Mackay Water Strategy

November 2022

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REVISION SCHEDULE

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Abbreviations

AD	Average Day
AMR	Automatic Meter Reading
BPS	Booster Pump Station
BWL	Bottom Water Level
CBD	Central Business District
CPP	Critical Pressure Point
CTM	Cairns Townsville Mackay
CTM Code	Planning Scheme Policy – Water & Sewerage [CTM Water Alliance]
DBP	Disinfection By-Product
DCDB	Digital Cadastral Database
DEWS	Department of Energy and Water Supply
DSS	Desired Standard of Service
EP	Equivalent Person
ET	Equivalent Tenement
FCV	Flow Control Valve
GFA	Gross Floor Area
HGL	Hydraulic Grade Line
HLPS	High Lift Pump Station
HW	Hazell Williams Coefficient
LTFF	Long Term Financial Forecast
MCA	Multi-Criteria Assessment
MDMM	Mean Day Maximum Month
PD	Peak Day demand
PDA	Priority Development Area
PH	Peak Hour
MRC	Mackay Regional Council
MSL	Maximum Service Level
NRW	Non-Revenue Water
PH	Peak Hour
PoC	Point of Connection
PIP	Priority Infrastructure Planning
PS	Pump Station
SCADA	Supervisory Control and Data Acquisition
TWL	Top Water Level
VSD	Variable Speed Drive
WPS	Water Pump Station
WSZ	Water Supply Zone
WTP	Water Treatment Plant

Executive Summary

Mackay Regional Council has undertaken an update of the water strategy for the Nebo Road Water Treatment Plant water supply scheme that services the Mackay and Sarina urban areas and the Marian Water Treatment Plant water supply scheme that services the Marian and Mirani urban areas. The aim of this revised water strategy is to develop a robust, sustainable capital investment program for the Nebo Road and Marian WTP schemes to update the Long Term Financial Forecast and Local Government Infrastructure Plan.

Population and Demand Assessment

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

1. The existing total population for the Nebo Road WTP scheme (Mackay and Sarina) is 118,336 EP and will increase to 196,979 EP at Ultimate. The existing total population for the Marian WTP scheme of 4,975 EP will increase to 10,435 EP at Ultimate.
2. The Ultimate population for Mackay is realised at 2062 based on a 1.2% growth rate and for Marian and Mirani is realised at 2065 based on a 2.0% growth rate derived from the average residential growth rate in the MGAM between 2021 and 2041.
3. The Planning Scheme Policy – Water & Sewerage [CTM Water Alliance] (CTM Code) unit demand of 240 L/EP/day (which does not include for non-revenue water) have been adopted for the Nebo Road WTP scheme as residential usage over the past 5 years has remained stable and in line with this figure. A unit demand of 270 L/EP/day was derived for the Marian WTP based on recent usage data.
4. The CTM Code adopt a NRW component of 16% of the 240 L/EP/day unit demand which is equivalent to 40 L/EP/Day. This value has been adopted and maintained for the 2022 water strategy based on a NRW assessment of recent data. An analysis of the Marian and Mirani scheme provided lower NRW results than the Mackay and Sarina scheme. A non-revenue component of 30 L/EP/day has been adopted for the Marian WTP scheme based on 10% of the Marian WTP unit demand.
5. The overall peaking factors adopted in the water strategy, based on analysis of the AMR data, are:
    a. Nebo Road WTP scheme:
        i. 1.75 for Peak Day
        ii. 1.5 for Mean Day Maximum Month, an increase from the current CTM Code factor of 1.45
    b. Marian WTP scheme:
        i. 2.0 for Peak Day
        ii. 1.6 for Mean Day Maximum Month
6. The peaking factors for each customer sector adopted in the water strategy are provided in Table 6-2 and Table 6-4 of Section 6. The PD peak hour factor for the single family residential (detached) demand sector is 4.66, an increase from the current CTM Code factor of 4.33. The Marian WTP scheme demand data exhibited a higher peak hour usage and a PD peak hour factor of 5.88 is recommended.
7. The existing Nebo Road WTP AD demand of 34.4 megalitres per day is estimated to increase to 56.5 megalitres per day at Ultimate. The Marian WTP AD demand will increase from 1.4 megalitres per day to 3.2 megalitres per day at Ultimate.
8. The predicted Nebo Road WTP PD demand in the 2021 planning horizon of 60.1 megalitres per day is estimated to increase to 98.6 megalitres per day in the Ultimate planning horizon. These figures include some headroom as the adopted CTM Code PD factor is higher than observed historical PD factors. The predicted Nebo Road WTP MDMM demand in the 2021 planning horizon of 51.1 megalitres per day is estimated to increase to 84.4 megalitres per day in the Ultimate planning horizon.
9. The Marian WTP PD demand will increase from 3.0 megalitres per day to 6.3 megalitres per day at Ultimate.

Water Allocation and Strategic Upgrade Timing

Mackay Water has an annual allocation of 16,000 megalitres (43.8 megalitres per day) from the Pioneer River system which will not be exceeded until 2041. The annual allocation of the Marian Weir is already exceeded and allocation is shared from the Dumbleton Weir. Allocation sharing between the Marian and Dumbleton Weir will bring forward the exceedance of the Dumbleton Weir allocation by one year.

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) is as follows:

a. Nebo Road WTP capacity upgrades are required in 2047 based on the adopted 68.5 megalitres per day maximum achievable output with partial clarifier bypass in place.

b. Marian WTP capacity upgrades are required in 2050 based on four megalitres per day production capacity.

A demand forecasting sensitivity was completed by reducing the Nebo Road WTP scheme 240 L/EP/d unit demand to 220 L/EP/day and reducing the NRW component from 16% to 10% would defer major capital works by up to 10 years. With the 280 L/EP/day base demand, reducing the MDMM factor from 1.5 to 1.45 defers major WTP upgrades by 2 years.

Strategic Options Assessment

Strategic options were identified and assessed to satisfy the Mackay and Marian Ultimate demands which included the following options:

a. Build a new 16 megalitres per day Southern WTP and 10 ML Walkerston Reservoir to augment the Nebo Road WTP production capacity.

b. Build a new 85 megalitres per day Southern WTP and 10 megalitre Walkerston Reservoir and decommission the Nebo Road WTP.

c. Upgrade the Marian WTP to six megalitres per day production capacity.

d. Build a transfer main from Walkerston to Marian and decommission the Marian WTP.

The recommended option for the major WTP upgrades in Mackay is the construction of a 16 ML/d Southern WTP to augment the Nebo Road WTP and 10 ML Walkerston Reservoir in 2047. The $30 Million NPC benefit of this option is considered significant enough to not warrant the reduction in resources afforded from decommissioning the Nebo Road WTP.

A preferred option for the Marian scheme has not been identified as the ability of the existing Marian WTP site and raw water intake to accommodate an capacity increase requires confirmation and should be verified prior to the next revision of the water strategy.

Consideration was given to supplying water to Eton via a proposed pipeline from either Walkerston or Marian when the current Eton treatment plant is potentially due for major renewal in 20 years time. Instead of renewing the plant, decommissioning the bores and treatment facility at end of useful life and supplying treated water to Eton from the other WTPs was investigated. The additional Eton MDMM demand estimate of 0.4 megalitres per day would bring forward the timing of major upgrades at the Marian WTP by five years and Nebo Road WTP by one year. Due to the shorter length and less pumping head required, a transfer main supplying Eton from the Nebo Road WTP via Walkerston is more cost efficient than from Marian WTP.

Network Upgrades

The following network augmentations were identified to maintain service standards into the future:

1. Shoal Point reservoir was identified to have a design volume of 1.2 megalitres at 2023 and a booster pump station to supply the high level areas. Persistent demands in the Mackay network will be overcome by building the future 10 megalitres Walkerston Reservoir.

2. Temporarily taking either of the Blacks Beach reservoirs offline for refurbishment works is viable considering the supply capacity from the Blacks Beach PS exceeds PD demand. In the long term, the no. 1 reservoir would pose a risk to constraining potential greenfield development or not containing enough emergency storage in case of supply issues. It is recommended the no. 1 reservoir be kept in the short term to enable refurbishment of the no. 2 reservoir and then the no. 1 reservoir decommissioned.

3. Decommissioning either of the Mount Oscar reservoirs is viable considering the available storage capacity in a single reservoir and ability to bypass the site (assuming there is a Mount Oscar Reservoir bypass main in place).

4. The Slade Point elevated tower is located in a constrained site with no space to increase storage. The tower does not meet storage requirements and is replenished via frequent operation of the Slade Point PS. An option to take Slade Point tower offline and supply half of the Slade Point zone from the Mount Bassett reservoir was investigated. In this arrangement, a booster pump station is required to supply the northern half of the Slade Point zone and a 1 km DN250 augmentation is required to ensure customer service pressures. The existing Slade Point PS should be retained to ensure fire flow performance standards. Alternatively, the existing Slade Point PS could be converted to a booster pump station to supply the entire Slade Point zone.

5. Storage deficiencies have been identified for the Marian Reservoir in the 2031 planning horizon and for the Mirani Reservoir in the Ultimate planning horizon. As the Marian WTP is able to produce more supply than PD up to the 2041 planning horizon, no augmentations to the Marian storage are recommended. In the Ultimate planning horizon, a 1.5 megalitres storage augmentation is recommended for the Marian Reservoir. As there is a 20-hour operation factor of safety in the Mirani Transfer PS capacity, it has been assumed the slight Ultimate Mirani storage deficiency can be accommodated by the Mirani Transfer PS capacity to replenish the reservoir.
6. A business case is required to further investigate the two options presented for reconfiguring the Green Street and Berry Steet zones.
7. A capacity assessment of all transfer pump stations, and trunk mains was undertaken to determine existing and future deficiencies. The capacity assessments are based on providing MDMM demand over 20 hours. The following capacity deficiencies are identified:
    a. A future supply deficiency is identified for the Nebo Road HL PS which is being upgraded in 2023. The HL PS should be sized to suit the WTP maximum achievable capacity which has been adopted as 68.5 ML/d in this study based on existing site constraints and partial clarifier bypass and is forecast to be exceeded in 25 years time. A 20 hour daily operation factor of safety should be incorporated per the CTM Code, resulting in a desired HL PS capacity of 82.2 ML/d.
    b. The Mirani Transfer PS is being considered for refurbishment and the works should consider existing electrical and pump station footprint to facilitate upgrading the pumps to suit Ultimate demand projections in future.
    c. The Alligator Creek trunk main has deficient capacity identified in the 2031 planning horizon. No augmentations are recommended as the downstream reservoirs have significant spare capacity to make up any shortfall in supply and the capacity calculations incorporate a MDMM over 20 hours factor of safety. The installation of new Nebo Road HL PS pumps with increased duty point will provide increased Alligator Creek supply.
    d. The Alligator Creek – Sarina pump set and Alligator Creek to Sarina DN250 trunk main will require upgrades in the Ultimate planning horizon. An additional DN225 main is required to achieve 20 hours MDMM supply or depending on the condition of the existing DN250 main, replacement with a DN375 pipeline when required.
8. A fire flow assessment was completed which identified 11 fire flow augmentation requirements as detailed in Section 8.4.
9. A service pressure assessment has been undertaken for all reticulation mains across all planning horizons and the following network augmentations are required:
    a. In Sarina an upgrade of the Armstrong Beach booster pump station is required in the Ultimate planning horizon.
    b. In Mirani 2.5 kilometres of DN250 distribution main is proposed in the Ultimate planning horizon from the reservoir to the town to mitigate peak hour headloss.
    c. In Marian a three stage five kilometres DN250 distribution main is proposed to mitigate peak hour headloss.
10. The Ultimate planning horizon was assessed for the full development of greenfield areas and it was found that the existing trunk network has sufficient capacity to accommodate Ultimate demand.
11. The implementation of a Pressure Managed Area to service the Mackay CBD was investigated and it is evident that the implementation of the CBD PMA has minimal impact on water age in the Mount Pleasant reservoir (~3 days water age), decreases water age in the Mount Oscar reservoir from up to five days to 3.5 days, and increases water age in the CBD from less than two days to mostly less than three days due to the extended travel time from the Nebo Road WTP.
12. A desktop network resilience assessment was undertaken to determine alternate supply strategies required as well as to calculate the time to empty a reservoir in the event of a reservoir, pump station or trunk main planned or unplanned outage. Alternative supply strategies and enabling works have been outlined for each reservoir in Section 10. It was identified that there is more than two days storage of AD demand in each reservoir in case up upstream supply failure except for the Slade Point reservoir and the Armstrong Beach Balance Tank. The Armstrong Beach Balance Tank has less than a day's storage and will require at least 250 kL/d trucked water supply or supply from the Armstrong Beach bore to maintain levels.

Capital Investment Summary

The total capital works to service the Mackay and Marian water supply networks over the next 20 years is forecast $22.0 Million. Cost estimates for proposed augmentations within this report are based on high level planning costs.

Table 1-1: CIP Summary (Timings below are based on modelled capacity triggers)

Infrastructure category	2021-25	2026-30	2031-35	2036-41
Fire Flow Main Augmentations	$2.8 M			
Fire Flow Pump	$0.1 M			
Network Augmentations – PMA	$0.6 M			
Network Augmentations – Mains	$3.2 M		$1.0 M	
Network Augmentations – Pumps				
Network Augmentations – Reservoir	$2.0 M			
Greenfield Infrastructure – Mains			$2.4 M	
Greenfield Infrastructure - Pumps	$0.3 M	$0.3 M		
Strategic Infrastructure				$9.3 M
TOTAL	**$9.0 M**	**$0.3 M**	**$3.4 M**	**$9.3 M**

Recommendations

The 2022 Water Strategy recommends the following actions:

1. In light of the greater than 20-year timing requirement for strategic augmentations, continue to monitor demand usage and population trends to refine the future timing of major capital works. Implement the upgrades outlined in the Nebo Road WTP Process Review (February 2020) to realise the maximum achievable capacity of the existing WTP.
2. Implement fire flow augmentations and actions as identified in the strategy. Field tests should be undertaken as part of detailed planning to reconfirm the need, sizing and costs.
3. Prepare a business case to determine the optimal configuration for the Berry Street mid-level and Green Street high-level zones.
4. 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.
5. A mechanical/electrical outage response protocol should be established for each pump station as well as a trunk main outage response protocol, condition assessment and leaks monitoring program.
6. Assess propose trunk main alignments treatment plant sites for future projects and start securing easements.
7. Review the maximum output achievable at the Nebo Road WTP and revise the water strategy in 2027.

Mackay Regional Council

Mackay Water Strategy

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1. Introduction

Mackay Regional Council has undertaken an update of the water strategy for the Nebo Road Water Treatment Plant (WTP) water supply scheme that services the Mackay and Sarina urban areas. The aim of this revised water strategy is to develop a robust, sustainable capital investment program for the Nebo Road WTP scheme to update the Long Term Financial Forecast (LTFF) and Local Government Infrastructure Plan. This strategy has also assessed the Marian WTP scheme that services the Marian and Mirani townships to identify the optimum strategic supply strategy to support the Marian WTP and Nebo Road WTP schemes.

A robust and accurate appreciation of the demand forecast, and population projection is a key component in the capital investment strategy required for the Mackay region. Mackay's population is heavily influenced by the performance of the mining sector which needs to be considered when developing the long-term plan. A downturn in the mining sector represents potential opportunities for increased utilisation of existing assets and deferment of strategic infrastructure in the Mackay Region. When there is an upturn in the mining sector there is a potential for high growth rates over short periods in the Mackay Region that can lead to the need of constructing strategic infrastructure sooner than anticipated.

Previous strategies have identified a preferred option to maximise the output capacity of Nebo Road WTP upgrade until such time that a new Southern Water Treatment Plant and associated trunk infrastructure is required. This strategy investigates further options to incorporate the Marian WTP scheme and the potential amalgamation of the schemes to accommodate the growth in both supply zones. The impacts of supplying the rural Eton scheme from either Marian or Nebo Road WTPs is also investigated.

Council has also embarked on a number of initiatives and projects in an effort to better understand demand, non-revenue water and treatment and distribution operational costs. This has included the installation of Automatic Meter Reading (AMR) technologies across the whole of the water meter fleet together with demand management and property leak detection via the myH2O water reporting. In consideration of the Mackay's changing growth rate, there is a need to re-examine the Council's water strategy to ensure future demand projections can be met.

The previous water strategy was completed in 2016 and this update of the strategy is to incorporate the latest population forecast from the 2020 to Ultimate planning horizons, to recommend local and strategic solutions and produce a capital investment program.

1.1. Project Scope and 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. Also included is the Marian WTP scheme strategy.

This strategy was undertaken in three phases that captured the following investigations. 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: Inputs - Establish and understand strategy inputs to qualify the changes to the Mackay supply network and investment strategy since the completion of the 2016 Strategy. Identify key constraints and assumptions that may influence the strategy update and inform MRC of their findings. The following scope items were undertaken and are further detailed in the Phase 1 Technical Memorandum:

1. Stakeholder workshop and needs analysis
2. Growth / Population projections
3. Data collection and gap analysis
4. Raw Water Sources
5. Renewals

Phase 2: Demand Forecast / Service Standards – Confirm the demand assumptions to be applied within the water strategy whilst clearly understanding and defining assumptions and sensitivities around these. The following scope items were undertaken and are further detailed in the Phase 2 Technical Memorandum:

1. Base Demand Forecasting
2. Demand Management
3. Peaking Factor Assessment
4. Update and validate existing hydraulic model
5. Desired Standards of Service

Phase 3: Strategic Options / Strategy Outcomes – Determine the provision of the pre-existing water supply capacity constraints and the associated investment requirements to achieve service standards up to Ultimate demand. Develop the capital investment strategy whilst clearly understanding and defining assumptions and sensitivities around proposed solutions. Recommendations will be finalised to form a holistic investment strategy to maintain network service standards. The following scope items are undertaken and presented in this report:

1. Water Sources
2. Strategic options identification and timing:
    a. Nebo Road WTP and Marian WTP capacity exceedance
    b. Strategic Options Identification and impacts from Eton scheme amalgamation
3. Assessment and development of the water supply infrastructure servicing strategy and network capacity across multiple planning horizons to ensure network can achieve minimum pressure, maximum pressure, and available fire flows in accordance with Council's service standards.
4. Risk assessment of the security of supply and contingency requirement of the strategic supply network.
5. A review of all reservoirs to determine criticality and identify opportunities to decommission assets.
6. Analyse existing network water quality performance and assess the impact to network quality imposed by major trunk main augmentations and implementation of future DMAs/PMAs.

1.1.1 Project Exclusions

The proposed twenty-year investment strategy from the 2020 Nebo Road WTP Process review has been adopted which outlines a maximum achievable output of 68.5 megalitres per day in future following clarifier bypass upgrades and within existing site constraints. This project will not cover assessment of a further Nebo Road WTP site expansion and upgrade requirements to increase maximum achievable output beyond 68.5 megalitres per day.

1.2. Stakeholder Consultation

The following workshops were held with Mackay Regional Council stakeholders to agree and confirm the outcomes at the end of each project phase throughout the development of the strategy. Separate technical memoranda were issued following each phase with the outcomes summarised in this report.

- Stakeholder Engagement Workshop, 11 June, 2021
- Phase 1 – Inputs Workshop, 11 October, 2021
- MGAM Challenge Workshop, 4 November, 2021
- Phase 2A – Demand Forecast, 16 December, 2021
- Phase 2B – Strategic Options, 28 February, 2022
- Phase 3 - Solutions Workshop, 21 July, 2022

1.3. Previous Studies and Relevant Reports

1.3.1 2016 Mackay Water Strategy and 2017 Sarina Water Strategy

The 2016 Mackay Water Strategy was initiated to challenge the capital investment plan required to service the Mackay's water supply system and the recommendations of the prior strategy completed in 2009. The main capital challenge was to assess the option of upgrading the Nebo Road Water Treatment Plant (WTP) compared to the implementation of a new WTP. The 2016 Strategy report also examined a number of overall strategic options involving the future sourcing, treatment, storage, and distribution of the water supply for the period from 2016 to 2046, as well as reviewing population forecasts and the standards of service including unit demand and peaking factors.

The key findings of the 2016 Mackay Water Strategy were:

1. A unit demand of 280 L/EP/d was adopted as Mackay's long-term average day consumption, following a comprehensive review of historical consumption data. This had included an allowance of 40 L/EP/d for non-revenue water. The unit demand represented a 18% reduction to the historic planning assumption of 340 L/EP/d.

2. The maximum historical peak day demand recorded (2012) was up to 57 megalitres per day, while the six-year average in peak day demand was 54 megalitres per day.

3. A re-based demand projection of 1.57% was adopted, from the initial state government-based projection of 2.4%. The applied forecast representing an 18-year deferment (2065) on realising the ultimate population demand (98.3 megalitres per day).

4. The water resources of the Pioneer Valley are managed by Sunwater under the Pioneer Water Plan. Mackay draws raw water supplies from Dumbleton Weir on the Pioneer River and from bores adjacent to the Nebo Road WTP. Based on the 2016 forecast, the system demand is estimated to exceed the annual licence allocation by 2029.

5. A maximum treatment capacity of 75 megalitres per day was assumed for the Nebo Road WTP based on existing site constraints. Major augmentation to the raw water pumps, WTP and treated water pumps will be required to increase the capacity beyond 75 Megalitres per day. Based on the 2016 forecast, the 75 Megalitres per day maximum output is exceeded by 2038, triggering the implementation of the major upgrade.

6. The preferred strategic supply option was to upgrade Nebo Road WTP to 90 Megalitres per day subject to detailed assessment of constraints to expanding the existing site. A 16 megalitres storage would be constructed at Walkerston (2038) to supply the southern region of Mackay and Sarina. In the event that the Nebo Road WTP could not be expanded then an alternative Southern WTP solution could be implemented to predominantly supply the area south of the river, with the Nebo Road WTP retained to supply the area north of the river and the Mackay CBD.

The 2016 Mackay Water Strategy also considered bulk supply to the Sarina and Sarina Beaches areas to supplement Sarina's existing and ageing water supply, without quantifying any localised infrastructure upgrades. The key outcome from the assessment was the preferred strategy to supply the area from the Nebo Road WTP, with decommissioning of the Mt Blarney WTP. This strategy utilises the existing and future spare capacity of the Alligator Creek pumping systems to defer trunk main augmentation, while using Alligator Creek balance tank as a re-chlorination station.

The 2017 Sarina Water Strategy investigated supplying Sarina and Beaches with potable water from Nebo Road WTP to provide a recommendation on decommissioning the Mt Blarney WTP. The Mt Blarney WTP was decommissioned in 2019 and Sarina and Beaches merged with the Nebo Road WTP scheme.

1.3.2 Nebo Road WTP Process Review (February 2020)

Nebo Road WTP process review (2020) has been undertaken to identify constraints and an investment program to achieve a reforecast treatment output of 68.5 Megalitres per day up to 2040. With raw water extraction from the Pioneer River, the treatment capacity is influenced by raw water quality (turbidity, low alkalinity, high organics), limiting the estimated output to between 30 and 40 ML/d. To achieve the required site performance, utilisation of bore water with a partial clarifier bypass is required, allowing deferment of a major treatment upgrade. The WTP capital program also includes the installation of an additional pathogen barrier to increase alignment to the health-based targets recommended in the Australian Drinking Water Guidelines (ADWG), replacement of borehole re-lift pumps, adding coagulation to the bore water treatment train (or alternatively routing the bore water into the raw water dosing tank) and renewal, upgrade and reconfiguration of the High Lift Pumping Station (HLPS).

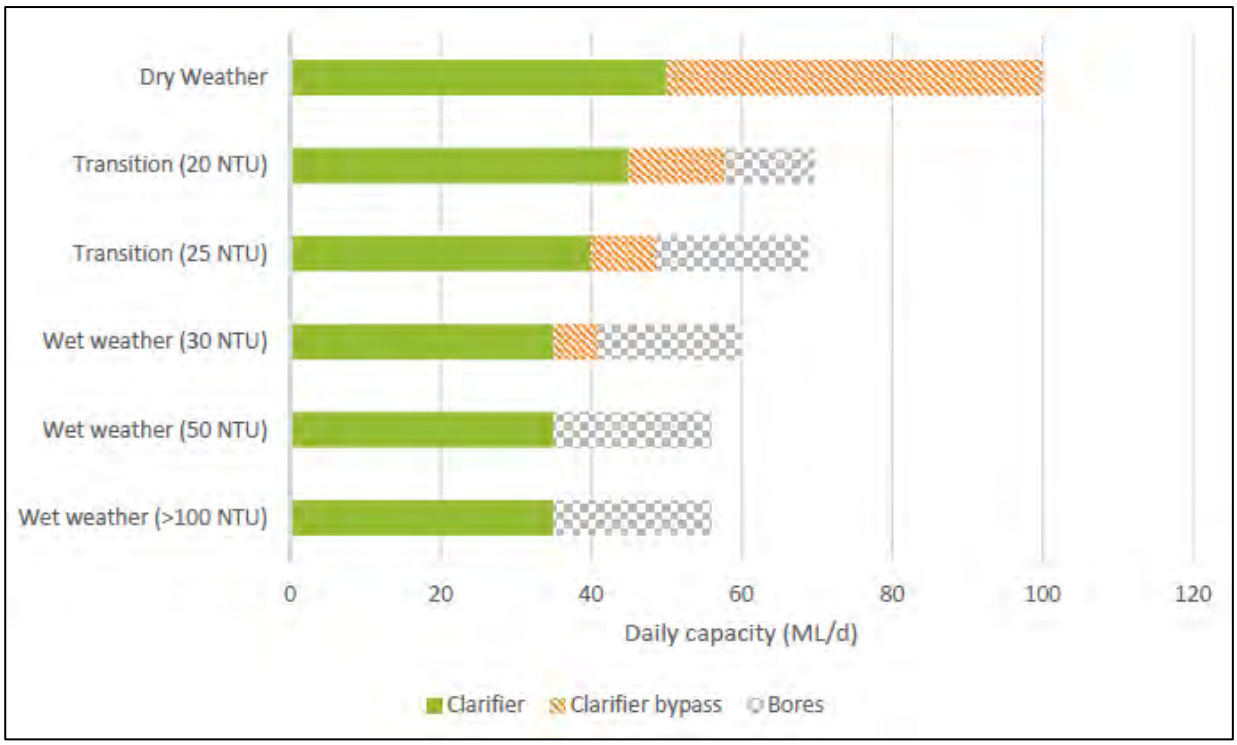


Figure 1-1: Summary of Proposed Clarifier Bypass and Bore Flowrates for a Range of River Water Turbidity Scenarios (Nebo Road WTP Process Review 2020 - Figure 9-5)

1.3.3 Nebo Road WTP HLPS Upgrade Business Case (June 2020)

The Nebo Road High Lift Pumping Station (HLPS) has been identified for replacement and upgrade to accommodate increase in output from the Nebo Road WTP. The Business Case recommends installing three large pumps and two small pumps to replace pumps 2 to 6, in a staged approach. This has been proposed as the preferred option, as long as the construction works can occur during low demand periods without undue risk of supply to customers. The pump size and timings are reviewed as part of this water strategy.

This water strategy provides an updated demand forecast and output capacity of the Nebo Road WTP that would supersede the forecast demands utilised in the Nebo Road WTP HLPS Upgrade Business Case. Refer Section 4.8.

1.3.4 Alligator Creek PS Assessment

The 2017 Sarina water strategy had identified the two pump sets at Alligator Creek WPS that were reaching the end of their useful life and were candidates for renewal. The total duty of the pump sets that transfer water from Alligator Creek balance tank to Sarina and Mount Griffiths reservoirs is larger than the inflow capacity to the Alligator Creek balance tank through the Baronga control valve (actuated valve controlling balance tank levels). Consequently, the inflow deficit creates a risk that the Alligator Creek balance tank will empty when the two pump sets (1&2 and 3&4) are operating simultaneously. The Alligator Creek PS Assessment recommendation was to downsize pumps 3 & 4 servicing Mount Griffith while pump 1 & 2 servicing Sarina reservoirs are replaced to accommodate the 2036 projected growth.

A subsequent feasibility study was conducted to assess the viability of switching the existing Alligator Creek pump sets to provide efficiencies in the capital costs of replacement, and to propose the optimum pump replacement. The hydraulic assessment informed the selection of the replacement pump sets. The pumps were replaced in 2021. The Sarina pump set has a 41 L/s duty capacity.

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

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 this is typically the inlets at 12.85 metres AHD or 10.6 metres AHD. The two bottom suction inlets (at 8.35 metres AHD and 6.037 metres AHD) are rarely opened to avoid stratification issues.

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

Nebo Road WTP receives raw water through 2 large sized trunk mains over a distance of approximately 11 km:

- RWM1: Older main constructed in 1968 consisting of 7.8km of DN500 irrigation class Reinforced Concrete Pipe and 3.2km of DN525 Asbestos Cement Pipe.
- RWM2: Newer main constructed in 1985 consisting of 5.0km of DN675 AC Pipe and 5.2km of DN600 Glass Reinforced Plastic Pipe.

The pipe diameters are optimum for 350 L/s flow (RWM1) and 600 L/s flow (RWM2). Currently, the flow is practically limited to <150 litre per second in RWM1 due to reliability issues. A business case is currently being developed to determine rehabilitation options for RWM1.

The water license with Sunwater expires in 2030 and has a nominal annual entitlement of 16,000 megalitres accessible from the Dumbleton Weir.

2.2. Groundwater System

The groundwater system that supplies to the Nebo Road WTP, during poor water quality conditions and other events, consists of seven operational bores that are currently capable of delivering a maximum instantaneous flowrate of 21 megalitres per day to the WTP. The borefield previously comprised 8 bores however Bore 4 has been decommissioned due to bore collapse and water quality issues.

The groundwater allocation is generally set under licence yearly by the Department of Natural Resources, Mines and Energy (DNRME) and has a volumetric limit of 1,300 megalitres annually. The seasonal entitlement is currently around 50% of the allocation. The allocation for 2015 was reduced to an emergency supply of 300 megalitres per year due to dry weather occurring over the previous two years. Groundwater is a contingency supply only and is mainly used when the river water has high turbidity after significant rain events which there is a risk of these increasing due to climate change.

2.3. Nebo Road Water Treatment Plant

The Nebo Road Water Treatment Plant 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 Dumbleton Weir extraction provides approximately 95% of the total supply input to Nebo Road WTP.

Raw water supply into Nebo WTP is dosed with powdered activated carbon (PAC), potassium permanganate, caustic soda, and /or sodium bicarbonate dosing, prior to coagulation and flocculation. The clarified water is then processed through rapid mixed bed media filters for further removal of solids and microbes. Groundwater extraction is lifted via bore pumps to an aeration basin to remove excess carbon dioxide, and to oxidise soluble iron and manganese. The water is then re-lifted into the bore water filters prior to entering the clear water tank. The treatment process is completed with chlorine dosing and essential contact time for disinfection prior to discharge from the Nebo Road high lift pump station (HLPS) into the distribution network.

The proposed 20-year investment strategy for the Nebo Road WTP outlined in the 2020 Nebo Road WTP Process Review has been adopted for the purposes of this study which outlines a maximum achievable output of 68.5 Megalitres per day with existing site constraints.

2.4. 2.4 Nebo Road High Lift Pump Station

Treated water is transferred from the Nebo Road balance tanks (total volume 10 megalitres) by the Nebo Road HLPS.

The Nebo Road HLPS pumps water into the DN875 diameter pipeline connection to the Mount Pleasant and Mount Oscar reservoirs (TWL 51.1 metres AHD and 48.7 metres AHD respectively) in north Mackay. The high lift pumps also supply water directly into the south Mackay network.

All of Mackay's potable water reservoirs, with the exception of the existing Silingardies Road reservoir and reservoirs in the Sarina region, 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.

There are six pumps of various sizes and condition, all with variable speed drives. Pump 1 experiences significant cavitation issues. TR-079 Asset Condition Assessment Memo concluded that Pump units 2 to 6 appear to be in reasonable condition for their age. However, their age is quite advanced (dates range from 1952 to 1981). Combinations of the existing pumps running in parallel are either not well suited and are unlikely to be able to meet the 2030 demands. Design for the upgrade of the HLPS is programmed for 2022.

2.5. Distribution Network

The existing water supply network for Mackay is shown in Appendix A. The following sections provide an overview of the existing system operation.

2.5.1 Mount Pleasant and Mount Oscar Reservoir Zone

The Mount Pleasant and Mount Oscar reservoir zone incorporates the Nebo Road HLPS, Mount Pleasant reservoir and Mount Oscar reservoir which are key trunk supply and storage assets of the Mackay network. The Nebo Road HLPS pumps water into the 800 mm diameter pipeline connection to the Mount Pleasant and Mount 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
- 300 mm diameter Nebo Road (Walkerston) main.

The Mount Pleasant reservoir complex consists of 3 x 18.2 megalitres reservoirs (total volume of 54.6 megalitres) at a TWL of 51.1 metres AHD. The Mount Oscar reservoir complex consists of 2 x 6.75 megalitres reservoirs (total volume of 13.5 megalitres) at a TWL of 48.7 metres AHD.

The Mount Pleasant and Mount Oscar reservoir zone directly feeds 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 Mount Bassett reservoir and Slade Point pump station (that supplies the Slade Point elevated tower). When the Nebo Road HLPS pumps are off, the reservoirs supply the demand south of the Pioneer River.

2.5.2 Mount Oscar High Level Zones

The area adjacent to the Mount Oscar reservoir, has properties at elevations that cannot be serviced by the hydraulic grade of the Mount Pleasant and Mount Oscar reservoir zone. Two high level pumped supply zones exist in the Mount Oscar reservoir zone to service these highly elevated properties:

- Berry Street Mid-Level Zone (MLZ) – Maximum water supply elevation 40 mAHD. The reservoir has a volume of 1.13 megalitres and a TWL of 64.1 metres 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 mAHD. The Green Street reservoir has a volume of 0.9 megalitres and a TWL of 37 metres AHD with a booster pump downstream that pressurises the HLZ area.

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

From the Mount 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 millimetre / 600-millimetre trunk main which in turn supplies the Blacks Beach reservoirs and Shoal Point reservoir. The Rural View reservoir has a volume of 10 megalitres and a TWL of 65.6 metres AHD and directly supplies the suburbs of Rural View and Bucasia. There are a number of highly elevated properties located near the Rural View reservoir which are supplied by the Premier Gardens booster pump station.

The Blacks Beach reservoir complex consists of a 2.25 megalitres reservoir and 4.6 megalitres resservoir (total volume of 6.85 megalitres) at a TWL of 65.4 metres 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 millimetre / 300-millimetre trunk main and an additional transfer pump station (that assists with improving reservoir turnover) from Rural View reservoir and/or Golf Links pump station. There is a small booster zone adjacent to the Blacks Beach reservoir to serve the highly elevated properties on Eulbertie Avenue and Blacks Beach Reservoir Road. The Eulbertie Ave booster pump station is located in the same building as the Blacks Beach transfer pump station located at the base of Blacks Beach Reservoir Road on Alan Naish Court. The Florence Street booster pump station is located at the top of Florence Street and services approximately 5 properties. In addition, the Dolphin Heads booster pump station on Camilleri Street supplies the high elevated areas of Dolphins Heads.

The Shoal Point reservoir has a volume of 0.5 megalitres and a TWL of 47.1 metres AHD and directly supplies the suburb of Shoal Point. Shoal Point reservoir is filled via a 375 millimetre / 300-millimetre 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 megalitres reservoir is proposed to replace the existing 0.5 megalitres reservoir.

2.5.4 Mount Bassett and Slade Point Pressure Zones

The Mount Bassett and Slade Point pressure zones are supplied under gravity from the Mount Oscar reservoir via 600 millimetre / 525 millimetre / 250 millimetres / 300-millimetre trunk mains 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 Mount Bassett reservoir.

The Mount Bassett reservoir has a volume of 5.57 megalitres at a TWL of 36.32 mAHD. The reservoir supplies the Mackay Port and the Mackay Harbour booster zone (booster pump situated on Mulherin Drive). The Mount Bassett reservoir, along with the actuated valve, also feeds the Slade Point pump station that operates at fixed speed to supply the Slade Point elevated tower. This elevated reservoir has a volume of 0.47 megalitres and a TWL of 47.58 mAHD supplying the suburb of Slade Point.

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

Water is transferred from the Mount Pleasant reservoirs through 450 millimetre / 375 millimetre / 250-millimetre trunk mains via the Janes Creek Pump Station (located on the Bruce Highway) which supplies 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 Glenella PRV zone is being extended with a new main connecting the Illalangi Estate Street Booster zone so the booster pump station can be decommissioned and pressure deficiencies around the Phillip Street high elevation areas can be mitigated.

The Farleigh reservoir has a volume of five megalitres and a TWL of 107 metres 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-millimetre trunk main to The Leap Break Tank. The Leap Break Tank has a volume of 0.7 megalitres and a TWL of 98 metres AHD and supplies properties at The Leap, along the Bruce Highway, Yakapari-Seaforth Road, and 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 reservoirs (2 x 0.03 ML, TWL 193.3 metres AHD) situated on Ian Reddacliff Drive. From the Bonson Scrub reservoirs there is a small booster pump station that supplies properties in the Bonson Scrub HLZ adjacent to the reservoirs.

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

The Seaforth reservoir has a volume of two megalitres with a TWL of 59.6 metres AHD supplying the suburb of Seaforth. Downstream of the Seaforth reservoir is the Mt Vista pump station and reservoir (0.3 megalitres, 115.6 metres AHD) that was constructed to serve elevated areas along Aviland Drive and View Court.

The Ball Bay reservoir has a volume of 1.5 megalitres with a TWL of 58.9 metres AHD supplying the suburbs of Ball Bay and Haliday Bay. A pressure sustaining valve at the intersection of Kippen Drive and Cape Hillsborough Road maintains pressure for properties on Kippen Drive.

2.5.6 Walkerston Pressure Zone

Walkerston is supplied by the Silingardies Road reservoir via the Walkerston pump station located on the Peak Downs Highway. The Silingardies Road reservoir has a volume of 2.25 megalitres and a TWL of 62.5 metres AHD.

2.5.7 Supply to Sarina

Sarina is supplied from the Nebo Road WTP via an existing 300-millimetre trunk main following the Bruce Highway and an actuated valve located at Alligator Creek. Water is supplied to the Alligator Creek ground level balance tank (0.17 megalitres) at a TWL of 18.5 metres AHD via the actuated valve (Baronga). The Alligator Creek pump station includes two separate pump

sets that supply water from the Alligator Creek balance tank to either the Sarina northern beaches or Sarina Township to the south.

Alligator Creek pumps 3 and 4 transfer water to the Mount Griffiths reservoir (1.8 megalitres) at a TWL of 67.5 metres AHD. The Mount Griffiths reservoir services Hay Point demand and acts as a balance tank to transfer water via gravity to the Mt Hayden reservoir (1.8 megalitres) at a TWL of 52 metres AHD which supplies Sarina Beach, Grasstree Beach and Campwin Beach demand. A booster pump station boosts pressure to properties on Perpetua Point.

Alligator Creek pumps 1 and 2 transfer water to the Sarina reservoirs which consists of two reservoirs (3.75 and 2.25 megalitres) both at a TWL of 67.6 metres AHD. The Sarina reservoirs services Sarina reticulation as well as the Armstrong Beach Balance tank (0.16 ML) at a TWL of 37.9 metres AHD via the South Sarina Booster pump station. The Sarina reservoirs have the ability to provide water to the Alligator Creek tank which supplies the Northern Beaches of Sarina however this isn't the current operating arrangement. The Armstrong Beach balance tank can also receive water from the Davis Gully bore when required. The Armstrong Beach booster pump station supplies the Armstrong Beach water network from the Armstrong Beach balance tank and has a capacity of 27 L/s. The Leslie Street booster pump station is located on the Sarina reservoir site and services surrounding high elevation properties. The Hill Street booster pump station is located adjacent the Sarina reservoirs on Hill Street and services high elevation properties along Jackson Street and West Street.

2.6. Marian WTP Scheme

The Marian WTP supplies the Marian and Mirani townships containing approximately a combined 4,400 residents and is a separate potable water network to the Nebo Road WTP scheme. Raw water is sourced from the Pioneer River via the Marian weir and treated at the Marian WTP. Treated water is pumped from the Marian WTP to the Marian reservoir (TWL 49.5 meters AHD, 1.6 ML) where the Marian reservoir booster pump station supplies the Marian township and the Mirani transfer pump station transports water to the Mirani reservoir (TWL 49.59 metres AHD, 1.6 megalitres) via a 4.6 kilometres DN150 trunk main. The Mirani reservoir booster pump station supplies the Mirani township from the Mirani reservoir. The Marian WTP can produce up to four megalitres per day.

