Water Supply Servicing Strategies
Rezoning Submission to the Proposed Waikato District Plan

Sleepyhead Estate - Ohinewai

231 Tahuna Road & 88 Lumsden Road, Ohinewai, Waikato
Ambury Properties Ltd
28/11/2019
Final

Document Control

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1. Executive Summary

Sleepyhead Estate is a mixed-use master planned community proposed to be located on a site adjacent to the Waikato Expressway and the North Island Main Trunk railway on the corner of Lumsden Road and Tahuna Road, Ohinewai.

Ambury Properties Ltd has lodged a submission on the Proposed Waikato District Plan requesting that the land be re-zoned to a mix of industrial, residential and business zones to accommodate the mixed-use community. To support the proposed re-zoning, Wood and Partners Consultants Limited have been engaged by APL to prepare an infrastructure assessment report for water supply servicing.

Six main servicing options have been investigated for the long-term servicing needs of the development. Due to the uncertainty of the long-term municipal water supply options to service the proposed development, six interim solutions for the initial stages of this development ahead of the final reticulation network and treatment facilities being available have also be considered.

The six potential long-term water supply servicing options considered in this report are;

- Option 1 – On-site bore supply with dual reticulation, part of the supply treated to potable standard and the remainder (non-potable) used for toilet flushing and irrigation. Rainwater reuse to supplement non potable supply.
- Option 2 – Supply from local water bodies (lakes adjacent to the site or the Waikato River) with dual reticulation, part of the supply treated to potable standard and the remainder (non-potable) used for toilet flushing and irrigation. Rainwater reuse to supplement non potable supply
- Option 3 – Rural farm supply with dual reticulation, part of the supply treated to potable standard and the remainder (non-potable) used for toilet flushing and irrigation. Rainwater reuse to supplement non potable supply.
- Option 4 – Te Kauwhata town supply delivered to an onsite reservoir via a 10km pumped rising main, with chlorine boosting. Boost pumping from the onsite reservoir through a single reticulation network throughout the development. Rainwater reuse to provide for non-potable uses.
- Option 5 – Huntly town supply delivered to an onsite reservoir via a 10km pumped rising main, with chlorine boosting. Boost pumping from the onsite reservoir through a single reticulation network throughout the development. Rainwater reuse to provide for non-potable uses.
- Option 6 – A centralised supply from the existing or a new treatment plant, delivering into a new pipeline to service the region. The supply would be delivered to an onsite reservoir with chlorine boosting. Boost pumping from the onsite reservoir through a single reticulation network throughout the development. Rainwater reuse to provide for non-potable uses

The long-term options require further investigations and design to be undertaken, and further coordination with the Waikato District Council and Watercare Services Limited. APL will continue to work closely with the municipal network operators to ensure that the ultimate build out of Sleepyhead Village can be serviced.

The interim options that have been considered include:

- Interim Option A – Bore Supply
- Interim Option B – Lake Take
- Interim Option C – River Take
- Interim Option D – Raw Water Supply from reticulated rural sources
- Interim Option E – Rainwater Harvesting
- Interim Option F – 150mm Pipeline from the South West

This assessment and report confirm that the level of development proposed can be serviced for water supply, however selection of the preferred strategy will require further consultation and design.

2. Introduction

2.1. Background

Ambury Properties Ltd (APL) have engaged Wood and Partners Consultants Ltd (Woods) to prepare infrastructure assessment reports in support of the re-zoning submission to the Proposed Waikato District Plan (PWDP). This report considers the water supply servicing for the proposed development. Other reports completed by Woods for the proposal include stormwater management, flooding assessment and wastewater servicing.

2.2. Development Description

Sleepyhead Estate is a mixed-use master planned community proposed to be located on a site adjacent to the Waikato Expressway and the North Island Main Trunk railway at Ohinewai.

APL are the property holding associate of the New Zealand Comfort Group Limited (NZCG), the manufacturer of Sleepyhead, Sleepmaker, Serta, Tattersfield and Design Mobel Beds along with Dunlop Foams and Sleepyhead flooring underlay. They also produce a wide range of related products including pillows, mattresses, drapes, furniture and other soft furnishings. The manufacturing operations are currently based at several locations in Auckland. APL has been investigating options to consolidate all of their manufacturing operations onto one site. It has searched extensively in Auckland and the Waikato for a suitable site.

APL has found a suitable property on the corner of Lumsden Road and Tahuna Road, Ohinewai (Allotment 405, Lots 1 and 2 DPS 29288 and Lots 1-3 474347). The property is zoned Rural in the operative and proposed Waikato District Plans.

The proposed NZCG 100,000 m^2 factory will be the major industrial anchor for the project. It will be accommodated in a 63 ha industrial hub with rail siding access from the North Island Main Trunk railway. The project will also include 8.7 ha of business development including a service station, local convenience stores and factory outlet shops. Approximately 52 ha of residential land for approximately 1100 new houses will also be provided, together with approximately 55 ha of public open space and stormwater management areas.

APL has lodged a submission on the proposed Waikato District Plan requesting that the land be re-zoned to a mix of industrial, residential and business zone to accommodate the mixed-use community.

To support the proposed re-zoning, APL are also seeking to embed a structure plan for Ohinewai within the District Plan. The structure plan will provide a framework for the development of the wider site, outlining the location of activities, the indicative road network and the general location of the green spaces that will provide for recreation and the management of stormwater.

This report has been prepared in support of the re-zoning request.

2.3. Fresh Water Take Environments

The surrounding water catchment for the development is part of The Waikato River Catchment, and includes the following water bodies:

- Lake Rotokawau located to the east of the site This is situated within a Department of Conservation (DoC) reserve and flows to Lake Waikare.
- Lake Waikare is a significant water body that extends from the site as far north as Te Kauwhata and eventually drains to the Waikato River
- Lake Ohinewai is a smaller water body to the south of the site. It drains via a land drainage scheme through the site into Lake Rotokawau

- The Waikato River flows in a northerly direction west of the site. The state highway, railway and Ohinewai township are between the river and the site.

2.4. Report Structure

To assist reading this report, the sections have been summarized below:

- Section 3 outlines the organisations with an interest in the development and consultation that has been completed to date.
- Section 4 describes the development, potential staging of the works and water demand.
- Sections 5, 6, 7 and 8 describe the potential components that could be utilised in the servicing solution for:
    - Section 5 - the potential water sources
    - Section 6 - the transmission (bulk) reticulation to get the water from the source to site
    - Section 7 - the water treatment components and processes
    - Section 8 – the network reticulation within the site.
- Section 9 presents a combination of the components from Sections 5 to 8, as six options to service the development.
- Section 10 describes (number of) interim servicing options as the development is being built taken from components from Sections 5 to 8.
- Section 11 completes an assessment of the options outlined in Sections 9 to 10.
- Section 12 concludes the reporting, with summary, conclusions and recommendations.

3. Key Stakeholders

3.1. Waikato District Council

Waikato District Council (WDC) is the current council authority for water supply for the proposed development. WDC have existing supply and treatment facilities in the area surrounding the development which potentially could supply the Sleepyhead Estate site.

Woods has contacted and met with WDC to ascertain their capabilities in providing a water supply solution for the proposed development and this has been incorporated into this report.

There are two substantial treatment plants in the district; at Te Kauwhata and Huntly. These plants are described in Section 5.5 and Section 5.6. There are plans to expand the Te Kauwhata supply, which is nearing capacity, to service the proposed lakeside development. Similarly, there is limited spare capacity available at the Huntly pant, likely to be taken up supplying the growth in Ngaruawahia.

In summary there is limited scope to draw from the existing regional water treatment plants, both of which are nearing capacity.

However, there are plans to increase the treatment capacity across the region, with a study for future water sources/treatment plant being commissioned by WDC/Watercare in October 2019.

That study is expected to be completed mid 2020 and will include in its scope potential significant demands, such as the Sleepyhead development. This study may recommend a single centralised plant with associated transmission mains. The Ohinewai site is ideally situated to draw from a single regional supply if it eventuates, as the supply may include a transmission main past the site if the plant was to service Huntly and Te Kauwhata.

