x 19.8	29.2 x 43.9	16.7 x 25.0
Square length (m)	28.3	16.1	35.5	20.4
Cost estimations				
Circular arrangement				
Direct costs	**$1,806,678**	**$1,957,435**	**$2,414,815**	**$2,894,117**
• Clarifier	$1,338,280	$1,449,952	$1,788,752	$2,143,790
• Piping (10% of clarifier cost)	$133,828	$144,995	$178,875	$214,379
• Site and landscaping (5% of clarifier cost)	$66,914	$72,498	$89,438	$107,190
• Electricals and controls (20% of clarifier cost)	$267,656	$289,990	$357,750	$428,758
Indirect costs	**$180,668**	**$195,743**	**$241,482**	**$289,412**
• Engineering and administrative costs (10% of direct cost)	$180,668	$195,743	$241,482	$289,412
Contingency (15% of direct + indirect costs)	**$298,102**	**$322,977**	**$398,445**	**$477,529**
Total project cost	**$2,285,447**	**$2,476,155**	**$3,054,741**	**$3,661,058**
Rectangular/square arrangement				
Direct costs	**$1,714,528**	**$1,893,195**	**$2,312,312**	**$2,818,361**

[2] Assumes the width to length ratio is 2:3

Capacity (ML/d)	75		90	
Type	**Simple upflow**	**Shallow depth with tube settlers**	**Simple Upflow**	**Shallow depth with tube settlers**
• Clarifier	$1,270,021	$1,402,367	$1,712,824	$2,087,674
• Piping (10% of clarifiers cost)	$127,002	$140,237	$171,282	$208,767
• Site and landscaping (5% of clarifiers cost)	$63,501	$70,118	$85,641	$104,384
• Electricals and controls (20% of clarifiers cost)	$254,004	$280,473	$342,565	$417,535
Indirect costs	**$171,453**	**$189,320**	**$231,231**	**$281,836**
• Engineering and administrative costs (10% of direct cost)	$171,453	$189,320	$231,231	$281,836
Contingency (15% of direct + indirect costs)	**$282,897**	**$312,377**	**$381,532**	**$465,029**
Total project cost (ex. GST)	**$1,724,370**	**$1,904,064**	**$2,325,587**	**$2,834,540**

3.3.3 Replacing Existing Clarifiers (item [3C])

The following cost estimations for replacing the existing clarifiers (item [3C]) were developed.

Two types of clarifiers are considered here; a simple upflow clarifier (such as those currently installed at Nebo Rd WTP) and a shallow depth clarifier with tube settlers. Two geometric arrangements are also considered for each type of clarifier; circular and rectangular/square. Furthermore, estimates have also been given for two and three new clarifiers.

Table 3-6 Dimensions and Cost Estimations for Replacement of Existing Clarifiers (Item [3C])

Capacity (ML/d)	75				90			
Type	Simple Upflow		Shallow with tube settlers		Simple Upflow		Shallow with tube settlers	
No of units	2	3	2	3	2	3	2	3
Dimensions								
Surface area (m^2)	1,202	801	391	260	1,442	962	469	313
Diameter (circular arrangement; m)	39.1	31.9	22.3	18.2	42.9	35.0	24.4	19.9
Rectangular dimensions (m)[3]	28.3 x 42.5	23.1 x 34.7	16.1 x 24.2	13.2 x 19.8	31.0 x 46.5	25.3 x 38.0	17.6 x 26.4	14.4 x 21.7
Square length (m)	34.7	28.3	19.8	16.1	38.0	31.0	21.7	17.7
Cost estimations								
Circular arrangement								
Direct costs	**$5,266,002**	**$6,045,033**	**$6,108,044**	**$6,497,305**	**$5,818,861**	**$6,690,694**	**$7,017,106**	**$7,452,736**
• Clarifiers	$3,437,779	$4,014,839	$4,061,514	$4,349,855	$3,847,305	$4,493,106	$4,734,893	$5,057,583
• Piping (10% of clarifiers cost)	$343,778	$401,484	$406,151	$434,986	$384,730	$449,311	$473,489	$505,758
• Site and landscaping (5% of clarifiers cost)	$171,889	$200,742	$203,076	$217,493	$192,365	$224,655	$236,745	$252,879
• Electricals and controls (20% of clarifiers cost)	$687,556	$802,968	$812,303	$869,971	$769,461	$898,621	$946,979	$1,011,517
• Demolition and disposal of existing clarifiers	$625,000	$625,000	$625,000	$625,000	$625,000	$625,000	$625,000	$625,000
Indirect costs	**$526,600**	**$604,503**	**$610,804**	**$649,730**	**$581,886**	**$669,069**	**$701,711**	**$745,274**
• Engineering and administrative costs (10% of direct cost)	$526,600	$604,503	$610,804	$649,730	$581,886	$669,069	$701,711	$745,274