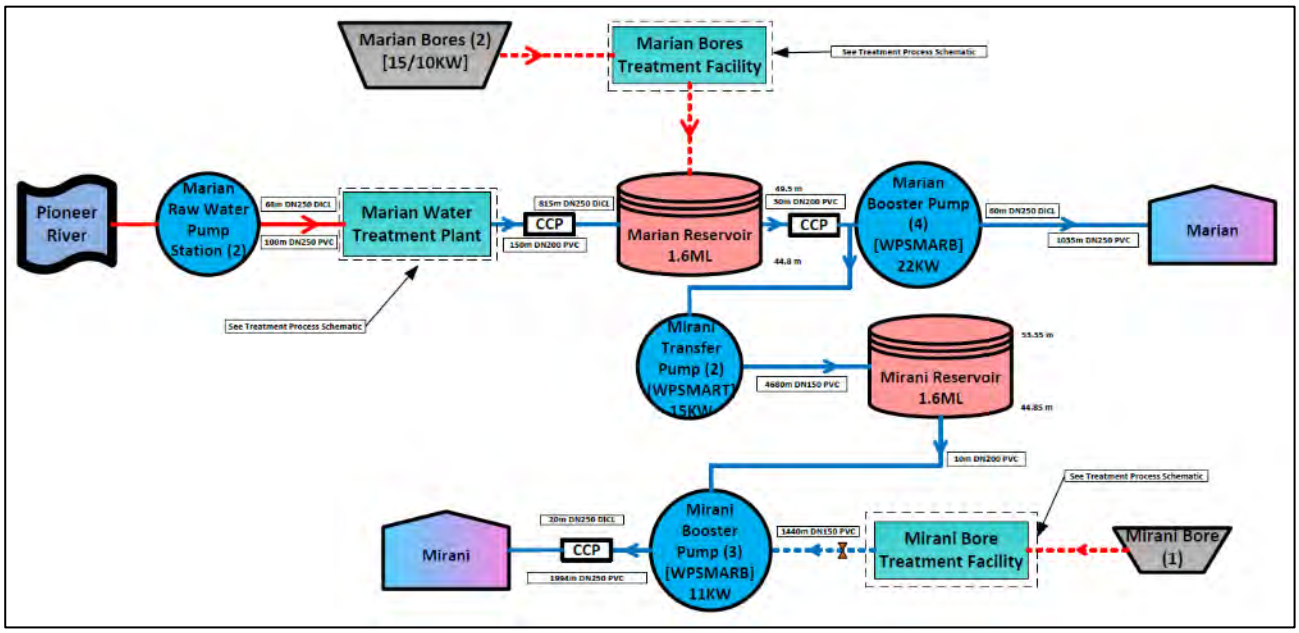


Figure 2-1: Marian and Mirani Water Supply

3. Population Projections

The Mackay Growth Allocation Model MGAM) 2020 model was used to aggregate parcel based residential dwellings and non-residential Gross Floor Areas (GFA) within the study areas for the 2020, 2021, 2026, 2031, 2036, 2041 and Ultimate planning horizons. The MGAM provided the following information on a Lot level basis:

- Count of Attached, Detached and Other residential dwellings. Note the MGAM "Other" residential dwelling and population category has been amalgamated with the "Attached" dwelling and population category for the purposes of this strategy as agreed with MRC during the Phase 1 Workshop.
- Population of Attached, Detached and Other residential dwellings.
- Gross Floor Area (m^2) of 14 non-residential development categories.

- Number of existing and anticipated employees within each of the 14 non-residential development categories.

3.1. Residential Population

The MGAM 2020 Planning Assumptions Report (PIE Solutions, May 2021) states that the MGAM's growth targets were informed by the Queensland Government 2018 medium series population projection published by the Queensland Government Statisticians Office (QGSO). The assumed population growth rates were adjusted in consultation with the Queensland Government Statistician Office in 2020, to reflect slower short-term growth and consideration of the impacts of COVID-19 border restrictions on migration.

A workshop was held on the November 4, 2021 to challenge the MGAM short-term growth rate as actual growth rate experienced in Mackay is high based on significant development activity and perceived low rental vacancies. It was determined the MGAM population projections would be adopted without change. Whilst the short-term growth allowance for COVID-19 in the MGAM was not reflective of the current growth trend in Mackay, the long-term trend aligns with the historical average growth rate Mackay has experienced through the mining booms and downturns. Regardless of short-term growth, the long-term population projection (to Ultimate) aligns with the adopted 1.2% growth rate.

MGAM data applicable to the study area was extracted based on the water supply serviceable area boundary layer provided by MRC. Table 3-1 and Table 3-2 summarises the residential population growth from the 2020 to Ultimate planning horizons for Mackay and Sarina as well as Marian and Mirani, respectively. A comparison between water meter connections numbers and the MGAM population was undertaken. The comparison confirms the MGAM 2020 residential EP provides a reasonable population baseline.

Table 3-1: MGAM Residential EP Projections Mackay and Sarina

Service Area	Development Type	2020	2021	2026	2031	2036	2041	Ultimate
Mackay and Sarina	Attached	12,539	12,667	13,068	14,175	16,559	19,231	34,210
	Detached	81,401	81,998	84,447	89,058	93,575	98,197	114,078
	TOTAL	**93,940**	**94,665**	**97,515**	**103,233**	**110,134**	**117,428**	**148,288**

Table 3-2: MGAM Residential EP Projections Marian and Mirani

Service Area	Development Type	2020	2021	2026	2031	2036	2041	Ultimate
Marian and Mirani	Attached	68	68	70	70	71	71	428
	Detached	4,303	4,314	4,462	4,945	5,426	6,081	8,805
	TOTAL	**4,372**	**4,382**	**4,532**	**5,015**	**5,497**	**6,152**	**9,233**

3.1.1 Occupancy Ratio

The occupancy rates used by the MGAM are set according to QGSO SA2 boundaries. The MGAM uses the projected occupancy rate of dwellings prepared by the QGSO with some adjustments made by MRC to reflect local trends per SA2. Table 3-3 summarises the average occupancy rates across the study area calculated by dividing the total dwellings by population. The occupancy ratio is used to analyse the residential water meter data and convert from L/property/day to L/EP/day in Section 4.4.

Table 3-3: Calculated Average Residential Occupancy Rates across the Study Areas

Service Area	Development Type	2020	2021	2026	2031	2036	2041	Ultimate
Mackay and Sarina	Attached	1.45	1.45	1.49	1.52	1.56	1.60	1.60
	Detached	2.52	2.53	2.54	2.54	2.54	2.55	2.58
Marian and Mirani	Attached	1.34	1.34	1.37	1.40	1.41	1.42	1.42
	Detached	2.58	2.58	2.62	2.64	2.66	2.68	2.68

3.2. Non-Residential Population

The historical ratio of Residential to Non-Residential consumption was used to derive the Non-Residential EP from the MGAM Residential EP. The ratio of Residential to Non-Residential demand has been approximately 80:20 over the past four years as presented in Table 3-4. The 80:20 ratio was used to derive a base year Mackay and Sarina Non-Residential population of 23,485 EP from the 2020 Residential population of 93,940 EP.

Table 3-4: Mackay and Sarina Ratio of Non-Residential EP*

Category	2017	2018	2019	2020

Residential consumption (ML/d)	20.3	21.1	21.6	20.4
Non-Residential consumption (ML/d)*	5.7	6.0	5.1	4.2
Component of Non-Residential usage out of total Residential and Non-Residential usage	22%	22%	19%	17%

*The Bakers Creek abattoir and Mackay Harbour were omitted from the analysis as these are large water users and will be accounted for separately in the demand projections.

3.2.1 Non-Residential Gross Floor Area to Equivalent Population Conversion Rates

The MGAM provides GFA projections for 14 non-residential development types which were categorised into Commercial, Industrial and Public/Open demand types for the purposes of allocating to the hydraulic planning model. Table 3-5 summarises the MGAM non-residential GFA per planning horizon.

Water usage data was used to derive planning unit rates to convert MGAM GFA to Non-Residential EP. The non-residential water meter data was categorised into Commercial, Industrial and Public/Open Space water usage which comprised of approximately 50%, 30% and 20% of the total non-residential usage, respectively. Table 3-6 presents the derived planning unit rates per Non-Residential demand category. The unit rates as agreed with MRC are used to convert the MGAM Non-Residential GFA projections to a future water demand for each planning horizon.

Table 3-5: Mackay and Sarina Total Non-Residential GFA

Non-Residential Development Type	Demand Category	Total GFA (Ha) – Mackay and Sarina						
		2020	2021	2026	2031	2036	2041	Ultimate
Other bed	Commercial	3	5	5	5	5	8	10
Visitor Accommodation	Commercial	16	16	16	16	17	18	22
Retail and services	Commercial	49	49	51	52	55	57	79
Showroom	Commercial	7	8	8	9	10	11	40
Commercial	Commercial	19	19	20	21	23	25	54
Light Industry	Industrial	133	131	137	145	154	159	268
General Industry	Industrial	34	34	38	41	42	42	143
Community	Public/Open Space	11	11	12	12	13	13	18
Education - Child care	Commercial	2	2	2	2	2	2	2
Education - Schools	Public/Open Space	17	16	18	19	20	21	21
Education - Tertiary	Public/Open Space	4	4	5	5	5	6	4
Hospital	Public/Open Space	8	8	8	8	8	8	7
Sports and Recreation	Public/Open Space	1	1	1	2	2	2	2
Rural and Other	Industrial	5	5	5	5	5	5	5
Total GFA		311	312	325	342	363	376	677
Non-Residential EP Projection		23,485	23,741	24,655	25,761	27,448	28,709	48,269

Table 3-6: Non-Residential EP Unit Rates

Category	Proportion of non-residential water meter consumption data	2020 Non-Residential EP	MGAM GFA (m2)	Unit Rates EP/m2
Commercial	50%	11,742	961,491	0.0122

Industrial	30%	7,045	1,731,026	0.0041
Public/Open Space	20%	4,697	417,527	0.0112
TOTAL	-	23,485	3,110,044	-

The Non-Residential GFA to EP conversation rates derived for the Nebo Road WTP scheme were also adopted for the Marian WTP scheme. There was not considered to be a benefit from deriving non-residential unit rates across individual schemes due to the small amount of non-residential demand in the regional schemes and the varied and unpredictable nature of non-residential water use. Marian WTP scheme Non-Residential EP projections are presented in Table 3-7.

Table 3-7: Marian and Mirani Total Non-Residential GFA and EP Projections

Service Area	2020	2021	2026	2031	2036	2041	Ultimate
Marian and Mirani Total GFA (Ha)	8	8	9	9	9	12	20
Marian and Mirani Non-Residential EP	547	595	615	643	686	796	1,203

3.3. Equivalent Population Projections

Total EP projections have been developed based on the current residential population projection from the MGAM and adding a non-residential component based on the 80:20 residential to non-residential water consumption ratio. An additional 5,300 EP has been added at each planning horizon to account for the Bakers Creek abattoir (Meter Property Key 184155) and Mackay Harbour (Meter Property Key 262540) large water users who on average use approximately 1.5 ML/day combined. The Ultimate population for Mackay is realised at 2062 based on a 1.2% growth rate and for Marian and Mirani is realised at 2065 based on a 2.0% growth rate derived from the average residential growth rate between 2021 and 2041.

Table 3-8 summarises the EP per reservoir supply area per planning horizon. Figure 3-1 summarises the EP projections and provides comparison to the previous study's projections. The total EP projections for the Marian WTP scheme is presented in Figure 3-2. The 2022 Water Strategy population projections are slightly lower in the Ultimate planning horizon (approx. 10,000 EP) than the 2016 Water Strategy population d. The Ooralea and Richmond areas are outside the Priority Infrastructure Areas (PIA). The Ultimate growth scenario only considers developments within the PIA and Richmond and Ooralea are not part of the water strategy.

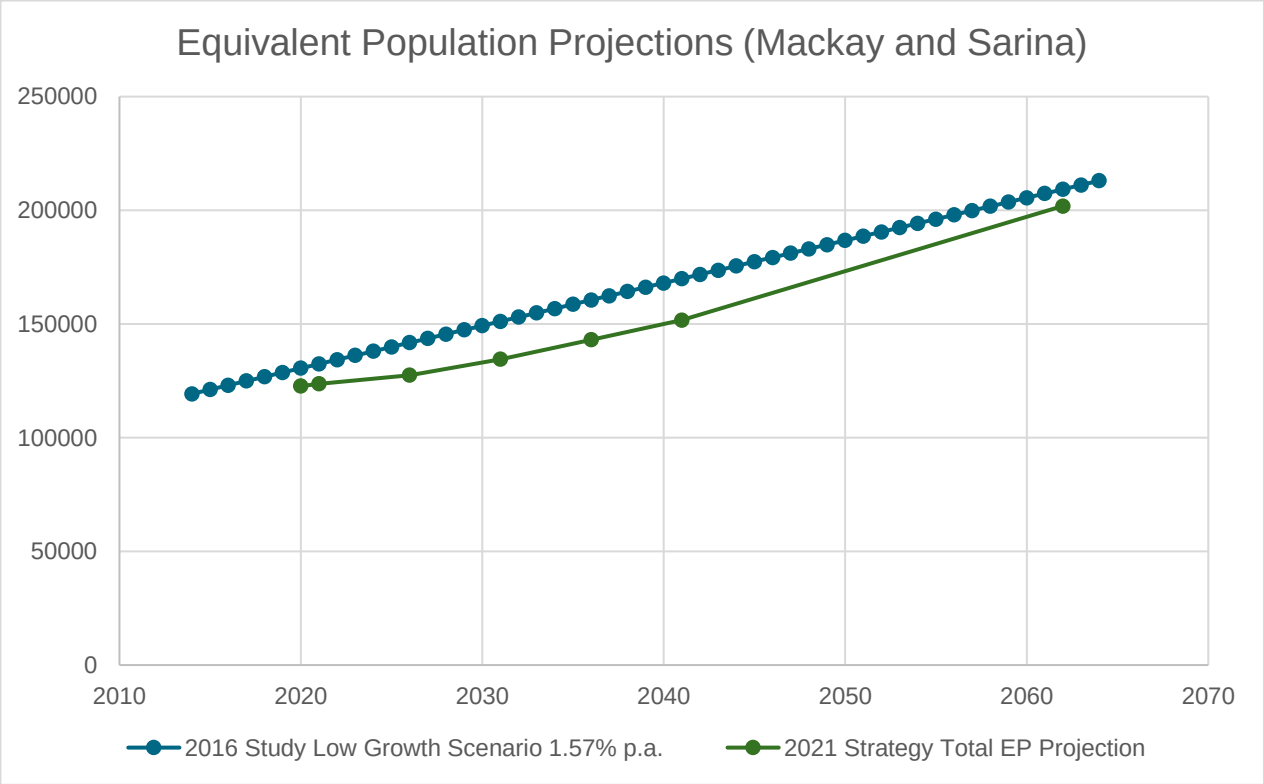


Figure 3-1: Mackay and Sarina EP Projections

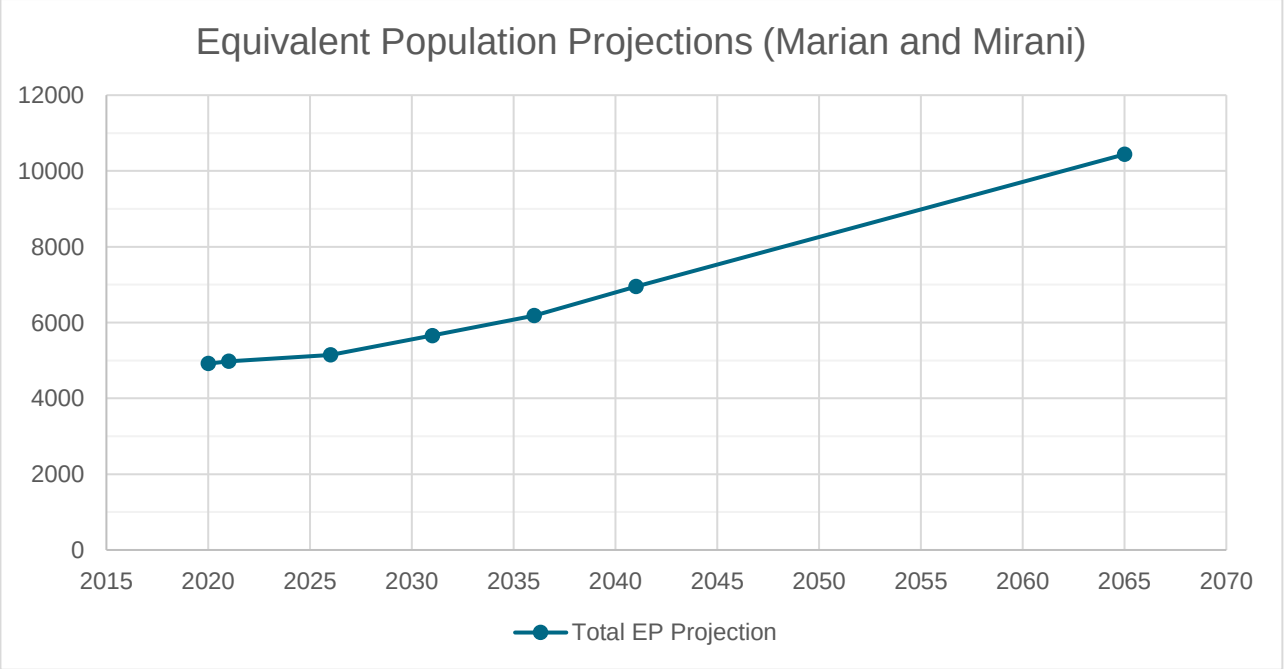


Figure 3-2: Marian and Mirani EP Projections

Table 3-8: Population Projections per Zone

Reservoir Supply Area	2021	2026	2031	2036	2041	Ultimate
Armstrong Beach	902	937	938	939	939	1,511
Ball Bay / Halliday Bay	738	770	801	801	801	920
Berry St	982	1,029	1,080	1,263	1,372	1,409
Blacks Beach	7,732	7,778	7,922	8,530	8,876	11,774
Farleigh	1,579	1,641	1,788	1,866	1,915	1,993
Green St	189	196	196	203	213	222
Leap Tank	654	683	683	683	684	752
Mount Griffiths	1,697	1,743	1,746	1,747	1,747	2,117
Mount Hayden	1,850	1,924	1,931	2,012	2,013	2,206
Mount Bassett	1,405	1,429	1,700	2,031	2,455	3,432
Mount Oscar	9,344	9,687	10,033	10,808	11,431	12,283
Mount Pleasant	63,333	65,211	67,963	70,650	74,052	101,365
Rural View	13,993	15,140	17,958	20,500	23,721	32,834
Sarina Town	4,562	4,847	5,021	5,255	5,565	8,936
Seaforth	1,185	1,234	1,275	1,316	1,316	1,524
Shoal Point	461	517	756	1,030	1,156	3,810
Silingardies	3,559	3,701	3,863	3,983	4,169	5,301
Slade Point	4,171	4,200	4,286	4,408	4,444	4,590
Total for Nebo Road WTP	**118,336**	**122,667**	**129,940**	**138,025**	**146,869**	**196,979**
Marian	3,476	3,621	3,963	4,279	4,644	6,587
Mirani	1,499	1,525	1,693	1,902	2,303	3,848
Total for Marian WTP	**4,975**	**5,146**	**5,656**	**6,181**	**6,947**	**10,435**

4. Nebo Road WTP 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 review and determine the unit demand, peaking factors and non-revenue water:

- Previous five years of WTP daily production and rainfall
- Previous five years of customer billing data to undertake a sectoral assessment
- WaterTrac model 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 from 2015 was provided to ascertain the peak deployable output to supply the Mackay supply network. The performance of the Nebo Road WTP was graphed against rainfall and is presented in Figure 4-1 to illustrate the influence on system demand.

The highest daily output from Nebo Road WTP is observed as 56.9 megalitres and occurred on the November 29, 2020. However, the proceeding day had a 20 megalitres reduction in output due to a trialling of clarifier dosing causing a subsequent blockage in the filter. Therefore, the peak output was to compensate for this short-term reduction causing a decline in reservoir storage and is not reflective of the peak system demand. This anomaly was removed from Figure 4-1.

The peak production from Nebo Road WTP since 2015 was 53.9 ML on December 8, 2019, representing over a 3.5 ML reduction from the previous peak production day (57.5 ML) recorded on December 6, 2012.

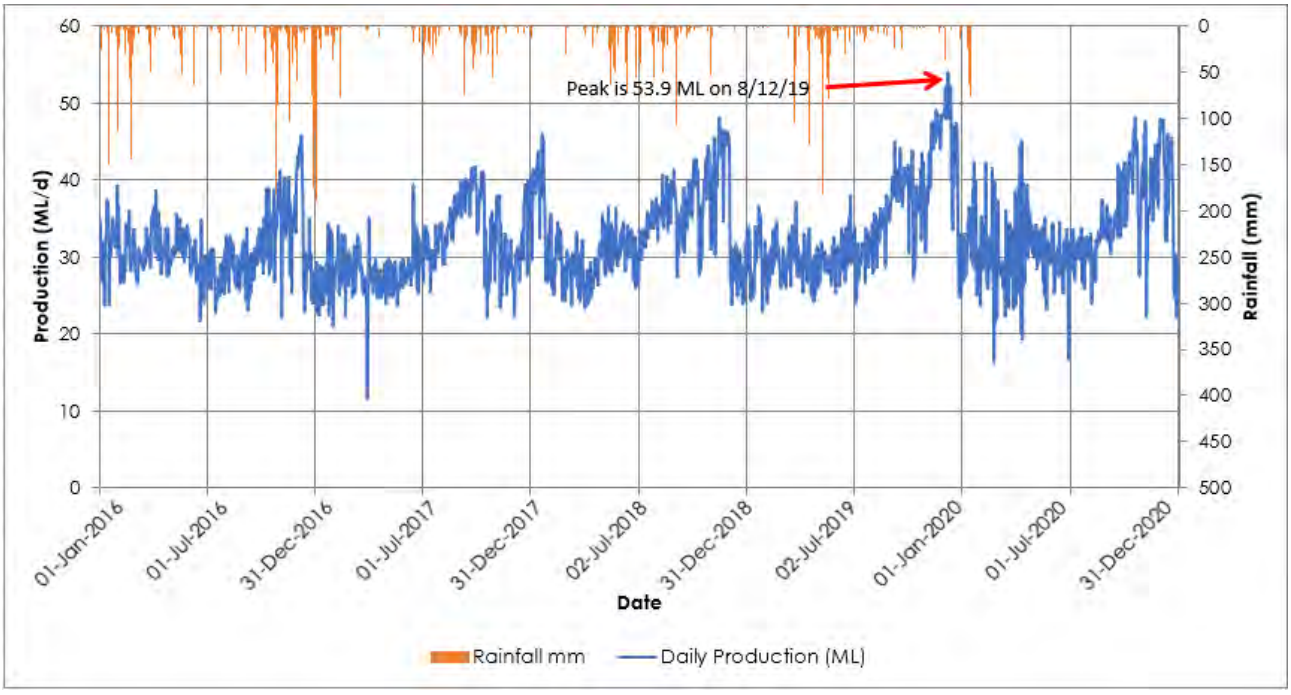


Figure 4-1: 2016 to 2020 Nebo Road WTP Daily Production Data (ML/d)

Similar to what occurred in December 2012, a prolonged dry period was observed leading up to the peak production day experienced in December 2019. Between 2016 and 2018 over 3,800 millimetres of rainfall was recorded which is approximately 55% more than that recorded for the subsequent two years up to 2019. In addition, the six months prior to the peak output from Nebo Road WTP in December 2019 saw only 8% (105 millimetres) of the yearly rainfall. Typical peak day production that occurs in years with average rainfall is in the range of 45-47 megalitres per day

The average daily demand requirement of the Mackay system based on Nebo Road WTP output is 32.4 megalitres per day. As with peak demand this has been influence by prolonged dry weather with an increase observed after 2017. It is noted that water has been supplied to the Sarina scheme from the Nebo Road WTP via the interconnecting pipeline since March 2015 with 98% of the Sarina scheme demand supplied from Nebo Road WTP in the 2017/18 financial year.

Figure 4-2 shows the 3 to 31 day moving average of demand in the maximum peak period over the last five years between November 13 to December 12, 2019. The 3-day moving average of 52.5 megalitres per day represents a reduction from the 56.2 megalitres per day observed from the proceeding peak demand period in December 2012. The infrastructure

requirements and timing of an alternative supply strategy for the Mackay should consider persistent demand requirements, referenced against the Nebo Road WTP capacity constraint of 68.5 megalitres per day. This is discussed in Section 8.1.8.

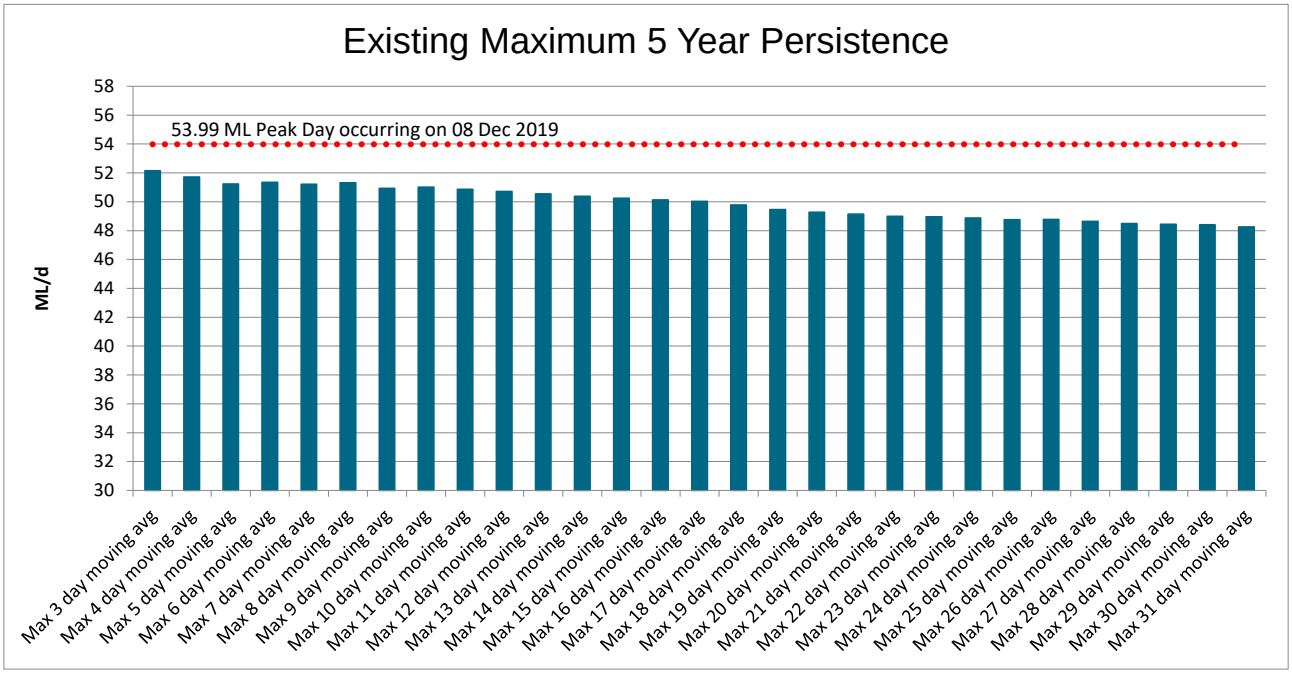


Figure 4-2: Maximum Persistence of Mackay Production – Past 5 Years

4.2. Non-Revenue Water

Non-revenue water (NRW) rates have been calculated from the WTP production figures and Automatic Meter Read (AMR) data as presented in Table 4-1. These results indicate increasing NRW in recent years however it is expected this result is caused by customer meter batteries failing as they approach their 10-year lifespan, reducing customer usage figures. Figure 4-3 presents the annual count of detached dwellings that registered a meter read. There has been a significant reduction in dwellings with an active meter since 2018 presumably because of failing meter batteries, resulting in increased NRW volumes. It was also noted that a mains scouring program was implemented from December 2020 to February 2021 due to a dirty water event which would further impact the 2020 results.

The Planning Scheme Policy – Water & Sewerage [CTM Water Alliance] (CTM Code) adopt a NRW component of 16% of the 240 L/EP/day unit demand which is equivalent to 40 L/EP/Day. This value has been adopted and maintained for the 2022 water strategy. A NRW reduction sensitivity assessment is undertaken and presented in Section 4.10. Reduction of the NRW component may be viable following meter battery replacements providing clarity of data.

Table 4-1: Mackay and Sarina NRW

Category	2017	2018	2019	2020
Production (ML/d)	30.5	33.4	33.8	33.3
Residential consumption (ML/d)	20.3	21.1	21.6	20.4
Non-Residential consumption (ML/d)	5.7	6.0	5.1	4.2
Large Users (ML/d)	1.3	1.6	1.5	1.4
Non-Revenue Water (ML/d)	3.2	4.7	5.6	7.2
Non-Revenue Water (%)	**10.4%**	**14.1%**	**16.4%**	**21.6%**

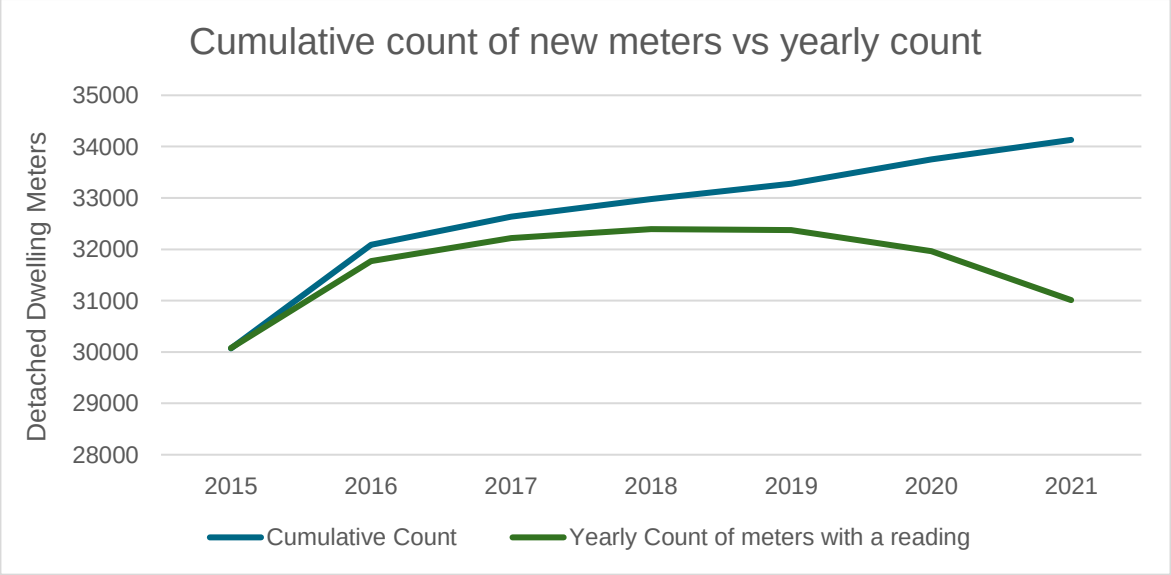


Figure 4-3: Nebo Rd WTP Scheme Yearly and Cumulative Count of Meter Reads per Dwelling

4.3. Climate Correction of Production and Demand Data

An in-house model (WaterTrac) that Stantec has developed assists 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 process of climate-correction can be summarised as follows:

- A soil moisture index is derived from the climate data (temperature, rainfall, evaporation) and is included as a fourth climate variable.
- 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.
- 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.

WaterTrac uses the following data to produce a climate-corrected trend of total water production:

- Daily production data from the Nebo Road WTP (1/7/2008 to 1/6/2021)
- Climate data for Mackay was obtained from SILO Data Drill (1/1/1980 to present). The Data Drill accesses grids of climate data interpolated from point observations by the Bureau of Meteorology.
- Serviced population between 2008 and 2015 were sourced from the 2016 Mackay Water Strategy. The population between 2016 and 2021 was determined from an assessment of number of residential connections multiplied by the occupancy rate (2.52 for detached dwellings and 1.45 for attached dwellings).

4.3.1 WaterTrac Model Build and Calibration

The model was calibrated over a two-year period from the start of 2018 to the end of 2019. The WaterTrac results are shown in Figure 4-4. Overall, a good correlation between observed and predicted demand was achieved between 2016 and 2021 indicating that production and climate are strongly related. The observed and predicted demand diverge looking back from 2016 indicating that there was a change in demand usage not influenced by climate. As the observed demand usage is higher than predicted prior to 2016, this shows that the AMR roll out caused a reduction in usage which has not rebounded since 2016.

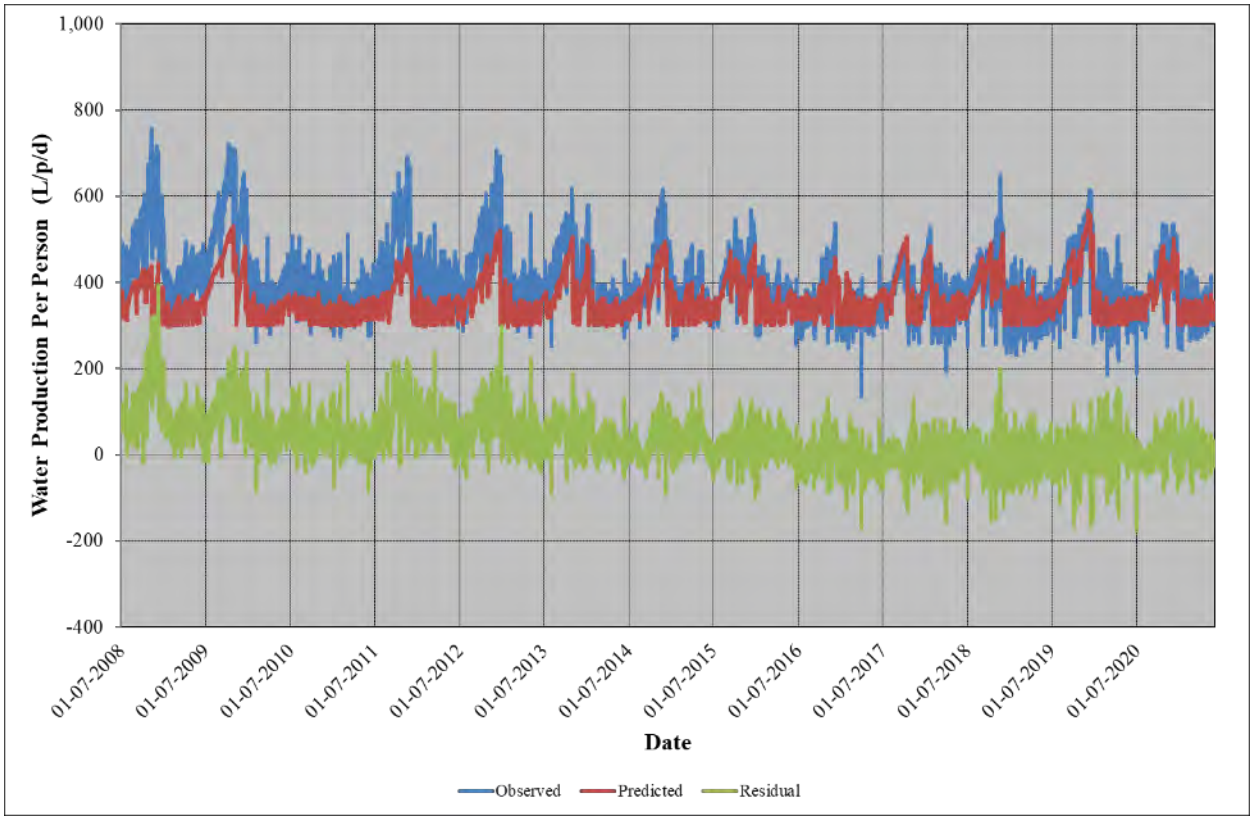


Figure 4-4: Observed, Predicted and Residual Daily Demands (L/Person/day)

4.3.2 Hindcasting

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 40 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.

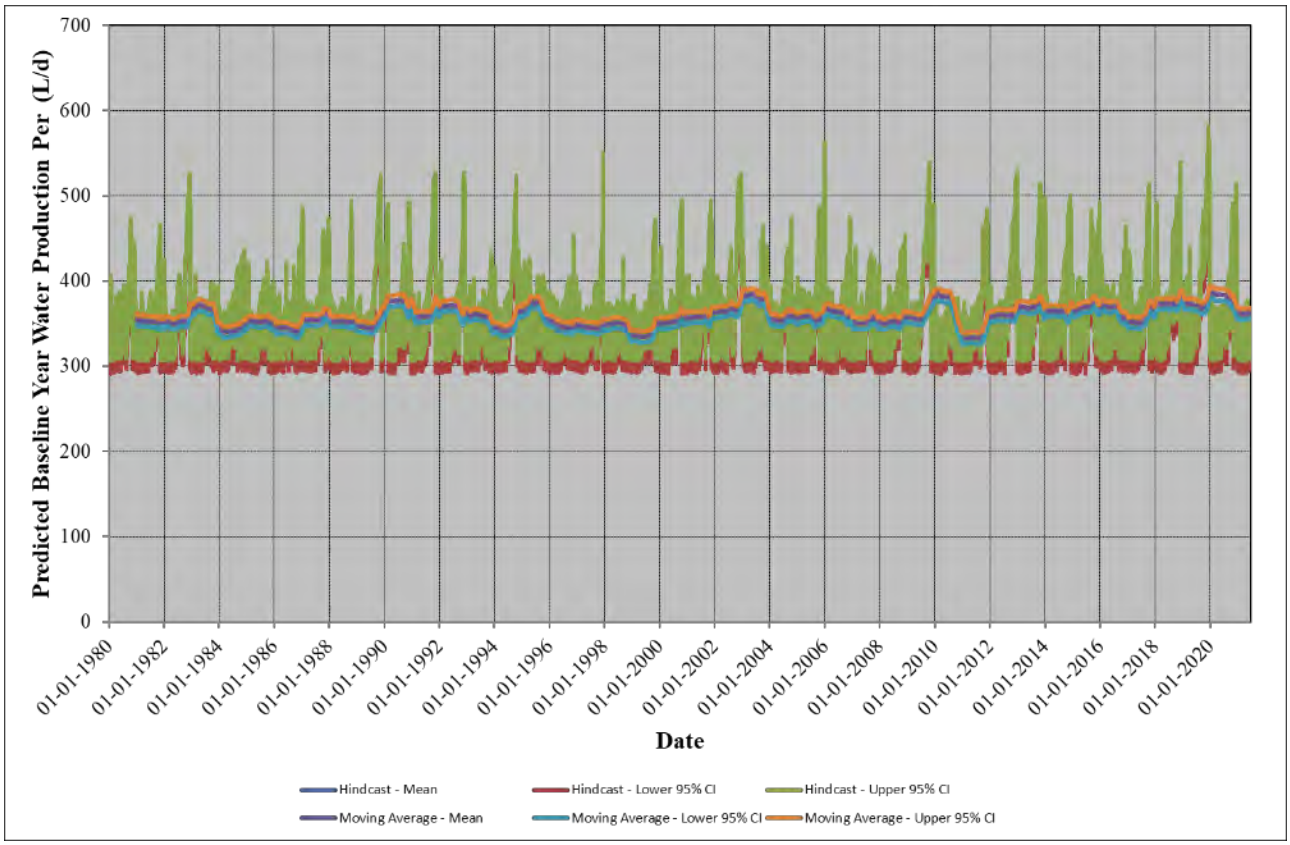


Figure 4-5: Baseline Model Hindcast

4.3.3 Climate Correction

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. Note these are a true representation of total water usage across population and includes non-revenue and non-residential usage in these figures. Significant impacts to historical demands include rainfall in 2010 being almost double the long-term average, dry periods in 2012 and 2019, the mining downturn in 2016 where population growth reduced in Mackay, and the connection of the Sarina scheme in 2015.

The climate corrected trend shows that water use has been on a steady decline since 2008 until 2017 from 450 L/person/day to 350 L/person/day where it has since stabilised at approximately 380 L/person/day. The reason for this decrease is thought to be the combined impact of new AMR metering increasing the awareness of water use and water conservation messaging ('Watch the flow of H2O'). The recent five years of stable demand provide justification for maintaining the current unit demands in the CTM Code.