3.2. Watercare Services Ltd

Watercare Services Ltd (WSL) have assumed the management of WDC's three waters as of October 2019. WSL are currently in a transition phase with WDC, where roles and responsibilities are being defined.

A meeting was held with WDC and WSL in October 2019, with Richard Pullar and Sharon Danks representing the respective organisations. In principle they were supportive of the development and providing a water supply, provided a mutually acceptable design was implemented. The limitations of the existing supply, as described in Section 3.1, were outlined. There was acknowledgement that a new future supply was needed for the District and plans for establishing this are being implemented. The Sleepyhead demand would be included in these plans, that would be realised in the medium term (5 to 10 years). In the meantime, the development would need to be self-sufficient for water supply.

3.3. Waikato Regional Council

Waikato Regional Council's (WRC) responsibilities for water supply in the Waikato region include regulating the impact on existing water bodies, ground water and water health.

Discussions with the WRC have established the following:

- In terms of water allocation, groundwater and surface water (rivers) are treated as one catchment, due to the interaction between the two systems.
- The Waikato river defines the catchment, from Lake Taupo to the mouth of the Waikato river, an extensive catchment.
- Presently the cumulative allocations in the Waikato river catchment are just below the limit available, however, there are a number of pending requests for allocation.
- These requests are dealt with on a first come first served basis. If they were all granted, the catchment would be overallocated between the months of October and April (summer).

- If Sleepyhead were to apply for consent to take groundwater (year-round) then its application would be considered after the pending allocations were resolved, ie would join the back of the queue. Some of these pending applications are significant (Watercare application for second take for Auckland's supply at Tuakau), so would take some time to process.
- If Sleepyhead were to apply for water between May and September, then the application would likely be granted, as there is spare allocation available over these months. However, there would be no supply over summer. Storage would be unrealistically large to cover this length of time.
- Options exist to utilise transferable water rights from an existing water allocation consent holder(s). There are consent holders with spare allocation available, and arrangements could be entered in to. WRC have confirmed that there are existing user groups that run through this model and that WRC can manage the consenting requirements.
- Private supply utilising groundwater bores or water takes from local water bodies will need to meet WRC's requirements.

3.4. Tangata Whenua Governance Group

The 3 waters options were presented to the Tangata Whenua Governance Group for the Sleepyhead Estate development on 22 October 2019. Minutes of the meeting are included in Appendix C.

Discussions of the water supply servicing options included:

- Local Authorities (WDC, WSL and WRC) and their servicing plans
- Supply Routes of Public Infrastructure
- Water take location & treatment quality
    - On site / bore take – General support for this. Requirement for information about volumes and treatment requirements
    - Lake – Concern shown for quality of the lakes and impacts on water levels
    - Waikato River – Iwi would not be in support of new take from the Waikato River as they understood that this was already at the allocation limit

3.5. Community

A community open day was held at the Ohinewai Hall on 31 October 2019. The Open Day included information on the proposed options for water supply and the following feedback was received on the day:

- Understanding of the water quality for on-site water treatment – potable standard needed.
- Local authority plans – WSL implementation of future supplies.
- Timing for the new WSL public water supply.
- Whether bore water take on the development's scale or construction activities would adversely affect existing bore supply and quality.
- Whether lowering of the groundwater due to water take would cause settlement at building & foundations – historical references to coal bores.
- Coordination of the development with local water supply – availability of a new supply for the area.

3.6. Department of Conservation

The Department of Conservation (DoC) have been contacted during the consultation process, however no meetings have been held or correspondence has been received.

3.7. Water Allocation Owners

It is understood that there are existing farm supply water authorities operating in the region. Water supplied from these sources would not be suitable for potable water and therefore would require treatment before being utilised.

Additionally, there are holders of consented water allocation within the wider Waikato River Catchment which may be available to assist with the consenting requirements associated with water take allocation.

Contact has been made with existing water allocation owners within the Waikato River catchment to determine whether they have surplus allocation which could be reallocated to this development, including:

- Allocation Holders – no infrastructure
- Allocation Holders – existing infrastructure for water supply

This allocation owners have been approached as local council supply may be unavailable or under capacity for the proposed development. Discussions with these suppliers confirm that allocation and supply is available in principle for this proposed development.

4. Water Supply Zones & Hydraulic Design

4.1. Proposed Land Use

APL is submitting as part of the re-zoning provisions for the Sleepyhead Estate, supporting Structure and Zoning Plans. These plans outline the proposed underlying zonings, indicative roading and roading network (Appendix A).

The Sleepyhead Estate Structure Plan has been used as a basis for modelling of the water supply flows as a result of the proposed land uses for the development. For modelling of the water supply demand, each water supply zone has been calculated separately based on anticipated land use. Figure 1 below outlines the water supply zones.

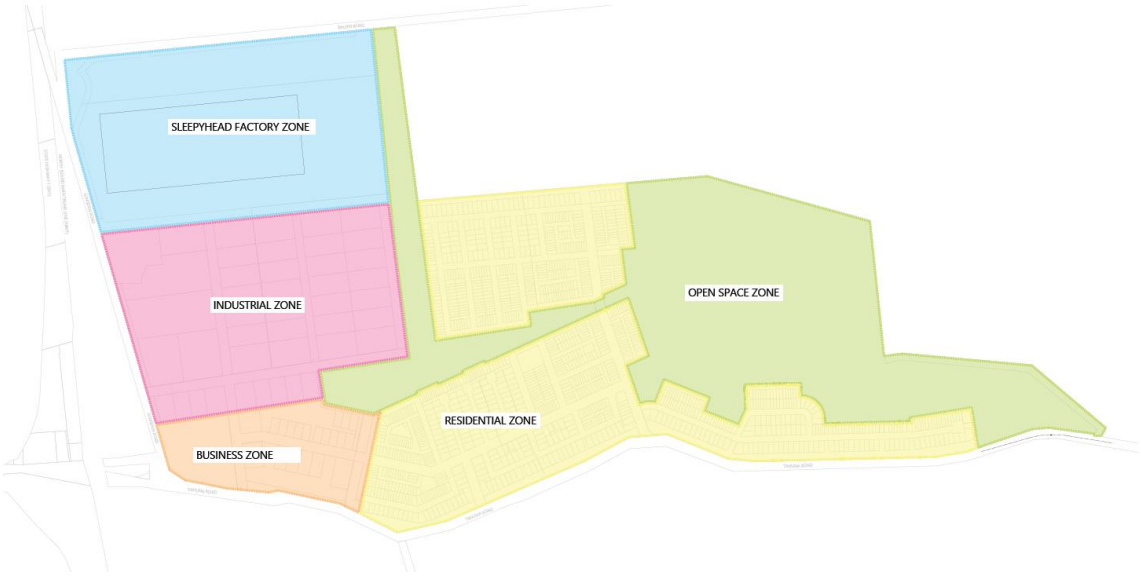


Figure 1: Proposed Sleepyhead Estate Land Uses / Water Supply Zones

4.2. Water Supply Zone Details

4.2.1. Sleepyhead Factory Zone

The proposed Sleepyhead factory comprises of a 10 Ha factory, a rail siding, carparks, container storage facility, and other associated structures and amenities. This zone is approximately 34 Ha of the overall 63 Ha industrial land use.

It is anticipated that the factory will provide work for 1500 staff and contain a visitor centre.

4.2.2. Industrial Development Zone

The remaining area zoned industrial is approximately 29 Ha. This will allow for the creation of new industry that is able to utilise the available transport linkages and amenities as part of this development.

It has been assumed that this zone will consist of dry industrial usage and not require high volumes of water supply.

4.2.3. Business Development Zone

Business (commercial) development is proposed across approximately 8.7 Ha including a service station and other local amenities to service the proposed wider development.

It is anticipated that this will be a mixture of dry commercial and low usage wet commercial.

4.2.4. Residential Subdivision Zone

This zone consists of approximately 52 Ha of housing to provide living space for factory workers and provide for growth in the region. Approximately 1100 dwellings are to be established in a medium to high density residential development. For water supply modelling purposes, 1250 dwelling unit equivalents (DUE) have been accounted for (conservative approach).

4.2.5. Open Space Zone

Approximately 55 Ha of open space is proposed for the eastern part of the site for public amenity and stormwater treatment and management structures. There may be public facilities, irrigation and other water uses as part of this zone.