[3] Assumes the width to length ratio is 2:3

Capacity (ML/d)	75				90			
Type	Simple Upflow		Shallow with tube settlers		Simple Upflow		Shallow with tube settlers	
No of units	2	3	2	3	2	3	2	3
Contingency (15% of direct + indirect costs)	$868,890	$997,430	$1,007,827	$1,072,055	$960,112	$1,103,964	$1,157,822	$1,229,702
Total project cost (ex. GST)	**$6,661,493**	**$7,646,966**	**$7,726,676**	**$8,219,090**	**$7,360,860**	**$8,463,728**	**$8,876,639**	**$9,427,712**
Rectangular/square arrangement								
Direct costs	**$5,063,368**	**$5,768,398**	**$5,959,693**	**$6,304,495**	**$5,609,416**	**$6,401,184**	**$6,859,556**	**$7,246,778**
• Clarifiers	$3,287,680	$3,809,924	$3,951,624	$4,207,033	$3,692,160	$4,278,655	$4,618,189	$4,905,021
• Piping (10% of clarifiers cost)	$328,768	$380,992	$395,162	$420,703	$369,216	$427,866	$461,819	$490,502
• Site and landscaping (5% of clarifiers cost)	$164,384	$190,496	$197,581	$210,352	$184,608	$213,933	$230,909	$245,251
• Electricals and controls (20% of clarifiers cost)	$657,536	$761,985	$790,325	$841,407	$738,432	$855,731	$923,638	$981,004
• Demolition and disposal of existing clarifiers	$625,000	$625,000	$625,000	$625,000	$625,000	$625,000	$625,000	$625,000
Indirect costs	**$1,150,688**	**$1,333,473**	**$1,383,069**	**$1,472,462**	**$1,292,256**	**$1,497,529**	**$1,616,366**	**$1,716,757**
• Engineering and administrative costs (10% of direct cost)	$1,150,688	$1,333,473	$1,383,069	$1,472,462	$1,292,256	$1,497,529	$1,616,366	$1,716,757
Contingency (15% of direct + indirect costs)	**$665,755**	**$771,510**	**$800,204**	**$851,924**	**$747,662**	**$866,428**	**$935,183**	**$993,267**
Total project cost (ex. GST)	**$5,104,123**	**$5,914,907**	**$6,134,897**	**$6,531,419**	**$5,732,078**	**$6,642,612**	**$7,169,739**	**$7,615,045**

3.4 Sludge Facilities

The following cost estimations for the upgrade of sludge facilities (items [4A] and [4B]) were developed on the basis of 75 and 90 ML/d treated water production.

Table 3-7 Cost Estimations for Additional Sludge Facilities (Items [4A] and [4B])

Item	Component	Inclusions	Exclusions	Cost Basis: 75 ML/d	Cost Basis: 90 ML/d
[4A]	Sludge Thickener	- Sludge Thickener - Standard and general arrangement drawings - Piping and Instrumentation Drawings - Operations manual		$564,938	$677,924
[4B]	Thickened Sludge Tank	- Thickened Sludge Tank - Standard and general arrangement drawings - Piping and Instrumentation Drawings - Operations manual		$262,039	$314,447
[4C]	Centrifuge	- Centrifuge - Standard and general arrangement drawings - Piping and Instrumentation Drawings - Operations manual		$305,241	$305,241
	Other direct costs	- Piping (10%)		$113,222	$129,761
		- Site preparation and landscaping (5%)		$56,611	$64,881
		- Electricals and controls (20%)		$226,444	$259,523
		- Walkways and stairs to tank (installed)		$276,893	$332,271
			TOTAL DIRECT COSTS	$1,805,387	$2,084,049
			INDIRECT COSTS (30%; inc. engineering & administrative)	$541,616	$625,215

	CONTINGENCY (15% of direct + indirect costs)	$352,050	$406,390
	TOTAL COST (ex. GST)	$2,699,053	$3,115,653

3.5 SCADA/PLC modification for Bore Filter Operation

The following cost estimation is for the modification or integration of the SCADA/PLC of Stage 1 and 2 River Filters to with Stage 1 Bore Filters [item 5].