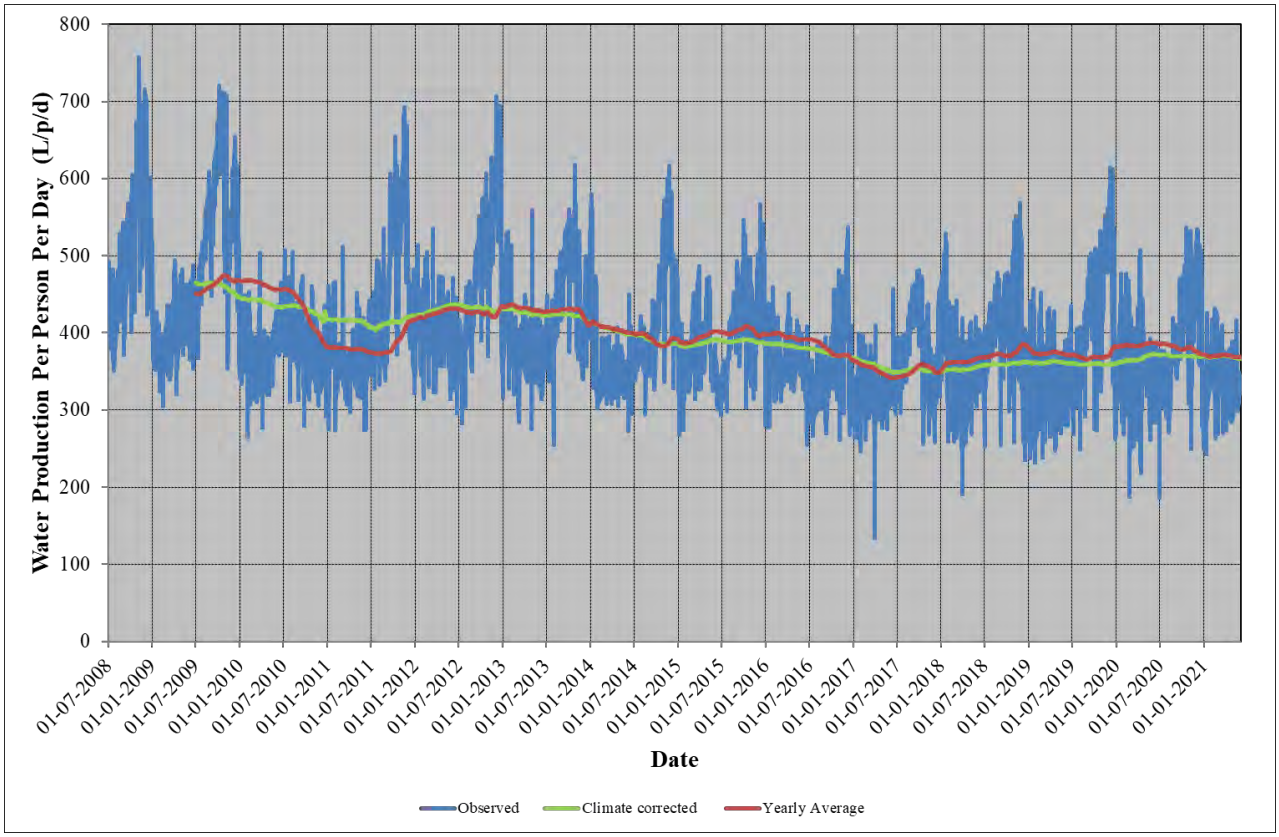


Figure 4-6: Observed and Climate Corrected per Person Water Production (L/person/day production includes non-revenue and non-residential usage)

4.4. Unit Demand Assessment

MRC has rolled out AMR devices on all properties which can assist in understanding behaviour of residential and non-residential customers. As detached dwelling demand makes up over half of the volume produced by the Nebo Rd WTP, the detached dwelling usage is used to determine a system unit demand. The historical average annual demand of detached dwellings from January 2015 to June 2021 is presented in Figure 4-7.

As with the bulk water production trend, detached dwelling usage has been relatively stable since 2015. On average, water use has been approximately 600 L/Dwelling/day. This water strategy has adopted a detached dwelling average usage of 600 L/Dwelling/Day and an occupancy ratio of 2.52 to derive a unit demand of 240 L/EP/Day. The previous water strategy used a detached dwelling average usage of 580 L/Dwelling/Day with an occupancy ratio of 2.69 and added a factor of safety of 10% to derive a unit demand rate of 240 L/EP/Day. It is recommended to maintain the CTM Code unit demand of 240 L/EP/Day as historical usage over the past five years has remained stable.

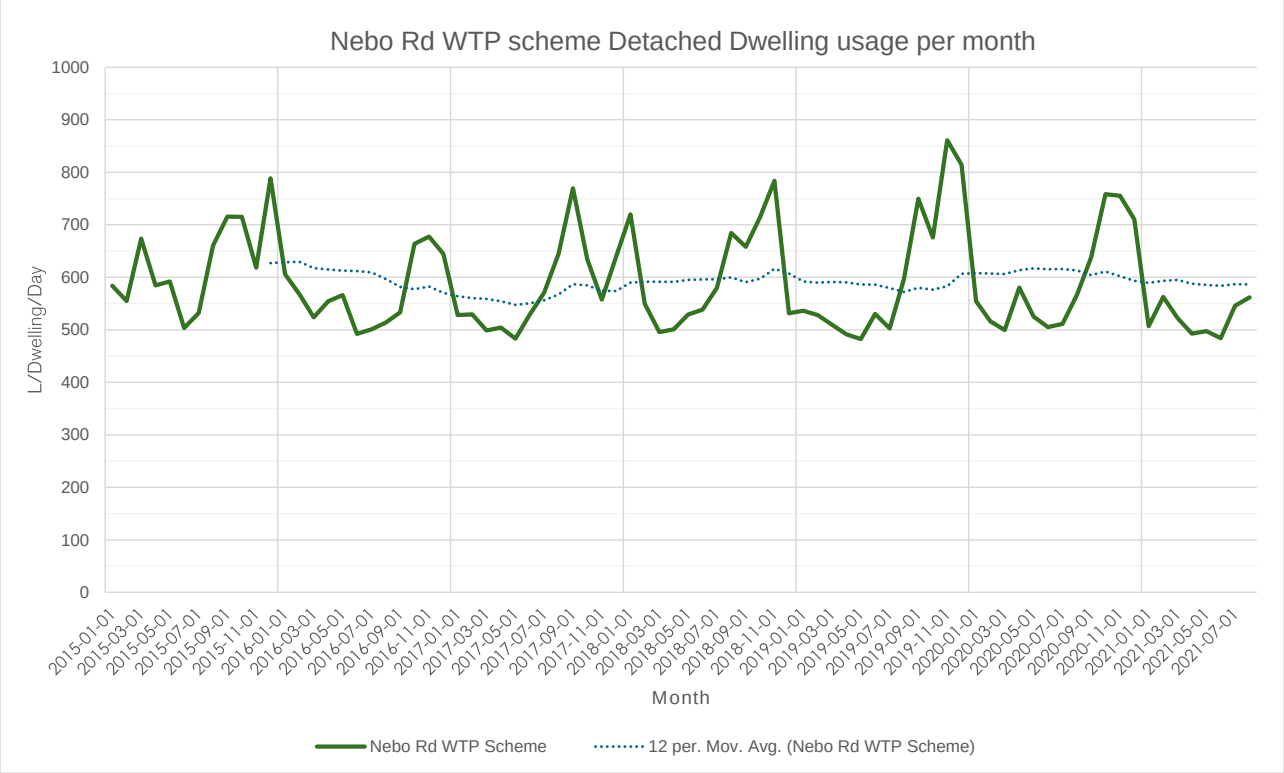


Figure 4-7: Nebo Rd WTP Scheme Detached Dwelling Average Monthly Usage

4.5. Peaking Factor Assessment

In the traditional approach to estimating peak demand factors, peak demands are compared with average demands on an annual basis. There are a number of problems with this approach. Firstly, the arbitrary use of discrete years of data results in large amounts of data being effectively discarded and secondly, the climate influence in any one year can bias the result. Peak demand periods typically occur once every three to five years. Peaks almost always occur during prolonged periods of hot and dry weather. It is important to compare peak demands with the climate-corrected demand for a useful comparison. It is noted that a longer-term average day is needed not just a single year.

The Peak Day (PD) and Mean Day max month (MDMM) demands have been examined over the periods of available data. Figure 4-8 compares the PD to average and MDMM to average ratios estimated based on both the observed and climate corrected average demands (averaged over a rolling 365-day period).

Historically the climate corrected PD factor never exceeds 1.71. The CTM Code adopts a peak day factor of 1.75. It is recommended that the CTM Code peak day factor remains as **1.75** as it contains an element of conservatism whilst remaining in line with historical values.

Historically the climate corrected MDMM factor never exceeds 1.52. The CTM Code adopt a mean day maximum month factor of 1.45. It is understood that climate correction was not used for MDMM in the previous 2016 water strategy. It is evident that a climate corrected MDMM factor of 1.5 occurred in 2012 and 2019. It is recommended the CTM Code MDMM factor be increased from 1.45 to **1.5**. The ramifications to this recommendation are:

- WTP production capacity requirements are increased to meet the larger forecast MDMM demand.
- Transfer Pump Station capacity requirements are increased to cater for the larger MDMM demand.

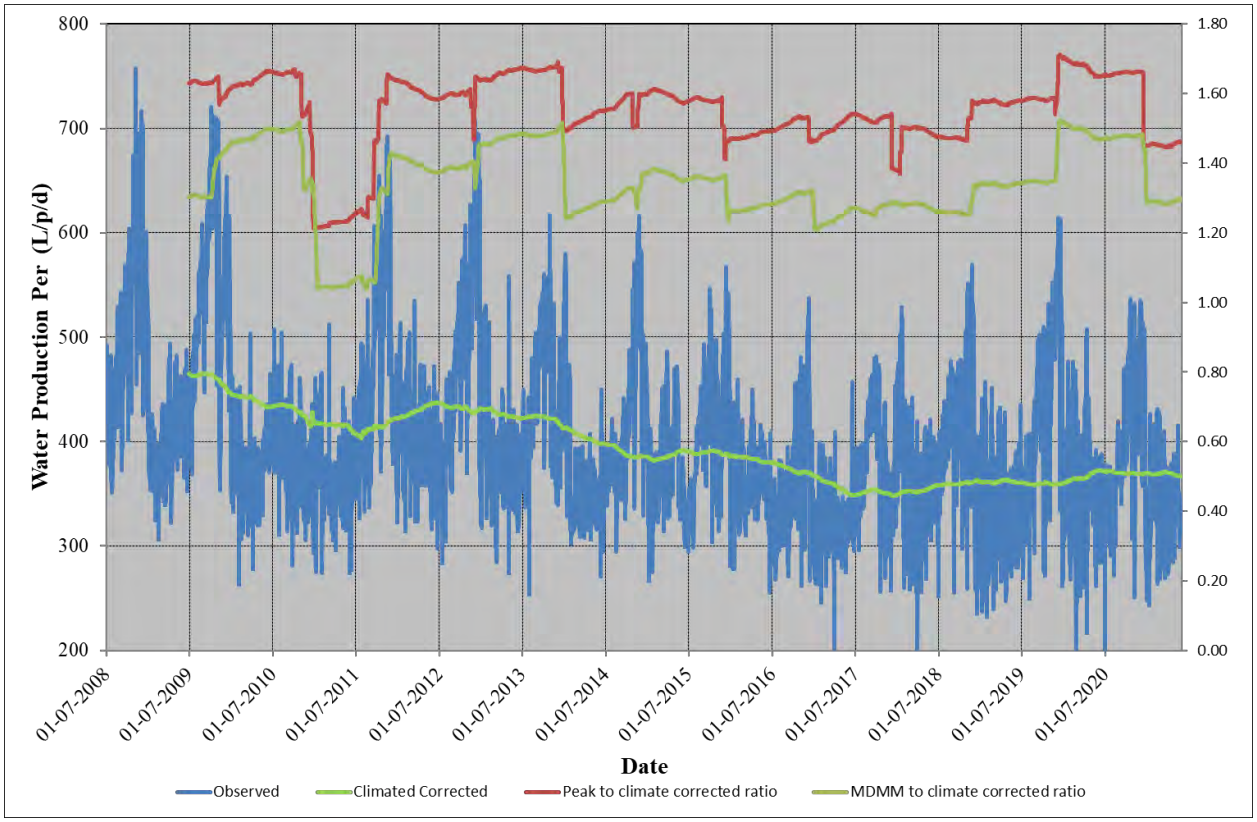


Figure 4-8: Mackay/Sarina Climate Corrected Peaking Factors

4.6. Sectoral Peaking Factor Assessment

Each customer sector has 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 factors such as external use in the afternoon. An assessment of residential (majority of water use) and non-residential customer behaviour using the AMR data was completed to understand Average Day (AD), MDMM and PD diurnal patterns and to inform peaking factors for different demand categories.

The PD demand in each suburb for each customer sector for the month of December 2019 was provided from the Aqualus AMR data. The customer sectors assessed were:

- Residential Detached Dwellings (Single Family Residential)
- Residential Attached Dwellings (Multi-Family Residential)
- Non-Residential Properties

A comparison of the PD factors across suburbs per customer sector was undertaken. In all cases it is evident that the larger suburbs' factors are generally in line with the CTM Code and no recommendation is made to change the current CTM Code. There is some variability in PD factors for the smaller suburbs however this is expected due to the erratic nature of water demand in smaller areas. The Single Family Residential (detached dwellings) MDMM factor is recommended to be increased from 1.55 to 1.6 in line with the overall network MDMM factor increase outlined in Section 4.5.

Table 4-2 summarises the peaking factors adopted per demand sector. The network PD demand derived from the overall PD factor outlined in Section 4.5 equates to the sum of the individual demand sector PD demands using the peaking factors outlined in Table 4-2. The single family residential (detached dwellings) Peak Hour (PH) factor was increased as outlined in Section 4.7.

Table 4-2: Mackay and Sarina Sectoral Peaking Factors

Factor	Single Family Residential - Detached	Multi-Family Residential - Attached	Commercial	Industrial	Community (Public/Open Space)
MDMM: AD	1.6	1.25	1.3	1.3	1.3
PD: AD	1.85	1.51	1.6	1.6	1.6
PH: PD	2.52	2.36	1.93	1.93	1.93
PH: AD	4.66	3.57	3.09	3.09	3.09

4.7. Diurnal Demand Assessment

Consumption per hour on the PD in the month of December 2019 for attached, detached and non-residential dwellings in each suburb was provided from the AMR data to understand diurnal water usage.

Detached Dwellings

The PD for detached dwellings in the majority of suburbs occurred on Sunday, December 8, 2019 which aligned with the overall PD of production recorded by the Nebo Road WTP. Significant outdoor usage is evident in the evening.

A large number of suburbs exhibited peak hour factors larger than the CTM Code as illustrated in Figure 4-9. An average of all suburbs was generated to determine a new PH:PD value of 2.52. This corresponds to a PH:AD factor of 4.66 which is recommended to be adopted in place of the current CTM Code value of 4.33.

Note the average suburb PH factor was adopted in lieu of a more conservative value to reduce the number of augmentations triggered by PH network performance. The PH performance assessment provides an indication of reticulation capacity with some risk allowance for deficient pressures. Demand management initiatives e.g., offset permitted afternoon watering days, can be used to target PH performance to forego expenditure on network augmentations.

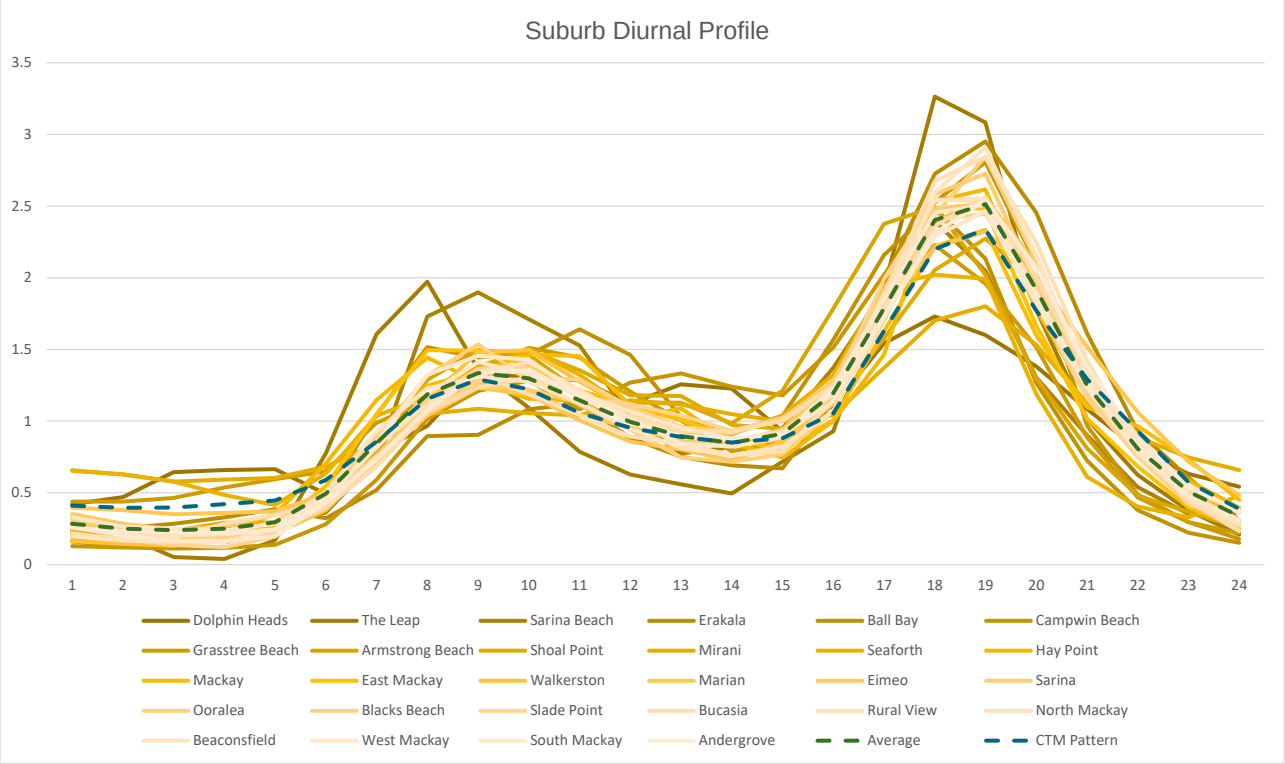


Figure 4-9: Detached Dwellings Normalised Diurnal Demand per Suburb (lighter colour line indicate larger suburb)

Attached Dwellings

The attached dwellings in each suburb generally exhibited a PD throughout the week leading to the network overall peak demand day on the December 8, 2019. There is more variability in the diurnal patterns for this customer sector.

It is recommended to keep the current CTM Code attached diurnal pattern and PH:AD factor of 3.57. Only a few of the smaller suburbs exhibited a PH factor larger than the CTM Code and as the attached dwellings sectoral demand is a small portion of the total network demand, it is not recommended to change the current CTM Code values.

Non-Residential Properties

AMR hourly data for non-residential demand did not differentiate between Commercial, Industrial and Community non-residential customer categories. The non-residential properties in each suburb generally exhibited a PD throughout the week leading to the network overall peak demand day of December 8, 2019. The non-residential property diurnal patterns varied so significantly from suburb to suburb that only the 4 suburbs with the largest number of non-residential properties were considered: Sarina, North Mackay, Paget and Mackay.

It was found that the non-residential diurnal patterns for the 4 suburbs containing the highest number of non-residential properties are generally in line with the CTM Code. No recommendation is made to change the existing CTM Code non-residential PH factors or diurnal pattern.

4.8. Nebo Road WTP Scheme Demand Forecast

The demand forecast for the Nebo Rd WTP based on the MGAM population projection and climate corrected peaking factors is presented in Figure 4-10. Compared to the previous water strategy, the overall MDMM demand has a lower forecast due to the reduced population forecast. The baseline forecast demand in 2021 contains higher PD and MDMM demand than historically observed peaks. The most recent dry season for comparison is 2019 with a PD production of 53.9 ML/d and MDMM of 48.4 ML/d. The combination of headroom in the peaking factors, NRW allowance, annual growth and climate correction has generated modelled baseline 2021 demand higher than observed demand.

The demands per reservoir supply area are summarised in Figure 4-3.

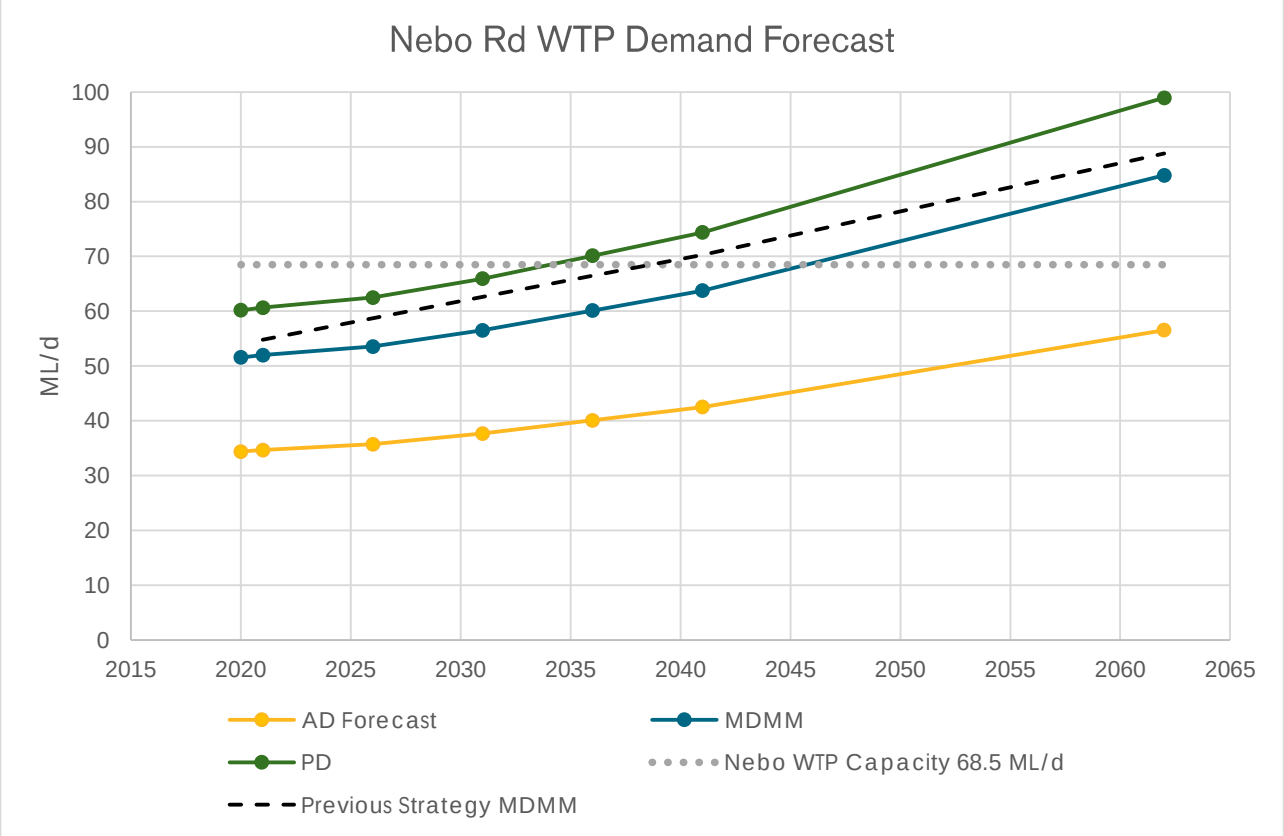


Figure 4-10: Nebo Rd WTP Demand Forecast

Table 4-3: Demand Forecast per Zone

Reservoir Supply Area	2021 AD (ML/d)	2021 MDMM (ML/d)	2021 PD (ML/d)	Ult. AD (ML/d)	Ult. MDMM (ML/d)	Ult. PD (ML/d)
Armstrong Beach	0.25	0.38	0.44	0.42	0.63	0.74
Ball Bay / Halliday Bay	0.2	0.3	0.4	0.3	0.4	0.5
Berry St	0.3	0.4	0.5	0.4	0.6	0.7
Blacks Beach	2.17	3.25	3.79	3.30	4.95	5.77
Farleigh	0.4	0.7	0.8	0.6	0.8	1.0
Green St	0.1	0.1	0.1	0.1	0.1	0.1
Leap Tank	0.2	0.3	0.3	0.2	0.3	0.4
Mount Griffiths	0.5	0.7	0.8	0.6	0.9	1.0
Mount Hayden	0.5	0.8	0.9	0.6	0.9	1.1
Mount Bassett	1.6	2.4	2.8	2.2	3.2	3.8
Mount Oscar	2.6	3.9	4.6	3.4	5.2	6.0
Mount Pleasant	17.8	26.6	31.1	28.4	42.5	49.6
Rural View	3.9	5.9	6.9	9.2	13.8	16.1
Sarina Town	1.3	1.9	2.2	2.5	3.8	4.4
Seaforth	0.3	0.5	0.6	0.4	0.6	0.7
Shoal Point	0.1	0.2	0.2	1.1	1.6	1.9
Silingardies	1.0	1.5	1.7	1.5	2.2	2.6
Slade Point	1.2	1.8	2.0	1.3	1.9	2.2
Total	**34.4**	**51.7**	**60.1**	**56.5**	**84.4**	**98.6**

4.9. Supply Infrastructure Upgrade Timing Requirements

The revised demand forecast indicates the timing for major upgrades to the Nebo Road WTP occurs at 2047 when MDMM demand exceeds the adopted Nebo Road WTP 68.5 megalitres per day capacity. The persistent demand assessment in Section 8.1.8 identifies that additional storage is required at this time in the form of the proposed Walkerston reservoir to accommodate the deficit between production capacity and demand persistence

4.10. Sensitivity to Demand Assessment

The timing of major supply infrastructure upgrades was assessed for sensitivity towards changes in the demand forecast via either base demand reduction, leakage management or peaking factor changes. The adopted Mackay 280 L/EP/day base demand comprises of 240 L/EP/day unit demand and additional 40 L/EP/day NRW allowance (16% of the unit demand). The PD and MDMM factors derived from the climate correction analysis of 1.75 and 1.5 include some headroom above historically observed peaking factors.

- Reducing the base demand from 280 to 265 L/EP/day via reduction in NRW from 16% to 10% of the unit demand would defer major WTP upgrades by 3 years.
- Reducing the base demand from 280 to 245 L/EP/day via reducing the unit demand from 240 to 220 L/EP/day as well as reducing NRW from 16% to 10% would defer major WTP upgrades by 10 years.
- With the 280 L/EP/day base demand, reducing the MDMM factor from 1.5 to 1.45 defer major WTP upgrades by 2 years.

4.11. Surface Water Allocation

Mackay Water has an annual allocation of 16,000 megalitres (43.8 megalitres per day) from the Pioneer River system. Based on the revised demand forecast for the Nebo Road WTP, the annual allocation will not be exceeded until 2041. The annual allocation of the Marian Weir is already exceeded, and allocation is shared from the Dumbleton Weir as discussed in Section 5.10. Allocation sharing between the Marian and Dumbleton Weir will bring forward the exceedance of the Dumbleton Weir allocation by one year.

The previous water strategy calculated the annual allocation would be exceeded by 2029 with the supply to Sarina. The latest demand forecast represents a significant deferral in having to purchase additional allocation from Sunwater.

5. Marian WTP Baseline Demand Assessment

5.1. Marian WTP Scheme Context

The residential properties in the Marian WTP scheme are typically larger in property size and residents' water use includes higher outdoor usage. Water demand unit rates and peaking factors specific to the Marian WTP are expected to be higher than the Nebo Road WTP scheme and are required to determine a demand forecast specific to the Marian WTP.

The process of determining the Marian WTP scheme's unit rates and peaking factors is as follows:

- Detached property water usage makes up approximately 80% of the total Marian WTP production volume. As such, monthly AMR data for detached properties was used to determine an average usage per property value.
- The occupancy ratio for detached dwellings in the Pioneer River SA2 area of 2.58 was used to convert the average detached dwelling usage from AMR data to a L/EP/Day demand unit rate.
- The flow meters at the Marian and Mirani Booster Pump Stations were used to derive the total daily demand for the scheme instead of the Marian WTP output flow meter. From this, yearly AD and PD volumes could be used to determine PD and MDMM factors.

5.2. Marian WTP Historic Daily Production

Production data from the Marian WTP from 2015 was provided to ascertain the peak deployable output to supply the rural townships of Marian and Mirani. The output from the Marian WTP is supplemented by supply from local bores when the WTP source water is untreatable (turbidity, organics or conductivity) or when the WTP is shutdown. In addition, the reservoirs at Marian and Mirani account for up to 3.2 megalitres of storage, providing a buffer to the bulk supply requirements to meet system demand, increasing variability in output.

The daily production from Marian WTP was graphed against rainfall and is shown in Figure 5-1. The maximum daily production of 3.1 megalitres per day was observed on December 6, 2019, which aligns with the same prolonged dry period leading to the Nebo Road WTP peak production day.

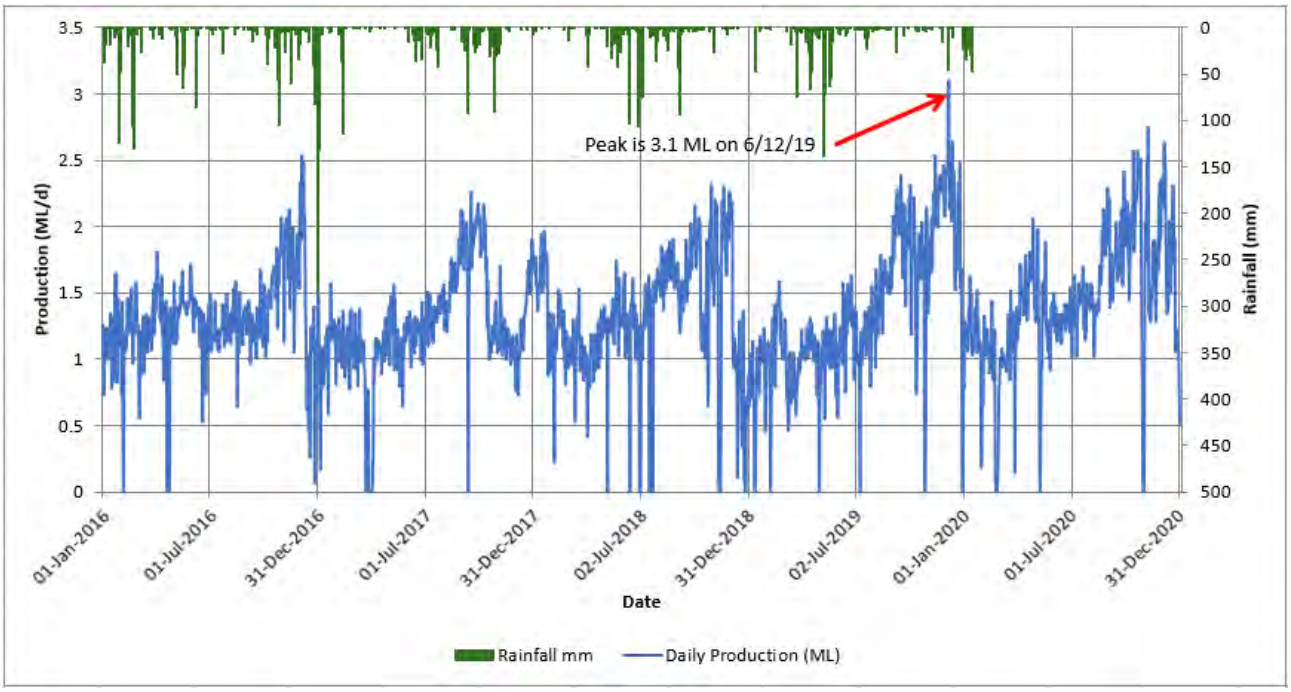


Figure 5-1: 2016 to 2020 Marian WTP Daily Production Data (ML/d)

The assessment of persistent peak demand days during the maximum demand period between November 15 to December 15, 2019, is shown in Figure 5-2. Despite a peak daily output of 3.1 megalitres per day there is a three-day moving average of 2.8 megalitres per day, representing an 8% reduction on required output. The persistent peak demand requirements indicate less variability to service the relatively small township of Marian and Mirani.

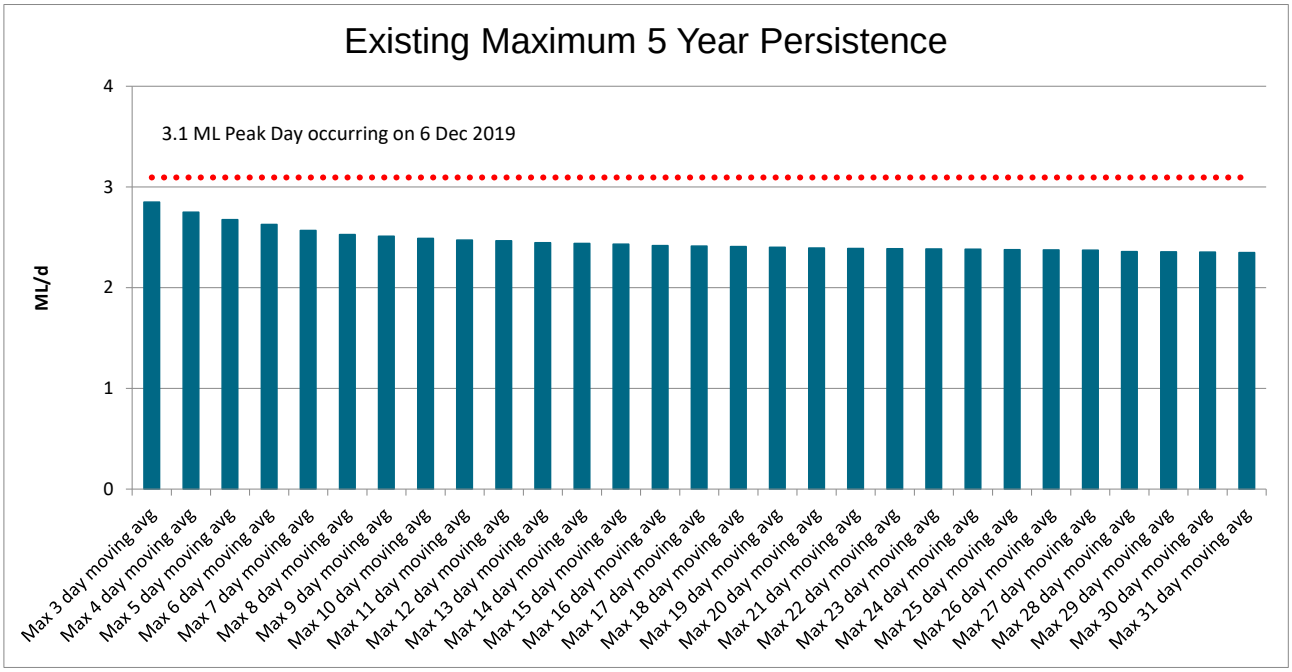


Figure 5-2: Maximum Persistence of Marian WTP Production – Past 5 Years

5.3. Non-Revenue Water

An analysis of the Marian and Mirani scheme provided lower NRW results than the Mackay and Sarina scheme. NRW has varied between 1% and 13% across the past four years of available data and is considered to be influenced through inaccuracies in the data and failing customer meter batteries in recent years. It is recommended that a NRW component of 10% of the average unit demand be adopted for the Marian and Mirani demand forecast. Reduced NRW rates are assessed as part of the sensitivity analysis in Section 5.9.

Table 5-1: Marian and Mirani NRW

Category	2017	2018	2019	2020
Production (ML/d)	1.25	1.33	1.36	1.44
Residential consumption (ML/d)	1.03	1.13	1.10	1.09
Non-Residential consumption (ML/d)	0.18	0.18	0.16	0.16
Non-Revenue Water (ML/d)	0.03	0.02	0.10	0.19
Non-Revenue Water (%)	**2.7%**	**1.2%**	**7.6%**	**13.3%**

5.4. Unit Demand Assessment

AMR data was used to provide an average detached dwelling demand for each month in the Marian WTP scheme as presented in Figure 5-3. A comparison to the Nebo Road WTP scheme is also provided.

It is evident that the residential demand in Marian and Mirani is typically higher during the warm seasons due to larger property areas and higher outdoor water usage. The usage across each month varies between 500 and 1000 L/prop/day and the yearly averages varies between 600 and 700 L/prop/day. With an occupancy ratio of 2.58 EP per property, average usage is between 230 and 270 L/EP/day. The adopted Marian WTP scheme unit demand rate is 300 L/EP/Day comprised of 270 L/EP/Day base demand and a 10% allowance for NRW.

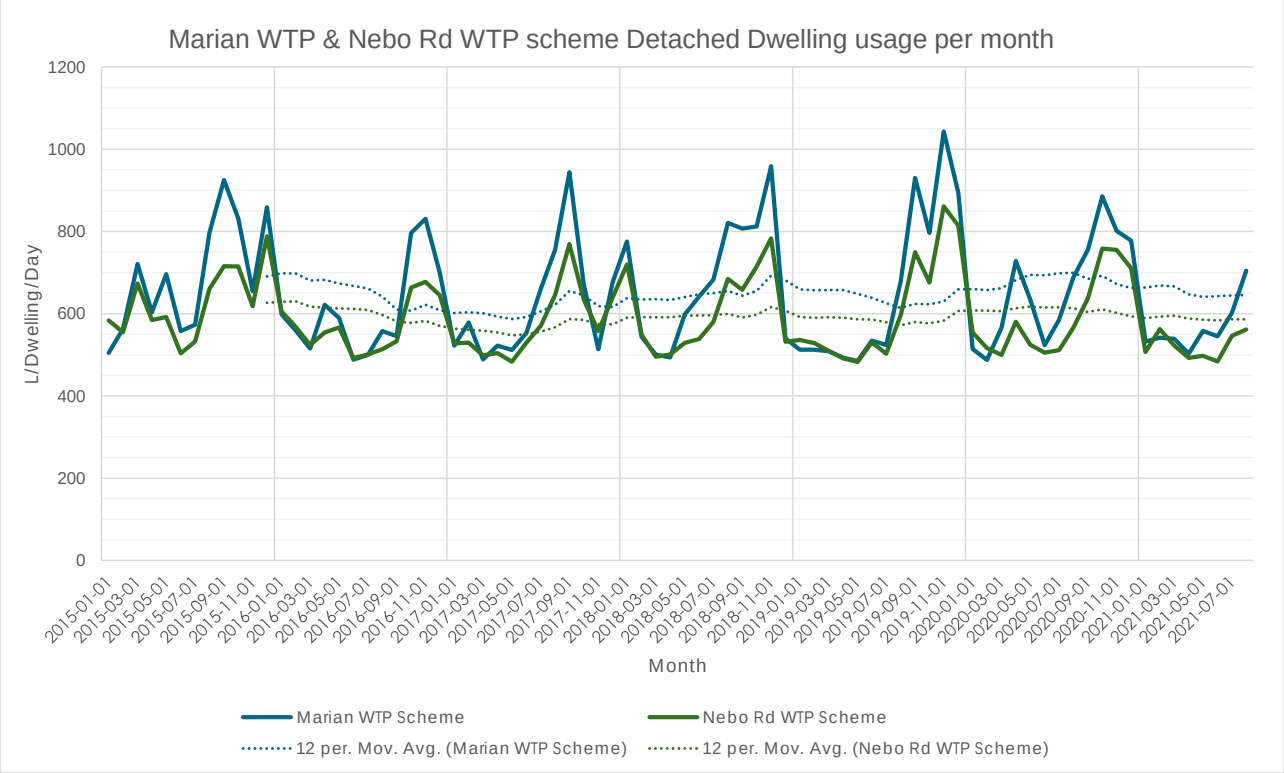


Figure 5-3: Marian WTP Scheme Average Detached Dwelling Usage

5.5. Peaking Factor Assessment

The flow meter data for the Marian and Mirani Booster Pump Stations was used to determine the daily demand for the Marian WTP scheme as presented in Figure 5-4. The Marian WTP output flow meter was not used for this purpose as the WTP had offline periods affecting the yearly average volumes.

The AD demand was derived by averaging the past three years of demand data, equating to 1.42 megalitres per day. A PD factor of 2.0 is derived from October 11, 2020, when the PD volume was 2.82 megalitres per day. The MDMM occurred during December 2019 of 2.30 megalitres per day and a MDMM factor of 1.6 is adopted for the Marian WTP scheme.

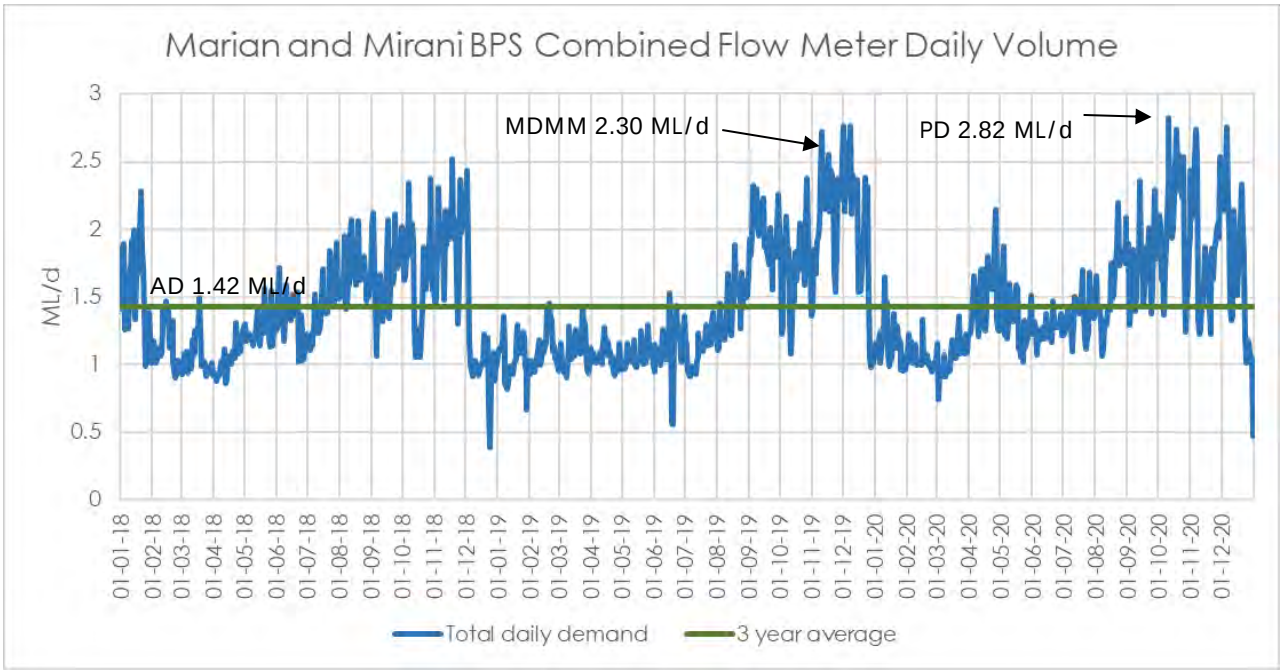


Figure 5-4: Combined Marian and Mirani BPS Flow Meter Volume

5.6. Diurnal Pattern Assessment

The diurnal patterns for each demand category were initially adopted from the Nebo Road WTP scheme and input to the Marian hydraulic model for comparison against the recorded flows at the Marian and Mirani booster pump station (BPS) flow meters. The PH:AD factor in the Detached diurnal pattern was increased from 4.66 to 5.88 to provide a closer match with observed Marian and Mirani peak hour figures. This also correlated with advice provided by MRC regarding customer complaints about service pressures received in Marian and Mirani during hot periods due to excessive PH consumption from outdoor usage.