4.3. Hydraulic Design Assumptions

The water supply demands have been developed using Watercare Services Ltd Code of Practice for Water Supply (C0P-01) version 2.2 dated 1/11/2019. These are generally in line with the Waikato Local Authority Shared Services Regional Infrastructure Technical Specifications, May 2018.

The demands for the proposed development have been calculated utilising the following parameters from the WSL COP-01, Chapter 6:

- Residential occupancy of 3 people per dwelling
- Residential Average Day Demand (ADD) of 220 litres/person/day (l/p/d)
- Commercial ADD based on Dry Retail with no toilets for customers; 1 person per 50m2 at 65 l/p/d (Dry Retail)
- Factory demands based on 1500 staff using 65 l/p/d Average Day Demand
- Industrial flows based on light water use; Average Day Demand of 4.5 l/m^2 gross floor area/day
- Residential, Industrial and Commercial Peak Day Demand (PDD) Peaking Factor of 2 (PDD/ADD)
- Residential, Industrial and Commercial Peak Hour Demand (PHD) Peaking Factor of 2.5 (PHD/PDD)
- Fireflow to SNZ PAS 4509. Assumed fire demand: Residential FW2 (25 l/s), Commercial FW3 (50 l/s). Specific design for industrial fire protection. These fire flows are to be confirmed when the buildings are designed.

4.4. Development Demands

The demands have been summarised in the table below. For full calculations refer to Appendix B – Development Demand Calculations.

Table 1: Demand Summary

Sub-precinct	Number of Lots	Gross Floor Area m^2	Average Day Demand (m^3/d)	Peak Day Demand (l/s)
A – Factory		100,000	97.5	2.3
B – Industrial		250,000	1125	26.0
C – Commercial		71,000	97.5	2.3
D – Residential	1250	4,000	825	19.1
E – Open Space			5	<0.1
Total	**1250**	**425,000**	**2,150**	**49.7**

The peak flows have been derived by applying conservative peak factors as detailed above, taken from the WSL COP-01. The total is dominated by the Industrial component, which is highly dependent on the type of industry.

Due to the unknown nature of the future activities in the development and the conservative nature of the demand assessment, the figures above are considered an upper bound of the demand, appropriate for this stage of the design process.

4.5. Staging of Demands

The demands will increase as the development is constructed and the various activities on the site start drawing water, e.g. foam factory, industrial, commercial and residential activities.

The build-out may be initially constrained by the interim water supply available and timing of the public network availability. The initial staging presented is considered a possible scenario based on the supply knowledge garnered to date and is subject to change.

A precise build-out programme for the development cannot be provided at this early stage of the development, however a general plan of the roll out of the development, with associated demands is given in

Table 2.

Table 2: Daily Water Demand Staging

Develop-ment Year	Residential DUEs	Business GFA (m2)	Industrial GFA (m2)	Average Daily Demand (m^3/d)	Peak Daily Demand (m^3/d)
1	150	57,300	71,900	500	1,001
2	175	3,000	76,700	1,004	2,008
3	300	1,000	0	1,203	2,406
4	75	13,700	101,400	1,756	3,512
5	225	0	0	1,905	3,809
6	175	0	0	2,046	4,092
7	150	0	0	2,145	4,290
Total	**1250**	**75,000**	**250,000**	**2,150**	**4,300**

4.5.1. On-Site Treatment Staging

For on-site treatment of interim demands, the plant can be provided in 250 m3/d, 500 m3/d and 1000 m3/d modules. Combinations of this can be built up for each stage. Based on peak daily demands, this equates to:

Table 3: Interim Demand Increments

Zone	PDD (m^3/d)	Number of DUEs	Gross Floor Area
Industrial	500		55,550
Commercial	500		182,050
Residential	500	380	

5. Supply Strategies

Six long term supply strategies (ie the source of the water) have been considered for this assessment, as well as interim solutions for the initial stages of the development.

The long-term solutions are set out in Section 9.

5.1. On Site Bore Supply

On site bore supply consists of utilising a series of groundwater bores to extract water for use as potable and non-potable supply.

5.1.1. Serviceability Check

The area surrounding the site shows many existing bores of various sizes and depths have been installed on site and the surrounding region indicating that bore supply is viable in the region, see Figure 2.

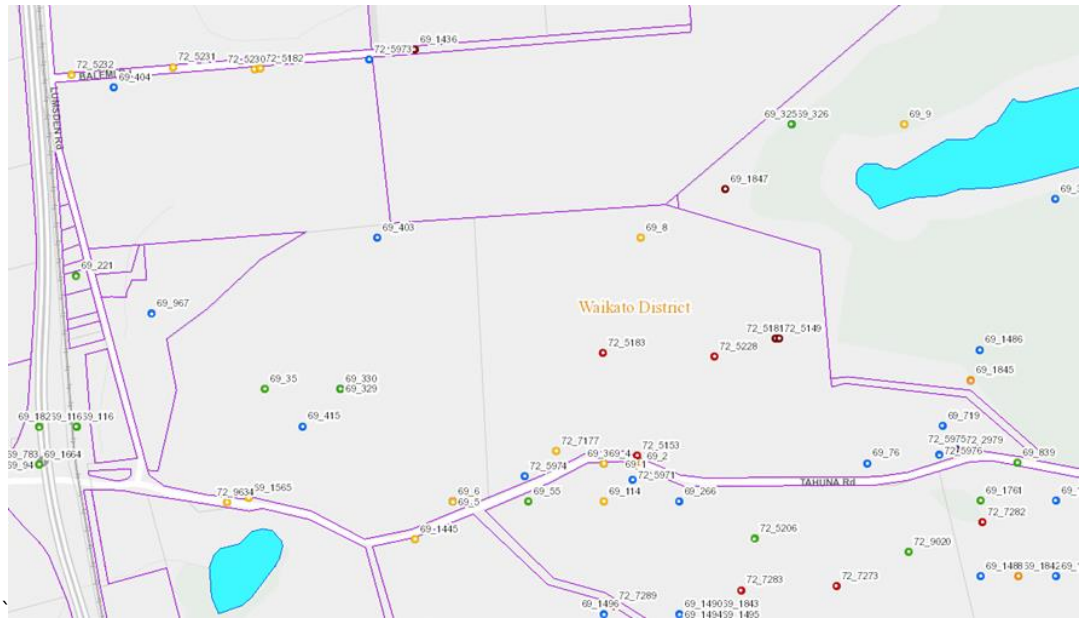


Figure 2: Existing Bore Locations (reference: Waikato Regional Council MAPS)

In addition to the existing bores on site, a new 100mm bore was sunk in August 2019. This bore had a yield of 5 l/s, i.e. approximately 10% of the final required demand.

Multiple bores could be used to provide an adequate supply. Bore yield testing of the bore field would be required to confirm the aquifer yield. Effects of a water take of this size on surrounding bores would need to be established by undertaking a comprehensive yield study that considered:

- The effect on the neighbouring bores
- The effect on the surrounding groundwater levels, lake levels and ground levels
- The effects on the groundwater quality

Testing will be undertaken as part of preliminary design of water supply systems.

5.1.2. Delivery Infrastructure

For bore water to be utilised for supply, the following infrastructure is required:

- Extraction pumps at the bore
- Water Treatment
- Reservoir & Booster Pump Station

5.1.3. Delivery Reticulation

Reticulation from the bore to the water treatment facility should be sized based on bore supply capabilities. From the treatment facility, either a single network is supplied to a single reservoir and booster pump station or a dual system is provided for potable and non-potable supply, each with their own reservoirs & booster pump stations.

All delivery reticulation for this supply strategy will be privately owned.

5.1.4. Water Quality

Water quality testing of the bore water would be required to establish the water quality parameters that would inform the treatment process selected. Anecdotally bore water from this area is known to be high in iron, which can be treated by oxidation to precipitate the soluble iron followed by sedimentation/filtration.

The bore head would need to be suitably protected to guard against contamination from the surrounding farmland runoff.