Table 3-8 Cost Estimations for SCADA/PLC modification (Item [5])

Item		Cost
[5]	SCADA/PLC integration or modification	$20,000
	TOTAL DIRECT COSTS	$20,000
	INDIRECT COSTS (30%; inc. engineering & administrative)	$2,000
	CONTINGENCY (15% of direct + indirect costs)	$3,300
	TOTAL COST (ex. GST)	**$25,300**

4 Summary of costs

Several options were given for clarifiers in this report. To provide a summary for the cost estimates of 75 and 90 ML/d upgrade the following options were selected.

- For the 75 ML/d upgrade, the refurbishment of the existing clarifiers [item 3A] and installation of an additional circular shallow depth clarifier with tube settlers [item 3B] was costed together with items 1, 2, 4 and 5.
- For the 90 ML/d upgrade, the replacement existing clarifiers and installation of two circular shallow depth clarifiers with tube settlers [item 3C] was costed together with items 1, 2, 4 and 5.

The summary of costing for an upgrade from the current capacity to 75 ML/d is given in

Table 4-1.

Table 4-1 Summary of costs for 75 ML/d upgrade

Item	Descriptor	Total Direct Cost	Total Indirect cost	Contingency	Total ex. GST	GST	Total inc. GST
[1]	Chemical dosing systems	$125,550	$37,665	$24,482	$187,697	$18,770	$206,467
[2]	Chemical dosing pumps	$91,800	$27,540	$17,901	$137,241	$13,724	$150,965
[3A]	Retrofit of existing clarifiers	$3,264,000 (direct + indirect)		$489,600	$3,753,600	$375,360	$4,128,960
[3B]	Installation of 1 shallow depth clarifier with tube settlers	$1,957,435	$195,743	$322,977	$2,476,155	$247,616	$2,723,771
[4]	Sludge management facilities	$1,805,387	$541,616	$352,050	$2,699,053	$269,905	$2,968,958
[5]	SCADA/PLC modification	$20,000	$2,000	$3,476	$25,476	$2,548	$28,024
				TOTALS	**$9,279,222**	**$927,923**	**$10,207,145**

The summary of costing for an upgrade from the current capacity to 90 ML/d is given in Table 4-2.

Table 4-2 Summary of costs for 90 ML/d upgrade

Item	Descriptor	Total Direct Cost	Total Indirect cost	Contingency	Total ex. GST	GST	Total inc. GST
[1]	Chemical dosing systems	$125,550	$37,665	$24,482	$187,697	$18,770	$206,467
[2]	Chemical dosing pumps	$91,800	$27,540	$17,901	$137,241	$13,724	$150,965
[3C]	Installation of 2 shallow depth clarifiers with tube settlers	$7,017,106	$701,711	$1,157,822	$8,876,639	$887,664	$9,764,302
[4]	Sludge management facilities	$2,084,049	$625,215	$406,390	$3,115,653	$311,565	$3,427,218
[5]	SCADA/PLC modification	$20,000	$2,000	$3,476	$25,476	$2,548	$28,024
				TOTALS	**$12,342,706**	**$1,234,271**	**$13,576,976**

Note: These cost estimations are for upgrades from the current plant capacity to either 75 or 90 ML/day.

The sludge management facilities are costed relative to the size requirements of the 75 and 90 ML/d upgrades[4]. That is, if the sludge facilities were upgraded to meet the equivalent of 75 ML/d treated water capacity and the WTP was later upgraded to meet 90 ML/d, this would require additional units. To overcome these extra requirements, if a step-wise approach to the upgrade was employed, MRC may consider installing sludge management facilities capable of meeting the equivalent 90 ML/d for the 75 ML/d upgrade. The cost estimation for this has been shown below.

Table 4-3 Summary of costs for 75 ML upgrade with sludge facilities capable of 90 ML/d

Item	Descriptor	Total Direct Cost	Total Indirect cost	Contingency	Total ex. GST	GST	Total inc. GST
[1]	Chemical dosing systems	$125,550	$37,665	$24,482	$187,697	$18,770	$206,467
[2]	Chemical dosing pumps	$91,800	$27,540	$17,901	$137,241	$13,724	$150,965
[3A]	Retrofit of existing clarifiers	$3,264,000 (direct + indirect)		$489,600	$3,753,600	$375,360	$4,128,960
[3B]	Installation of 1 shallow depth clarifier with tube settlers	$1,957,435	$195,743	$322,977	$2,476,155	$247,616	$2,723,771

[4] With the exception of the Centrifuge which, with 1 additional can managed loads produced from treating 75 and 90 ML/d.

[4]	Sludge management facilities	$2,084,049	$625,215	$406,390	$3,115,653	$311,565	$3,427,218
[5]	SCADA/PLC modification	$20,000	$2,000	$3,476	$25,476	$2,548	$28,024
				TOTALS	$9,695,822	$969,583	$10,665,405