Attached and Non-Residential diurnal patterns were adopted as per the Nebo Road WTP scheme due to the small sample size of available data within the Marian WTP scheme.

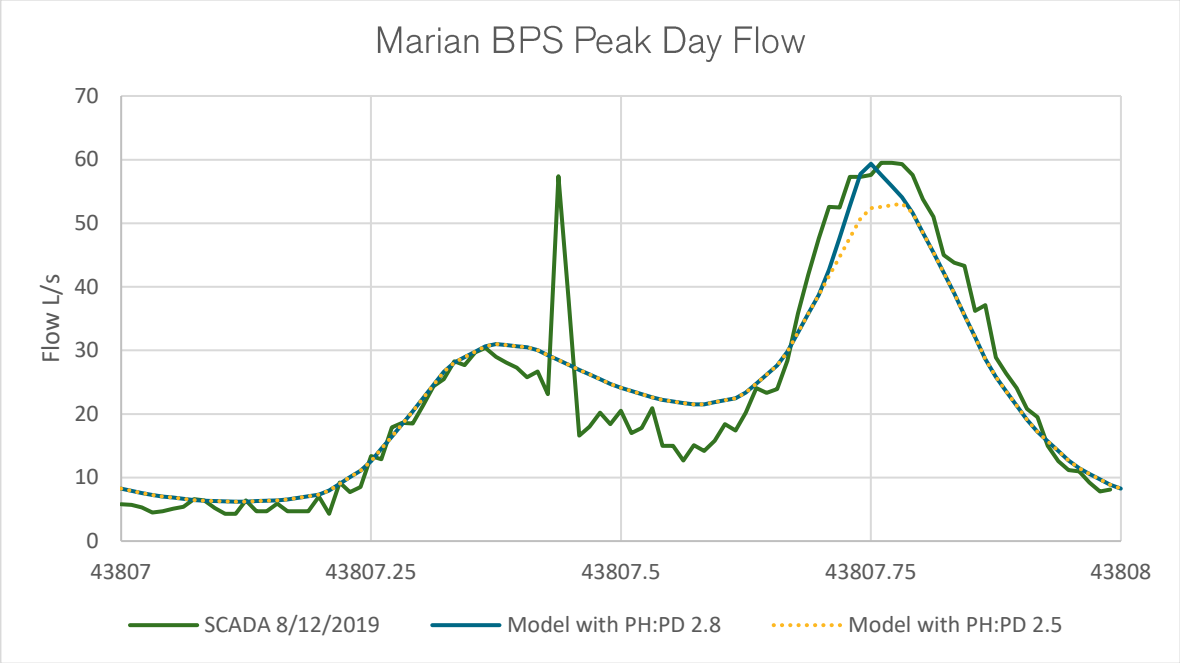


Figure 5-5: Marian Booster Pump Station Diurnal Profile

5.7. Marian WTP Demand Forecast

The demand forecast for the Marian WTP using the 2020 MGAM population projection and determined peaking factors is presented in Figure 5-6. The demands per reservoir supply area are summarised in Table 5-2.

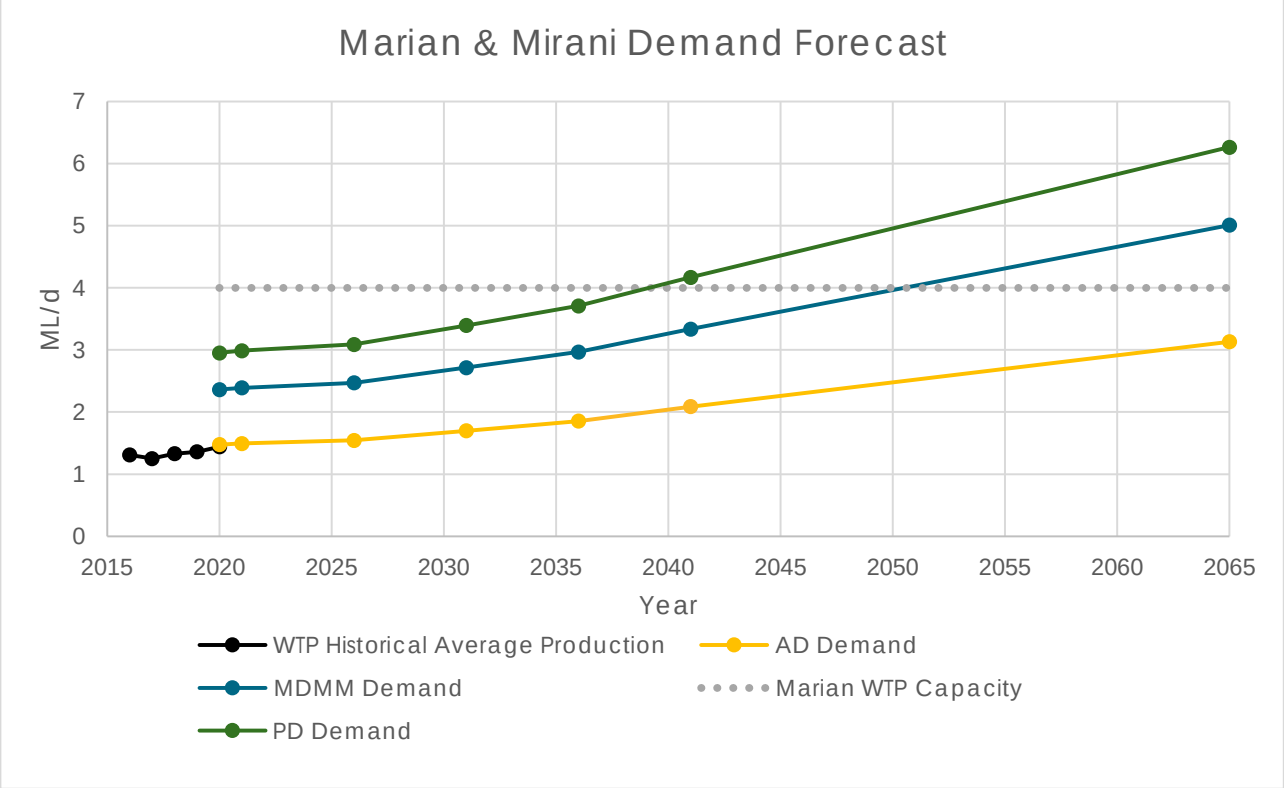


Figure 5-6: Marian WTP Demand Forecast

Table 5-2: Demand Forecast per Zone

Reservoir Supply Area	2021 AD (ML/d)	2021 MDMM (ML/d)	2021 PD (ML/d)	Ult. AD (ML/d)	Ult. MDMM (ML/d)	Ult. PD (ML/d)
Marian	1.0	1.7	2.1	2.0	3.2	4.0
Mirani	0.4	0.7	0.9	1.2	1.8	2.3
Total	**1.4**	**2.4**	**3.0**	**3.2**	**5.0**	**6.3**

5.8. Supply Infrastructure Upgrade Timing Requirements

The existing Marian WTP capacity is four megalitres per day and expected to be exceeded by the forecast MDMM demand in 2050.

5.9. Sensitivity to Base Demand Assessment

The timing of major supply infrastructure upgrades was assessed for sensitivity towards changes in the Marian base demand and leakage management. The adopted Marian 300 L/EP/day base demand comprises of 270 L/EP/day unit demand and additional 30 L/EP/day NRW allowance (10% of the unit demand).

Reducing the base demand from 300 to 240 L/EP/day would be required to eliminate the need for the Marian WTP major upgrade entirely.

5.10. Surface Water Allocation

Water is licensed from Sunwater and accessed via the Marian Weir with a volumetric limit of 460 megalitres per annum (1.26 megalitres per day). Based on the Marian WTP demand forecast, this annual limit is already exceeded. Spare allocation is shared from the downstream Dumbleton Weir to accommodate the deficit.

6. Standards of Service

A summary of the standards of service criteria that were reviewed and updated as part of the demand assessment of the Nebo Road WTP is summarised as follows:

Table 6-1: CTM Code Water Network Design Criteria

Parameter	Current CTM Code Criteria	Criteria adopted in this study
Average Day Demand (AD) per EP Estimated Non-Revenue Water (NRW)	240L/EP/d + 40 L/EP/d NRW	240L/EP/d + 40 L/EP/d NRW
Peaking Factors: MDMM/AD PD/AD PH/AD	 1.45 1.75 Refer Table 6-2	 1.5 1.75 Refer Table 6-2

Table 6-2: Mackay and Sarina Sectoral Peaking Factors

Factor	Single Family Residential - Detached	Multi-Family Residential - Attached	Commercial	Industrial	Community (Public/Open Space)
MDMM: AD	1.6	1.25	1.3	1.3	1.3
PD: AD	1.85	1.51	1.6	1.6	1.6
PH: PD	2.52	2.36	1.93	1.93	1.93
PH: AD	4.66	3.57	3.09	3.09	3.09

The CTM Code does not currently cater for regional schemes which typically exhibit higher unit demands and peaking factors in reality. For reference, the factors derived for Marian and Mirani as part of the Marian WTP demand assessment are summarised as follows:

Table 6-3: Proposed Marian and Mirani Water Network Design Criteria

Parameter	Criteria adopted in this study
Average Day Demand (AD) per EP Estimated Non-Revenue Water (NRW)	270L/EP/d + 30 L/EP/d NRW
Peaking Factors: MDMM/AD PD/AD PH/AD	 1.6 2.0 Refer Table 6-4

Table 6-4: Marian and Mirani Sectoral Peaking Factors

Factor	Single Family Residential - Detached	Multi-Family Residential - Attached	Commercial	Industrial	Community (Public/Open Space)
MDMM : AD	1.65	1.25	1.3	1.3	1.3
PD : AD	2.1	1.51	1.6	1.6	1.6
PH : PD	2.80	2.36	1.93	1.93	1.93
PH : AD	5.88	3.57	3.09	3.09	3.09

7. 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 meet the Ultimate demand. Opportunities for amalgamating the Marian WTP and Nebo Road WTP schemes when major upgrades are triggered were investigated. The impact of supplying the Eton regional scheme from the Marian WTP or Nebo Road WTP is also considered.

7.1. Considerations for Developing Options

The proposed twenty-year investment strategy for the Nebo Road WTP outlined in the 2020 Nebo Road WTP Process Review has been adopted for the purposes of this study which outlines a maximum achievable output of 68.5 megalitres per day with existing site constraints. The strategic options assessment is premised by this maximum theoretical output. This capacity is used as the trigger point for all major strategic upgrade strategies and assumes the minor capital works proposed in the Nebo Road WTP Process Review have been implemented.

The trigger timing for major upgrades at Nebo Road WTP is forecast to be 2047 and 2050 for the Marian WTP.

7.1.1 Mackay Northern and Southern Zone Network Configuration

The past two water strategies (2009 and 2016) have identified a future network configuration splitting the Mackay scheme into northern and southern zones as illustrated in Figure 7-1 with supply to the north via the Nebo Road WTP and the south provided via a future Southern WTP located near Walkerston and proposed Walkerston reservoir. A preferred site has been selected for the proposed Southern WTP and the future Walkerston reservoir site has already been purchased by MRC. The exact extents of the northern and southern zone boundary have not been determined for this strategy due to the greater than 25-year future timing of the network reconfiguration however it is estimated that a boundary following Archibald Street is suitable to ensure the Ultimate demand of the southern zone does not exceed the capacity of the proposed 16 megalitres per day Southern WTP. The potential boundary is further south than the boundary proposed by the past two strategies which was following Shakespeare Street just south of the Mackay CBD.

It is noted that as part of the 2016 strategy it was decided to upgrade the Nebo Road WTP as much as possible and defer the Southern WTP but still construct the Walkerston reservoir with the idea to have the Nebo Road High Lift Pump Station (HLPS) configured into two pump sets. One pump set would have a lower head to supply the Mount Pleasant reservoirs to service the northern zone and the other pump set would have a higher head to supply the proposed Walkerston reservoir to service the southern zone including Sarina. The intent of the preferred option was to provide a level of storage on the southern side of the Pioneer River and allow driving head to supply Sarina via Alligator Creek as the demand increases.

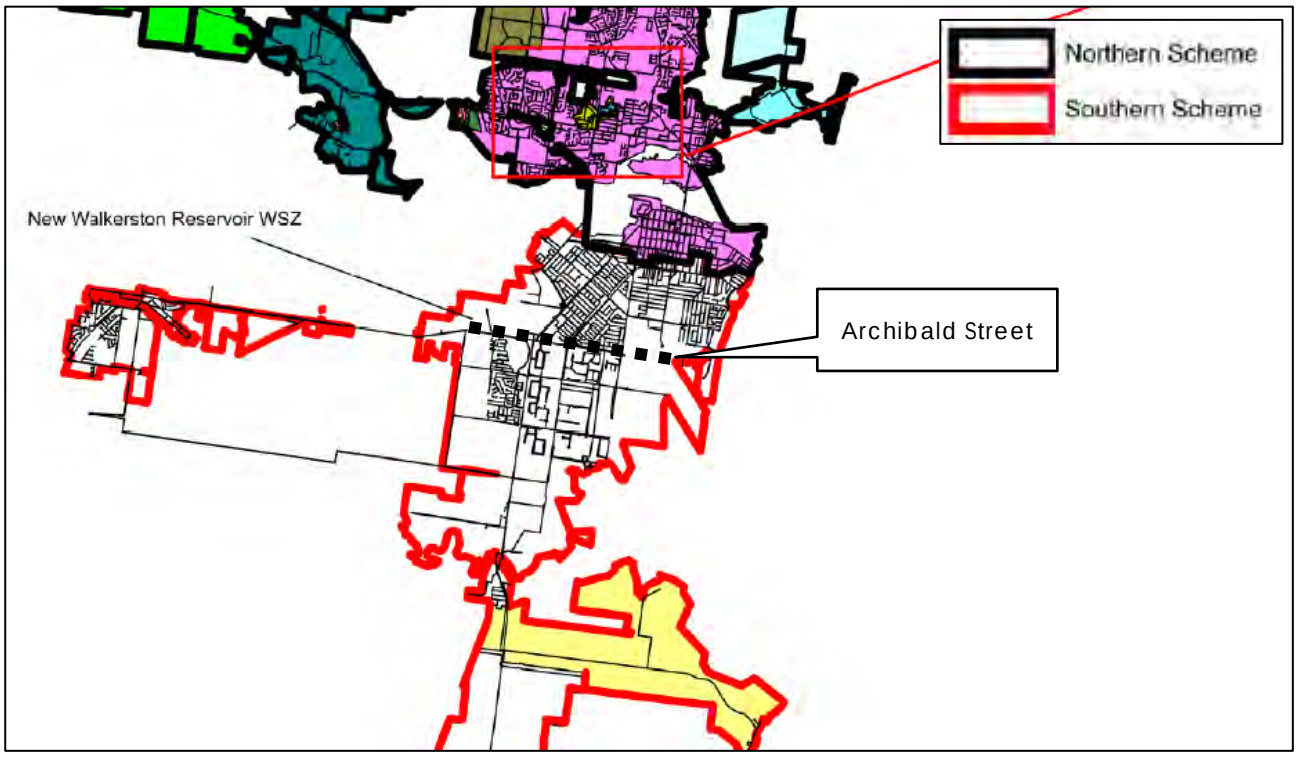


Figure 7-1: 2016 Water Strategy Appendix D – Northern and Southern Scheme Zones

7.1.2 Marian Weir

The option of building a larger Marian WTP to meet the Ultimate demand at Marian as well as supplement the Nebo Road WTP scheme via a Marian-Walkerston transfer main to avoid the need for a future Southern WTP (at Walkerston) was initially considered. The approach would require a total production capacity of 22 megalitres per day at Marian WTP. This option was discounted due to physical constraints of the Marian weir and impact to other water users.

The Marian WTP will require a major upgrade regardless to meet the Ultimate demand of the Marian scheme. An option to decommission the Marian WTP and supply the Marian scheme from Mackay via a Walkerston-Marian transfer pipeline is assessed in this strategy.

7.1.3 Eton Demand

Consideration was given to supplying water to Eton via a proposed pipeline from either Nebo Road WTP or Marian WTP when the current Eton treatment plant is potentially due for major renewal in 20 years time. Instead of renewing the plant, decommissioning the bores and treatment facility at end of useful life and supplying treated water to Eton from the other WTPs was investigated. Refer Figure 7-2 for potential transfer main alignments from the Marian or Silingardies reservoirs to the Eton reservoir.

The Eton demand forecast was approximated using the MGAM population projection in combination with the Marian WTP unit rates and peaking factors. The Eton demand forecast estimate is presented in Table 7-1. The additional Eton MDMM demand estimate of 0.4 megalitres per day would bring forward the timing of major upgrades at the Marian WTP by five years and Nebo Road WTP by one year. A DN150 main would have sufficient capacity to convey the Ultimate MDMM Eton demand.

The length of transfer main to Eton and required pumping head are summarised in Table 7-2. Due to the shorter length and less pumping head required, a transfer main supplying Eton from the Nebo Road WTP via Walkerston is more cost efficient than from Marian WTP.

Table 7-1: Estimated Eton Demand Forecast

Category	2020	2021	2026	2031	2036	2041	Ultimate
Total EP	597	597	602	634	635	656	791
AD Demand ML/d	0.18	0.18	0.18	0.19	0.19	0.20	0.24
MDMM Demand ML/d	0.29	0.29	0.29	0.30	0.30	0.31	0.38
PD Demand ML/d	0.36	0.36	0.36	0.38	0.38	0.39	0.47

Table 7-2: Estimated Eton Demand Forecast

Infrastructure	From Marian	From Walkerston
Transfer main length	18 km	13.3 km
Required pumping head (static head + 3 m/km headloss)	80 m	51 m

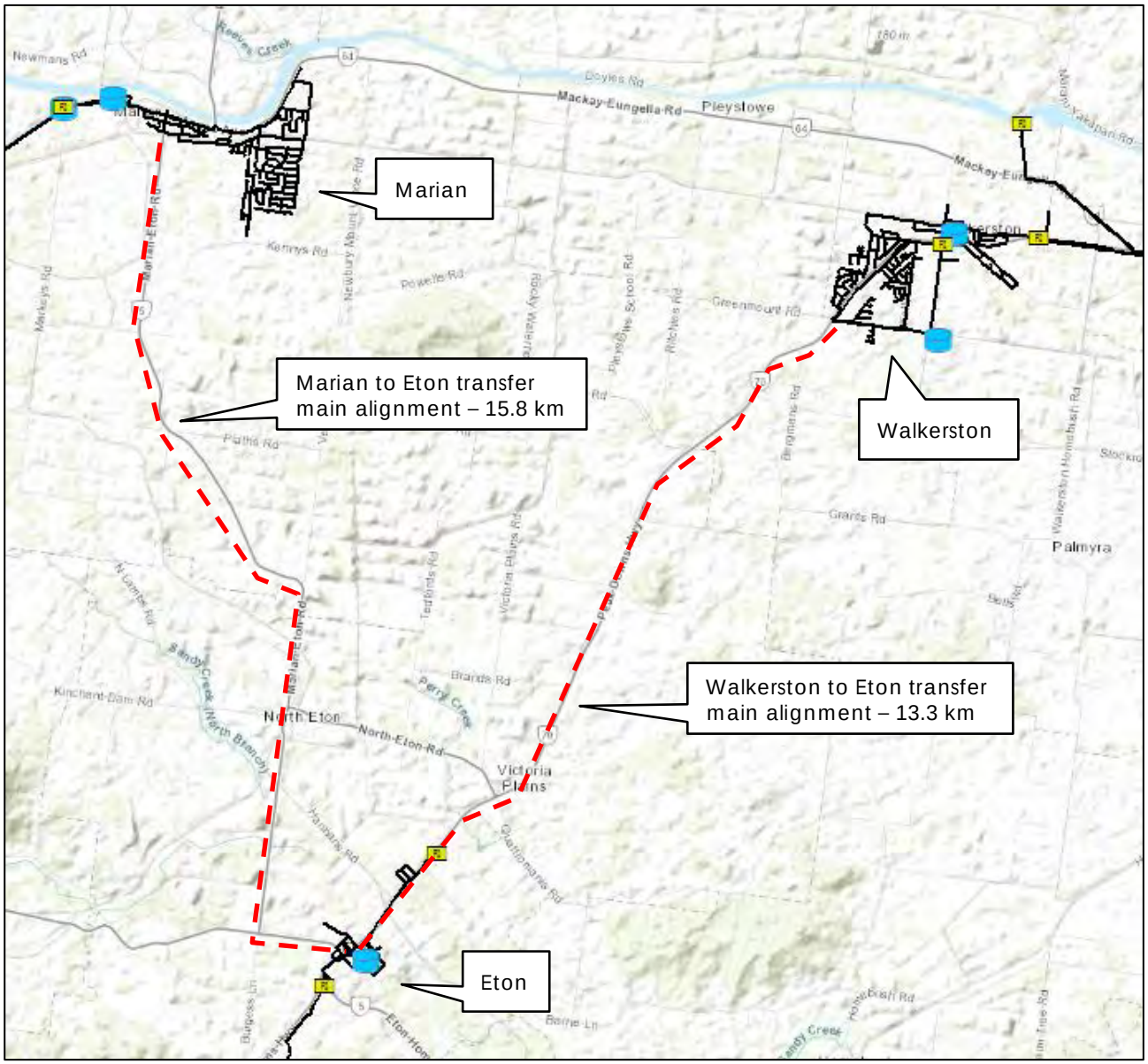


Figure 7-2: Eton Transfer Main Alignment Options

7.2. Previous Water Strategy (2016) Strategic Options

A maximum treatment capacity of 75 megalitres per day was assumed for the Nebo Road WTP in the 2016 water strategy based on existing site constraints. Based on the 2016 demand forecast, the 75 megalitres per day maximum output is exceeded by 2038 due to considering demand persistence requirements and triggering the implementation of a major upgrade. Four options were assessed in the 2016 strategy:

- Option 1 – Construct a new Southern WTP with Walkerston reservoir
- Option 2 – Upgrade Nebo Road WTP to 90 megalitres per day with Erakala reservoir (more storage constructed on the northern side of the Pioneer River)
- Option 2A – Upgrade Nebo Road WTP to 90 megalitres per day with Walkerston reservoir (storage constructed on the southern side of the Pioneer River)
- Option 3 – Northern WTP with Erakala reservoir.

The preferred strategic supply option was to upgrade Nebo Road WTP to 90 megalitres per day subject to detailed assessment of constraints to expanding the existing site (Option 2A) to the south into an existing park. A 16 megalitres storage would be constructed at Walkerston (2038) to supply the southern region of Mackay and Sarina. In the event that the Nebo Road WTP

could not be expanded then an alternative Southern WTP solution could be implemented to predominantly supply the area south of the river, with the Nebo Road WTP retained to supply the area north of the river and the Mackay CBD.

7.3. Nebo Road WTP Scheme Options Development and Assessment

Consolidating water treatment plants significantly reduces operational expenditure and resource requirements of MRC. In consideration of the adopted maximum capacity of 68.5 megalitres per day at Nebo Road WTP and the WTP footprint constraints, the following two options to satisfy Ultimate demand are assessed:

- **Option 1 (Augment Nebo Road WTP)** – Build a new Southern WTP and new Walkerston reservoir storage to augment the Nebo Road WTP supply.
- **Option 2 (Replace Nebo Road WTP)** – Decommission the Nebo Road WTP and build a new Southern WTP and Walkerston reservoir storage to service Mackay.

7.3.1 Option 1 – Build Southern WTP to Augment Nebo Road WTP

When the Nebo Road WTP reaches its capacity of 68.5 megalitres per day, additional supply to Mackay is enabled via a new Southern WTP in Walkerston. The strategic infrastructure requirements are shown in Figure 7-3. The option consists of the following major infrastructure elements:

- Construction of a new 16 megalitres per day Southern WTP and refurbishment/maintenance of the Nebo Road WTP.
- New 2.5-kilometre 450-millimetre diameter raw water main from Dumbleton Weir to the Southern WTP.
- New six-kilometre 450-millimetre diameter treated water delivery main to feed Walkerston reservoir.
- A 10 megalitres reservoir at Walkerston (site already acquired by MRC).
- Isolate Silingardies reservoir and supply respective supply area from proposed Walkerston reservoir via new 1.5-kilometre 300-millimetre distribution main
- A 12-kilometre 600-millimetre diameter main from the Walkerston reservoir to the south Mackay zone via Stockroute Road.

Raw Water Intake and Pumps

By 2047 the new Southern WTP will be required to service demand growth and the raw water intake and pumps at the Dumbleton weir will require a total Ultimate capacity of 85 megalitres per day to convey water to Mackay.

To achieve the 85 megalitres per day design requirement at the Dumbleton Weir intake, the existing pumps require upgrading so multiple duty pumps can be operated. An option outlining pump upgrades and minor structural works is described in the Dumbleton Raw Water Supply Planning Report (Mackay Infrastructure Alliance, 2010). There would be a requirement to upgrade the power supply at the Dumbleton Weir intake to achieve 985 L/s.

Raw Water Pipelines

Nebo Road WTP receives raw water through 2 large sized trunk mains over a distance of approximately 11 km:

- RWM1: Older main constructed in 1968 consisting of 7.8km of DN500 irrigation class Reinforced Concrete Pipe and 3.2km of DN525 Asbestos Cement Pipe.
- RWM2: Newer main constructed in 1985 consisting of 5.0km of DN675 AC Pipe and 5.2km of DN600 Glass Reinforced Plastic Pipe.

The pipe diameters are optimum for 350 L/s flow (RWM1) and 600 L/s flow (RWM2). Currently, the flow is practically limited to <150 litre per second in RWM1 due to reliability issues. A business case is currently being developed to determine rehabilitation options for RWM1.

A total flow of 85 megalitres per day is required to be conveyed from the Dumbleton Weir with 16 megalitres per day diverted to the Southern WTP and 68.5 megalitres continuing to the Nebo Road WTP.

A 2.5 kilometres DN450 augmentation to the existing raw water pipelines is required between the Dumbleton Weir and the proposed Southern WTP to convey 85 megalitres per day. The RWM1 rehabilitation is required to ensure the existing raw water pipelines can transport 68.5 ML/d to Nebo Road WTP.

Water Treatment and Transfer

Option 1 requires construction of the Southern WTP at the corner of the 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 16 megalitres per day and would need to be constructed by 2047. A transfer pump station would pump water to a 10 megalitres reservoir located at Walkerston.

Required trunk mains from the Southern WTP to the storage consists of six kilometres of 450-millimetre diameter pipeline in 2047.

The existing Nebo Road WTP will continue to service the northern zone which includes the Mackay CBD. The new Walkerston reservoir would supply Ooralea and the southern zone.

Future refurbishment works at Nebo Road WTP will also be required.

Distribution Mains

A distribution main will convey water from the proposed Walkerston reservoir to the southern zone via Stockroute Road. The trunk main would consist of 12-kilometre of 600-millimetre diameter main to connect into the existing 600-millitre diameter southern distribution trunk main at the corner of Crichtons Road and Connors Road. The 600-millimetre diameter distribution main is sized to supply PH demand in the southern zone and transfer of MDMM demand to Sarina.

In the event of outage of the Walkerston reservoir outlet main, supply to the south zone and Sarina would revert to the original Mount Pleasant and Nebo Road HLPS supply configuration. The Peak Downs Highway DN300 main can provide some additional capacity to supply the southern zone if the proposed Walkerston reservoir 600-millimetre diameter outlet main fails.

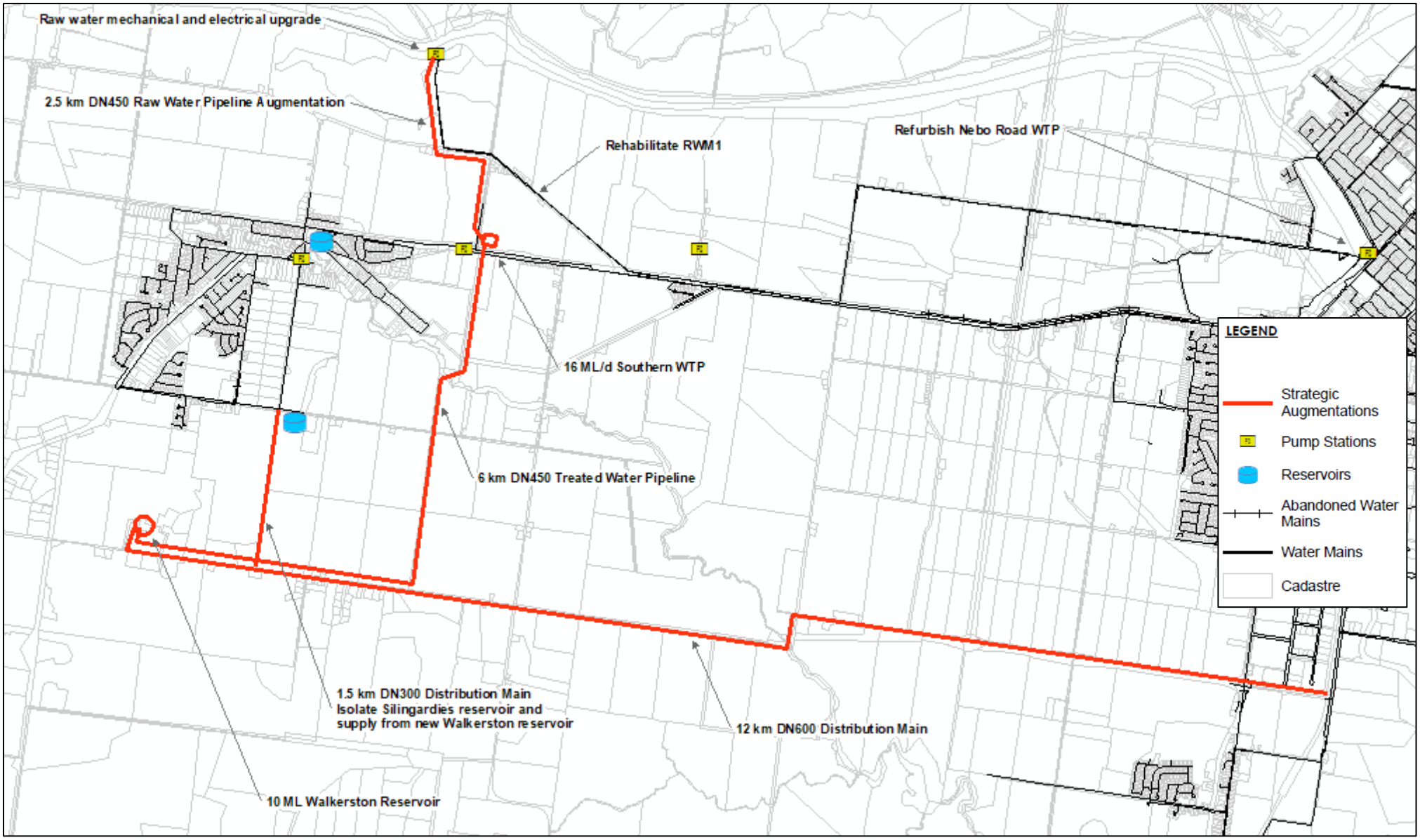


Figure 7-3: Option 1 – Build Southern WTP to Augment Nebo Road WTP

7.3.2 Option 2 – Build New Southern WTP and Decommission Nebo Road WTP

Constructing the Southern WTP affords the opportunity to decommission the Nebo Road WTP and operate a single WTP moving forward. The strategic infrastructure requirements are shown in Figure 7-4. The option consists of the following major elements:

- Construction of a new 85 megalitres per day Southern WTP and decommissioning of the Nebo Road WTP.
- New 2.5-kilometre 450-millimetre diameter raw water main from Dumbleton Weir to the Southern WTP.
- New 900 metre 750-millimetre raw water main diverting the existing DN500 and DN600 raw water mains along Palm Road to the Southern WTP.
- Conversion of the existing raw water main east of Palm Road to treated water transfer mains.
- New 900 metre 750-millimetre treated water transfer main along Palm Road connecting the Southern WTP to the converted transfer mains to Nebo HL PS.
- New six kilometre 450-millimetre diameter treated water delivery main to feed Walkerston reservoir.
- A 10 megalitres reservoir at Walkerston (site already acquired by MRC).
- Isolate Silingardies reservoir and supply respective supply area from proposed Walkerston reservoir via new 1.5-kilometre 300-millimetre distribution main.
- A 12-kilometre 600-millimetre diameter main from the Walkerston reservoir to the south Mackay zone via Stockroute Road.

Raw Water Intake and Pumps

By 2047 the new Southern WTP will be required to service demand growth and the raw water intake and pumps at the Dumbleton weir will require a total Ultimate capacity of 85 megalitres per day to convey water to Mackay.

To achieve the 85 megalitres per day design requirement at the Dumbleton Weir intake, the existing pumps require upgrading so multiple duty pumps can be operated. An option outlining pump upgrades and minor structural works is described in the Dumbleton Raw Water Supply Planning Report (Mackay Infrastructure Alliance, 2010). There would be a requirement to upgrade the power supply at the Dumbleton Weir intake to achieve 985 L/s.

Raw Water Pipeline

Option 2 will require a diversion of the existing raw water pipelines from the raw water intake directly to the 85 megalitres per day Southern WTP site. Construction of 900 metres of DN750 raw water trunk main will be required to connect into the existing raw water mains at the corner of Mackay Eungella Road and Palms. An additional 2.5 kilometres DN450 augmentation to the raw water pipelines is required between the raw water intake and the proposed Southern WTP to convey 85 megalitres per day.

The remainder of the raw water pipelines east of the Southern WTP will be repurposed to potable water transfer mains from the Southern WTP to the Nebo Road HL PS.

Water Treatment and Transfer

Option 2 requires construction 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 85 megalitres per day and would be constructed by 2047. Two transfer pump sets are required at the WTP, one to pump water to a 10 ML reservoir located at Walkerston and the other to pump water to the Nebo HL PS balance tank.

Required trunk mains from the Southern WTP to the Walkerston storage consists of six kilometres of 450-millimetre diameter pipeline in 2047.

The Nebo Road WTP will be decommissioned however the Nebo HL PS and balance tank will remain to convey water from the Southern WTP to Mount Pleasant reservoir. The original raw water pipelines become treated water transfer mains from the Southern WTP to the Nebo HL PS balance tank. An additional 900 meters of DN750 is required along Palm Road to join the Southern WTP to the converted treated water mains conveying treated water to the Nebo HL PS balance tanks. Rehabilitation of RWM1 is required to ensure the existing pipelines can transport 68.5 ML/d to the Nebo Road balance tanks.

The north/south zone configuration is implemented in the same fashion as Option 1.

Distribution Mains:

A distribution main will convey water from the proposed Walkerston reservoir to the southern scheme via Stockroute Road. The trunk main would consist of 12 kilometres of 600-millimetre diameter main to connect into the existing 600-millimetre diameter southern distribution trunk main at the corner of Crichtons Road and Connors Road. The 600-millimetre distribution main is sized to supply peak hour demand in the south zone and transfer of MDMM demand to Sarina.

In the event of outage of the Walkerston reservoir outlet main, supply to the south zone and Sarina would revert to the original Mount Pleasant and Nebo Road HL PS supply configuration. The Peak Downs Highway DN300 main can provide some additional capacity to supply the south zone if the proposed Walkerston reservoir 600-millimetre outlet main fails.

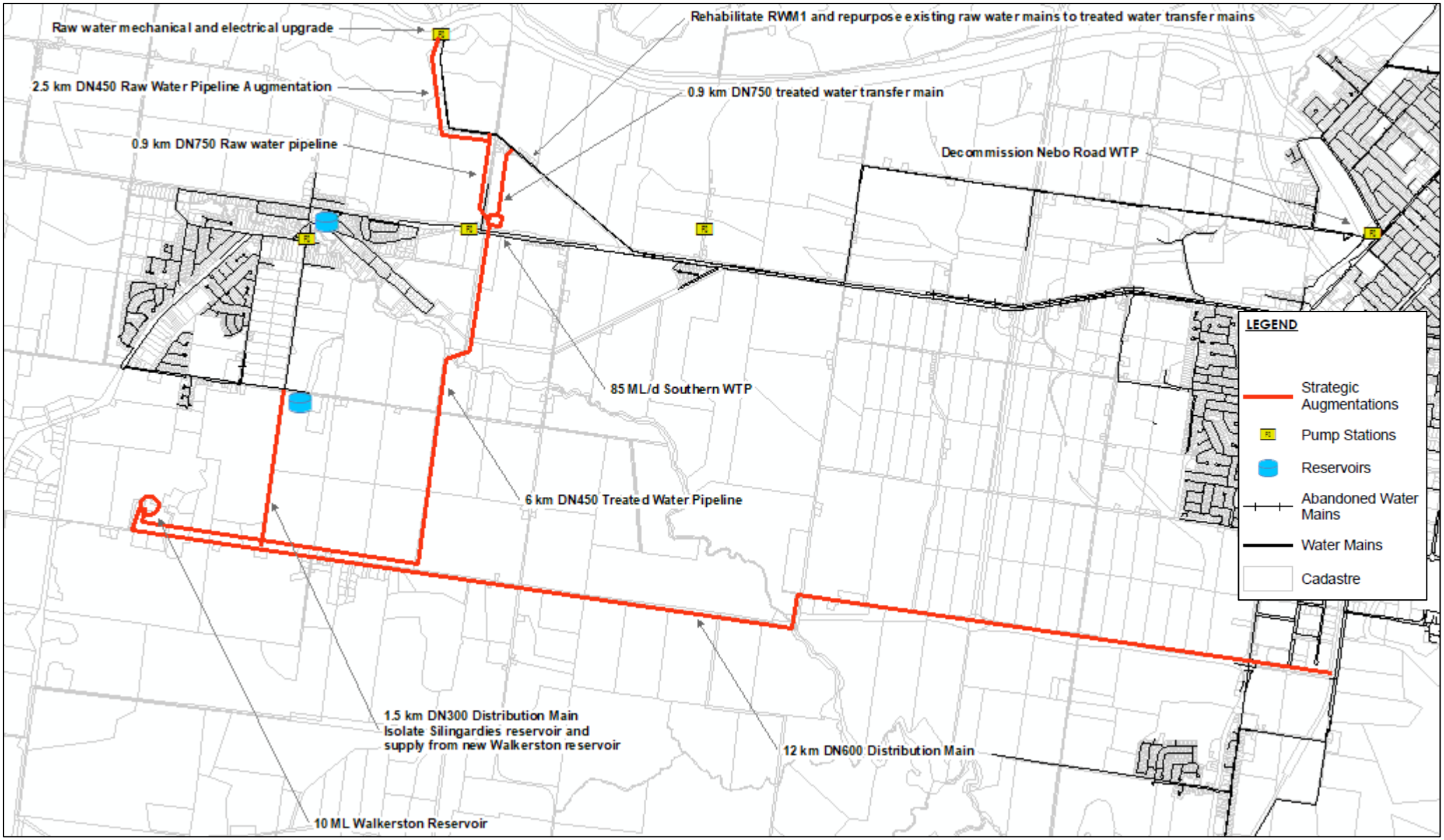


Figure 7-4: Option 2 – Build New Southern WTP and Decommission Nebo Road WTP

7.3.3 Strategic Options Cost Comparison

The options for building the Southern WTP have a number of common elements; same proposed WTP site and proposed Walkerston reservoir with north/south network configuration. The key differentiator is ability to decommission the Nebo Road WTP and the costs. The increased capital expenditure of a single larger plant is compared against the increased operational expenditure and resource requirements of operating two plants. A high-level cost estimating exercise was undertaken to compare the two options.

The following operational costs were adopted in the cost comparison with references provided to comparative cost sources:

- $237/megalitres for the Nebo Road WTP (2022 production cost data)
- $600/megalitres for the proposed 16 megalitres per day capacity Southern WTP (Adopted average of Nebo Road WTP and Marian WTP 2022 production cost data)
- $150/megalitres for the proposed 85 megalitres per day capacity Southern WTP (Assumed reduction from the Nebo Road WTP operational cost)

The following capital costs were assumed based on discussions with other Southeast Queensland bulk water service providers and industry estimates for other WTPs:

- $50 Million for a new 16 megalitres per day capacity WTP (Option 1)
- $20 Million refurbishment nominal cost for Nebo Road WTP (Option 1)
- $150 Million for a new 85 megalitres per day capacity WTP (Option 2)
- $6 Million for 900 m of DN750 raw water main and 900 m of DN750 treated water main (Option 2)

Note the following major items are common to both options and were not accounted for in the cost comparison:

- Raw water intake pump capacity and electrical upgrade
- Raw water pipeline rehabilitation
- 2.5 kilometres DN450 raw water pipeline augmentation
- Six kilometres DN450 treated water transfer main to Walkerston reservoir from Southern WTP
- 10 megalitres Walkerston reservoir and 12-kilometer DN600 outlet main
- Isolating Silingardies reservoir and new 1.5 kilometres 300-millimetre distribution main
- Land acquisition costs for the Southern WTP

Table 7-3 provides an NPC determination for both options adopting the above cost assumptions over a 50-year timeframe at a discount rate of 5 %.