5.1.5. Advantages and Limitations

The advantages for this supply strategy are:

- Does not require interface with council reticulation and therefore is not limited to delays in infrastructure upgrades to meet development demands
- Delivery Infrastructure through Building Consent process
- Can be staged where the number of bores is increased to match demand
- Supported by Iwi

The limitations associated with this supply strategy are:

- Consenting requirements for water take – part of the Waikato River catchment allocations and negotiations required to secure allocation from others
- May have ground settlement implications adjacent to where bores are situated
- Groundwater can be affected by local conditions
- Groundwater is not guaranteed and could experience low flow events or shut down of bore
- Requires on site water treatment including removal of metals such as iron and manganese.
- Requires infrastructure and reticulation to be privately owned, maintained and managed by a body corporate structure.

5.2. Waikato River Supply

5.2.1. Summary

This supply strategy requires a water take from the Waikato River for use as potable and non-potable supply.

5.2.2. Serviceability Check

The Waikato River lies approximately 500m to the west of the site, on the other side of the state highway and railway.

Water take from this river would require detailed investigations for environmental and ecological effects and require a water take consent. Available allocation would be dependent on acquiring rights from others or applying for new allocation.

5.2.3. Delivery Infrastructure

For a water take from the river to be utilised for supply, the following infrastructure is expected to be required:

- Extraction pump station
- Primary Water Treatment at source – filtration
- Bulk Supply Main to site
- Inline Booster Pump Station
- Secondary Water Treatment – for potable water
- Reservoir & Booster Pump Station

The level of treatment required will be determined by the environmental testing undertaken in the initial stages of design.

5.2.4. Delivery Reticulation

The network reticulation for this strategy will be privately owned and managed by a body corporate.

5.2.5. Water Quality

Water quality testing of the river supply would be required to establish the water quality parameters that would inform the treatment process selected.

5.2.6. Advantages and Limitations

The advantages for this supply strategy are:

- Does not require interface with council reticulation and therefore is not limited to delays in infrastructure upgrades to meet development demands
- Delivery Infrastructure through Building Consent process
- Infrastructure sizes can be staged based on demand

The limitations associated with this supply strategy are:

- Consenting requirements for water take
- High level of consultation required – lots of stakeholders including Iwi, other water users
- Requires on site water treatment including treatment for municipal wastewater and other contaminants.
- Requires infrastructure and reticulation to be privately owned, maintained and managed by a body corporate structure.
- Intake structures expensive and location must consider ecological effects

5.3. Supply from Local Water Bodies

5.3.1. Summary

This supply strategy requires a water take from adjacent local lakes for use as potable and non-potable supply.

5.3.2. Serviceability Check

There are several nearby lakes including Lake Waikare to the north, Lake Rotokawau to the east and Lake Ohinewai to the south, see Figure 3.

Water take from these bodies would require detailed investigate for environmental and ecological effects and require a water take consent. Once the initial reporting is completed, a better understanding on whether these locations will be a suitable source for the water supply demands of the site will be determined.

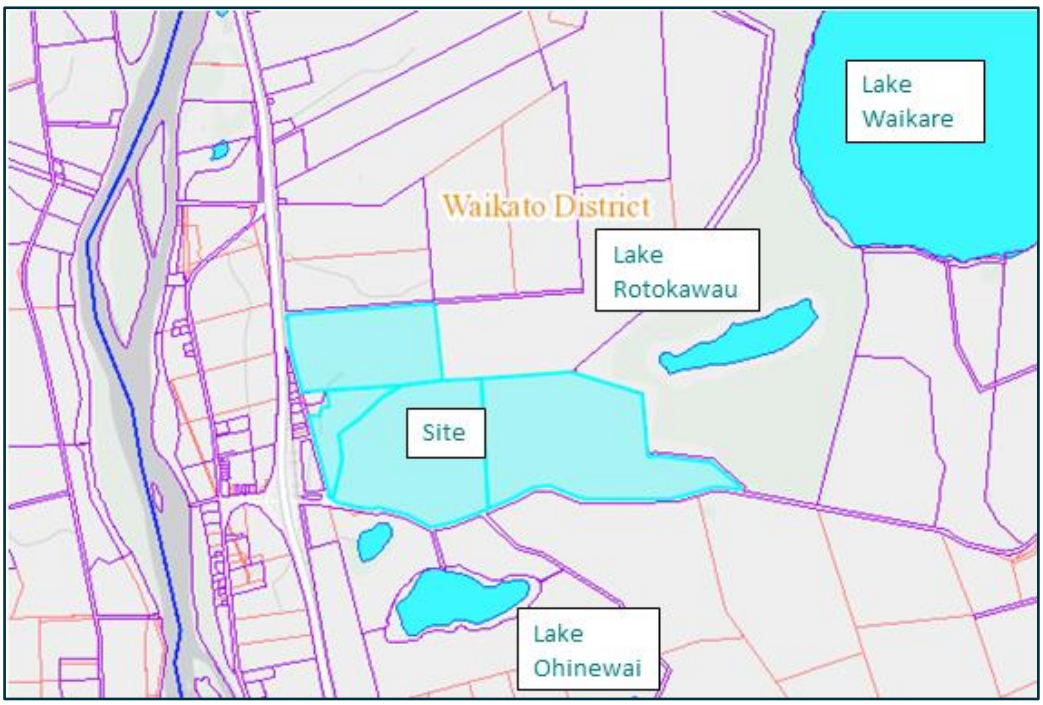


Figure 3: Local Water Bodies (source: WRC Maps)

5.3.3. Delivery Infrastructure

For water take from local water bodies to be utilised for supply, the following infrastructure is expected to be required:

- Extraction pump station
- Primary Water Treatment at source – filtration
- Bulk Supply Main to site
- Inline Booster Pump Station
- Secondary Water Treatment – for potable water
- Reservoir & Booster Pump Station

The level of treatment required will be determined by the environmental testing undertaken in the initial stages of design.

5.3.4. Delivery Reticulation

The network reticulation for this strategy will be privately owned and managed by a body corporate.

5.3.5. Water Quality

Water quality testing of the river supply would be required to establish the water quality parameters that would inform the treatment process selected. The upstream catchments of the lake would possibly contaminate the supply with municipal wastewater and from surrounding land use, which would need to be accounted for in the treatment process.

5.3.6. Advantages and Limitations

The advantages for this supply strategy are:

- Does not require interface with council reticulation and therefore is not limited to delays in infrastructure upgrades to meet development demands
- Delivery Infrastructure through Building Consent process
- Infrastructure sizes can be staged based on demand

The limitations associated with this supply strategy are:

- Consenting requirements for water take
- Not preferred by Iwi
- Nearest body Lake Rotokawau within DoC reserve and therefore unlikely to be approved
- High level of consultation required – lots of stakeholders including Iwi, other water users
- Requires on site water treatment include treatment for contaminants present in adjacent lakes
- Requires infrastructure and reticulation to be privately owned, maintained and managed by a body corporate structure.
- Intake structures expensive and location must consider flora and fauna affects

5.4. Rural Farm Supply

5.4.1. Summary

Existing raw water supplies for farm applications are available within the Waikato region from existing water allocation owners and could be utilised as a supply source. This strategy would include extension of a private bulk reticulation to site and treatment at site.

5.4.2. Serviceability Check

Each rural farm supplier needs to be checked for:

- Level of surplus supply available
- Security of supply
- Existing supply infrastructure and any upgrades required
- Supply agreement requirements
- Existing level of treatment and quality of water provided

This will determine whether supply from the rural farm supply source is viable and able to service the development.

5.4.3. Delivery Infrastructure

Delivery infrastructure may be constructed by the developer or the supplier depending on the supplier's capabilities and interest in extending their network.

This will be either metered at source or at the development depending on who builds and owns the infrastructure.

The likely bulk infrastructure model for this strategy is:

- Bulk Supply Main to site
- Inline Booster Pump Station

- Water Treatment – for potable water
- Reservoir & Booster Pump Station

5.4.4. Delivery Reticulation

The network reticulation for this strategy will be privately owned and managed by a body corporate.

5.4.5. Water Quality

Water quality testing of the rural supply would be required to establish the water quality parameters that would inform the treatment process selected. The supply may be contaminated with municipal wastewater or from surrounding farm use, which would need to be accounted for in the treatment process.