Table 7-3: NPC

Infrastructure Cost	Option 1 Build Southern WTP to Augment Nebo Road WTP	Option 2 Build New Southern WTP and Decommission Nebo Road WTP
CAPEX – Southern WTP	$50 M	$150 M
CAPEX – Nebo Road WTP Refurbishment	$20 M	-
CAPEX – Raw Water Pipeline Diversion	-	$6 M
OPEX – Proposed Southern WTP	$600/ML	$150/ ML
OPEX – Nebo Road WTP	$237/ML	-
Total NPC (over 50 years)	**$175 M**	**$206 M**

7.3.4 Options Assessment

Due to both strategic options utilising the same locations for the proposed treatment plant, pipelines and reservoir site, environmental and social criteria were not assessed as the impacts are the same between options. The following environmental and socials risks are noted from previous water strategies for the construction of the Southern WTP:

- Southern WTP preferred site to be constructed adjacent to existing cemetery which could potentially lead to localised public disapproval.
- Southern WTP has potential image corridor issues to address.
- Delivery trunk main crosses major transport route. Will likely be under bored. 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

The flexibility, operability and economic criteria are the key differentiators between options. There is a clear economic difference between options with the cost of reducing the number of treatment plants from two sites to one (Option 2) being significantly larger. The benefit of operating a single treatment plant (Option 2) is the reduced operational resourcing requirements and this requires quantification against the NPC deficit.

There are also some resilience benefits in Option 1 having two treatment plants available to supply Mackay. The treatment technology of the future WTP will be required to mitigate the risk of brown river events.

7.3.5 Preferred Option

The recommended option for the major WTP upgrades in Mackay is the construction of a 16 megalitres per day Southern WTP to augment the Nebo Road WTP. The $31 Million NPC benefit of this option is considered significant enough to not warrant the reduction in resources afforded from decommissioning the Nebo Road WTP.

It is recommended to undertake a detailed costing exercise of the options and operational resource requirements of an additional WTP to provide a better comparison between options.

7.4. Marian WTP Scheme Options Development and Assessment

A major upgrade is required at the Marian WTP in 2050 and an options assessment to satisfy the Ultimate demand in Marian was undertaken. The intent of the Marian WTP strategic options assessment was to identify timing and opportunities to amalgamate the Marian and Mackay schemes. The Marian WTP is forecast to exceed its capacity after the proposed Southern WTP is built and therefore doesn't impact the timing of the Southern WTP. The strategic options are:

- **Option 1 - Upgrade Marian WTP:** Upgrade the Marian WTP to a total production capacity of six megalitres per day to satisfy the Marian scheme's Ultimate demand. The capacity of the raw water intake and Marian WTP site to accommodate this production increase has not been investigated. An assumption as to the cost of the upgrade was made based on the cost of the original Marian WTP construction cost.
- **Option 2 - Decommission Marian WTP:** Build a transfer pipeline from Walkerston to Marian and supply Marian from the Nebo Road WTP, enabling the decommissioning of the Marian WTP. Treated water would descend from the future Walkerston reservoir to the Marian reservoir via the 18-kilometre pipeline.
    - A DN375 sized pipeline is required to ensure the hydraulic gradient from the Walkerston reservoir to Marian reservoir is greater than the pipeline headloss at the required flow of 6 megalitres per day.
    - The additional Marian demand on the Mackay scheme will accordingly increase Ultimate demand on the proposed Southern WTP by six megalitres per day, regardless of adopting either Mackay Scheme's Options 1 or 2. The additional Southern WTP capacity will increase the capital expenditure associated with amalgamating the schemes.
    - The pipeline alignment is proposed to follow the Marian rail corridor as this runs adjacent to Pleystowe providing opportunity to establish a Pleystowe service connection.

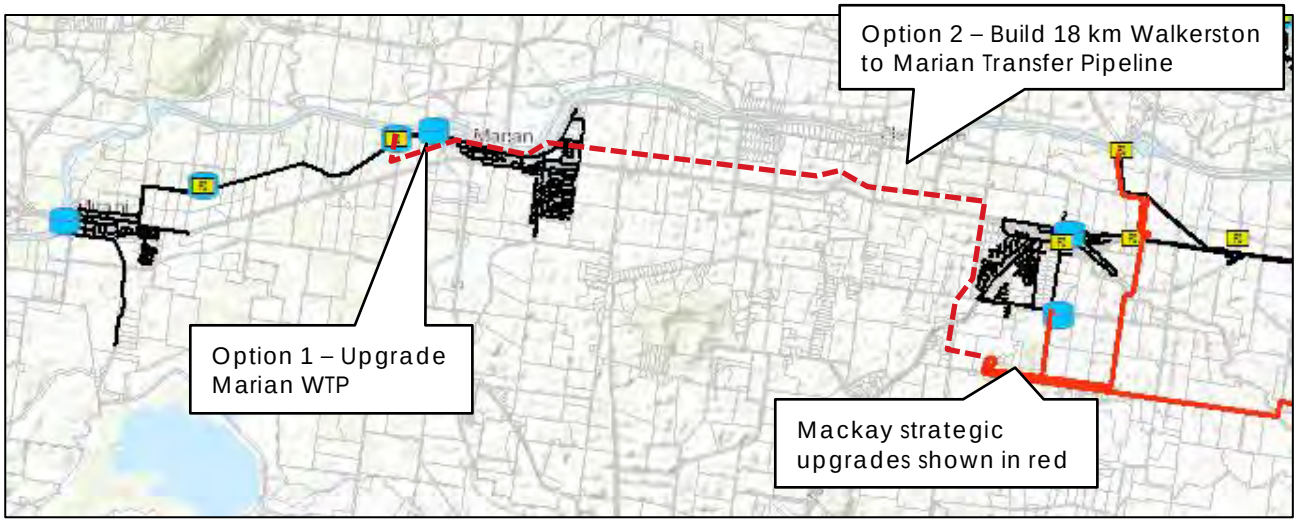


Figure 7-5: Marian WTP Strategic Options

7.4.1 Strategic Options Cost Comparison

When the Marian WTP capacity is exceeded in 2050, the option to decommission the WTP and amalgamate the Marian scheme with Mackay was assessed by comparing the cost of the transfer pipeline from Walkerston to the Marian WTP upgrades. A high-level cost estimating exercise was undertaken to compare the two options.

The following operational costs were assumed with references provided to comparative cost sources:

- $864/megalitres for Marian WTP (2022 production cost data)
- $150/megalitres for the treatment and transfer from the Southern WTP (as outlined in the Mackay strategic options assessment)

The following capital costs were assumed:

- $10 Million for the Marian WTP capacity upgrade from four megalitres per day to six megalitres per day (Derived from the estimated final cost of the original Marian WTP construction including raw water intake of $13 Million)
- $27 Million for the Walkerston to Marian eighteen-kilometre DN375 transfer pipeline (based on assumed $1500/metre unit rate)
- $10 Million for the six megalitres per day additional capacity required at the Southern WTP (assumed as a proportional increase of the $150 million 85 ML/d treatment plant cost outlined in Mackay Option 2)

Table 7-4 provides a NPC determination for both options adopting the above cost assumptions over a 50-year timeframe at discount rate of 5%.

Table 7-4: Marian Options NPC

Infrastructure	Option 1 - Upgrade Marian WTP	Option 2 - Decommission Marian WTP
CAPEX – Marian WTP 2 ML/d capacity Upgrade	$10 M	-
CAPEX – Southern WTP 6 ML/d additional capacity	-	$10 M
CAPEX – Walkerston to Marian Transfer Pipeline (Gravity supply from Walkerston)	-	$27 M
OPEX – treatment and conveyance	$864/ML	$150/ML
Total NPC (Over 50 years)	**$26 M**	**$40 M**

7.4.2 Options Assessment

The benefit of the proposed Walkerston to Marian transfer main is enabling the decommissioning of the Marian WTP and reduction of operational resource requirements. The high-level cost estimate indicates it will require greater capital expenditure and has not accounted for decommissioning costs of the Marian WTP.

The social and environmental impacts of each option were not assessed. The resilience of a single transfer pipeline from Walkerston could be improved by installing two parallel mains with equivalent capacity to the single main option outlined.

7.4.3 Preferred Option

In light of the greater than 25 year timeframe for proposed augmentations, a preferred option has not been identified. The following information requires verification to inform a decision prior to the next revision of the water strategy:

- The ability of the existing Marian WTP site and raw water intake to accommodate the capacity increase requires confirmation.

7.5. Strategic Options Assessment Outcomes

The recommended option for the major WTP upgrades in Mackay is the construction of a 16 megalitres per day Southern WTP to augment the Nebo Road WTP in 2047. The $31 Million NPC benefit of this option is considered significant enough to not warrant the reduction in resources afforded from decommissioning the Nebo Road WTP.

A preferred option for the Marian scheme has not been identified as the ability of the existing Marian WTP site and raw water intake to accommodate an capacity increase requires confirmation and should be verified prior to the next revision of the water strategy.

8. Network Assessment

A network assessment was undertaken for all reservoirs and distribution infrastructure to determine required network augmentations to maintain service standards across all planning horizons.

8.1. Reservoir Capacity Assessment

A capacity assessment was undertaken for all network reservoirs to determine existing and future deficiencies. The capacity assessment presented in Table 8-1 is based on providing 3 x (PD-MDMM) operational storage with four hours MDMM emergency storage. Storage requirements for demand persistence is discussed in Section 8.1.8.

The Shoal Point, Slade Point, Marian and Mirani reservoirs do not meet storage requirements and are discussed in the following sections. In summary, a new two megalitres reservoir is proposed for Shoal Point and options to reconfigure the Slade Point zone are provided. As the Marian reservoir can be refilled more rapidly than it drains, augmentations are only proposed for the Ultimate planning horizon.

Opportunities to rationalise storage at reservoirs sites with more than one tank were investigated for the following sites and discussed in the following sections:

- Blacks Beach reservoirs
- Mount Oscar reservoirs
- Berry Street and Green Street reservoirs

Table 8-1: Required Reservoir Capacity per CTM Code [3 x (PD-MDMM) + 4 hrs MDMM]

Reservoir	Existing Capacity (ML)	Required Capacity (ML)					
		2021	2026	2031	2036	2041	Ultimate
Mount Pleasant	55.51	17.73	18.2	19.0	19.7	20.7	28.4
Mount Oscar	13.6	2.6	2.7	2.8	3.0	3.2	3.4
Slade Pt	0.47	1.2	1.2	1.2	1.2	1.2	1.3
Mount Bassett	5.57	1.6	1.6	1.7	1.8	1.9	2.2
Blacks Beach	6.7	2.17	2.18	2.22	2.39	2.49	3.3
Rural View	10	3.9	4.2	5.0	5.7	6.6	9.2
Shoal Pt	0.4	0.1	0.1	0.2	0.3	0.3	1.1
Seaforth	2	0.3	0.3	0.4	0.4	0.4	0.4
Halliday	1.5	0.2	0.2	0.2	0.2	0.2	0.3
The Leap	0.64	0.2	0.2	0.2	0.2	0.2	0.2
Farleigh	5	0.4	0.5	0.5	0.5	0.5	0.6
Silingardies	2.25	1.0	1.0	1.1	1.1	1.2	1.5
Berry St	1.14	0.27	0.29	0.30	0.35	0.38	0.39
Sarina Town	6.0	1.3	1.4	1.4	1.5	1.6	2.5
Armstrong Beach	0.16*	0.3	0.3	0.3	0.3	0.3	0.4
Mount Griffiths	2.3	0.5	0.5	0.5	0.5	0.5	0.6
Mount Haden	2	0.5	0.5	0.5	0.6	0.6	0.6
Marian	1.6	1.5	1.6	1.7	1.9	2.0	2.9
Mirani	1.6	0.7	0.7	0.7	0.8	1.0	1.7

*Storage provided by Sarina Town reservoirs whilst Armstrong Beach balance tank provides suction pressure for the Armstrong Beach Booster Pump Station (BPS). No augmentations required.

A sensitivity analysis for required storage capacity using the 1.45 MDMM factor in the CTM Code is provided for reference in Table 8-2. There is a slight increase in required storage for all reservoirs due to the lower MDMM factor. All reservoirs still have sufficient capacity except where already identified in Table 8-1. The only exception is the Rural View reservoir which exhibits a 0.5 megalitres deficiency in the Ultimate planning horizon. As the sensitivity analysis has only identified a marginal deficiency in the Ultimate planning horizon, no actions are recommended.

Table 8-2: Required Reservoir Capacity Sensitivity Analysis with 1.45 MDMM factor

Reservoir	Existing Capacity (ML)	Required Capacity (ML)					
		2021	2026	2031	2036	2041	Ultimate
Mount Pleasant	55.51	20.2	20.8	21.7	22.6	23.7	32.4
Mount Oscar	13.6	3.0	3.1	3.2	3.5	3.7	3.9
Slade Pt	0.47	1.3	1.3	1.4	1.4	1.4	1.5
Mount Bassett	5.57	1.8	1.8	1.9	2.0	2.2	2.5
Blacks Beach	6.7	2.47	2.49	2.53	2.73	2.84	3.76
Rural View	10	4.5	4.8	5.7	6.6	7.6	10.5
Shoal Pt	0.4	0.1	0.2	0.2	0.3	0.4	1.2
Seaforth	2	0.4	0.4	0.4	0.4	0.4	0.5
Halliday	1.5	0.2	0.2	0.3	0.3	0.3	0.3
The Leap	0.64	0.2	0.2	0.2	0.2	0.2	0.2
Farleigh	5	0.5	0.5	0.6	0.6	0.6	0.6
Silingardies	2.25	1.1	1.2	1.2	1.3	1.3	1.7
Berry St	1.14	0.31	0.33	0.35	0.40	0.44	0.45
Sarina Town	6.0	1.5	1.5	1.6	1.7	1.8	2.9
Armstrong Beach	0.16*	0.3	0.3	0.3	0.3	0.3	0.5
Mount Griffiths	2.3	0.5	0.6	0.6	0.6	0.6	0.7
Mount Haden	2	0.6	0.6	0.6	0.6	0.6	0.7

8.1.1 Shoal Point Reservoir

The existing Shoal Point reservoir does not have sufficient capacity to provide for the Shoal Point Waters development and future growth in the area. A new reservoir, booster pump station and dosing unit is programmed for construction in 2023. The network configuration proposed in the previous water strategy as part of the proposed reservoir implementation was reviewed and updated to provide improved reservoir turnover with a separate inlet/outlet arrangement as shown in Figure 8-1.

Table 8-1 indicates that 1.1 megalitres of storage is sufficient in Shoal Point through to the Ultimate planning horizon. The 2023 reservoir project has allowed for a two megalitres reservoir and dosing unit to be built which will meet storage requirements and allow additional emergency storage.

The Shoal Point Waters Masterplan (https://www.shoalpointwaters.com.au/) provides the location and heights for the new reservoir which are lower than the existing reservoir as presented in Table 8-3.

Table 8-3: Shoal Point Reservoir Details

Reservoir	Capacity (ML)	Top Water Level (TWL) (mAHD)	Bottom Water Level (BWL) (mAHD)	Minimum Operating Level (MOL) (mAHD)
Existing	0.4	47.1	43.3	45.2
Proposed	2	45.85	39.75	43.5

The maximum serviceable elevation from the new reservoir has been determined as 19 mAHD based on the following:

- 22 m service pressure requirements.
- The MOL in the proposed reservoir is 43.5 mAHD based on a 50% emergency storage allowance.
- A 2.5 m network headloss allowance derived from the Ultimate simulated network headloss between the proposed reservoir site and Belangason Way where the highest elevation customers are located. Hydrant flow test data was provided for the Shoal Point area and the flow test data indicates the hydraulic model provides realistic measures of headloss in these areas.

There are existing customer connections in the Shoal Point reservoir supply area above the 19 mAHD maximum serviceable elevation at No. 13 and 30 Belangason Way. Low pressure complaints have also been notified at Triton Court where even though 22 m pressure is maintained in the main, the topography and high-set houses may cause low pressures downstream of the customer's service connection. It is proposed to integrate these properties into the proposed Shoal Point booster pump station service area.

Outside of the proposed booster pump station service area, the highest elevated customer is located at no. 29 Denman Ave at 19 mAHD. The minimum operating level in the Shoal Point reservoir to maintain service standards for this customer is 41.5 mAHD up to the 2041 planning horizon and then increasing to 43.5 mAHD in the Ultimate planning horizon when peak hour demand and network headloss is at maximum. The Ultimate minimum operating level could be reduced to 42 mAHD if there's connectivity provided between the Pappy's Beach estate and Shoal Point Waters development, increasing network connectivity.

8.1.2 Shoal Point Booster Pump Station

A proposed Shoal Point BPS will supply all customers above the Shoal Point reservoir's maximum serviceable elevation of 19 mAHD as shown in Figure 8-2. The existing DN150 Asbestos Cement (AC) main in Volute Street will be rezoned into the BPS service area to ensure service pressures are achieved to the customers along Belangason Way and Triton Court as well as enable future growth in the Medium Density Residential area at the end of Belangason Way. A proposed closed valve and 510 metre DN150 main following Shoal Point Road are required to enable this rezoning as indicated in Figure 8-3. The proposed Shoal Point Road main is recommended as DN150 to minimise pump head required in a fire event and enable development of the Medium Density Residential area.

The breakdown of total population in the BPS service area is provided in Table 8-4. The required peak hour and fire flow duty flow and head for the proposed booster pump station for existing and ultimate population are provided in Table 8-5 and Table 8-6.

Table 8-4: Shoal Point BPS Service Population (EP)

Planning Horizon	Shoal Point Waters	Pappy's Beach	Volute St, Triton Ct, Belangason Way & Shoal Point Rd	Medium Density Residential Area	Total EP
Existing	730	0	138	6	874
Ultimate	772	80	138	600	1,590

Table 8-5: Shoal Point BPS Peak Hour Duty Points

Planning Horizon	Required Service Pressure	Elevation Delta from Reservoir MOL to highest customer	Peak Hour Flow (PH:AD 4.6)	Peak Hour Headloss*	Duty PH
Existing	22 m	1 metre	13.0 L/s	5 m	13.0 L/s @ 28 m
Ultimate	22 m	1 metre	23.7 L/s	5 m	23.7 L/s @ 28 m

*Peak hour network headloss determined on basis that HLZ customers will be maximum one kilometre distance from BPS and development mains will be sized to ensure no more than 5 m/km peak hour headloss gradient.

Table 8-6: Shoal Point BPS Fire Flow Duty Points

Planning Horizon	Required Residual Pressure	Elevation Delta from Reservoir MOL to highest customer	Background demand (2/3 PH demand)	Fire Flow	Total Fire Flow	Fire Flow Network Headloss*	Duty Fire Flow
Existing	12 m	1 m	8.6 L/s	15 L/s	23.6 L/s	10 m	23.6 L/s @ 23 m
Ultimate	12 m	1 m	15.8 L/s	15 L/s	30.8 L/s	15 m	30.8 L/s @ 28 m

*Fire flow network headloss determined by simulating fire event at end of Belangason Way (Hydrant ID HYTSHBEL002).

The following key information was used in assessing the booster pump station service area:

- The Shoal Point Waters development layout was sourced from the developer's website (https://www.shoalpointwaters.com.au/) and count of dwellings within the booster pump station's service area was undertaken as illustrated in Figure 8-1.
- Volute Street, Triton Court, Shoal Point Road and Belangason Way contain 40 detached (108 EP) and 20 attached (30 EP) existing dwellings that will be rezoned onto the BPS as shown in Figure 8-3.
- The available fire flow in the existing hydrants adjacent to the proposed valve closures indicated in Figure 8-3 were assessed to still be able to achieve desired fire flow requirements following closure.

An identified risk is that following the rezoning the pressures in the existing DN150 AC main along Volute Street will increase from 37 metres to 65 metres.

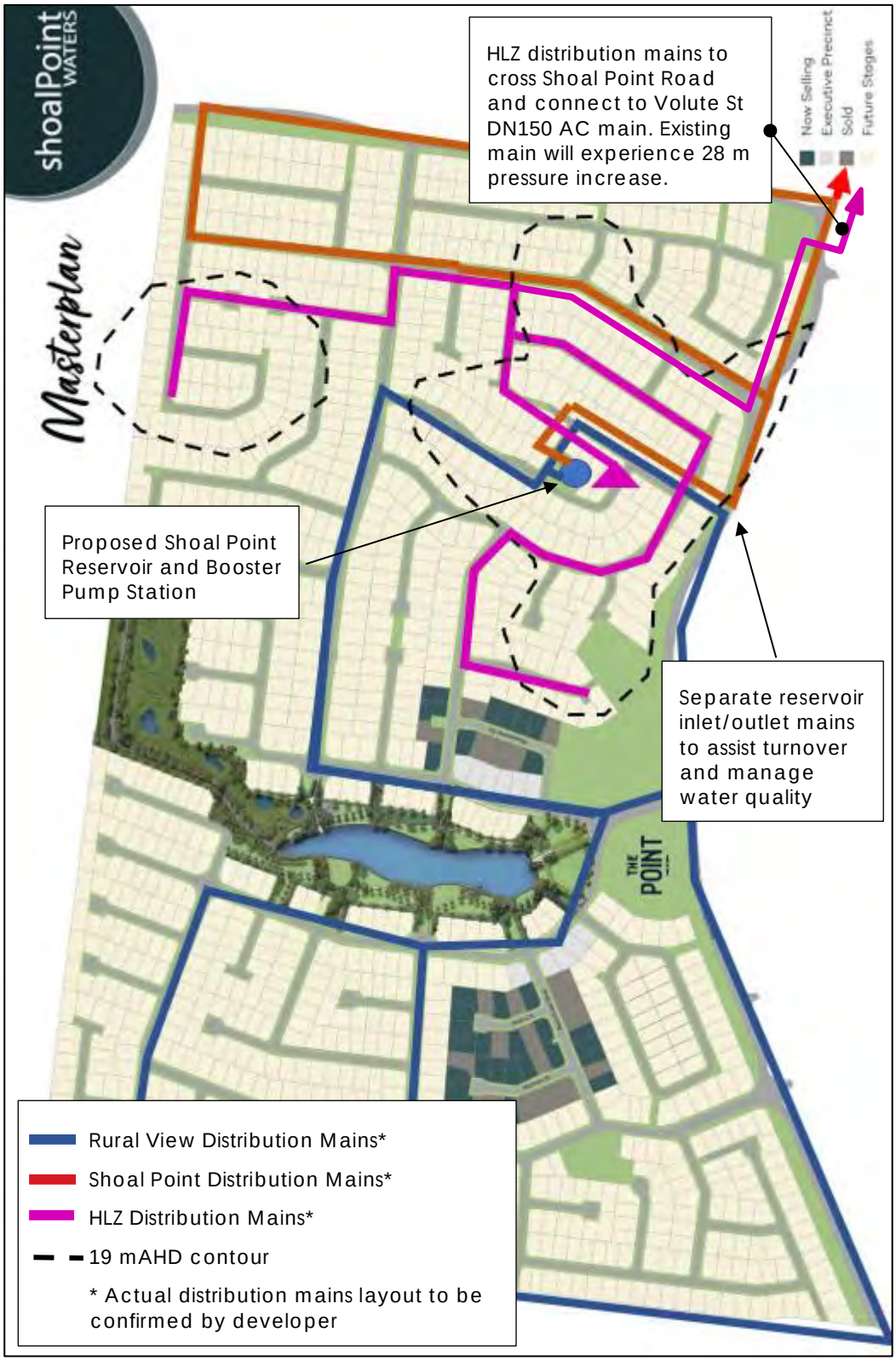


Figure 8-1: Shoal Point Proposed Reservoir Configuration (https://www.shoalpointwaters.com.au/)

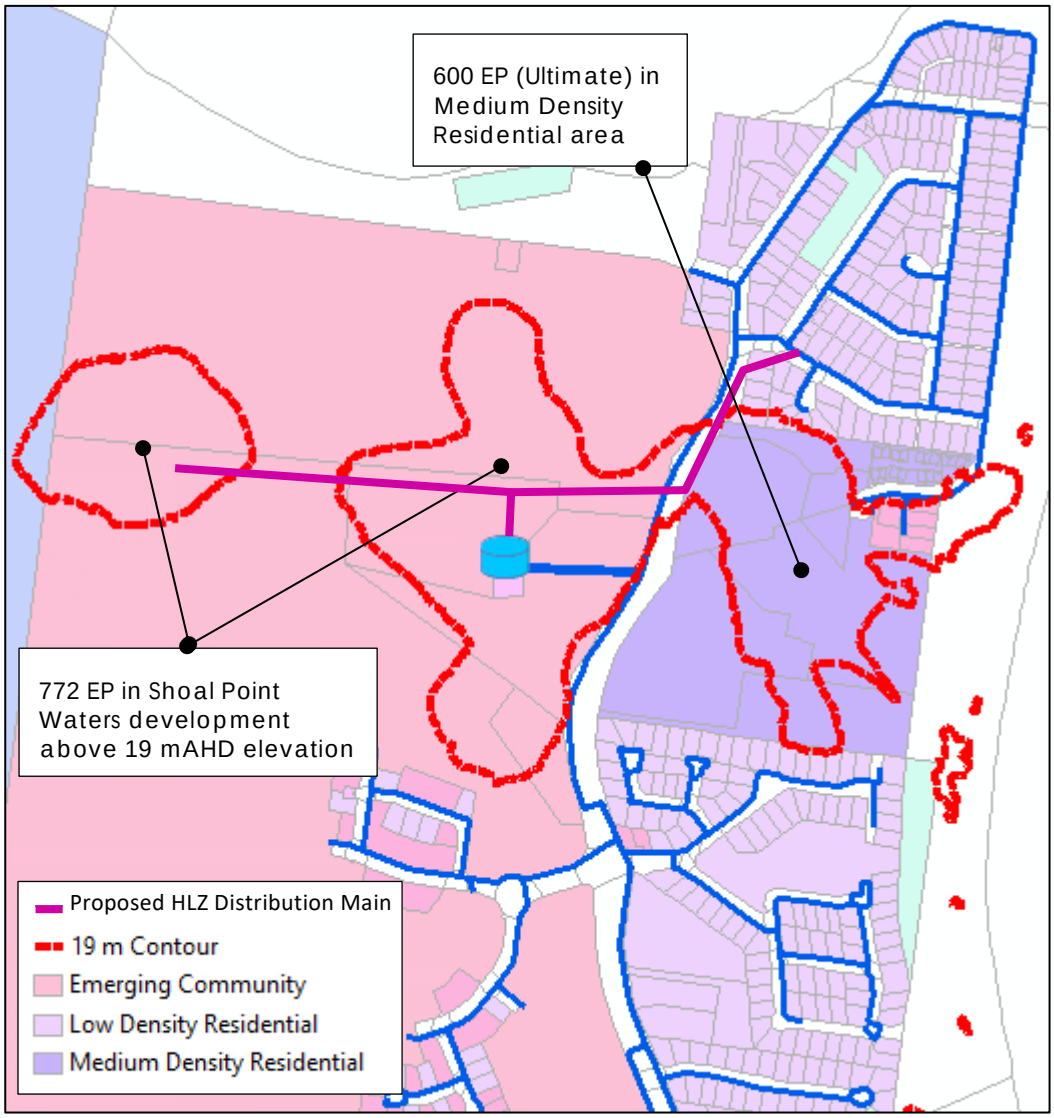


Figure 8-2: Shoal Point Land Use and HLZ supply area

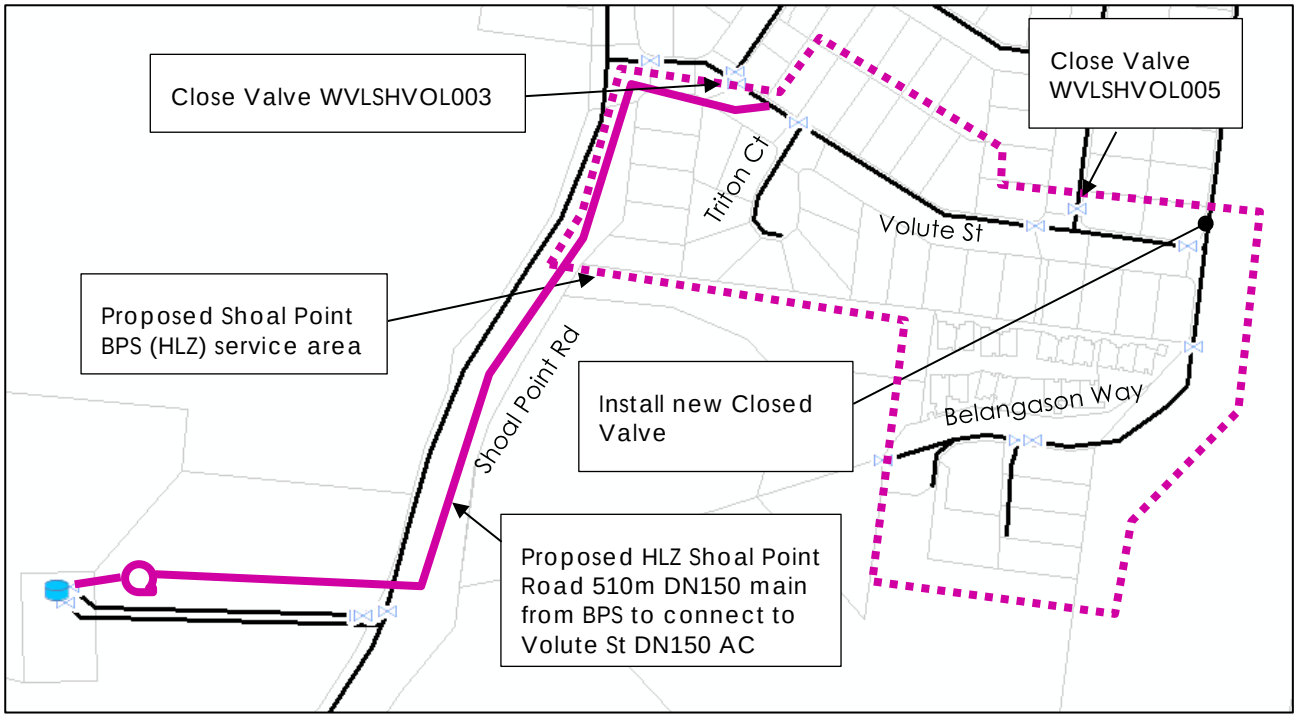


Figure 8-3: Shoal Point BPS Service Area Valving

8.1.3 Marian and Mirani Reservoirs

Storage deficiencies have been identified for the Marian reservoir in the 2031 planning horizon and then for the Mirani reservoir in the Ultimate planning horizon as presented in Table 8-1. As the Marian WTP is able to produce more supply than PD demand up to the 2041 planning horizon as illustrated in Figure 5-6, no augmentations to the Marian storage are recommended due to the ability to refill the reservoir more rapidly than it drains. In the Ultimate planning horizon, a 1.5 megalitres storage augmentation is recommended for the Marian reservoir.

As there is a 20 hr operation factor of safety in the Mirani Transfer PS capacity, it has been assumed the slight Ultimate Mirani storage deficiency can be accommodated by the Mirani Transfer PS capacity to replenish the reservoir.

8.1.4 Slade Point

The Slade Point elevated tower is located in a constrained site with no space to increase storage. The tower does not meet storage requirements and is replenished via frequent operation of the Slade Point Pump Station (PS). Whilst the Slade Point zone maintains customer service pressures during normal operation, there is no ability to take the elevated tower offline and the tower contains little storage to enable taking the Slade Point PS offline. It was investigated to decommission the elevated tower and replace with a booster pump station supply.

To take the elevated tower offline, a new BPS is required to supply the northern half of the Slade Point zone in the event of reservoir outage as shown in Figure 8-4. The Slade Point Road existing DN250 AC main does not have the capacity to provide peak hour demand to the customers upstream of the proposed booster pump station. A new one-kilometre DN250 augmentation to the existing Slade Point Road main is required to ensure customer service pressures or replacement of the existing DN250 AC main based on condition assessment data. In this arrangement, there are some fire flow deficiencies in hydrants on single existing DN100 mains and the existing Slade Point PS should be retained as fire flow supply pumps.

Alternatively, the existing Slade Point PS could be converted to a booster pump station to supply the entire Slade Point zone. The pumps are sized to provide more flow than peak hour demand in Slade Point. This configuration also provides increased fire flow capacity to Albatross Street as the pumps can pressurise the network to a higher degree than the existing Slade Point elevated tower.

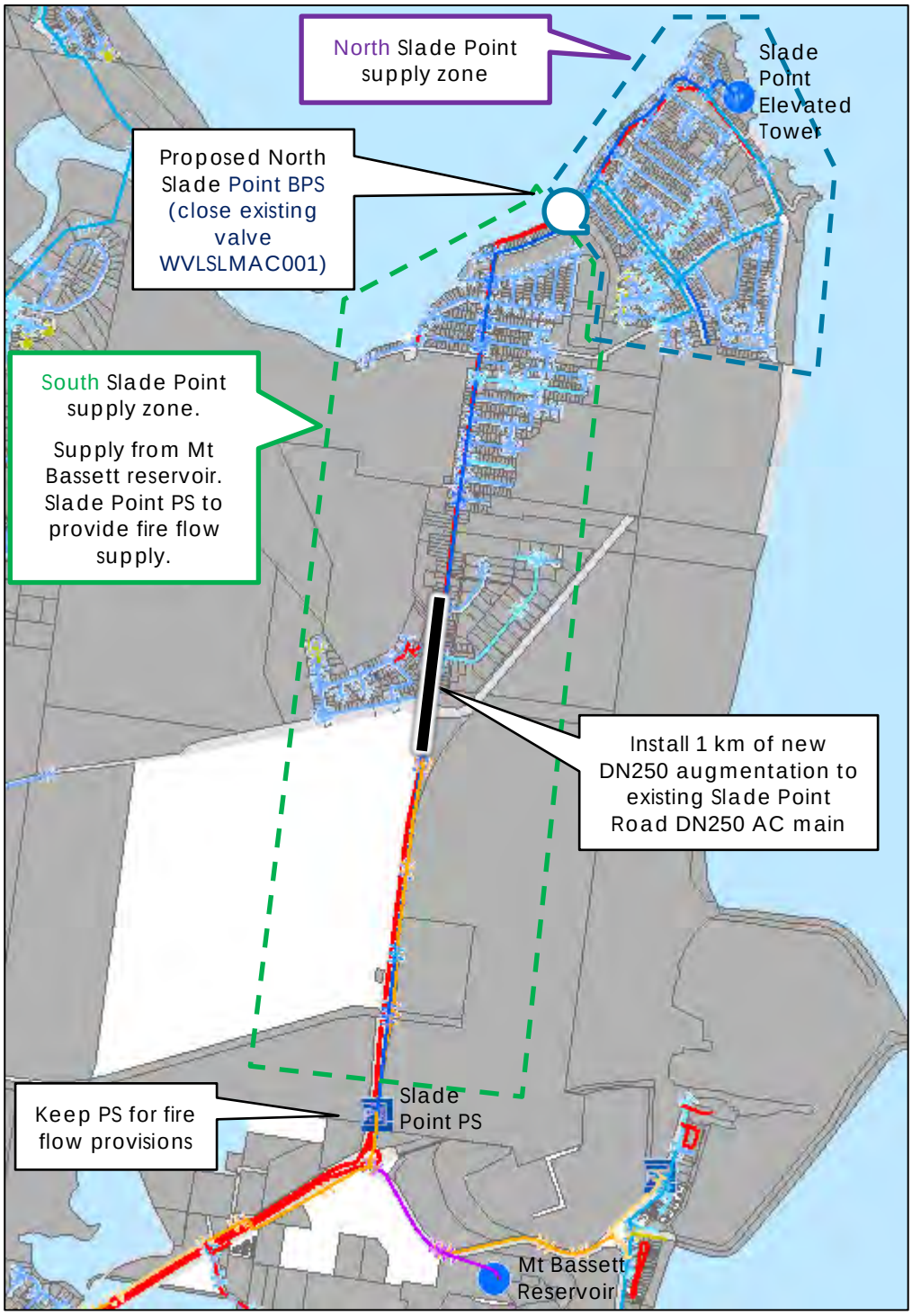


Figure 8-4: Slade Point Zone Proposed Reconfiguration to improve Reliability

8.1.5 Blacks Beach Reservoirs

The Blacks Beach reservoirs require refurbishment and opportunities to decommission either of the reservoirs were investigated. Existing infrastructure includes:

- Reservoir No. 1, Built 1972 = 2.21 = 2.21 ML
- Reservoir No. 2, Built 1980 = 4.5 ML
- Due to the differing BWL of each reservoir, there is 1.5 ML dead storage in Reservoir No. 2.
    - Blacks Beach PS capacity = 80 L/s (or 5.7 megalitres per day over 20 hours)

Temporarily taking either reservoir offline for refurbishment works is viable considering the supply capacity from the Blacks Beach PS exceeds PD demand. In the long term, the Blacks Beach reservoir #1 would pose a risk to constraining potential greenfield development or not containing enough emergency storage in case of supply issues. Additionally, taking reservoir #1 offline unlocks 1.5 ML dead storage in reservoir #2. It is recommended the Blacks Beach reservoir #1 be kept in the short term to enable refurbishment of the Blacks Beach reservoir #2 and then Blacks Beach reservoir #1 decommissioned.

Storage Requirements

Table 8-1 indicates that Blacks Beach reservoir #1 has sufficient storage until 2031. As the supply capacity of the Blacks Beach PS exceeds the PD demand of the Blacks Beach zone, the 2031 storage deficiency could be ignored considering the ability to refill the reservoir more rapidly than it can drain.

Supply Reliability

There is less than one day storage in Blacks Beach reservoir #1 should there be supply issues such as power outages in cyclonic conditions or an upstream pipe burst in the one kilometre of DN300 DICL main built 1992 following Eimeo Road. The likelihood of failure and time to repair requires consideration against the storage volume in Blacks Beach reservoir #1.

Resilience

If there is a requirement to take both Blacks Beach reservoirs or Blacks Beach PS offline for an extended period of time, the Blacks Beach zone can be supplied directly from the Rural View reservoir during AD demand. During MDMM demand however the high elevation customers at Chapman Ct and Palmview Ct will experience peak hour pressures as low as 15 m. Field testing of this supply arrangement is required to confirm viability.

Sensitivity to growth

The MGAM indicates the greenfield area between Blacks Beach and Eimeo is developed in the Ultimate planning horizon. Should the greenfield development progress in the short term, the Blacks Beach reservoir #1 will become a constraint.

8.1.6 Mount Oscar

The opportunity to improve water quality and reduce operation and maintenance requirements by decommissioning one of the Mount Oscar reservoirs was investigated. Existing infrastructure includes:

- Reservoir No. 1, Built 1959 = 6.8 megalitres
- Reservoir No. 2, Built 1959 = 6.8 megalitres

Decommissioning either reservoir is viable considering the available storage capacity in a single reservoir and ability to bypass the site (assuming there is a Mount Oscar reservoir bypass main in place). The likelihood of failure of the upstream supply main requires consideration against the available storage.

Storage Requirements

Table 8-1 indicates there is sufficient storage capacity provided by a single 6.8 megalitres reservoir to satisfy Ultimate demand. The storage capacity is provided for the Green St zone, Berry St zone, the Andergrove DMA (DMA 5), the Mount Pleasant DMA (DMA 7), and the properties directly serviced by the reservoir north of Malcolmson St. Storage for Slade Point and Mackay Harbour are provided by the Mount Bassett reservoir.

The Beaconsfield-Andergrove DMA (DMA 3-4) receives the majority of its supply from the Mount Pleasant reservoirs via the Holts Road flow meter (Pipe asset ID A33428) and a partial supply from the Mount Oscar reservoirs via the Cutler Drive flow meter (Pipe asset ID A33439). It has 12,200 EP in the 2041 planning horizon and there is sufficient spare storage in a single Mount Oscar reservoir to provide supply for the 2041 population.

Resilience

If there is a requirement to take the Mount Oscar reservoirs offline, the Mount Pleasant reservoirs can provide supply to the Mount Oscar and cascading zones (assuming there is a Mount Oscar reservoir bypass main in place). The ability to bypass the reservoirs requires confirmation. Hydraulic model results indicate that network pressure with the Mount Oscar reservoir bypassed would result in a 5 metres pressure decrease. Additionally, the bypass main at the Mount Oscar reservoir site decreases to slightly negative pressure (-0.5 m) in the 2041 peak hour demand with Mount Bassett filling. To mitigate the risk of negative pressures in the bypass-main and to minimise the impact to customer pressure when bypassing Mount Oscar reservoirs, timed lockout can be implemented on the Mount Bassett inlet valve or pressure sustaining valve installed to prevent the reservoir from filling during peak hour conditions or filling too fast. The spare capacity within the Mount Bassett reservoir allows for a timed lockout to be implemented and there is minimal risk to the reservoir emptying under PD conditions.

Supply Reliability

A single Mount Oscar reservoir can provide two days' worth of average network demand in the event of upstream DN600 MSCL pipe failure. The risk of mains failure and repair time of the DN600 MSCL main requires consideration against the available storage. Note Mount Oscar reservoir can still be supplied via the Cutler Drive main from Mount Pleasant and a NRV is in place to prevent this during normal operation. In this event, the NRV will need to be opened and storage in the Mount

Oscar, Mount Bassett and Slade Point reservoirs should be monitored to prevent the Mount Oscar reservoir from draining whilst the other 2 reservoirs remain full.

8.1.7 Berry Street MLZ and Green Street HLZ

The capacity of the respective assets in the Berry Street MLZ and Green Street HLZ are sufficient however due to their poor condition and access difficulties, options to reconfigure the zones and decommission the assets were investigated. Existing infrastructure includes:

- Green Street BPS: Modelled peak hour flow = 3 L/s, pump head = 50 meters.
- Green Street reservoir (located suction side of BPS): Volume = 0.8 megalitres, TWL = 37 mAHD
- Berry Street transfer PS: Modelled flow = 45 L/s, pump head = 28 metres.
- Berry Street reservoir: Volume = 1.14 ML, TWL = 64 mAHD

The Green Street reservoir is on the suction side of the Green Street PS and does not provide any storage for the HLZ. The Mount Oscar reservoir is higher than the Green Street reservoir and as such, the Green Street reservoir can be decommissioned resulting in an approximately 10 to 15 metres suction pressure increase to the Green Street PS.

Two options were investigated to decommission the Green Street PS as presented in Figure 8-5:

1. **Option 1 – Relocate HLZ PS to Berry Street reservoir site:** Decommission Green Street PS and reservoir and build a new HLZ PS at the Berry Street reservoir site. In this configuration, the proposed HLZ PS would draw off the Berry Street reservoir. A HLZ main already runs through the Berry Street reservoir site that the proposed HLZ PS could discharge into.
2. **Option 2 – Merge Mid-Level Zone and High-Level Zone via Berry St PS:** Upgrade the Berry Street mid-level pumps with high-level variable speed pumps and generator. Combine the MLZ and HLZ and operate as a single boosted zone from the upgraded Berry St PS. Decommission Green Street PS and reservoir. The proposed BPS target head would be higher than the Berry Street reservoir TWL and as such, the Berry Street reservoir would need to be decommissioned.

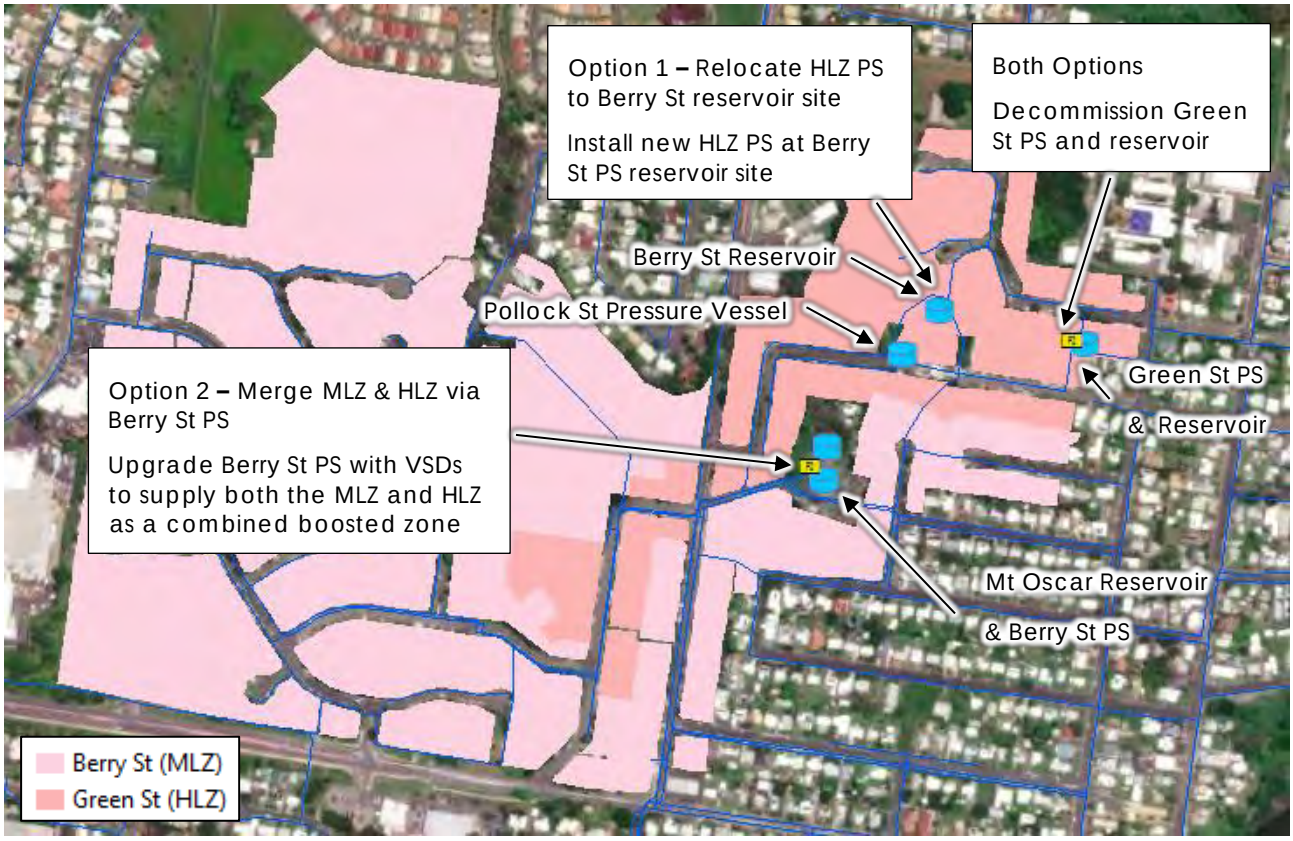


Figure 8-5: Proposed Berry Street and Green Street zone reconfiguration options

Table 8-7 summarises the risks and benefits of the two options and provides qualitative capital works and operations and maintenance comparisons. Further quantitative analysis as part of business case is required to confirm the preferred option.

Table 8-7: Mount Oscar HLZ Reconfiguration options

Criteria	Option 1 – Relocate HLZ PS to Berry St reservoir site	Option 2 – Merge MLZ and HLZ via Berry St PS
Benefits	Removes Green St PS and reservoir.	Removes Green St PS and reservoir as well as Berry St reservoir. Results in 1 less PS and reservoir to operate than Option 1. Refurbishment of the Berry St PS is currently required and could be used as opportunity to upgrade the pumps. Addresses marginal peak hour pressure deficiencies in the mid-level zone.
Risks/ Detriments	In case of high-level PS outage, 100 EP will experience pressure below 22 meters in AD demand however this is not a change from the existing network configuration performance.	18 m pressure increase in mid-level zone mains. The lowest elevation mid-level mains along Raymond Crocker Ave and Andrew Milne Dr are AC and would experience pressures close to 80 metres. A PRV could be installed along Norris Road to mitigate the pressure increase in the existing Berry Street zone. In case of PS outage, approximately 670 EP will experience pressures below 22 meters during an outage in AD demand. Recommend installing standby pump and generator.
Required Capital Works	Installation of new high-level booster pump station, enclosure, suction main and discharge main at Berry St reservoir site. Refurbishment cost of existing Berry St PS (cost would be foregone in Option 2) Decommissioning works for Greet St PS & reservoir.	Berry Street PS Upgrade including generator with increased duty point and Variable Speed Drives Norris Road PRV Decommissioning works for Greet St PS and reservoir and Berry St reservoir.
Operational and Maintenance Expenditure	New HLZ PS at Berry St reservoir site Existing Berry St PS Existing Berry St reservoir	Upgraded Berry Street booster PS New Norris Road PRV

8.1.8 Persistence Analysis

The CTM Code Water Network Design Criteria requires a persistence analysis for major trunk reservoirs to determine storage requirements. Figure 8-6 presents the daily demand profile from the 2019 summer factored up to simulate 2047 peak demand with a PD demand of 79.9 megalitres per day. The total daily demand in excess of the 68.5 megalitres per day production capacity requires reservoir storage to accommodate the production deficit. In this instance, the demand in excess of the production capacity is 94 megalitres and therefore 94 megalitres of storage is required.

There is 95 megalitres of network storage available allowing for 4 hour MDMM emergency storage and the reduced storage from decommissioning the 2.2 megalitres Blacks Beach reservoir and 6.8 megalitres Mount Oscar reservoir as discussed in Section 8.1.5 and 8.1.6. Additional storage is recommended in the form of the proposed Walkerston reservoir.

To determine the required volume of the proposed Walkerston reservoir, the persistence demand analysis was applied in the Ultimate planning horizon when 85 megalitres per day MDMM demand is realised and there is 104 megalitres of network storage available incorporating 4 hour MDMM emergency storage and assuming the Blacks Beach and Mount Oscar reservoirs are recommissioned. The demand persistence storage requirement in the Ultimate planning horizon is 114 megalitres. 10 megalitres of storage is required at the proposed Walkerston reservoir to ensure Ultimate storage requirements are met.

For reference, the 3*(PD – MDMM) + 4 hrs MDMM storage assessment for the Ultimate Nebo Road WTP and Southern WTP supply areas equates to 46 megalitres and 11 megalitres respectively, totalling 57 megalitres. The persistence analysis provides a higher required storage estimate than the 3*(PD – MDMM) assessment due to the headroom in the 1.75 PD factor generating an additional 3 ML of required storage each day across the 17 consecutive days that demand exceeds production.

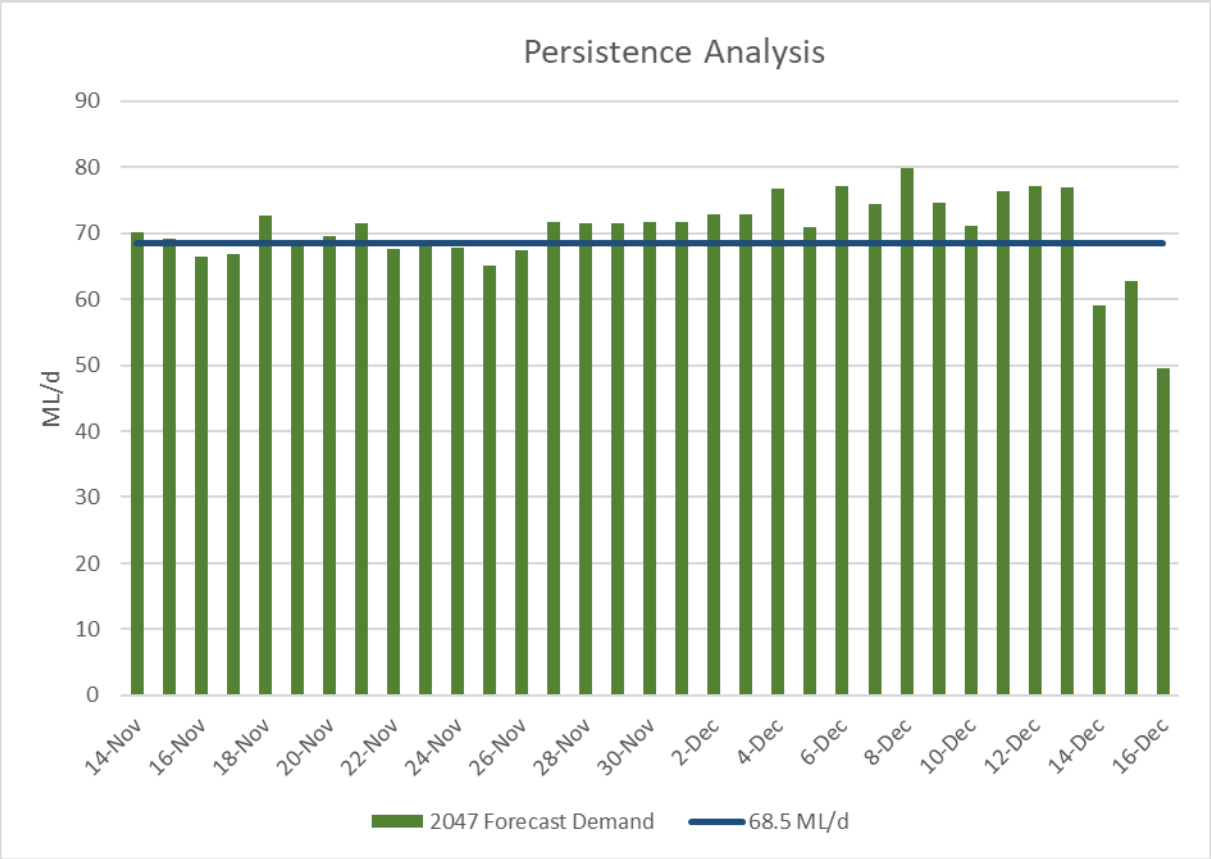


Figure 8-6: Persistence Demand Assessment for 2047 Planning Horizon when MDMM = 68.5 ML/d

8.2. Pump Station and Trunk Main Capacity Assessment

A capacity assessment of all transfer pump stations and trunk mains was undertaken to determine existing and future deficiencies and is presented in Table 8-8 and Table 8-9. The capacity assessments are based on providing MDMM demand over 20 hours per the CTM Code. The following capacity deficiencies are identified:

- A future supply deficiency is identified for the Nebo Road HL PS which is being upgraded in 2023. The HL PS should be sized to suit the WTP maximum achievable capacity which has been adopted as 68.5 ML/d in this study based on existing site constraints and partial clarifier bypass and is forecast to be exceeded in 25 years time. A 20 hour daily operation factor of safety should be incorporated per the CTM Code, resulting in a desired HL PS capacity of 82.2 ML/d.
- The Mirani Transfer PS is being considered for refurbishment and the works should consider existing electrical and pump station footprint to facilitate upgrading the pumps to suit Ultimate demand projections in future.
- The Alligator Creek trunk main and pump sets have deficiencies discussed in the following sections.

Table 8-8: Required Pump Station Capacity (MDMM over 20 hours per CTM Code criteria)

Pump Station	Capacity (L/s)	2021	2026	2031	2036	2041	Ultimate
Nebo Road HLPS	870	717	742	785	832	884	1177
Golf Links Drive	290	130	137	156	176	197	283
Blacks Beach	80	45	45	46	50	52	69
Ashburtons Road	56	15	16	16	16	16	19
Janes Creek	60	24	25	27	27	28	30
Berry Street	24	6	6	6	7	8	8
Slade Point	65	24	25	25	26	26	27
Walkerston	35	21	22	23	23	24	31
Alligator Ck: Griffiths Pump Set	22	21	21	21	22	22	25

Pump Station	Capacity (L/s)	2021	2026	2031	2036	2041	Ultimate
Alligator Ck: Sarina Pump Set	41	32	34	35	36	38	61
South Sarina	12	5	5	5	5	5	9
Mirani Transfer	21	10	10	11	13	15	26

Table 8-9: Required Trunk Main Capacity

Trunk Main	Capacity (L/s)	2021	2026	2031	2036	2041	Ultimate
Harbour Road TM	75	58	58	60	63	65	72
Shoal Pt TM	30	3	3	4	6	7	22
Alligator Ck Trunk Main	55	53	55	56	58	60	86
The Leap Trunk	25	11	12	12	12	12	14
Hay Point Road TM	25	11	11	11	12	12	13

8.2.1 Alligator Creek Trunk Main

SCADA at the Alligator Creek flow meter shows the supply to the Alligator Creek balance tank ranges between 55 and 60 L/s. A conservative 55 L/s capacity was adopted as the supply available to the combined Sarina, Armstrong Beach, Mount Griffiths and Mount Haden reservoirs. Table 8-9 indicates the existing trunk main capacity is deficient in 2031. Previous water strategies incorporated the implementation of the proposed Walkerston reservoir which would increase supply to Alligator Creek. This revision of the water strategy has deferred the Walkerston reservoir, leaving the Alligator Creek supply with potential future capacity deficiencies. No augmentations are proposed to increase supply capacity due to the following mitigating factors:

- The installation of new Nebo Road HL PS pumps with increased duty point will provide increased Alligator Creek supply.
- All reservoirs downstream of Alligator Creek have twice the required capacity to make up any shortfall in supply.
- Trunk main capacity calculations incorporate a MDMM over 20 hours factor of safety.

8.2.2 Alligator Creek PS – Sarina Pump Set

The Sarina pump set will require upgrades in the Ultimate planning horizon and the Alligator Creek to Sarina DN250 trunk main will need either upgrading with an additional DN225 main or depending on the condition of the existing main, replacing with a suitably sized pipeline to achieve 20 hours MDMM supply.

VSD installation on both Alligator Creek pump sets and dual operation of the pumps should be limited to not exceed the supply capacity of the Alligator Creek trunk main.

8.3. Reticulation Capacity Assessment

8.3.1 Mackay

A service pressure assessment has been undertaken for all reticulation mains across all planning horizons for the Mackay and Sarina network. The specific locations presented in Table 8-10 were identified in the model to experience pressures below 22 metres during peak hour demand. No augmentations are recommended as these deficiencies are driven by local elevation high points or pump operation and are not caused by insufficient network capacity.

The Ultimate planning horizon was assessed for the full development of greenfield areas and it was found that the existing trunk network has sufficient capacity to accommodate Ultimate demand. The Greenfield infrastructure proposed as part of the previous water strategy is discussed in Section 8.3.4. The Armstrong BPS will require an upgrade to a duty of 20 L/s at 20 metre head in the Ultimate planning horizon to maintain customer service pressures.

Table 8-10: Peak hour pressure assessment

Reservoir	Location	2021 Min Pressure	Comment
Rural View	9 properties at end of Palmview Court	21 m	Low pressures driven by high elevation of customers and distance from reservoir. Network augmentations would provide minimal benefit. Expected low frequency of event.
Slade Point	5 properties at end of	16 m	Low pressures are driven by high elevation of customers

Reservoir	Location	2021 Min Pressure	Comment
	Albatross St		relative to nearby reservoir. Pressure service standards unable to be achieved without booster pumps.
Berry Street	10 properties along Bona Vista Dr	21 m	Low pressures driven by high elevation of customers. Consider frequency and magnitude of non-standard pressures when reconfiguring Berry St zone as discussed in Section 8.1.7.
Walkerston/ Mount Pleasant	60 properties along Peak Downs Hwy in Alexandra	21 m	Pressures upstream of the Walkerston PS are impacted by the operation of the pumps. Avoid operating Walkerston PS during peak hour. The available spare capacity in Silingardies reservoir will accommodate this non-capital solution.
Sarina	5 properties at No. 14 Gurnett St, No. 30, 32 and 27 Langdon St and No. 52 Anzac St	21 m	Low pressures are driven by high elevation of customers relative to nearby reservoir. Pressure service standards unable to be achieved without local booster pumps.
Sarina	22 properties along Utah Ave and Penfold St	19 m	Low pressures caused by South Sarina BPS operating at end of its curve during peak hour with Armstrong BT filling. Avoid filling Armstrong BT during peak hour.

8.3.2 Mirani

A service pressure assessment has been undertaken for all reticulation mains across all planning horizons for the Mirani network. The full development of Mirani in the Ultimate planning horizon causes significant headloss in the Walz Lane DN250 and DN150 dual distribution mains. An additional 2.5 kilometres of DN250 distribution main is proposed in the Ultimate planning horizon from the reservoir to the town to mitigate peak hour headloss.

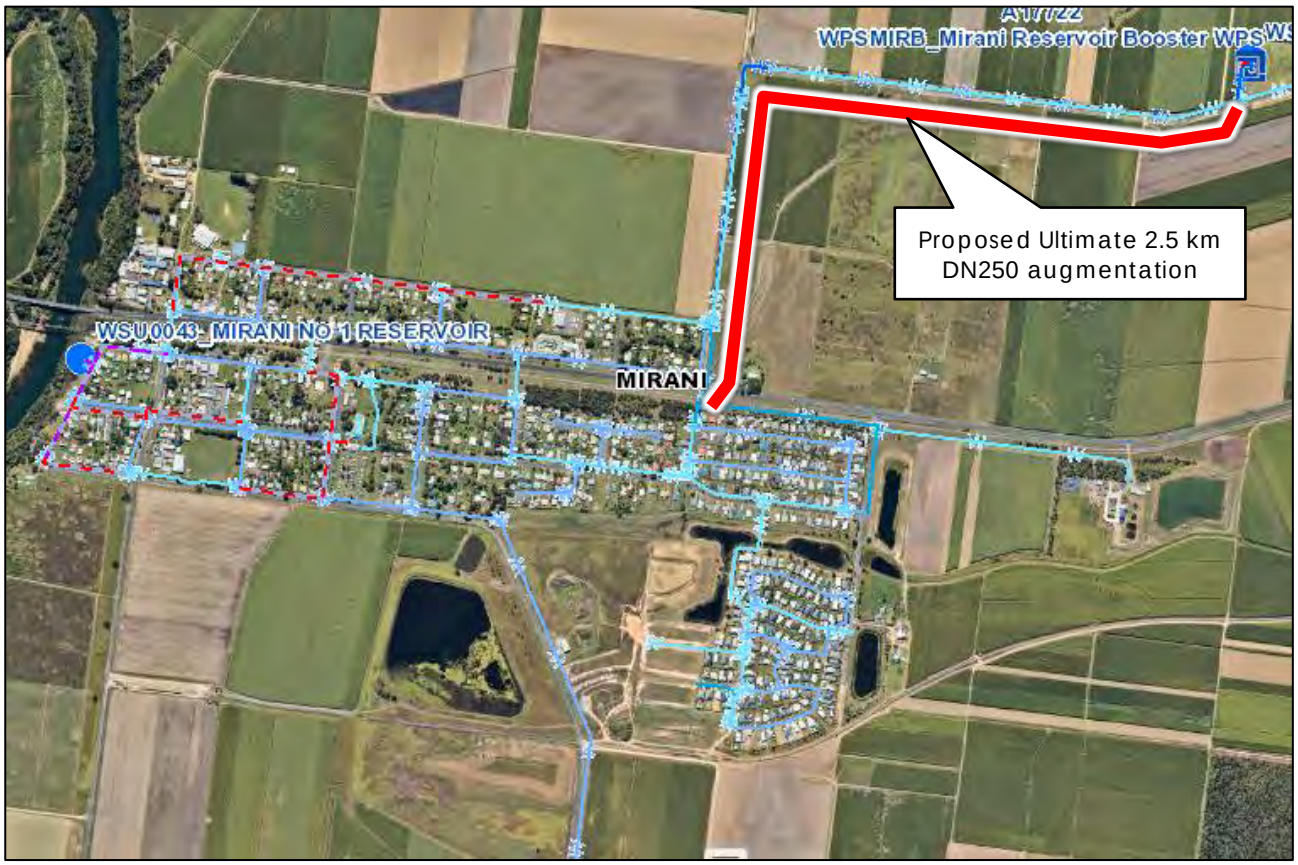


Figure 8-7: Mirani Augmentation

8.3.3 Marian

A service pressure assessment has been undertaken for all reticulation mains across all planning horizons for the Marian network. Customer pressure complaints have been reported in the Marian township and modelling indicates a progressive decline in pressure across the planning horizons as presented in Figure 8-8. The Marian BPS is operating at full speed during peak demand and there is significant headloss in the existing distribution mains.

The progressive installation of a DN250 distribution main is proposed to mitigate peak hour headloss as presented in Figure 8-9. The staging of the DN250 has been assessed to minimise upfront capital expenditure and has been sized to accommodate Ultimate demand.

- Stage 1 – 2.8 kilometres required now and improves network resilience in case of failure of the existing single Anzac Ave main supplying the township.
- Stage 2 – one kilometre required prior to 2036 to maintain pressure service standards.
- Stage 3 – 1.2 kilometres required in the Ultimate planning horizon to accommodate the full development of the Marian township. This stage is located adjacent developable land where potential alignments are uncertain. If an alignment can't be secured to connect the future Stage 2 DN250 main with the McCall St DN150 main as illustrated in Figure 8-9, the existing Kennys Rd DN150 AC main will require augmenting or renewal and upsized.

A sensitivity analysis was undertaken to confirm the timing of the above augmentations with Mackay unit demands and peaking factors applied in Marian. The modelled 2021 Marian peak hour demand is 60 litres per second. The modelled 2041 peak hour demand with Mackay unit demands and peaking factors is 57 L/s. The Marian capacity augmentations can be deferred to the 2041 planning horizon if Marian customer water consumption behaviours can be influenced to match the unit demands and peaking factors of Mackay.

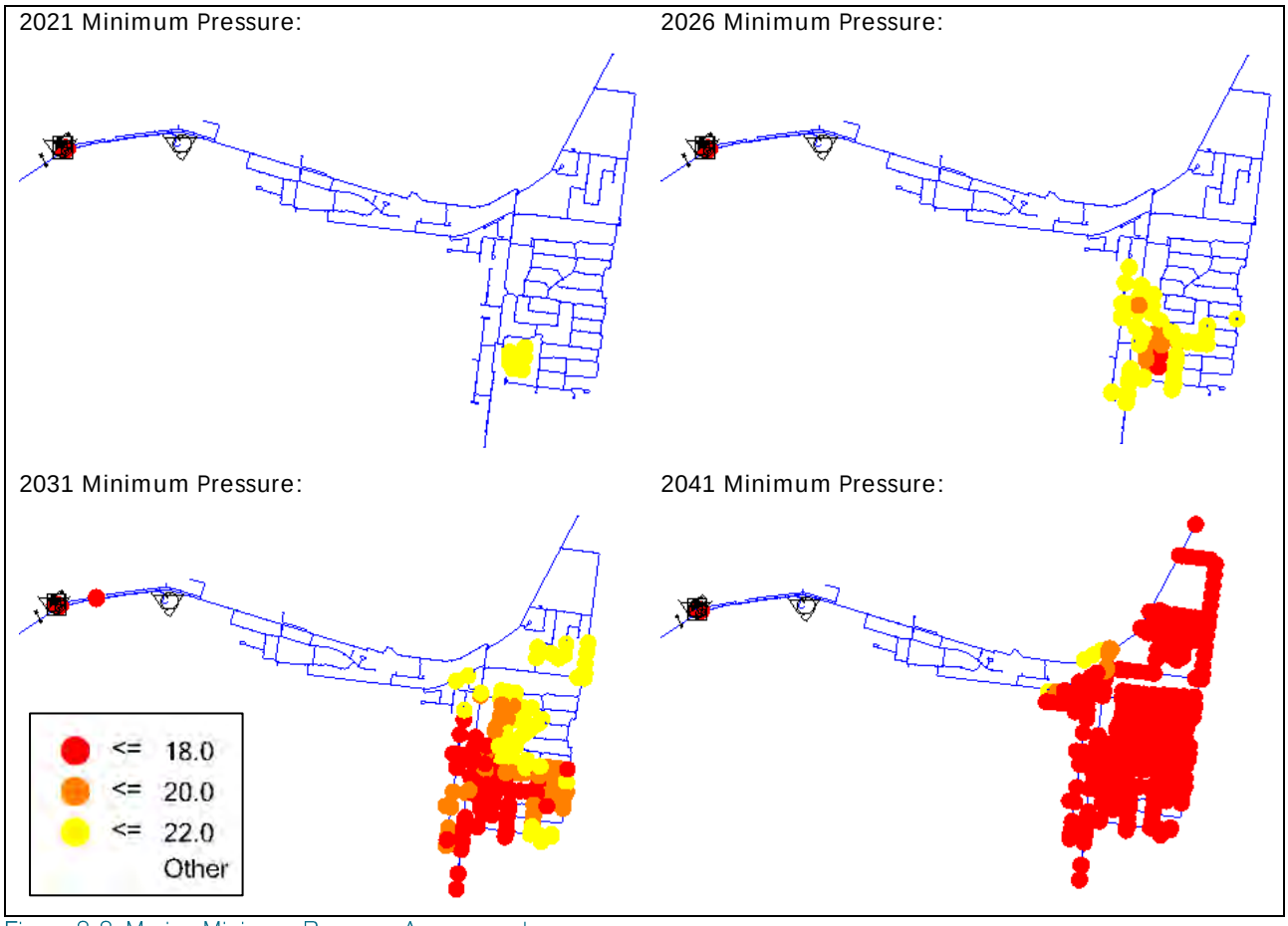


Figure 8-8: Marian Minimum Pressure Assessment

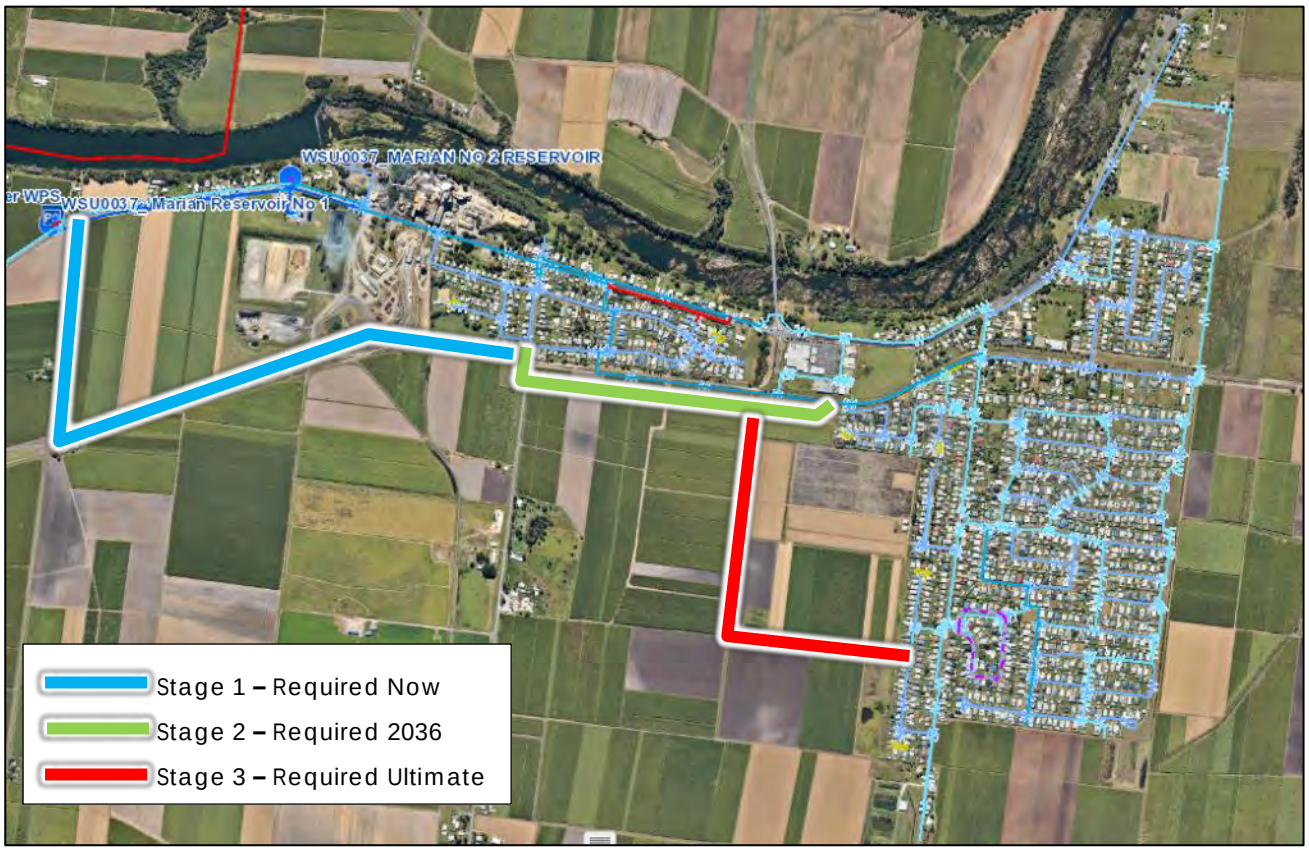


Figure 8-9: Marian proposed DN250 staged augmentation approach

8.3.4 Greenfield Infrastructure

There are a number of proposed greenfield developments which the two previous water strategies have identified required infrastructure. The network assessment through to the Ultimate planning horizon has determined that there is sufficient network capacity to convey water to the nearest trunk main for each development. The proposed infrastructure from previous water strategies were reviewed and it was found the required upgrades are all internal to the greenfield development areas and no external trunk main upgrades are required. The internal infrastructure is discussed in the following section.

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 in the 2026 planning horizon.

Figure 8-10: Previous water strategy (2016) greenfield infrastructure – Richmond Hills

The **Richmond** growth corridor is outside the water service area for the Mackay scheme and does not have any serviceable population forecast in the MGAM. As such, the infrastructure recommended in the previous water strategy has not been adopted for this water strategy.

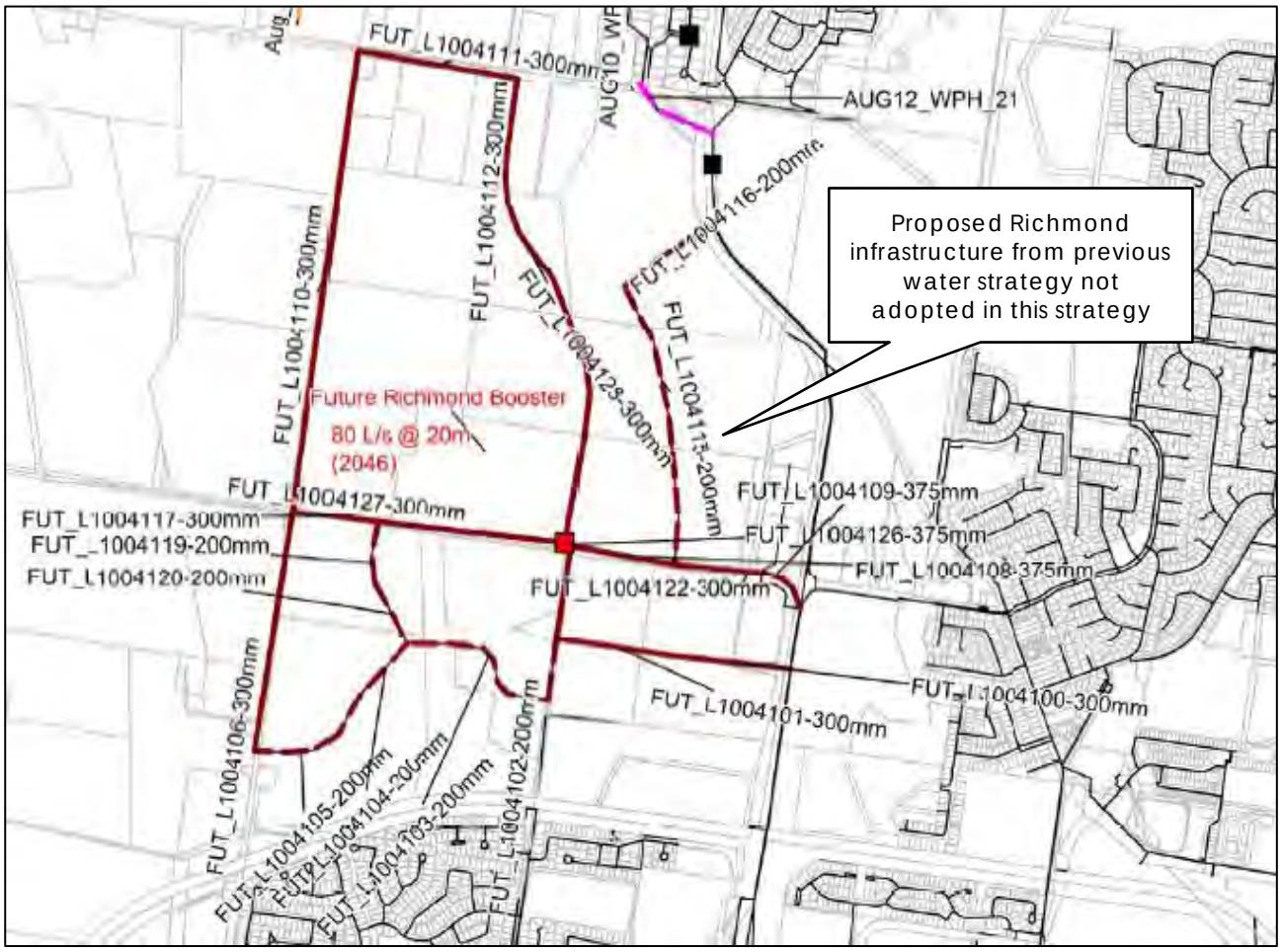


Figure 8-11: Previous water strategy (2016) greenfield infrastructure – Richmond

Ooralea growth corridor is forecast in the MGAM to be developed after 2041. The greenfield area requires distribution mains for the new development. A 300-millimetre diameter trunk main will be required. No change is recommended from the previous water strategy.

Figure 8-12: Previous water strategy (2016) greenfield infrastructure – Ooralea

The **Blacks Beach** greenfield area is located between the Blacks Beach and Rural View water supply zones and is forecast in the MGAM to be developed after 2041. The previous water strategy had adopted four sections of trunk main connecting the Blacks Beach water supply zone to Rural View as shown in Figure 8-13. It is assumed there is a closed valve proposed on this trunk main to maintain the zone boundaries. This strategic plan has revised the timing of the proposed trunk main from 2021 to the Ultimate planning horizon in line with the MGAM. The trunk main size remains unchanged.

The greenfield development to the north of the **Rural View** reservoir has a proposed distribution main planned for the 2021 planning horizon in the previous water strategy. The MGAM forecasts development to occur in 2031 in this area and the timing of the distribution main has been revised to suit as shown in Figure 8-13.

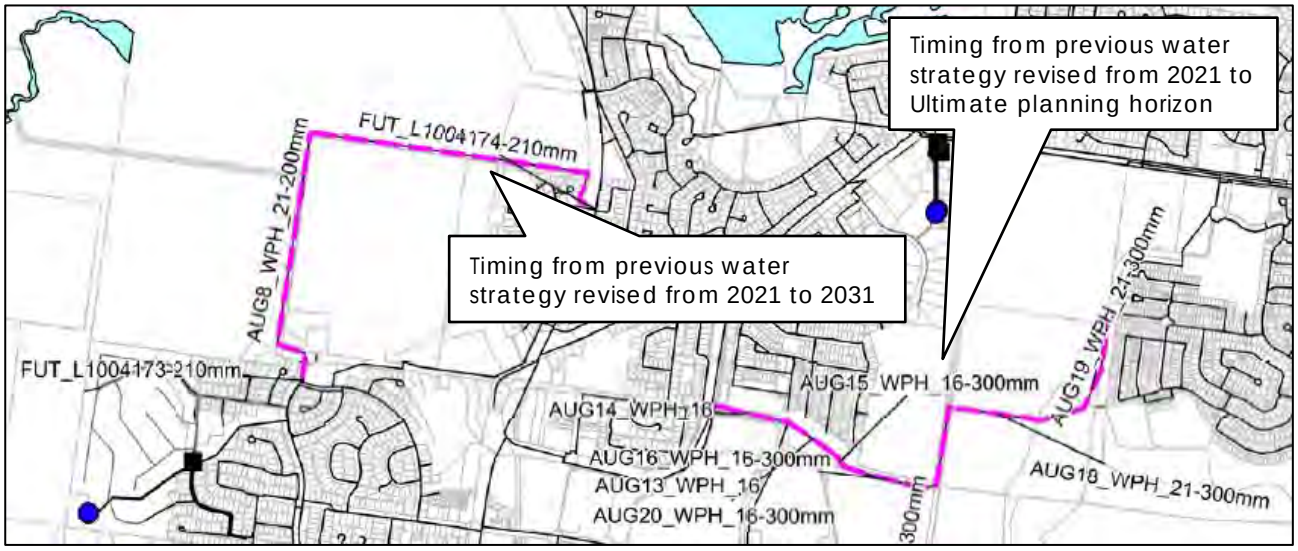


Figure 8-13: Previous water strategy (2016) greenfield infrastructure – Blacks Beach and Rural View

8.4. 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 non-residential properties.
- 7.5 L/s at 12 m for rural residential properties.
- All hydrants were initially assigned a default 15 L/s fire flow category. 30 L/s was assigned to hydrants if within 40 m of a MGAM Non-Residential parcel. If fire flow deficiencies were initially identified, aerial imagery and Google Maps data was used to reduce hydrant fire flow categories from 30 L/s to 15 L/s or from 15 L/s to 7.5 L/s if land use types were confirmed as residential or rural, respectively.
- Fire flows can be obtained utilising multiple hydrants where practicable.
- The fire flow assessment was undertaken with a background demand of 2/3 Peak Hour demand in the 2021 planning horizon.
- The Nebo Road HL PS was set to not operate in all fire flow assessments to understand network fire flow capacity without the future Walkerston reservoir. It is noted that the Nebo Road HL PS operating does not mitigate the need for proposed fire flow augmentations.
- A maximum allowable velocity of 4 m/s was adopted in the fire flow assessment in accordance with the CTM Code.

8.4.1 Mackay Fire Flow Assessment

The fire flow results and full description of each deficiency and recommendation are presented in Appendix B. A total of 89 fire flow deficiencies were identified within the Mackay and Sarina networks. A summary of the fire flow augmentations and recommended actions are presented in Table 8-11 and Table 8-12, respectively. Fire flow testing of hydrants should be undertaken at the augmentation locations to confirm the project need as well as the locations where marginal deficiencies are identified to confirm actual network performance.