5.4.6. Advantages and Limitations

The advantages for this supply strategy are:

- Does not require interface with council reticulation and therefore is not limited to delays in infrastructure upgrades to meet development demands
- Delivery Infrastructure through Building Consent process or by others
- Infrastructure sizes can be staged based on demand

The limitations associated with this supply strategy are:

- Agreements required with other organisations for supply including sign up costs associated
- Requires on site water treatment
- Requires infrastructure and reticulation to be privately owned, maintained and managed by a body corporate structure.
- Risk on others consent being renewed
- Risk on changes in policy by external suppliers affecting water supply to site

5.5. Te Kauwhata Town Supply

This supply strategy utilises the existing town supply operated by WDC from the treatment plant at Hall Road, Te Kauwhata.

5.5.1. Serviceability Check

The Te Kauwhata water supply (TKWS) currently services Te Kauwhata and Meremere. The treatment plant has a 3 MLD (million litres/day) capacity. The WDC plan to increase this capacity to 9 MLD, to supply 10,000 people by 2045.

Given this increase in capacity, it may be feasible to draw from the TKWS to supply the development, provided the timing of the upgrade was suitable and to the agreement of all parties. This would require the agreement of, and coordination with WDC/Watercare, to include the development demands in the plant capacity upgrade.

5.5.2. Delivery Infrastructure

For this strategy, it is anticipated that the following infrastructure is required:

- Bulk Supply Main to site
- Inline Booster Pump Station
- Chlorine Boost
- Reservoir & Booster Pump Station

It is likely that this infrastructure will be constructed either:

- As part of a wider regional infrastructure upgrade, whereby the developer will connect and pay infrastructure levies; or
- By the developer for the Sleepyhead Estate development only; or
- A combination of both.

5.5.3. Delivery Reticulation

Reticulation within the network shall be publicly vested water supply

5.5.4. Water Quality

The water supplied would be potable prior to pumping along the delivery main. There may be a need for chlorine boost at the development site, if the residual has dropped during the transport along the transmission pipeline.

5.5.5. Advantages and Limitations

The advantages for this supply strategy are:

- Utilises council owned treatment plant
- Council responsible for maintenance and upgrades of infrastructure
- Long term security of supply

The limitations associated with this supply strategy are:

- Would need to fit with the Council timing of the plant upgrade
- Development levies likely to be high to pay for infrastructure and maintenance
- Depends on council infrastructure growth to match development growth
- Requires more complex consenting and approvals process
- Changes in WSL servicing strategies over the next year may mean that this plant is not a suitable supply option

5.6. Huntly Town Supply

This supply strategy utilises the existing town supply operated by WDC from the treatment plant at Jackson Road.

5.6.1. Serviceability Check

The Huntly water supply supplies Huntly and Ngaruawahia townships and has a capacity of 8 MLD. The current demand is 4 MLD for Huntly and 2 MLD for Ngaruawahia, which leaves a spare capacity of 2 MLD. This spare capacity is anticipated to supply the growth in Ngaruawahia. Pending the outcome of the region wide water supply strategy review (due mid 2020), Huntly may be a viable supply for the development, if the treatment plant is upgraded.

5.6.2. Delivery Infrastructure

For this strategy, it is anticipated that the following infrastructure is required:

- Bulk Supply Main to site
- Inline Booster Pump Station
- Chlorine Boost

- Reservoir & Booster Pump Station

It is likely that this infrastructure will be constructed either:

- As part of a wider regional infrastructure upgrade, whereby the developer will connect and pay infrastructure levies; or
- By the developer for the Sleepyhead Estate development only; or
- A combination of both.

5.6.3. Delivery Reticulation

Reticulation within the network shall be publicly vested water supply.

5.6.4. Water Quality

The water supplied would be potable prior to pumping along the delivery main. There may be a need for chlorine boost at the development site, if the residual has dropped during the transport along the transmission pipeline.

5.6.5. Advantages and Limitations

The advantages for this supply strategy are:

- Utilises council owned treatment plant
- Council responsible for maintenance and upgrades of infrastructure
- Long term security of supply

The limitations associated with this supply strategy are:

- Limited capacity of the existing plant
- Development levies likely to be high to pay for infrastructure and maintenance
- Depends on council infrastructure growth to match development growth
- Requires more complex consenting and approvals process
- Changes in WSL servicing strategies over the next year may mean that this plant is not a suitable supply option

5.7. Pipeline from Huntly to Te Kauwhata (Centralised reticulation)

This strategy links water supply from Huntly to the south of the site and Te Kauwhata to the north of the site, utilising spare or future upgraded capacity in each system to make up the required capacity for the development and provide security of supply to the region.

5.7.1. Serviceability Check

Based on serviceability of the existing treatment plants discussed in Section 5.5.1 and Section 5.6.1, there is potential spare capacity available from an expanded Te Kauwhata plant, or a new regional plant (as discussed in Section 3.1 above).

5.7.2. Delivery Infrastructure

For this strategy, the delivery infrastructure is likely to include:

- Bulk Supply Main to site from each supply source
- Inline Booster Pump Station on each supply lines
- Chlorine Boost

- Reservoir & Booster Pump Station

It is likely that this infrastructure will be constructed either:

- As part of a wider Waikato District infrastructure upgrade, whereby the developer will connect and pay infrastructure levies; or
- By the developer for the Sleepyhead Estate development only; or
- A combination of both.

5.7.3. Delivery Reticulation

Reticulation within the network shall be publicly vested water supply.

5.7.4. Water Quality

The water supplied would be potable prior to pumping along the delivery main. There may be a need for chlorine boost at the development site, if the residual has dropped during the transport along the transmission pipeline.

5.7.5. Advantages and Limitations

The advantages for this supply strategy are:

- Utilises council owned treatment plants
- Council responsible for maintenance and upgrades of infrastructure
- Does not rely heavily on council infrastructure growth to match development growth
- Provides security of supply for the Waikato District

The limitations associated with this supply strategy are:

- Must integrate with the timing of a possible supply upgrade for the Waikato District
- Development levies likely to be high to pay for infrastructure and maintenance
- Requires more complex consenting and approvals process
- High construction costs

5.8. Other Strategies Considered

Other supply strategies have been considered and dismissed as not suitable for this development.

5.8.1. Rainwater Harvesting

Rainwater harvesting from roof and paved areas is suitable for irrigation and non-potable supply. For potable water supply, rainwater harvesting requires a high frequency maintenance that is normally not undertaken which can cause detrimental health problems.

Rainwater harvesting also requires sufficient rainfall for tanks to remain full and is subject to emptying in drought periods. For this reason, it is not normally suitable for fire demands.

Rainwater harvesting may be used for irrigation and flushing toilets as part of this development but is not considered suitable for firefighting or potable supply.

5.8.2. Wastewater Harvesting

Wastewater harvesting is utilising treated wastewater for water supply. This is largely underused in New Zealand as there are sufficient alternatives.

Should on site treatment of wastewater be utilised, then potentially if treated to a high level (including UV) then this could be utilised for non-potable supply.

Public stigmata would likely rule this strategy our for potable supply and it is likely that there will be insufficient flow for the development to solely rely on this strategy.

5.9. Interim Supply Strategies

For the initial stages of the development, when demand is low, it is anticipated that the final water supply strategy will not be in place or construction completed, therefore interim solutions have been investigated.

It is likely that a combination of these will be utilised for different interim supply requirements.

These have been fully explored in Section 10.

5.9.1. Scaled back versions of Long term strategies

The initial stages of on site treatment strategies outlined in Section 5 above could be utilised as an interim solution for a portion of the development. In addition the below options may provide an interim solution.

5.9.2. Rainwater Harvesting

It is anticipated that the factory will utilise rainwater harvesting for irrigation and flushing toilets. Given the size of the proposed factory, it is likely that the roof area supply will exceed its own requirements and have spare capacity. This could be utilised for supply.

The interim infrastructure required for this strategy is:

- Reservoir – likely to be large in order to supply for several days/weeks between rainfall events.
- Container Treatment Plant
- Container Booster Pump Station

5.9.3. Existing Bores

There are several existing bores on site. It is proposed that these are utilised until the permanent servicing strategy is confirmed, constructed and commissioned.