A review of the fire flow augmentations recommended in the previous water strategy is presented in Table 8-13.

Table 8-11: Recommended Fire Flow Augmentations

Augmentation ID	Reservoir	Location	Scope	Comment
AUG_FF001	Mount Pleasant	Glenella Connection Road	130m DN150	Augment 130m with DN150. Adopt AUG001_FF_MWS from previous water strategy. Currently in design.
AUG_FF002	Mount Pleasant	Domino Crescent	370m DN150	Upgrade existing DN100 AC to DN150
AUG_FF003	Mount Pleasant	Bradford St	150m DN150	Upsize 150m to DN150 or check if connectivity to Palmview Village private mains can be used to improve fire flow availability
AUG_FF004	Mount Pleasant	Kay Ct	360m DN150	Adopt AUG004_FF_MWS & AUG005_FF_MWS from previous water strategy. Currently in design.
AUG_FF005	Mount Pleasant	Naish Ave	200m DN150	Upgrade existing DN100 AC to DN150
AUG_FF006	Mount Pleasant	Fursden St	-	Aug006_FF_MWS from previous strategy. DN150 main was constructed however subsequent hydrant testing could not achieve 30 L/s. A single hydrant operating individually is unlikely to provide 30 L/s so confirm fire flow availability with adjacent hydrants operating simultaneously. Additionally, confirm HYTGLFUR001 hydrant capacity to ensure no downstream blockage along Fursden St.
AUG_FF007	Mount Pleasant	Mclennan St, industrial area	350m DN150	Upgrade existing DN100 AC to DN150
AUG_FF008	Sarina	Millenium Dr	280m DN100	Install new main connecting end of Authur St to Millendium Dr
AUG_FF009	Blacks Beach	Bourke Street	100m DN150	Replace decommissioned Bourke St connection. Connect pipe Asset ID "BBBLACK005 - BBBLACK006" to "BL124 - BL043"
AUG_FF010	Armstrong Beach	Melba St	180m DN150	Upgrade existing DN100 PVC to DN150
AUG_FFSD	Farleigh	Sunset Drive WPS	New FF pumps	At present, the existing Rural Residential properties along Sunset Drive are supplied by the Sunset Drive water pump station which does not have the capacity to provide fire flow availability. Hydrants are not present in GIS along Sunset Drive. Confirm existence of Sunset Drive hydrants and upgrade Sunset Drive WPS with fire flow pumps.

Recommended actions based on the current water strategy network modelling identified deficiencies is provided in Table 8-12.

Table 8-12: Fire Flow Actions Summary

Deficient Hydrant	Reservoir	Location	Action
HYTSLALB004	Slade Point	Albatross St	Requires booster pump station or 200 m of DN150 main to achieve fire flow standards for hydrant servicing 4 houses.
HYTAGDAV006	Mount Pleasant	No 32 Davlyn Drive	Possible GIS error - check model connectivity at intersection of Kean St and Davlyn Dr (pipe GIS asset ID 21345)
HYTAGFOR002, HYTAGFOR003	Mount Pleasant	Forest Ct, Andergrove	Confirm MDPE pipe pressure rating and model internal diameter of 89mm

Deficient Hydrant	Reservoir	Location	Action
HYTNMOAS005	Mount Pleasant	No. 31 Oasis Dr, North Mackay	Install hydrant on nearby DN100 main "NM259E - NM259J"
HYTNMBOVEY001, HYTNMBOVEY002, HYTNMNORRI009	Mount Pleasant	No. 35 Bovey St, North Mackay	Open valve WVLNMBOVEY001 and close valve WVLNMNORRI002 to remove dead leg whilst maintaining DMA boundary
HYTMBWAL006	Mount Pleasant	Walz Ave and Joyce St, McEwens Beach	Consider application of rural 7.5 L/s fire flow category
HYTBCCOO002 and HYTBCCOO001	Mount Pleasant	Bakers Creek Wreckers / Bus Depot	Install hydrant on adjacent DN450 trunk main Asset ID "SMTMCOO002 - SMTMMAI001"
HYTWMOKE006	Mount Pleasant	Blue Care Mackay, Okeefe St	Possible GIS error. Confirm network connectivity at Okeefe St and Field St intersection
HYTWMDUP001, HYTWMDUP002	Mount Pleasant	Dupuy St (resorts/retirement home)	>30 L/s fire flow available in upstream hydrant HYTWMDON003 on Donaldon Street. Confirm distance to HYTWMDON003 is suitable for fire support.
HYTPAFOR003	Mount Pleasant	Formation St, Paget	No action as new main recently constructed.
No hydrant on GIS but assumed to exist	Mount Pleasant	No. 137 Connors Rd, Paget	DN300 across road "MC733 - MC998". No hydrants shown in GIS. Check if existing hydrant available or cut-in hydrant on DN300 main.
HYTSAHOE002	Sarina	Hoey St (Sarina retirement home)	Closed valve at north end of Hoey St in model for no apparent purpose (WVLSABRO003). Recommend opening valve to increase network connectivity.
HYTHPEDM002, HYTHPEDM003, HYTHPEDM004, HYTHPEDM005, HYTHPPEN005	Mount Griffiths	Edmunds Ave, Hay Point	Long DN100 main with many vacant/large lots. Consider application of rural 7.5 L/s fire flow category. Ensure Louisa Creek Rd PRV opens in fire event.

Additionally, Table 8-13 summarises the previous water strategy fire flow augmentations against the latest network modelling outcomes from the current water strategy.

Table 8-13: Previous Water Strategy Fire Flow Augmentation Review

Previous Water Strategy Augmentation ID	Comment
Aug001_FF_MWS	Identified as project AUG_FF001 in this strategy.
Aug002_FF_MWS	Augmentation constructed in 2022
Aug003_FF_MWS	Does not improve Albatross Street hydrant performance. Project removed.
Aug004_FF_MWS & Aug005_FF_MWS	Identified as project AUG_FF004 in this strategy.
Aug006_FF_MWS	Fursden St DN150 main was constructed however subsequent hydrant testing could not achieve 30 L/s. A single hydrant operating individually is unlikely to provide 30 L/s so confirm fire flow availability with adjacent hydrants operating simultaneously. Additionally, confirm HYTGLFUR001 hydrant capacity to ensure no downstream blockage along Fursden St.
Aug007_FF_MWS	1.3 km 50mm service connection unlikely to provide any fire fighting capacity. Contact Illawong Beach Resort for on-site fire protection information and undertake fire risk assessment.
Aug008_FF_MWS & Aug009_FF_MWS	No hydrant located in vicinity of commercial precinct at No. 216 Harbour Road. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment.
Aug010_FF_MWS	Hydrant is more than 120 m from nearest building and assumed for operational use only. Project removed.

8.4.2 Mirani Fire Flow Assessment

The Mirani water supply network is able to accommodate all residential fire flow requirements. However, the hydrants adjacent to the non-residential premises presented in Table 8-14 were identified to not achieve the fire flow DSS. No augmentations are recommended as all deficiencies are marginal and the properties are in primarily residential areas. It has been assumed the use of the Mirani bore can supplement the supply in a fire flow event to achieve DSS. Refer Figure 8-14 for locations.

Table 8-14: Mirani Non-Residential Fire Flow Assessment

Location	Available Fire Flow	Comment
Mirani State High School	29 L/s	Assumed the use of Mirani bores can achieve fire flow standards
Mirani Hotel	26 L/s	Assumed the use of Mirani bores can achieve fire flow standards
Mirani State School	26 L/s	Assumed the use of Mirani bores can achieve fire flow standards
No. 11 Maud Street industrial lot	26 L/s	Assumed the use of Mirani bores can achieve fire flow standards

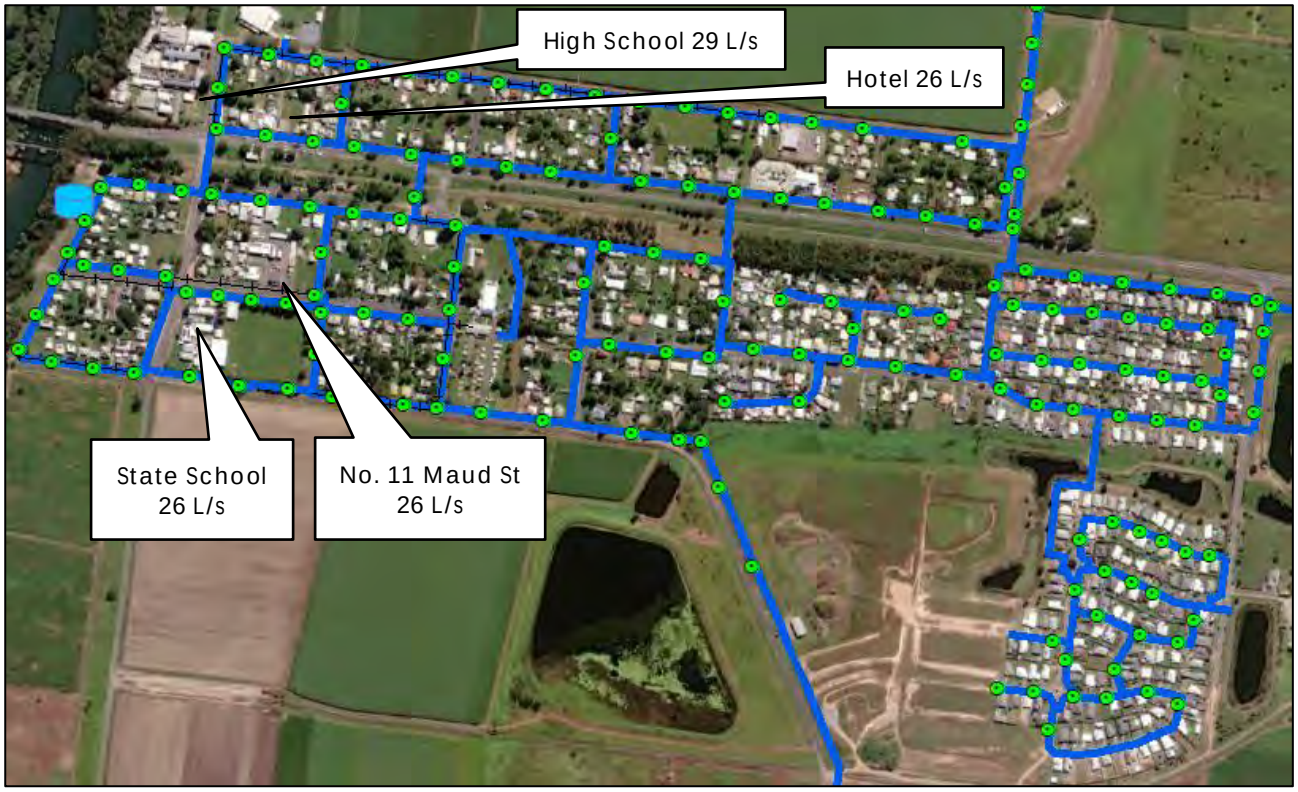


Figure 8-14: Mirani Non-Residential Fire Flow Assessment

8.4.3 Marian Fire Flow Assessment

The Marian water supply network is able to accommodate the majority of residential fire flow requirements. However, the hydrants adjacent to the properties presented in Table 8-15 were identified to not achieve fire flow DSS. Refer Figure 8-15 for locations. No augmentations are recommended as all deficiencies are marginal and the properties are in primarily residential areas.

Table 8-15: Marian Fire Flow Assessment

Location	Available Fire Flow	Comment
Bowls Club, 16 Reg Smith Street	24 L/s	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment.
Anzac Avenue Petrol Station	28 L/s	Hydrants on adjacent DN200 main provide 30 L/s.
Ridgeway Court residential properties	12 L/s	Marginal Failure. Recommend no augmentation.
No. 29 to 45 Anzac Ave 13 L/s	13 L/s	Residential zoning but Rural in nature. Marginal Failure. Recommend no augmentation.

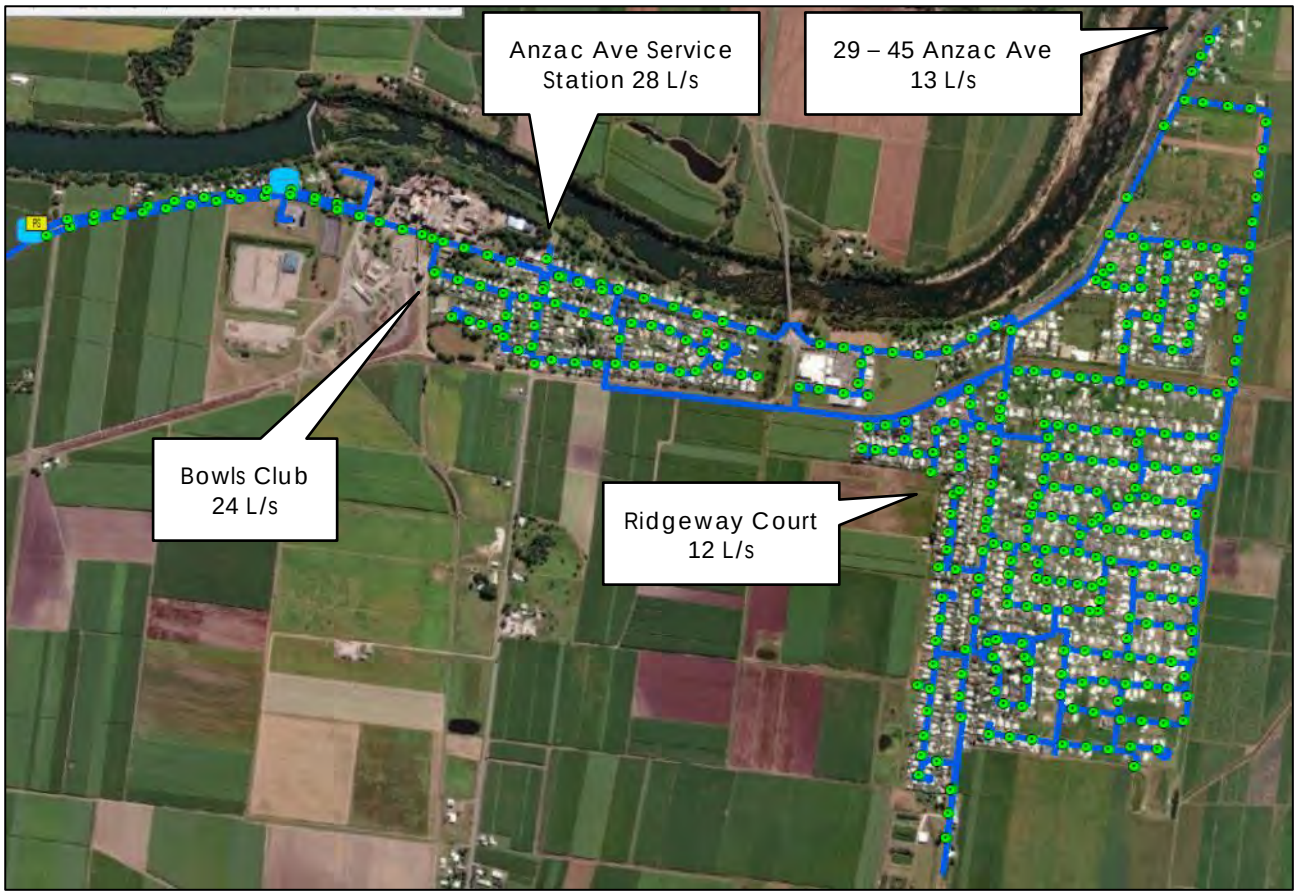


Figure 8-15: Marian Fire Flow Assessment

8.5. CBD Pressure Management

The implementation of a Pressure Managed Area (PMA) capturing the Mackay Central Business District (CBD) was investigated with the following objectives:

- Reduce pressures in the Mackay CBD and Priority Development Area (PDA).
- Maximise turnover of Mount Pleasant and Mount Oscar reservoirs.
- Minimise the number of inlets to the PMA by supplying the CBD solely from the Forgan Bridge DN450 main.
- Ensuring DSS are maintained in present and future planning horizons with the PMA implemented.

A selection of valves as listed below were closed in the hydraulic model simulating the proposed PMA as illustrated in Figure 8-18, isolating the CBD and PDA supply to solely the Forgan Bridge DN450 main and water age results during AD demand conditions compared before and after. The average water age in the Mount Pleasant and Mount Oscar reservoirs are presented in Figure 8-16 and Figure 8-17.

- WVLMCSHA009
- WVLMCSHA021
- WVLMCHOW003
- WVLMCGRI001
- WVLSMGEO003
- WVLMCMIL002
- WVLMCEVA12
- WVLSMSTE002
- WVLSMSTE005
- WVLSMSTE004
- WVLSMSYM001
- Install new valve on pipe Asset ID MC314 - MC315
- Install new valve on pipe Asset ID MC316 - MC318
- Install new valve on pipe Asset ID MC255 - MC272

It is evident that the implementation of the CBD PMA has minimal impact on water age in the Mount Pleasant reservoir (~3 days water age), decreases water age in the Mount Oscar reservoir from up to 5 days to 3.5 days, and increases water age in the CBD from less than 2 days to mostly less than 3 days due to the extended travel time from the Nebo Road WTP.

The achievable pressure reduction in the CBD is approximately 15 m based on a 40 m maximum pressure and potential PMA target pressure of 25 m. A fire flow assessment was undertaken with the PMA implemented and found that no additional hydrants failed to maintain DSS than those presented in Section 8. However, there is a potential risk to existing fire systems failing testing within high rise buildings within the Mackay CBD due to the reduction of pressure. The buildings at risk should be identified and a risk assessment undertaken with liaison with building managers/ operators prior to implementing a PMA within the CBD area. A nominal cost of $600k has been allowed for in the capital investment program for the installation of boundary valves, inlet PRV and flowmeter, telemetry and commissioning works of the PMA.

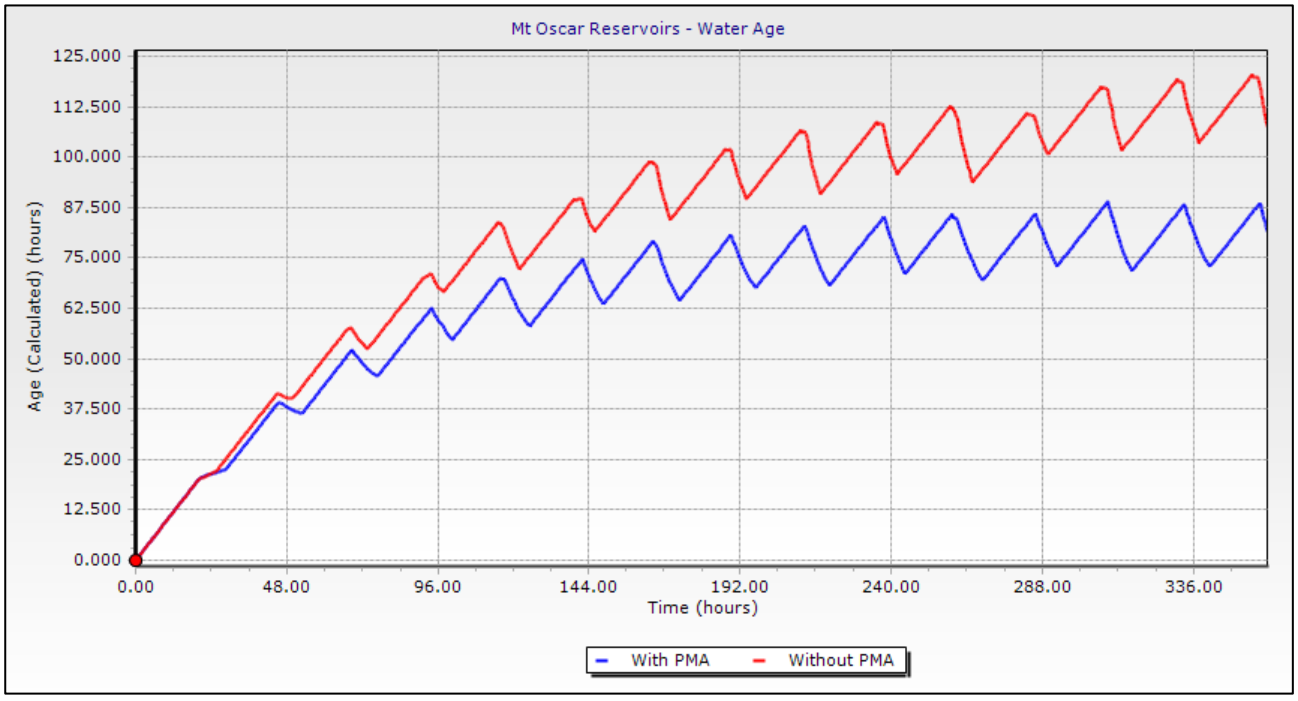


Figure 8-16: Mount Oscar Pre and Post PMA Implementation Water Age Comparison

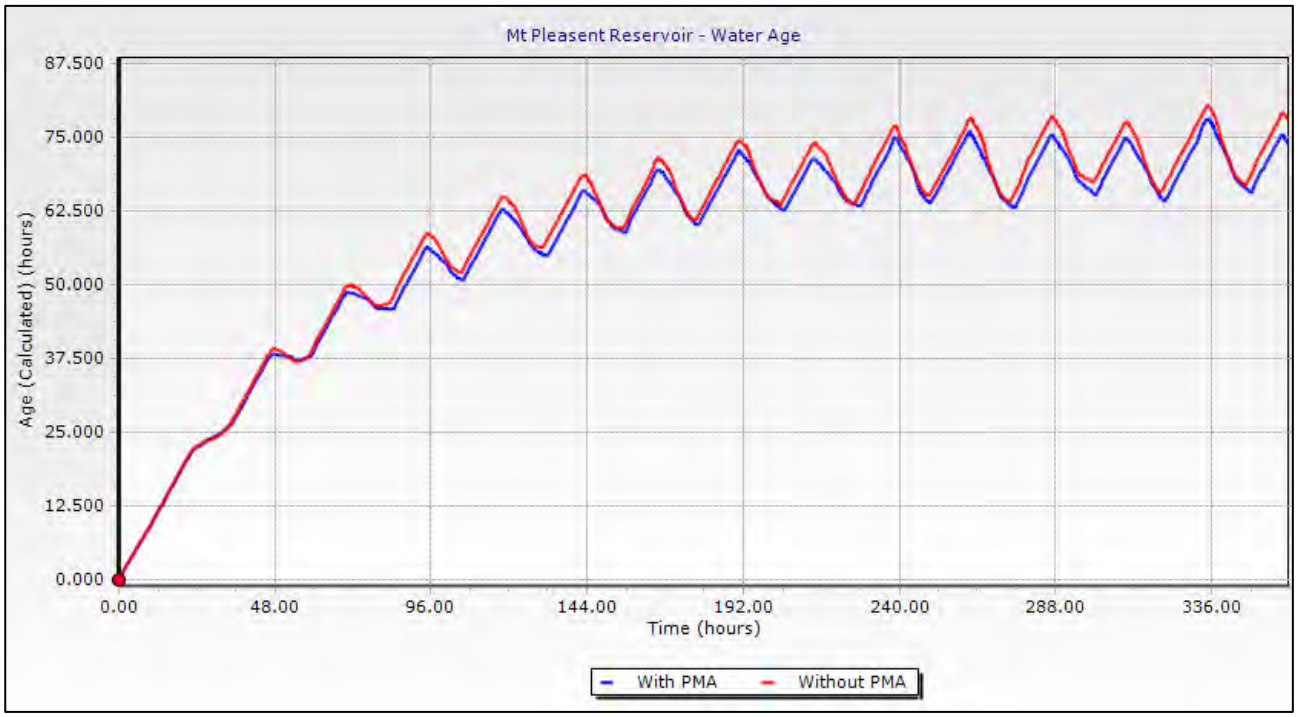


Figure 8-17: Mount Pleasant Reservoirs Pre and Post PMA Implementation Water Age Comparison

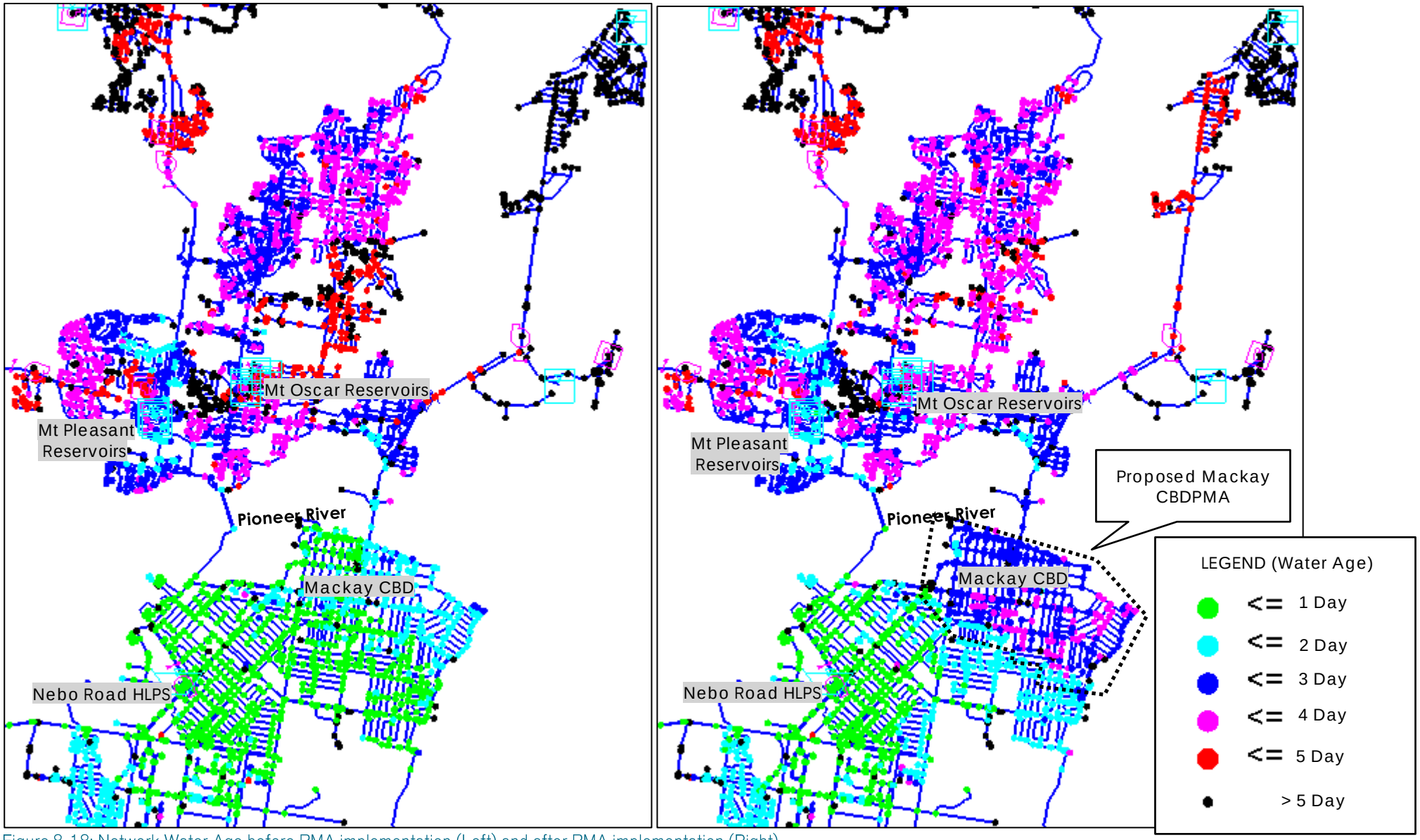


Figure 8-18: Network Water Age before PMA implementation (Left) and after PMA implementation (Right)

9. Capital Investment Program

Table 9-2 presents a summary of the required augmentations to maintain service standards through to the Ultimate planning horizon as outlined in this water strategy.

A summary of the overall investment program is provided in Figure 9-1 and Table 9-1. The total capital works to service the Mackay water supply network up to Ultimate demand is $177 Million of which $20.6 Million is forecast over the next 20 years.

Cost estimates for proposed augmentations within this report are based on high level planning costs. Infrastructure cost estimates are to be confirmed through the detailed planning phase which will confirm the needs and benefits of the infrastructure, undertake detailed options assessment (which includes cost estimates and MCA) to select a feasible solution.

Table 9-1: CIP Summary (Timings are based on modelled capacity triggers)

Infrastructure category	2021-25	2026-30	2031-35	2036-41
Fire Flow Main Augmentations	$2.8 M			
Fire Flow Pump	$0.1 M			
Network Augmentations – PMA	$0.6 M			
Network Augmentations – Mains	$3.2 M		$1.0 M	
Network Augmentations – Pumps				
Network Augmentations – Reservoir	$2.0 M			
Greenfield Infrastructure – Mains			$2.4 M	
Greenfield Infrastructure - Pumps	$0.3 M	$0.3 M		
Strategic Infrastructure				$9.3 M
TOTAL	**$9.0 M**	**$0.3 M**	**$3.4 M**	**$9.3 M**

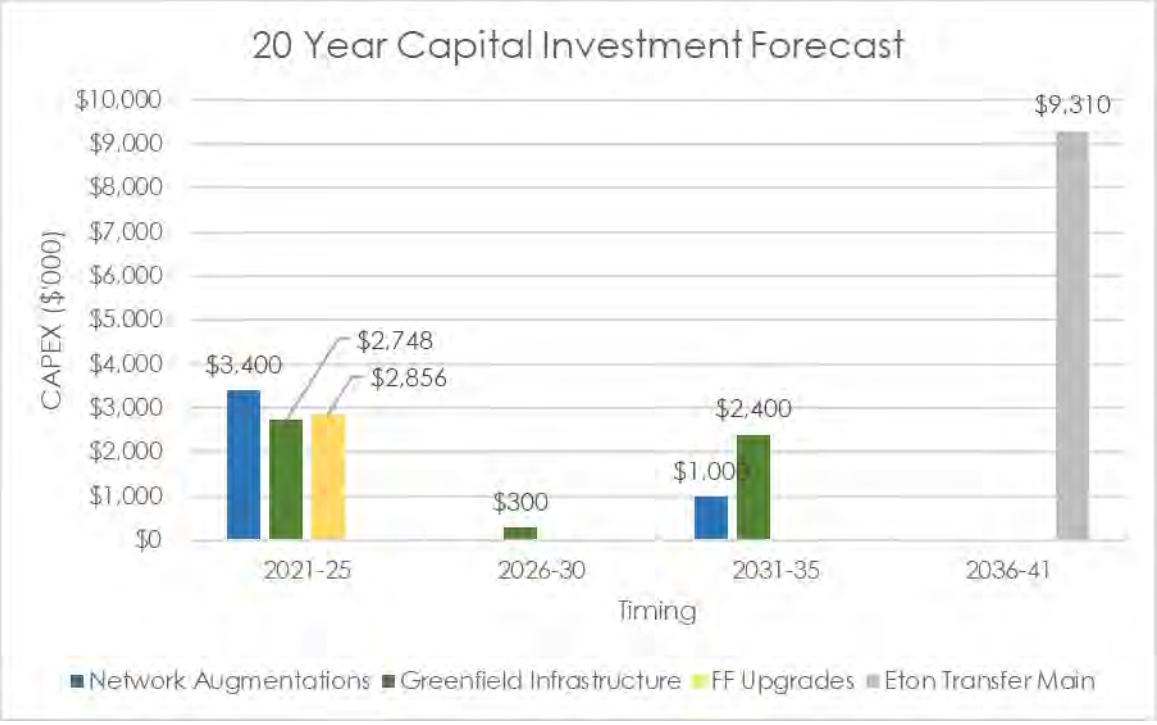


Figure 9-1: 20 Year Capital Investment Forecast Summary

Table 9-2: Capital Investment Program (Timings / Planning Horizons are based on modelled capacity triggers)

Planning Horizon	Asset Type	Infrastructure Requirement	Augmentation ID	Length / Size	Unit Rate	Planning Cost Estimate ($'000)	Infrastructure Funding	Location / Description
2022	Water main	Fire flow Augmentation	AUG_FF001	130m DN150	$1300/m	$169	MRC	Glenella Connection Road
2022	Water main	Fire flow Augmentation	AUG_FF002	370m DN150	$1300/m	$481	MRC	Domino Crescent
2022	Water main	Fire flow Augmentation	AUG_FF003	150m DN150	$1300/m	$195	MRC	Bradford St
2022	Water main	Fire flow Augmentation	AUG_FF004	360m DN150	$1300/m	$468	MRC	Kay Ct
2022	Water main	Fire flow Augmentation	AUG_FF005	200m DN150	$1300/m	$260	MRC	Naish Ave
2022	Water main	Fire flow Augmentation	AUG_FF007	350m DN150	$1300/m	$455	MRC	Mclennan St, industrial area
2022	Water main	Fire flow Augmentation	AUG_FF008	280m DN150	$1300/m	$364	MRC	Millenium Dr
2022	Water main	Fire flow Augmentation	AUG_FF009	100m DN150	$1300/m	$130	MRC	Bourke Street
2022	Water main	Fire flow Augmentation	AUG_FF010	180m DN150	$1300/m	$234	MRC	Melba St
2022	Fire pumps	Fire flow Pump Station	AUG_FFSD	2 kW	-	$100	MRC	Sunset Drive PS fire flow pump upgrade
2022	PMA	Network Augmentation	PMA_CBD	-	-	$600	MRC	Implementation and commissioning of the CBD PMA
2022	Reservoir	Greenfield – Shoal Point	Shoal_Pt_Res	1.2 ML	-	$2,000	MRC	Proposed Shoal Point Reservoir
2022	Water main	Greenfield – Shoal Point	Shoal_Pt_LLZ	210m DN300	$1200/m	$252	MRC	Shoal Point LLZ 300mm main to replace existing Shoal Point Road DN150 AC main "SH101 - SH007"
2022	Water main	Greenfield – Shoal Point	Shoal_Pt_HLZ	280m DN150	$700/m	$196	MRC	Shoal Point HLZ main connecting proposed BPS to existing Volute Street main.
2022	Booster PS	Greenfield – Shoal Point	Shoal_Pt_BPS	15 kW	-	$300	Developer	Shoal Point HLZ BPS to service high elevations areas
2022	Booster PS	Network Augmentation	Green St BC	-	-	-	MRC	Green Street HLZ reconfiguration business case.
2022	Water Main	Network Augmentation	Marian_Stg1	2.8km DN250	$1000/m	$2,800	MRC	Marian distribution main – Stage 1
2026	Booster PS	Greenfield – Richmond Hills	Bovey_Ps	10 kW	-	$300	Developer	Boveys Road BPS (Greenfield infrastructure)

Planning Horizon	Asset Type	Infrastructure Requirement	Augmentation ID	Length / Size	Unit Rate	Planning Cost Estimate ($'000)	Infrastructure Funding	Location / Description
2031	Water Main	Greenfield – Rural View	FUT_L1004173 & FUT_L1004174	2.4km DN200	$1000/m	$2,400	Developer	Rural View distribution mains (Greenfield infrastructure)
2036	Water Main	Network Augmentation	Marian_Stg2	1km DN250	$1000/m	$1,000	MRC	Marian distribution main – Stage 2
2041	Water Main	Strategic Augmentation	Eton_Transfer	13.3km DN150	$700/m	$9,310	MRC	Eton supply main from Walkerston and transfer PS
2047	WTP	Strategic Augmentation	Southern WTP	16 ML/d	-	$50,000	MRC	New Southern WTP
2047	Water Main	Strategic Augmentation	WTP_transfer	8.5km DN450	$2500/m	$21,250	MRC	New Southern WTP raw and treated water transfer mains
2047	Electrical	Strategic Augmentation	-	-	-	$1,000	MRC	Dumbleton Weir raw water pumps electrical upgrade. Details of Upgrade and Cost Estimate to be confirmed. A nominal $1 M has been included for the power and pump reconfiguration works.
2047	Reservoir	Strategic Augmentation	Walkerston Res	10 ML	-	$8,000	MRC	Proposed Walkerston Reservoir
2047	Water Main	Strategic Augmentation	Walkerston_Out	12km DN600	$3000/m	$36,000	MRC	Proposed Walkerston Reservoir outlet main
2047	Water Main	Strategic Augmentation	Walkerston_DN300	1.5km DN300	$1200/m	$1,800	MRC	Proposed Walkerston Reservoir outlet main to Walkerston township
2050	WTP	Strategic Augmentation	Marian WTP	2 ML/d	-	$10,000	MRC	Marian WTP Upgrade to satisfy Ultimate demand
Ultimate	Reservoir	Storage Capacity	Marian Res	1.5 ML	-	$1,500	MRC	Marian Reservoir storage upgrade
Ultimate	Transfer PS	Network Augmentation	Mirani PS	-	-	-	MRC	Mirani Transfer PS upgrade. Upcoming refurbish works to consider potential upgrade to achieve Ultimate capacity.
Ultimate	Water Main	Network Augmentation	Marian_Stg3	1.2km DN250	$1000/m	$1,200	MRC	Marian distribution main
Ultimate	Water Main	Network Augmentation	Mirani_Ult	2.5km DN250	$1000/m	$2,500	MRC	Mirani distribution main
Ultimate	Booster PS	Network Augmentation	Armstrong_Ult	-	-	$300	MRC	Armstrong Beach BPS upgrade to increase peak hour capacity.
Ultimate	Transfer PS	Network Augmentation	AlligatorPS_Ult	-	-	$500	MRC	Alligator Creek – Sarina pump set upgrade.
Ultimate	Trunk Main	Network Augmentation	Sarina_TM	12.5km DN225	$1000/m	$12,500	MRC	Alligator Creek to Sarina trunk main augmentation
Ultimate	Water Main	Greenfield - Ooralea	FUT_L1004190 to FUT_L1004192	6.4km DN300	$1200/m	$7,680	Developer	Ooralea greenfield distribution mains from previous water strategy
Ultimate	Water	Greenfield –	Blacks_Ult	2.2 km	$1200/m	$2,640	Developer	Blacks Beach greenfield development distribution main from

Planning Horizon	Asset Type	Infrastructure Requirement	Augmentation ID	Length / Size	Unit Rate	Planning Cost Estimate ($'000)	Infrastructure Funding	Location / Description
	Main	Blacks Beach		DN300				previous water strategy

10. Resilience Assessment

A desktop network resilience assessment was undertaken to determine alternate supply strategies required as well as to calculate the time to empty a reservoir in the event of a pump station or trunk main planned or unplanned outage. Alternative supply strategies and enabling works have been recommended for each reservoir in Table 10-1.

A resilience assessment was undertaken for all transfer pump stations and trunk mains and it was identified that there is more than two days storage of AD demand in each respective target reservoir except for the Slade Point reservoir which is discussed in Section 8.1.4 and the Armstrong Beach Balance Tank. The Armstrong Beach Balance Tank has less than a day's storage in case of upstream supply main failure and will require at least 250 kL/d trucked water supply to maintain balance tank levels or supply from the Armstrong Beach bore.

A mechanical/electrical outage response protocol should be established for each pump station as well as a trunk main outage response protocol, condition assessment and leaks monitoring program.

Table 10-1: Reservoir outage assessment

Reservoir	Resilience Strategy
Mount Pleasant	Multiple reservoirs available to take individual reservoir offline.
Mount Oscar	Refer Section 8.1.6
Slade Point	Refer Section 8.1.4
Mount Bassett	Supply Mount Bassett zone directly from Mount Oscar reservoir. Mount Bassett zone pressures will drop to 17 m when Slade Pt PS is operating. Throttle valve downstream of Slade Pt PS to reduce pump flowrate.
Blacks Beach	Refer Section 8.1.5
Rural View	Supply Rural View zone from the Blacks Beach reservoir and fill Blacks Beach from the Golf Links PS. Suction pressure at the Premier Garden BPS won't be maintainable and temporary storage will be required.
Shoal Point	Supply Shoal Point zone directly from Rural View reservoir. The Rural View reservoir TWL is 18 m higher than the Shoal Point reservoir and a PRV is required on the bypass to minimise the pressure increase.
Seaforth	Can directly supply Seaforth zone from The Leap balance tank however 40 m pressure increase. Require throttled valve or PRV on Seaforth bypass.
Halliday	Can directly supply Ball Bay / Halliday zone from The Leap balance tank however 40 m pressure increase. Supply Halliday zone directly from The Leap balance tank via existing Halliday PRV.
The Leap	Supply The Leap zone and Seaforth and Ball Bay reservoirs directly from the Farleigh reservoir. Customers at the top of Westlake Drive will experience deficient service pressures when Seaforth is filling. Throttle the Seaforth fill rate to mitigate upstream deficient pressures.
Farleigh	Supply Farleigh zone from The Leap tank and fill The Leap via the Jane St PS. Pump head from Jane St PS will consequently increase and pressure in Bruce Hwy trunk main will increase by 20 m.
Silingardies	There are significant customer pressure deficiencies in the Walkerston zone if supplied directly from the Mount Pleasant reservoir. Walkerston PS pumping into the Walkerston zone without storage will increase pressure by 40 m at minimum flow. Install VSDs on Walkerston pumps to operate the Walkerston zone as a boosted zone should Silingardies reservoir be taken offline.
Berry St	Refer Section 8.1.7
Green St	Refer Section 8.1.7
Sarina Town	Multiple reservoirs available to take individual reservoir offline.
Armstrong Beach	Supply Armstrong Beach BPS directly from Sarina Town reservoirs.
Mount Griffiths	The Mount Griffith zone is too far from the Sarina reservoirs to maintain peak hour pressures if supplied from Sarina. A booster pump station is required to service the zone should the Mount Griffith reservoir require taking offline. The existing Alligator Creek Mount Griffith pump set has VSD installed. The ability of the pump set to operate in the following two modes requires confirmation: 1. As a BPS and supply the Mount Griffiths zone when Mount Haden reservoir is not filling. 2. As a transfer PS and provide through flow to the Mount Haden reservoir whilst maintaining customer service pressures in the Mount Griffith zone.
Mount Haden	Supply Mount Haden zone directly from Mount Griffiths reservoir. Mount Griffiths reservoir TWL is 15 m higher than Mount Haden reservoir. Install a PRV on the Mount Haden reservoir bypass.

11. Conclusions

The 2022 Water Strategy conclusions are:

1. The existing total population for the Nebo Road WTP scheme (Mackay and Sarina) is 118,336 EP and will increase to 196,979 EP at Ultimate. The existing total population for the Marian WTP scheme of 4,975 EP will increase to 10,435 EP at Ultimate.
2. The Ultimate population for Mackay is realised at 2062 based on a 1.2% growth rate and for Marian and Mirani is realised at 2065 based on a 2.0% growth rate derived from the average residential growth rate in the MGAM between 2021 and 2041.
3. The Planning Scheme Policy – Water & Sewerage [CTM Water Alliance] (CTM Code) unit demand of 240 L/EP/day (which does not include for non-revenue water) have been adopted for the Nebo Road WTP scheme as residential usage over the past 5 years has remained stable and in line with this figure. A unit demand of 270 L/EP/day was derived for the Marian WTP based on recent usage data.
4. The CTM Code adopt a NRW component of 16% of the 240 L/EP/day unit demand which is equivalent to 40 L/EP/Day. This value has been adopted and maintained for the 2022 water strategy based on a NRW assessment of recent data. An analysis of the Marian and Mirani scheme provided lower NRW results than the Mackay and Sarina scheme. A non-revenue component of 30 L/EP/day has been adopted for the Marian WTP scheme based on 10% of the Marian WTP unit demand.
5. The overall peaking factors adopted in the water strategy, based on analysis of the AMR data, are:
    a. Nebo Road WTP scheme:
        i. 1.75 for Peak Day
        ii. 1.5 for Mean Day Maximum Month, an increase from the current CTM Code factor of 1.45
    b. Marian WTP scheme:
        i. 2.0 for Peak Day
        ii. 1.6 for Mean Day Maximum Month
6. The peaking factors for each customer sector adopted in the water strategy are provided in Table 6-2 and Table 6-4 of Section 6. The PD peak hour factor for the single family residential (detached) demand sector is 4.66, an increase from the CTM Code factor of 4.33. The Marian WTP scheme demand data exhibited a higher peak hour usage and a PD peak hour factor of 5.88 is recommended.
7. The existing Nebo Road WTP AD demand of 34.4 megalitres per day is estimated to increase to 56.5 megalitres per day at Ultimate. The Marian WTP AD demand will increase from 1.4 megalitres per day to 3.2 megalitres per day at Ultimate.
8. The predicted Nebo Road WTP PD demand in the 2021 planning horizon of 60.1 megalitres per day is estimated to increase to 98.6 megalitres per day in the Ultimate planning horizon. These figures include some headroom as the adopted CTM Code PD factor is higher than observed historical PD factors. The predicted Nebo Road WTP MDMM demand in the 2021 planning horizon of 51.1 megalitres per day is estimated to increase to 84.4 megalitres per day in the Ultimate planning horizon.
9. The Marian WTP PD demand will increase from 3.0 megalitres per day to 6.3 megalitres per day at Ultimate.
10. Mackay Water has an annual allocation of 16,000 megalitres (43.8 megalitres per day) from the Pioneer River system which will not be exceeded until 2041. The annual allocation of the Marian Weir is already exceeded and allocation is shared from the Dumbleton Weir. Allocation sharing between the Marian and Dumbleton Weir will bring forward the exceedance of the Dumbleton Weir allocation by 1 year.
11. 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) is as follows:
    a. Nebo Road WTP capacity upgrades are required in 2047 based on the adopted 68.5 megalitres per day maximum achievable output.
    b. Marian WTP capacity upgrades are required in 2050 based on four megalitres per day production capacity.

12. A demand forecasting sensitivity was completed by reducing the Nebo Road WTP scheme 240 L/EP/d unit demand to 220 L/EP/day and reducing the NRW component from 16% to 10% would defer major capital works by up to 10 years. With the 280 L/EP/day base demand, reducing the MDMM factor from 1.5 to 1.45 defers major WTP upgrades by 2 years.

13. Strategic options were identified and assessed to satisfy the Mackay and Marian Ultimate demands which included the following options:

    a. Build a new 16 megalitres per day Southern WTP and 10 megalitre Walkerston reservoir to augment the Nebo Road WTP production capacity.

    b. Build a new 85 megalitres per day Southern WTP and 10 megalitre Walkerston reservoir and decommission the Nebo Road WTP.

    c. Upgrade the Marian WTP to six megalitres per day production capacity.

    d. Build a transfer main from Walkerston to Marian and decommission the Marian WTP.

14. The recommended option for the major WTP upgrades in Mackay is the construction of a 16 megalitres per day Southern WTP to augment the Nebo Road WTP in 2047. The $30 Million NPC benefit of this option is considered significant enough to not warrant the reduction in resources afforded from decommissioning the Nebo Road WTP.

15. A preferred option for the Marian scheme has not been identified as the ability of the existing Marian WTP site and raw water intake to accommodate an capacity increase requires confirmation and should be verified prior to the next revision of the water strategy.

16. Consideration was given to supplying water to Eton via a proposed pipeline from either Nebo Road WTP or Marian WTP when the current Eton treatment plant is potentially due for major renewal in 20 years time. Instead of renewing the plant, decommission the bores and treatment facility at end of useful life and supplying treated water to Eton from the other WTPs was investigated. The additional Eton MDMM demand estimate of 0.4 megalitres per day would bring forward the timing of major upgrades at the Marian WTP by five years and Nebo Road WTP by one year. Due to the shorter length and less pumping head required, a transfer main supplying Eton from the Nebo Road WTP via Walkerston is more cost efficient than from Marian WTP.

17. Shoal Point reservoir was identified to have a design volume of 1.2 megalitres at 2023 and a booster pump station to supply the high level areas. 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 building the future 10 megalitres Walkerston reservoir.

18. Temporarily taking either of the Blacks Beach reservoirs offline for refurbishment works is viable considering the supply capacity from the Blacks Beach PS exceeds PD demand. In the long term, the No. 1 reservoir would pose a risk to constraining potential greenfield development or not containing enough emergency storage in case of supply issues. It is recommended the No. 1 reservoir be kept in the short term to enable refurbishment of the No. 2 reservoir and then the No. 1 reservoir decommissioned.

19. Decommissioning either of the Mount Oscar reservoirs is viable considering the available storage capacity in a single reservoir and ability to bypass the site (assuming there is a Mount Oscar reservoir bypass main in place).

20. The Slade Point elevated tower is located in a constrained site with no space to increase storage. The tower does not meet storage requirements and is replenished via frequent operation of the Slade Point PS. A booster pump station is required to supply the northern half of the Slade Point zone in the event of reservoir outage and a one-kilometre DN250 augmentation is required to ensure customer service pressures. The existing Slade Point PS should be retained to ensure fire flow performance standards. Alternatively, the existing Slade Point PS could be converted to a booster pump station to supply the entire Slade Point zone.

21. Storage deficiencies have been identified for the Marian reservoir in the 2031 planning horizon and for the Mirani reservoir in the Ultimate planning horizon. As the Marian WTP is able to produce more supply than PD up to the 2041 planning horizon, no augmentations to the Marian storage are recommended. In the Ultimate planning horizon, a 1.5 megalitres storage augmentation is recommended for the Marian reservoir. As there is a 20-hour operation factor of safety in the Mirani Transfer PS capacity, it has been assumed the slight Ultimate Mirani storage deficiency can be accommodated by the Mirani Transfer PS capacity to replenish the reservoir.

22. A business case is required to further investigate the two options presented for reconfiguring the Green Street and Berry Steet zones.

23. A capacity assessment of all transfer pump stations, and trunk mains was undertaken to determine existing and future deficiencies. The capacity assessments are based on providing MDMM demand over 20 hours. The following capacity deficiencies are identified:

a. A future supply deficiency is identified for the Nebo Road HL PS which is being upgraded in 2023. The HL PS should be sized to suit the WTP maximum achievable capacity which has been adopted as 68.5 ML/d in this study based on existing site constraints and partial clarifier bypass and is forecast to be exceeded in 25 years time. A 20 hour daily operation factor of safety should be incorporated per the CTM Code, resulting in a desired HL PS capacity of 82.2 ML/d.

b. The Mirani Transfer PS is being considered for refurbishment and the works should consider existing electrical and pump station footprint to facilitate upgrading the pumps to suit Ultimate demand projections in future.

c. The Alligator Creek trunk main has deficient capacity identified in the 2031 planning horizon. No augmentations are recommended as the downstream reservoirs have significant spare capacity to make up any shortfall in supply and the capacity calculations incorporate a MDMM over 20 hours factor of safety. The installation of new Nebo Road HL PS pumps with increased duty point will provide increased Alligator Creek supply.

d. The Alligator Creek – Sarina pump set and Alligator Creek to Sarina DN250 trunk main will require upgrades in the Ultimate planning horizon. An additional DN225 main is required to achieve 20 hours MDMM supply or depending on the condition of the existing DN250 main, replacement with a DN375 pipeline when required.

24. A fire flow assessment was completed which identified 11 fire flow augmentation requirements as detailed in Section 8.4.

25. A service pressure assessment has been undertaken for all reticulation mains across all planning horizons and the following network augmentations are required:

    a. In Sarina an upgrade of the Armstrong Booster Pump Station is required in the Ultimate planning horizon.

    b. In Mirani 2.5 kilometres of DN250 distribution main is proposed in the Ultimate planning horizon from the reservoir to the town to mitigate peak hour headloss.

    c. In Marian a three stage 5.0 kilometres DN250 distribution main is proposed to mitigate peak hour headloss.

26. The Ultimate planning horizon was assessed for the full development of greenfield areas, and it was found that the existing trunk network has sufficient capacity to accommodate Ultimate demand.

27. The implementation of a Pressure Managed Area to service the Mackay CBD was investigated and it is evident that the implementation of the CBD PMA has minimal impact on water age in the Mount Pleasant reservoir (~3 days water age), decreases water age in the Mount Oscar reservoir from up to 5 days to 3.5 days, and increases water age in the CBD from less than 2 days to mostly less than 3 days due to the extended travel time from the Nebo Road WTP.

28. A desktop network resilience assessment was undertaken to determine alternate supply strategies required as well as to calculate the time to empty a reservoir in the event of a reservoir, pump station or trunk main planned or unplanned outage. Alternative supply strategies and enabling works have been outlined for each reservoir in Section 10. It was identified that there is more than two days storage of AD demand in each respective target reservoir in case up upstream supply failure except for the Slade Point reservoir and the Armstrong Beach Balance Tank. The Armstrong Beach Balance Tank has less than a day's storage and will require at least 250 kL/d trucked water supply or supply from the Armstrong Beach bore to maintain levels.

29. The total capital works to service the Mackay and Marian water supply networks over the next 20 years is forecast to be $22.0 Million.

12. Recommendations

The 2022 Water Strategy recommendations are:

1. In light of the greater than 20-year timing requirement for strategic augmentations, continue to monitor demand usage and population trends to refine the future timing of major capital works. Implement the upgrades outlined in the Nebo Road WTP Process Review (February 2020) to realise the maximum achievable capacity of the existing WTP.

2. Implement fire flow augmentations and actions as identified in the strategy. Field tests should be undertaken as part of detailed planning to reconfirm the need, sizing, and costs.

3. Prepare a business case to determine the optimal configuration for the Berry Street mid-level and Green Street high-level zones.

4. 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.
5. A mechanical/electrical outage response protocol should be established for each pump station as well as a trunk main outage response protocol, condition assessment and leaks monitoring program.
6. Assess propose trunk main alignments treatment plant sites for future projects and start securing easements.
7. Review the maximum output achievable at the Nebo Road WTP and revise the water strategy in 2027.

13. References

Mackay Water Strategy – Year 2016 to Year 2046 (March 2016);

Sarina Water Strategy Year 2016 to Year 2036 (September 2017);

Nebo Road WTP Process Review;

Nebo Road WTP High Lift Pumping Station Performance Assessment Report;

Nebo Road WTP High Lift Pumping Station Upgrade Business Case;

Nebo Road Bore Water Relift PS Upgrade – Business Case;

Nebo Road WTP – Capital Expenditure Program – Business Case;

Mackay CBD – Water Main Renewal (WMR) Program – Business Case;

Firefighting Augmentation – WMR Program – Business Case;

Bores Renewal Program and Asset Management Plan;

Reservoirs Renewal Program and Asset Management Plan;

WPS Renewal Program and Asset Management Plan;

WM Renewal Program and Prioritisation Study;

Mackay CBD WN Optimisation Study;

Dumbleton Raw Water Pump Station (RWPS) and Raw Water Mains study reports and Operations & Maintenance (O&M) Manuals;

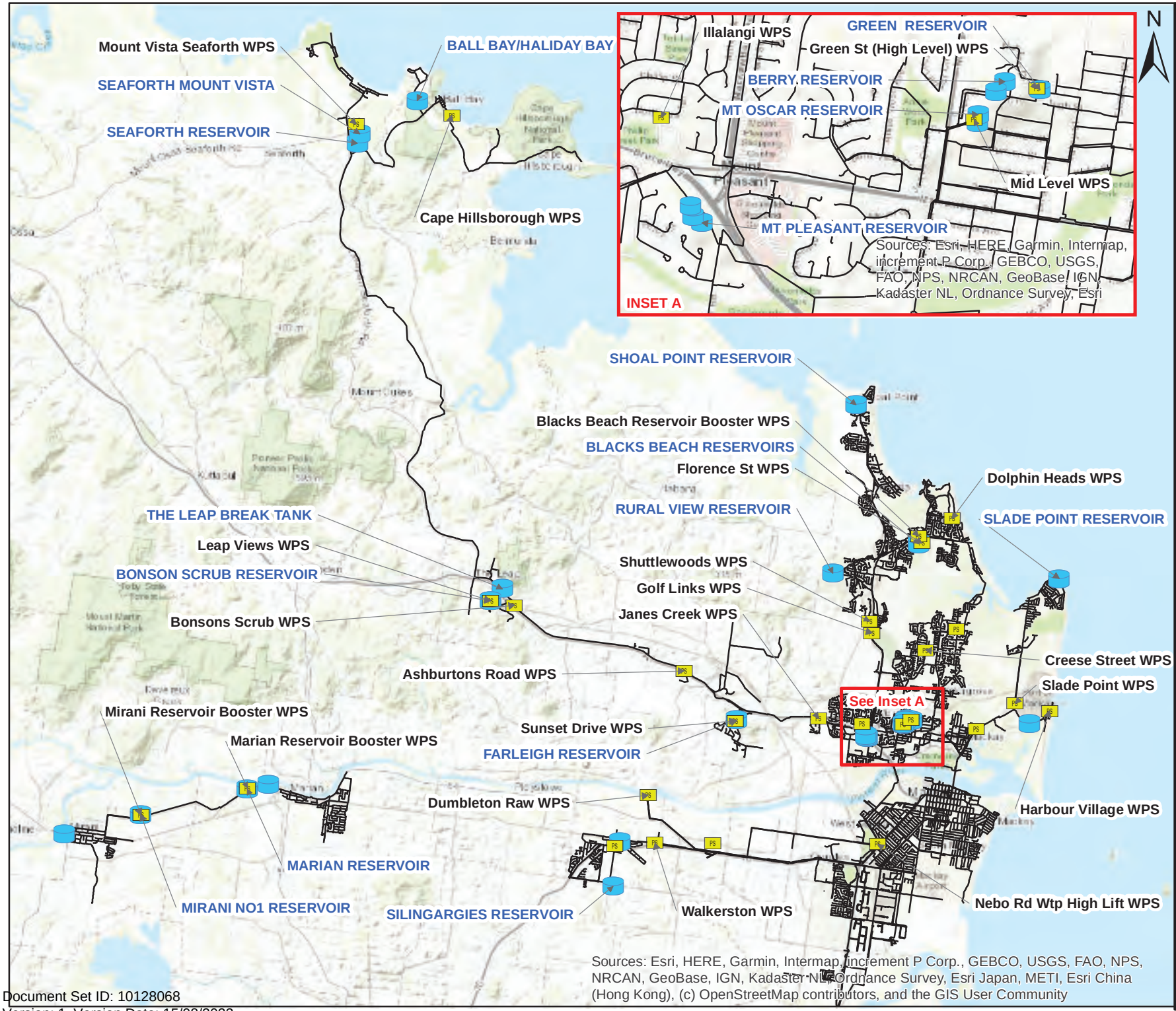
Latest version of Council's Drinking Water Quality Management Plan (DWQMP);

Most Recent MGAM (Mackay Growth Allocation Model) Report; and

MGAM 2020 Planning Assumptions Report (PIE Solutions, May 2021).

Appendices

Appendix A Existing Water Supply Network



LEGEND

- Pump Stations
- Reservoirs
- Water Mains

REVISIONS	REV	DATE	DESCRIPTION	APPD
	00	03-Oct-22	ISSUED FOR INFORMATION	GIS

Mackay REGIONAL COUNCIL

Mackay Regional Council
Sir Albert Abbott Administration Building
73 Gordon Street
Mackay QLD 4570

For more information
www.mackay.qld.gov.au
or call 1300 622 529

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Kilometers

ORIGINAL PRODUCTION SCALE 1:0 — 1 CM EQUALS 500 METRES

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PUBLICATION DATE : Monday, October 3, 2022
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PROJECTION: MAP GRID OF AUSTRALIA, ZONE 55
HORIZONTAL DATUM: GEOCENTRIC DATUM OF AUST 1994

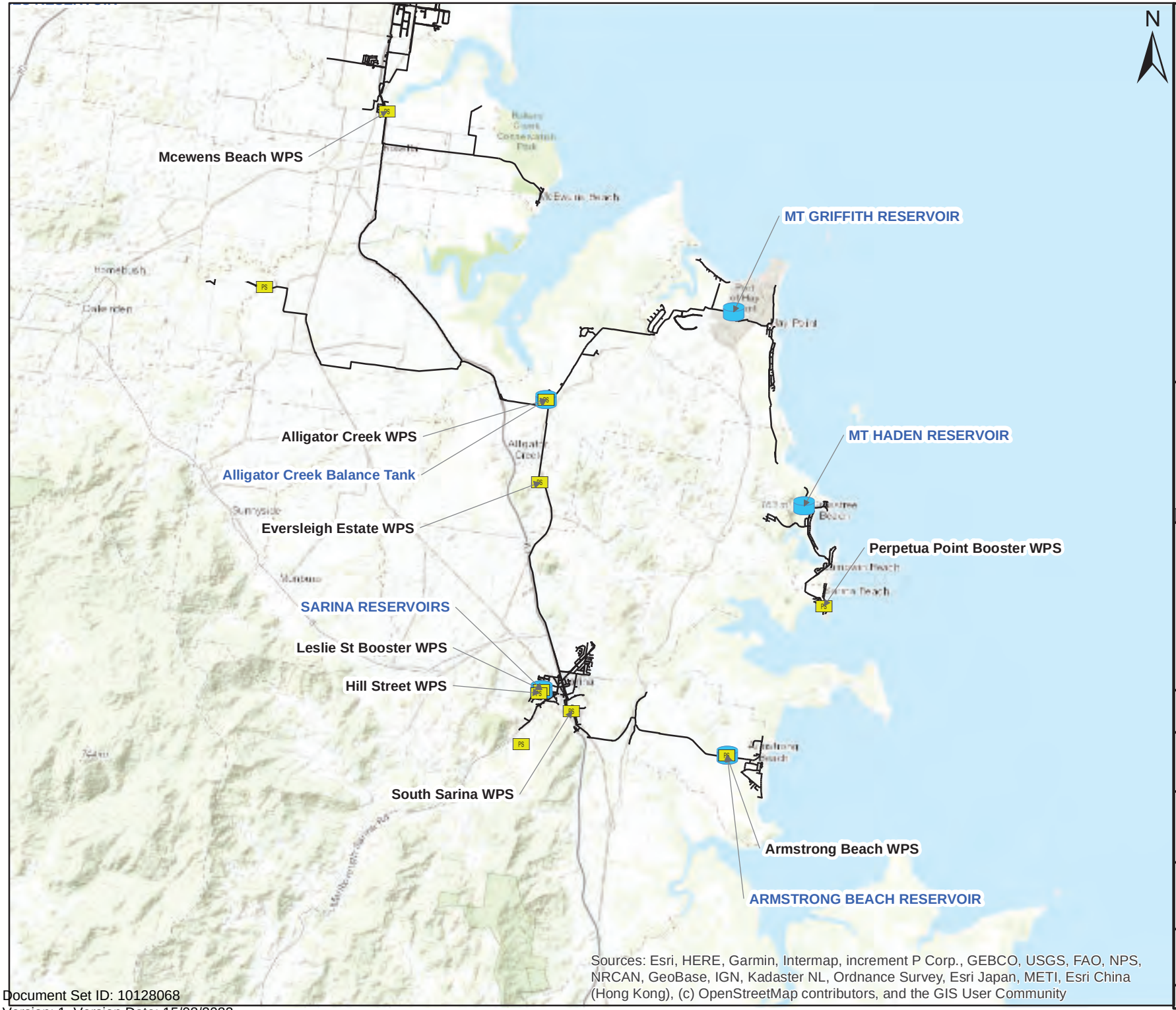
PROJECT

Mackay Water Strategy

TITLE

APPENDIX A
EXISTING WATER SUPPLY NETWORK

Mackay Regional Council



LEGEND

- Pump Stations
- Reservoirs
- Water Mains

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

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PROJECT

Mackay Water Strategy

TITLE

APPENDIX A
EXISTING WATER SUPPLY NETWORK

Mackay Regional Council

Appendix B Fire Flow Assessment

Area	Model ID	Hydrant ID	Address	No. Deficient Hydrants	Land Use	Achieved/ Desired Capacity (L/s)	Pipe Dia/ Material	Action / Augmentation
Leap	T004	No hydrant on GIS but assumed to exist	No. 95 Westlake Dr	1	Rural Residential	6.9 / 7.5	DN100 PVC	Marginal Failure. Recommend no augmentation.
Cape Hillsborough	CPH03, CPH04	HYTBYKIP020, HYTBYKIPPE001	Kippen Dr	2	Rural Residential	5 / 7.5	DN100 PVC	Marginal Failure. Recommend no augmentation.
Farleigh	FL016, FL015	No hydrant on GIS but assumed to exist	Palm Ridge Dr	2	Rural residential	6 / 7.5	DN100 PVC	Marginal Failure. Recommend no augmentation.
Shoal Point	BU047	No hydrant on GIS but assumed to exist	Bucasia beach front caravan resort	1	Commercial	18 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Rural View	PL058	HYTRVPAL002, HYTRVPAL003	No. 21 Palmview Ct	2	Residential	14 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
Blacks Beach	HYTDHBEA002	HYTDHBEA001, HYTDHBEA002	Dolphin Heads Resort	2	Commercial	20 / 30	DN100 PVC/AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Blacks Beach	EI112	HYTDHBEA006, HYTDHBEA007, HYTDHBEA008	End of Beach Rd	3	Residential	13 / 15	DN100 PVC/AC	Marginal Failure. Recommend no augmentation.
Blacks Beach	EI030	HYTEIMAN007	Eimeo Pacific Hotel	1	Commercial	23 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Blacks Beach	Multiple locations	-	Jamsine Dr, Bourke St, WhiteSans Blue, Stanton Pl	10	Residential	13 / 15	DN100 AC	AUG_FF009 replace decommissioned Bourke St connection. Connect pipe Asset ID "BBBLACK005 - BBBLACK006" to "BL124 - BL043"
Blacks Beach	HYTBBBOU006	HYTBBBOU006	Big 4 Mackay Blacks Beach	1	Commercial	19 / 30	DN100 AC	AUG_FF009 replace decommissioned Bourke St connection. Connect pipe Asset ID "BBBLACK005 - BBBLACK006" to "BL124 - BL043"
Blacks Beach	J370	HYTEICHA003	No. 19 Chapman Ct	1	Residential	14 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
Blacks Beach	Multiple locations		All Blacks Beach 30 L/s hydrants	12	Commercial	25 / 30	DN400 DICL	3m length of DN200 AC main downstream of the Blacks Beach Road reservoir (Asset ID BL017A - BL017B) causing velocity constraint across the Blacks Beach zone. Fire flow achieved if velocity constraint

Area	Model ID	Hydrant ID	Address	No. Deficient Hydrants	Land Use	Achieved/ Desired Capacity (L/s)	Pipe Dia/ Material	Action / Augmentation
								ignored.
Slade Pt	HYTSLSCA001	HYTSLSCA001, HYTSLSCA002, HYTSLSCA003	Seabreeze hotel	3	Commercial	26 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Slade Pt	SLCAMPB002	HYTSLCAM001, HYTSLCAM002	No. 32 Campbell St	1	Industrial	29 / 30	DN100 AC	Velocity constraint and marginal Failure. Recommend no augmentation.
Slade Pt	SP104	HYTSLALB004	Albatross St	1	Residential	7.5 / 15	DN100 AC	Requires booster pump station or 200 m of DN150 main to achieve fire flow standards for hydrant servicing 4 houses.
Andergrove	AB250	HYTAGDOM001, HYTAGDOM002, HYTAGDOM005, HYTAGDOM004, HYTAGNEW003	Domino Cres	5	Residential	10 / 15	DN100 AC	AUG_FF002 - Upgrade existing 370m DN100 AC to DN150
Andergrove	AB196	HYTAGDAV006	No 32 Davlyn Drive	1	Residential	14 / 15	DN100 PVC	Possible GIS error - check model connectivity at intersection of Kean St and Davlyn Dr (pipe GIS asset ID 21345)
Andergrove	AB159	HYTAGFOR002, HYTAGFOR003	Forest Ct	2	Residential	11 / 15	DN100 MDPE	Confirm MDPE pipe pressure rating and model internal diameter of 89mm
North Mackay	NM259K	HYTNMOAS005	No. 31 Oasis Dr	1	Residential	11 / 15	DN63 PVC 55m	Install hydrant on nearby DN100 main
North Mackay	MG149	HYTMPKAY001	Kay Ct	2	Major Centre	18 / 30	DN100 PVC 360m	AUG_FF004 (AUG004 and AUG005 from previous water strategy)
North Mackay	MG365	HYTGLSTE002	No. 17 Stephanie Ct	1	Residential	14.7 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
North Mackay	GLGREEN004	HYTGLGRE006, HYTGLGRE007, HYTGLGRE008	Greendwood Dr	3	Residential	13 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
North Mackay	MG082	HYTMPNOR004	No. 11 Northview Tc	6	Residential	9 / 15	DN100AC	Check hydrant capacities following proposed Jane Creek PS zone extension
North Mackay	MG172A	HYTGLSCH007, HYTGLSCH008	Community Kids Glenella Early Education Centre	2	Kindergarten	19 / 30	DN100 AC	Fire flow provided from hydrant HYTGLSCH003 on DN150 main on opposite side of road
North Mackay	J1705	HYTNMBOVEY001, HYTNMBOVEY002, HYTNMNORRI009	No. 35 Bovey St	3	Residential	9 / 15	DN100 PVC	Open valve WVLNMBOVEY001 and close valve WVLNMNORRI002 to remove dead leg whilst maintaining DMA boundary
North Mackay	NM023	HYTMPNAI002, HYTMPNAI003, HYTMPNAI004, HYTMPWOO001	Naish Ave	4	Residential	10 / 15	DN100 AC	Augmentation ID AUG_FF005 - Upsize 200m to DN150

Area	Model ID	Hydrant ID	Address	No. Deficient Hydrants	Land Use	Achieved/ Desired Capacity (L/s)	Pipe Dia/ Material	Action / Augmentation
North Mackay	HYTMPZEI004	HYTMPZEI003, HYTMPZEI004	Dan Murphys / Mt Pleasant Tavern	2	Commercial	20 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
North Mackay	NM113	HYTNMBRA001, HYTNMBRA002, HYTNMBRA003, HYTNMBRA004	Bradford St	4	Residential	10 / 15	DN100 AC	Augmentation ID AUG_FF003 - Upsize 150m to DN150 or check if connectivity to Palmview Village private mains can be used to improve available fire flow
North Mackay	NMTHEGO001	HYTNMMAL014, HYTNMMAL015, HYTNMTHEGO001, HYTNMTHEGO002, HYTNMTHEGO003	Goosies club	5	Commercial	27 / 30	DN100 PVC	Marginal Failure. Recommend no augmentation.
North Mackay	NMMCKIN001	HYTNMROB007	No. 20 McKinley St	1	Residential	2 / 15	32mm PE	Fire flow provided from hydrant HYTNMROB008 40m across the park
North Mackay	NM398	HYTNMLOU001	Loughnane Ct	1	Community Facilities	24 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
North Mackay	AB363	HYTBEHOL006	Carlisle Christian College	1	School	27 / 30	DN100 AC	No action. College has internal fire protection systems.
North Mackay	AGSNOWW001	HYTAGSNOWW003, HYTAGSNOWW004	Snow Wright Ct, Mackay Gymnastics	2	Community Facilities	21 / 30	DN100 PVC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
North Mackay	AB047	HYTAGLOR003, HYTAGLOR004	Lorraine Ct	2	Medium Density Res	13 / 15	DN100 AC	Marginal Failure. Recommend no augmentation.
North Mackay	MG254	HYTGLMAC002, HYTGLBRI001	Glenella Gonnection Road	2	Industrial	21 / 30	DN100 AC	Augmentation ID AUG_FF001 - Augment 130m with DN150. Currently in design - AUG001 from previous water strategy.
North Mackay	NM356	HYTNMSHI002	Shinn St	4	Industrial	18 / 30	DN100 AC	Fire flow augmentation works completed 2022. Confirm hydrant capacity achieves DSS.
North Mackay	GLFURSD001	HYTGLFUR003	Fursden St	5	Industrial	15 / 30	DN100 AC	AUG006 from previous water strategy. Fursden St recently augmented with DN150 main however field testing indicated 30 L/s still not achieved. Confirm HYTGLFUR001 hydrant capacity to ensure no blockage along Fursden St before proceeding with Heaths Road cross-connection
McEwens	HYTMBWAL006	Multiple hydrants	Walz Ave and	8	Township	6.3 / 7.5	DN100	Consider 7.5 L/s fire flow category

Area	Model ID	Hydrant ID	Address	No. Deficient Hydrants	Land Use	Achieved/ Desired Capacity (L/s)	Pipe Dia/ Material	Action / Augmentation
Beach			Joyce St				PVC	
South Mackay	BC034	No hydrant on GIS but assumed to exist	No. 18 Pratts Rd	1	Rural	7.2 / 7.5	DN100 AC	Marginal Failure. Recommend no augmentation.
South Mackay	BC030	HYTBCCOO002 and HYTBCCOO001	Bakers Creek Wreckers / Bus Depot	2	Industrial	23 / 30	DN100 AC	Install hydrant on adjacent DN450 trunk main
South Mackay	MC912A	HYTOORAL005	End of Raleigh St	1	Residential	14.5 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
South Mackay	MC717	HYTPAHEI004	Heinrich St, industrial estate	1	Industrial	28 / 30	DN100 AC	Marginal Failure. Recommend no augmentation.
South Mackay	HYTWMPAG008	HYTWMPAG008	Hot Tots Educational Centre, Paget St	1	Child Care	26 / 30	DN100 PVC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
South Mackay	MC577	HYTOOMCL003, HYTOOMCL004, HYTOOMCL005, HYTOOMCL006	Mclennan St, industrial area	4	High Impact Ind	13 to 27 / 30	DN100 AC	Augmentation ID FF_AUG007 - Upsize to DN150 349m
South Mackay	MCPENEL001	HYTMCPEN001	Ozcare Mackay Aged Care Facility	1	Aged Care	27 / 30	DN100 PVC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
South Mackay	HYTSMELA001	HYTSMELA001, HYTSMELA002	Elamang St	2	Residential	13 / 15	DN100 AC	Marginal Failure. Fire flow decreased to 12 L/s if CBD PMA implemented.
South Mackay	HYTSMIRV005	HYTSMIRV005, HYTSMIRV004	Irving St	2	Residential	13 / 15	DN100 AC	Marginal Failure. Fire flow decreased to 12 L/s if CBD PMA implemented.
South Mackay	HYTEMBIN002	HYTEMBIN001, HYTEMBIN002	Ocean International	2	Hotel	28 / 30	DN100 AC	Velocity Constraint. Sufficient fire flow provided from hydrants on opposite side of road
South Mackay	MC804	HYTEMMCI003, HYTEMMCI002	Good Shapehard Lodge	2	Aged Care	30 / 30	DN80 PVC	Marginal failure of 27 L/s if CBD PMA implemented. No augmentatoin recommended
South Mackay	MC091	No hydrant on GIS but assumed to exist	Mackay State High School, Vincent St	1	School	24 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
South Mackay	HYTEMRAE010	HYTEMRAE009, HYTEMRAE010	Rae St	2	Residential	13 / 15	DN80 CICL	Marginal Failure. Recommend no augmentation.
South Mackay	MC067	HYTMCRIV027	Mackay Fish Market	1	Commercial	29 / 30	DN100 AC	Property located on river (open body water source). Recommend no augmentation.

Area	Model ID	Hydrant ID	Address	No. Deficient Hydrants	Land Use	Achieved/ Desired Capacity (L/s)	Pipe Dia/ Material	Action / Augmentation
South Mackay	MC085R	HYTMCEIG002	Fourth Ln (access lane)	1	CBD	19 / 30	DN80 PVC	Sufficient fire flow provided from nearby hydrant on Wood Street
South Mackay	J1619	HYTWMOKE006	Blue Care Mackay, Okeefe St	3	Aged Care	20 / 30	DN100 PVC	Possible GIS error. Confirm network connectivity at Okeefe St and Field St intersection
South Mackay	MC623	HYTWMDUP001, HYTWMDUP002	Dupuy St (resorts/retirement home)	2	Commercial	23 / 30	DN100 CICL	>30 L/s fire flow available in upstream hydrant HYTWMDON003 on Donaldon Street. Confirm distance to HYTWMDON003 is suitable for fire support.
South Mackay	MC829	HYTPAFOR003	Formation St	1	Industrial	25 / 30	DN100 PVC	No action as new main recently constructed.
South Mackay	MC734	No hydrant on GIS but assumed to exist	Connors Rd	1	Industrial	21 / 30	DN100 AC	DN300 across road. No hydrants shown in GIS. Check if existing hydrant available or install hydrant.
South Mackay	MCEND	No hydrant on GIS but assumed to exist	Milton St	1	Industrial	14 / 30	DN100 PVC	Aug010_FF_MWS from previous strategy. More than 80 m from nearest building. Recommend descope augmentation
South Mackay	MC415	No hydrant on GIS but assumed to exist	Illawong Beach Resort	1	Resort	2 / 30	50mm PVC	Aug007_FF_MWS from previous strategy. Contact premise/QFES for on-site fire protection information as long 50mm service connection unlikely to provide any fire fighting capacity.
Walkerston	W086	HYTWKLUS007	No. 43 Luscombe St	1	Residential	14 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation. Ensure Walkerston PS is on in fire event.
Walkerston	W103	HYTWKETW002	Etwell Ct	1	Residential	13 / 15	DN100 AC	Marginal Failure. Recommend no augmentation. Ensure Walkerston PS is on in fire event.
Walkerston	J1275	HYTWKBEN002	Benjamin Ct	1	Residential	13 / 15	DN100 AC	Marginal Failure. Recommend no augmentation. Ensure Walkerston PS is on in fire event.
Walkerston	W154	HYTWKOGM003	Ogmore Ct	1	Residential	13 / 15	DN100 AC	Marginal Failure. Recommend no augmentation. Ensure Walkerston PS is on in fire event.
Walkerston	W153	HYTWKMER002	Merino Ct	1	Residential	13 / 15	DN100 AC	Marginal Failure. Recommend no augmentation. Ensure Walkerston PS is on in fire event.
Walkerston	HYTWKCRE013	HYTWKCRE013	Walkerston Primary School	1	School	27 / 30	DN100 AC	30 L/s fire flow achieved via drawing through adjacent hydrants
Walkerston	W008	HYTWKMCC016	Walkerston State School	1	School	28 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk

Area	Model ID	Hydrant ID	Address	No. Deficient Hydrants	Land Use	Achieved/ Desired Capacity (L/s)	Pipe Dia/ Material	Action / Augmentation
								assessment
Walkerston	HYTWKBRA002	HYTWKBRA002	Western Suburbs Leagues Club	1	Commercial	19 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Walkerston	Upstream of Walkerston PS	-	Peak Downs Hwy and Alexandria Rd	9	Residential	11 / 15	DN150 AC	Ensure Walkerston PS is OFF in fire event upstream of the PS.
Sarina Town	HYTSAELI002	HYTSAELI002	Elizabeth St Kindergarten	1	Commercial	27 / 30	DN100 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Sarina Town	SAREEFC004	HYTSAREE001, HYTSAREE003, HYTSACRE002, HYTSAHOO002, HYTSACRE003, HYTSAHOO001	Reef Dr	6	Residential	12 / 15	DN100 PVC	Augmentation ID AUG_FF008 - Install new main connecting end of Authur St to Millendium Dr
Sarina Town	HYTSAPIR001	HYTSAPIR001	Pirie St	1	Residential	1 / -	25mm	Hydrant on 25mm pipeline. Assumed for operational use only.
Sarina Town	HYTSAMAR001, HYTSAMAR002	HYTSAMAR001, HYTSAMAR002	End of Marlborough Sarina Dr	2	Residential	1 / -	25mm	Hydrant on 25mm pipeline. Assumed for operational use only.
Sarina Town	SABRUCE003	HYTSABRUCE001	Ampol Sarina Service Center	1	Commercial	24 / 30	DN150 PVC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Sarina Town	SAKEATI001	HYTSAKEA002	No. 10 Keating St	1	Residential	14 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation. Ensure Armstrong Reservoir not filling in fire event.
Sarina Town	121	No hydrant on GIS but assumed to exist	QCV Sarina	-	Commercial	17 / 30	DN150 AC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Sarina Town	SAGURNE01	No hydrant on GIS but assumed to exist	Soto Rd Train Station	-	Commercial	10 / 30	DN100 PVC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Sarina Town	J591	HYTSAHOE002	Hoey St (Sarina retirement home)	6	Aged Care	20 / 30	DN100 PVC	Closed valve at north end of Hoey St in model for no apparent purpose (WVLSABRO003). Recommend opening valve to increase network connectivity.
Sarina Town	HYTSAPEN001	HYTSAPEN001	No. 12 Penfold St	1	Residential	13 / 15	DN100 AC	Marginal Failure. Recommend no augmentation. Ensure Armstrong Reservoir

Area	Model ID	Hydrant ID	Address	No. Deficient Hydrants	Land Use	Achieved/ Desired Capacity (L/s)	Pipe Dia/ Material	Action / Augmentation
								not filling in fire event.
Armstrong Beach	J672	HYTABCRE002	No. 681 Armstrong Beach Rd	1	Residential	14 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
Armstrong Beach	1576	HYTABRAN005	Rankin Ct	1	Township	13 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
Armstrong Beach	1491, J754	HYTABMEL001, HYTABMEL003	No. 1 Melba St	2	Township	12 / 15	DN100 PVC	Augmentation ID AUG_FF010 - Upsize 180m to DN150
Campwin Beach	1532	HYTCBHAC005	No. 24 Hackett Ct	1	Township	13.8 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
Grasstree Beach	J730	HYTGBCRA006	No. 13 Crawford St	1	Township	14.5 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
Hay Point	J804	No hydrant on GIS but assumed to exist	Coal Terminal Building at end of Hay Point Rd	1	Spec Purpose	29 / 30	DN150 DICL	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Hay Point	J839	HYTHPEDM002, HYTHPEDM003, HYTHPEDM004, HYTHPEDM005, HYTHPPEN005	Edmunds Ave	6	Township	12.5 / 15	DN100 PVC	Long DN100 main with many vacant/large lots. Consider 7.5 L/s policy. Ensure Louisa Creek Rd PRV opens in fire event.
Sarina Beach	SBFERRI002	HYTSBFERRI001	No. 20 Ferries Tce	1	Township	14.6 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
Sarina Beach	171	HYTSBANT002	No. 2 Antoney Lane	1	Township	13 / 15	DN100 PVC	Marginal Failure. Recommend no augmentation.
Sarina Beach	J982	HYTSBSAR006, HYTSBSAR005	Sandpiper Hotal/Caltex	2	Township	25 / 30	DN100 PVC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment
Sarina Beach	1539, 1540	HYTSBPOO004, HYTSBOWE002, HYTSBOWE001, HYTSBPOO005	Sarina Beach Motel	4	Township	16 / 30	DN100 PVC	Individual Non-Residential Premise. Contact premise/QFES for on-site fire safety asset data and undertake risk assessment

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