Discussions with the Waikato Regional Council have established the Waikato Catchment is near its allocation limit and obtaining consent for a new groundwater take is unlikely in the short term. However, it would be possible to come to an arrangement with allocation holders that have spare existing allocation available, to provide the supply.

A hydrogeological study will be required to confirm the yield available from groundwater.

The interim infrastructure required for this strategy is:

- Extraction pumps
- Reservoir
- Container Treatment Plant
- Container Booster Pump Station

5.9.4. Tanker Supplied

Where bore water or rainwater is not sufficient, it is proposed that water is tanked into site. This will be required for the factory fire suppression reservoir as it requires 2300 kl to be filled over 12 hours. Camlock couplings will be provided to enable this operation to be undertaken.

5.9.5. Line from West of Waikato River

There is a 150mm line terminating on Te Ohaki Road on the western side of the Waikato River. This could be extended up Te Ohaki Road and drilled across the Waikato River to provide a temporary supply to the site.

The interim infrastructure required for this strategy is:

- Container Treatment Plant
- Container Booster Pump Station

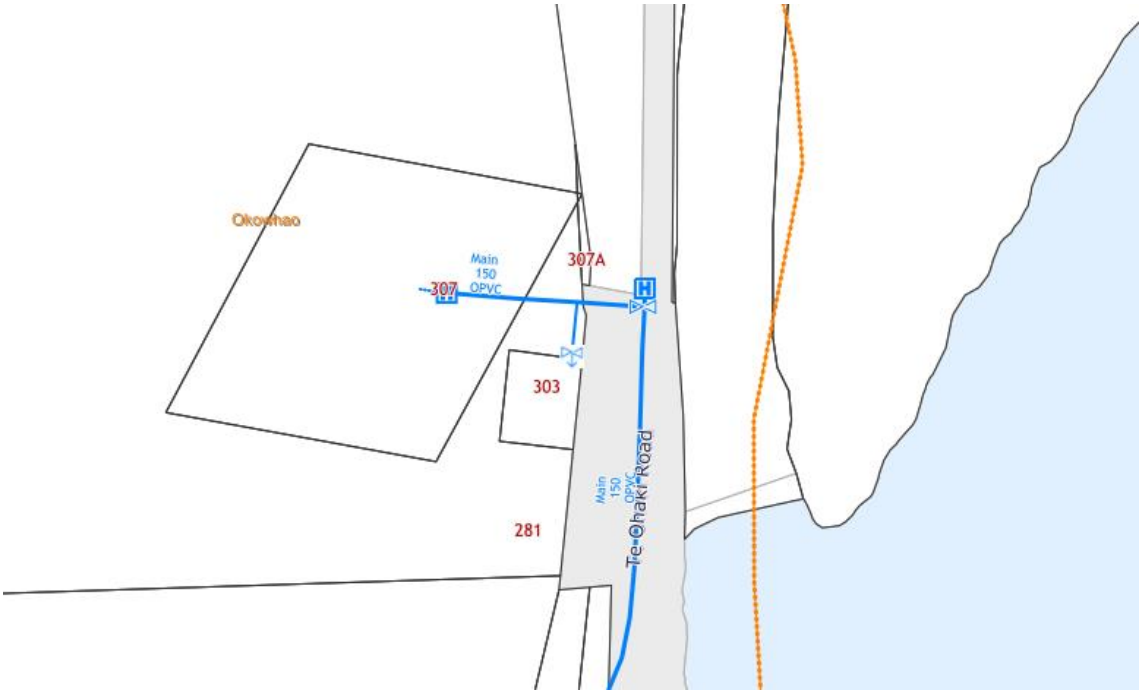


Figure 4: Termination of 150mm dia Supply (source: WDC Maps)

5.9.6. Water Cooler Supply

To supply initial potable water to site for use in the office or facilities, water coolers could be provided with water delivered to site in 15 litre bottles.

5.10. Infrastructure Ownership

Ownership of the bulk and reticulation infrastructure will depend on the supply source and construction arrangement

5.10.1. Publicly Owned

Publicly owned assets are normally constructed by the developer and its representatives and vested into council. This model will be utilised if water supply is from WDC, WRC or WSL assets as it will be an extension of their infrastructure.

Reticulation from these assets will also be vested for pipelines within public road reserves.

Meters will be supplied by the authority for supply from their network once vested.

5.10.2. Privately Owned – Body Corporate

Where water supply is sourced from bores, private extraction pump stations and the like, the water supply infrastructure and reticulation will be privately owned and run by a body corporate. There are complications with privately owned assets in public roads and therefore the model for the road ownership should also be reviewed under this option.

The reticulation will also be privately owned where a public water source is supplied through private roads. A bulk supply meter will be installed on the public/private boundary and internal meters will be run by the body corporate.

5.10.3. Privately Owned – By Others

Where water is sourced from a privately owned and run water source such as a rural farm supply from water allocation owners and it is likely that the bulk infrastructure will be constructed by that supplier as an extension of their network.

A bulk water meter will be installed at the boundary of the site with the reticulation within the development run as a body corporate asset similar to Section 5.10.2.

Other models include the developer acting as an agent of that supplier and completing the construction and vesting of the bulk infrastructure

6. Bulk Reticulation Requirements

6.1. Summary

For the above mentioned supply sources, a range of bulk infrastructure will be required in order to transport the water from source to the development and then provide flowrates and pressures to service the water demand and fire demand requirements.

The infrastructure identified below may be utilised in some or all of the supply options.

6.2. Bulk Supply Pipeline

6.2.1. Summary

In order to provide supply for the development from external sources, a bulk supply pipeline is required. For the development flows, this has been estimated at a DN300 pipeline.

6.2.2. Location

Typically, the bulk main would be located in the back berm of a road at a suitable cover to allow for future upgrade of the road and clearance from other services.

Depending on the supply location, the route selected should consider:

- The distance from the source to the development – longer distances may require inline booster pump stations
- Topography of the route – where there are high points along the route, inline booster pump stations may be required to pass this location
- Level of importance of road – where installed on state highways, the installation requirements and traffic managements increase
- The ownership of the land – installation privately owned land will require permission/consent and easements

6.2.3. Arrangement

It is anticipated that a single main will be required as there will likely be upgrades in the future within the region to provide security of supply.

Where there are localised high points or low points within the bulk line, air valves and scour valves shall be installed.

Isolation gate valves (sluice valves) shall be installed where there are road crossings or other areas where isolation is required for maintenance activities.

6.2.4. Staging

For water supply it its normally more efficient and cost effective to complete the full catchment pipeline for the initial stage.

Other staging options could include:

6.2.4.1. Dual Pipelines – Different Sources

For staged flows – provide smaller pipelines with the initial pipeline able to service part of the development and a later pipeline to service the remaining part of the development. This could be considered if the initial flows from the source were not sufficient for the entire development and an upgrade was anticipated. If the upgrade did not occur, then the later pipeline could come from an alternative source.

6.2.4.2. Dual Pipelines – Same Source

Two pipelines could be installed to provide security of supply to the development from the same supply source.

This could be considered for staged flows to the development if budget didn't allow for a larger pipeline to be installed initially. The initial stage would provide a smaller pipeline able to service part of the development and then a second pipeline would be required later to service the remaining part of the development.

6.2.4.3. Dual Pipelines – Limited Initial Flows

This could be considered if the initial flows from the source were not sufficient for the entire development and an upgrade was anticipated. If the upgrade did not occur, then the later pipeline could come from an alternative source.

The pipeline would be sized to the capacity of the initial flows.

6.3. Inline Booster Pump Station

6.3.1. Summary

An inline booster pump station is required where the supply pipeline is:

- Too long – pressure is lost due to friction in the pipeline over the length
- Small diameter – pressure is lost due to higher friction in the pipeline for small pipeline diameters
- Has a high point – pressure in the pipeline is too low to overcome a localised high point

6.3.2. Location

The inline booster pump is located adjacent to the pipeline where one of the above conditions occurs.

6.3.3. Arrangement

The inline booster pump station consists of:

- A series of booster pumps, normally within a concrete chamber
- Control panel with telemetry linkage
- Magflow meters incoming and out going
- Pressure gauges and instrumentation
- Valves, fittings and pipework.

6.3.4. Staging

It is likely that if an inline booster pump station is required, then it will need to be installed as part of the initial build.

The number of pumps could be staged so that the flows are staged to the development depending on development demand.

6.4. Reservoir & Gravity Supply

6.4.1. Summary

The traditional water supply strategy is utilising gravity from a reservoir located in high elevations. This would need to be supplied by another reservoir located above it or from a pumped supply.

6.4.2. Location

A reservoir to supply gravity supply to the development would need to be located suitably higher than the development and the elevation increases the further away the reservoir is from the site due to friction losses in the supply pipeline.

6.4.3. Arrangement

The reservoir can be located on a high elevation such as a naturally formed high point such as a hill or mounted on a tower (water-tower).

6.4.4. Staging

Where located on a natural high point such as a hill or ridgeline, the size of the reservoir can be reduced, and multiple reservoirs can be linked together to provide staged flows.

The flow rate to the reservoir can be staged also, from the pumped supply or gravity supply utilising flow restriction devices.

6.5. Booster Pump Station & Reservoir

6.5.1. Summary

Typically for developments where the local water source does not meet pressure at the development, or requires treatment before being reticulated to the development, a booster pump station & reservoir is required.

6.5.2. Location

Typically, this is located:

- Centrally in the development to reduce pipe sizes from it
- Where the incoming water supply doesn't require additional booster pumping
- At localised high points within the development – to reduce pumping requirements

6.5.3. Arrangement

The incoming supply would be fed into a header reservoir, which the booster pumps would draw to pressurise the development network.

The arrangement normally includes:

- Reservoir sized for peak hourly and fire demands or 24 hours storage, depending on supply
- Incoming valve arrangement and mag flow to limit supply to the reservoir to avoid overtopping
- Booster pumps fed from the reservoir, can be in a concrete chamber or in a building depending on size
- Outgoing valves, magflow meter, gauges to confirm pressure
- Control cabinet

6.5.4. Staging

The number of pumps and size of reservoir can be staged to meet development growth demands.

6.6. Interim Bulk Reticulation Options

For the initial stages of the development, the final supply infrastructure may not be available and may require interim measures. These may be required due to:

- Final supply not being available due to delayed infrastructure construction or upgrades
- The final location of the development infrastructure not being available
- Alternative supply for initial stages
- Additional treatment requirements for initial stages requiring additional infrastructure

6.6.1. Container Booster Pump Station

A container booster pump station will provide the same arrangement as Section 6.5, however can be relocatable and cater for smaller flows. Container pump stations are suited to short term use as containers themselves generally have shorter life spans due to roofing requirements.

6.6.2. Relocatable Reservoir

A temporary relocatable reservoir may be supplied in association with initial works where the permanent infrastructure isn't available.

6.6.3. Timber Tank Reservoir

A timber tank reservoir is a low-cost alternative to other reservoir designs and is suitable for short to mid lifespans. This is suited for use with initial booster pump stations.

6.6.4. Modular Systems

A modular pump station could be constructed from a series of container booster pump stations. When additional boost is required, another container booster pump station is added in. A hanger structure could be utilised to protect these containers from the elements providing them with a longer design life. The supply network could be zoned to each pump station also.

A modular reservoir could be constructed whereby extensions could be made when more storage is required.

7. Water Treatment Requirements

7.1. Summary

For the abovementioned supply strategies, it is anticipated that some level of treatment will be required to provide potable water for drinking or non-potable water for irrigation, flushing toilets and other identified uses.

The infrastructure identified below may be utilised in some or all of the supply options.

7.2. Treatment Plants

7.2.1. Summary

An on-site treatment plant can be utilised to convert raw water from farm supply, bores or local water bodies to potable water. The treatment process selected will depend on the water source selected and water quality test results from the source. The two sources considered are bore supply and river/lake supply, which are anticipated to have differing treatment requirements. There are several stages of treatment of which it depends on the water source which parts are utilised in the treatment train. These include:

- Aeration and dosing to remove iron and manganese (for bore supplies)
- Flocculation & Sedimentation (outlined below)
- Filtration for Particle Removal (outlined in Section 7.3)
- Disinfection (outlined in Sections 7.4 & 7.5)

7.2.2. Location

It is anticipated that a water treatment will be constructed on site adjacent to the Reservoir & Booster Pump Station for distribution to the subdivision. If the treatment is plant is part of a larger centralised plant, then this may not be located on site.

7.2.3. Arrangement

Typically, the treatment train arrangement is:

- Filtration at source
- Aeration to oxidise metal elements
- Coagulation, Flocculation and Sedimentation to remove chemical elements which are undesirable
- Particle removal through sand filters and reverse osmosis if required
- Disinfection by UV and/or Chlorination

The treatment plant can be installed as a single fixed facility or as a modular facility which grows as the development grows.

7.2.3.1. Fixed Facility

A fixed facility would be constructed at the start of the development and capable to service the entire development.

7.2.3.2. Modular Facility

A modular facility would be constructed so that additional parts can be added as required to meet development needs.

Typically the incoming filtration would be installed in two stages, and the sedimentation plant would be split into more parts. The best staging for the development would need to be developed with the staging and costings for the development.

7.2.4. Aeration / Air Stripping

Aeration or Air Stripping involves installation of Aerators to entrain air in the water by 'breaking up' the water and passing it through the air, eg, sprays or trickling towers, or by bubbling air through the water. This causes metal particles (typically iron and manganese) in the water to oxidise and come out of solution so they can be removed as particles. This is expected to be required for the bore supply.

7.2.5. Coagulation, Flocculation & Sedimentation

This phase on the treatment plant allows for the removal of undesirable metals and other small particles that contribute to turbidity, taste and odour, by the use of adding chemicals known as coagulants, which react with the intended particles. Once the reaction occurs, this creates build ups of new larger particles knows as flocs which join up and settle out.

Typically, after this process, tanks are provided for clarification which further allows particles to settle out.

7.2.6. Staging

If a modular plant is installed, then staging can be undertaken effectively based on number of connections (demand). For a fixed plant, it is likely that this would contain less stages, however this may be lower cost overall.

7.3. Filtration

7.3.1. Summary

There are typically one or two stages of filtration undertaken as part of the treatment process, depending on the results of jar testing of the raw water to establish the degree of filtration required:

- Stage 1 - Gravity filtration through sand filters to remove turbidity, taste and odour.
- Stage 2 if required, for example if Boron or other dissolved impurity exceeds maximum allowable values. – If testing shows this is the case then a polishing stage after the Stage 1 conventional treatment will be needed, eg reverse osmosis or ion exchange

For the purposes of this application, it is assumed that conventional treatment (Stage 1) will provide sufficient filtration. It is noted this is the case at the Huntly water treatment plant.

7.3.2. Location

A suitable location will be selected on site to locate the treatment plant. An area has been set aside in the master plan for this.

7.3.3. Rapid Sand Filter

For plant of this size, the typical primary filtration is a rapid sand filter. This normally contains two types of sand overlaid with a layer of small coal particles. These are designed to strain out particles too large to pass through the spaces between the sand grains and allow smaller particles to travel down into the sand where they are removed by adsorbing into the sand grains.

Rapid sand filters are typically cleaned by backwashing utilising treated water. It is important to size the sand filters appropriately so that the backwashing process isn't frequent and therefore doesn't require large amounts of treated water to complete.

7.3.4. Slow Sand Filter

A slow sand filter is similar to a rapid rand filter, however water travels through about ten times slower. This allows for a microbial community to live in the sand and this removes biological elements from the water. These are not designed to remove large amounts of particles from the water and should be used following the clarification process.

7.3.5. Cartridge Filtration

Cartridge filters are constructed with rigid or semi rigid materials in a pressure vessel and water is forced through filters of less than 1 micron in size.

7.3.6. Membrane Filtration

Membrane filters are primarily for the removal of bacteria and very small particles. This is often known as microfiltration, ultrafiltration and nanofiltration, depending on the system utilised.

Nanofiltration is usually undertaken in the form of reverse osmosis where a membrane similar to that of skin stops particles passing through while allowing water to pass. They operate at high pressures and are expensive to install and operate.

7.3.7. Staging

All filtration types can be modular and staged according to water demand. Typically, rapid sand filters will be supplied in 2-3 stages, and membrane filtration may be staged in 10 or more stages. The staging will need to be determined based on planned development build out and the most efficient cost arrangement

7.4. UV Treatment

7.4.1. Summary

Ultraviolet (UV) light at a wavelength of 254 nm can inactivate micro-organisms by damaging their DNA and it is effective against the majority of viruses. This is typically used as a disinfectant combination with chlorine.

The intensity of the light determines the ability of UV light to inactivate micro-organisms, and particles decrease the intensity of light passing through the water. The plant used must consider the quality of the water being treated to ensure suitable treatment is undertaken.

7.4.2. Location

Should a UV treatment facility be required, this will either be located at the reservoir & booster pump station on site or as the last stage in the water treatment plant.

7.4.3. Arrangement

UV treatment facility shall be the last phase of the water treatment for potable water and located at the end of the water treatment plant before the reservoir and booster pump station.

7.4.4. Staging

Plant can be staged based on demand/flow.

7.5. Chlorination Boost

7.5.1. Summary

Where base chlorination levels are lower than the required level by the time the reach the furthest lot within the development, a chlorination boost facility is provided.

7.5.2. Location

Should a chlorination boost plant be required, this will be located at the reservoir & booster pump station on site.

7.5.3. Arrangement

As a separate room/chamber of the booster pump station facility, the chlorination facility includes the following items:

- Dissolved Chlorine Storage Tank
- Water quality monitoring & water testing equipment for incoming and outgoing flows
- Jockey pump for adding chlorine
- Control system
- Safety equipment
- Ventilation

7.5.4. Staging

Plant size and implantation can be staged.

7.6. New Treatment Plants

Where bore supply or water take is required, a new treatment plant is required to covert raw water to potable and non-potable water supply. For this assessment, two suppliers have provided details for their water treatment products:

- MENA Water FZC
- Smith & Loveless NZ Ltd

A summary of their capabilities is included in the section below and further details have been provided in Appendix G – Treatment Details.

7.6.1. MENA Water FZC

MENA Water FZC are an international company based in the UAE that provide containerised systems for water treatment. MENA's NZ agent is Stewart & Cavalier Ltd Engineers.

7.6.1.1. Treatment Process

The proposed treatment process for the MENA plan for this site is a conventional sedimentation and gravity sand filtration treatment plant. This has been selected for raw water from the Waikato River or similar open water body supply. Should other supply routes be required, additional plant is required such as reverse osmosis membrane plant or similar.

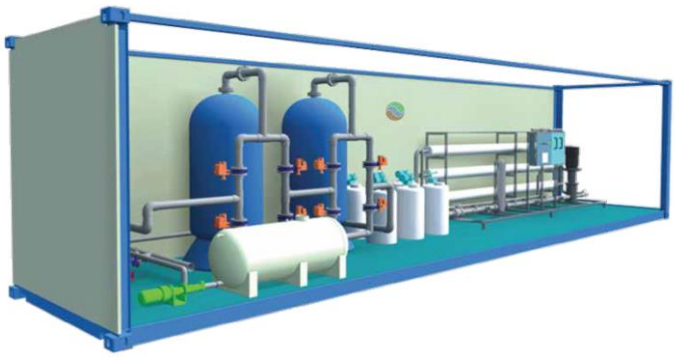


Figure 5: MENA Containerised Plant Typical Arrangement

7.6.1.2. Staging

MENA typically provide containerised systems which can be staged in 500 m3/day stages or larger plant which can produce higher daily outputs.

7.6.1.3. Budget Estimate

Table 4: MENA System Budget Costing

Item	Total
Land Cost (not included)	n/a
Earthworks	Low
Civil Works	High
MENA Systems	Medium
Total	**Medium**

7.6.2. Smith & Loveless NZ Ltd

Smith & Loveless NZ Ltd (S&L) provide components for the construction of water and wastewater treatment plants throughout NZ and Australia. Their main package systems for water treatment are AQUA-FER and AQUA-4 Treatment Systems.

7.6.2.1. Treatment Process

For this development, S&L propose to utilise one of two systems depending on water source:

- Bore Water Supply – AQUA-FER Packaged Plant, including
    - Aeration & Chemical Dosing for Iron/Manganese Removal
    - Sedimentation
    - Filtration
    - Disinfection
- River Water Supply – AQUA-4 Packaged Plant, including
    - Chemical Dosing
    - Flocculation
    - Sedimentation
    - Filtration
    - Disinfection

7.6.2.2. Staging

Both systems can be staged in 500m3/day iterations.

7.6.2.3. Budget Estimate

Table 5: S&L System Budget Costing

Item	Total
Land Cost (not included)	n/a
Earthworks	Low
Civil Works	High
S&L Systems	Medium
Total	**Medium**

7.7. Interim Treatment Solutions

It is anticipated that interim solutions will be utilised for the initial stages of the development until the permanent water supply strategy infrastructure is completed. These interim servicing solutions are likely to require some form of treatment.

7.7.1. Container Treatment Plant

Several suppliers provide containerised treatment plant systems which can be utilised to treat initial flows until the future water supply strategy is in place.

7.7.2. Modular Systems

Containerised systems can be constructed as a modular system which could reduce redundancy for the plant installed as per Section 7.7.1. Several suppliers can also provide treatment facilities in modular form which can be installed in stages as demand flows increase.

8. On Site Reticulation Options

There are two on site reticulation types considered for this development:

- Combined system – single piped network for potable water to be used for all applications
- Split Potable & Non-Potable System – dual piped network for separate potable / non-potable water uses.

8.1. Combined System

A combined system utilises a single piped network throughout the development with potable water supplied to properties within the development for use as potable and non-potable requirements.

8.1.1. Network Reticulation

This option would follow the council's standards for water reticulation. Pipe sizes will be determined to supply fire and peak hourly demand.

8.1.2. Treatment Requirements

For a combined potable & non-potable system, all water is to be treated to potable standards. Due to the higher flows in a combined system, it is unlikely that further chlorination boost is required.

8.2. Split Potable & Non-Potable System

A Split Potable & Non-Potable System utilises two pipe networks throughout the development with potable and non-potable water provided separately. Each property will have two connections and two meters.

8.2.1. Network Reticulation

For a split system, two piped networks will be provided.

8.2.1.1. Potable Network

The potable network will supply potable water only to properties for drinking water, showers, taps, etc. This pipeline is likely to be smaller diameter than the non-potable network.

8.2.1.2. Non-Potable Network

The non-potable network will supply water to households for irrigation and flushing toilets, and the development for fire demand. As the fire demand flows are usually higher than the water demand flows, it is likely that most of this network will be larger than the potable network.

8.2.2. Treatment Requirements

For non-potable water, only filtration is required.

For potable water, full treatment and disinfection is required.

8.3. Pressure Zones

8.3.1. Network Reticulation

For this development, the levels across the site are relatively even, and therefore it is not considered that different pressure zones will be required

8.3.2. Incoming Bulk Reticulation

It is likely that incoming flows from externally sourced water supplies will be on a different zone pressure to the development.

Where split systems are utilised, it is likely that the non-potable supply will be in the same pressure zone as the external supply and this may mean that it is delivered to the properties at a different pressure to the potable supply.

8.3.3. Estimate Development Pressures

Based on the topography and supply options, the pressures within the development can be estimated as shown in Table 6. Either boost pumping or pressure reduction will be used to achieve these supply pressures, depending on the pressure of the source water.

Table 6: Pressure Zones

Zone	Ground level m RL		Pressure settings m		
	Minimum	Maximum	Ground level RL	Pressure	HGL
Potable	8.5	20	10 -20	50	60
Non- Potable	8.5	20	10 -20	50	60

9. Proposed Servicing Options

9.1. Summary

Six long term servicing options have been explored as part of this assessment, with the likely infrastructure option considered for each strategy. Preliminary costings have been undertaken for the main components of the works.

For each option, the following has been explored:

- Network Reticulation Options – either potable or dual potable/non-potable supply for use as water use and fire demand.
- Delivery Infrastructure Options – pump stations, reservoirs and other infrastructure
- Bulk Reticulation Options – Bulk watermains external to local reticulation
- Treatment Options – including chlorination dosing, filtration, water treatment and other treatment infrastructure.
- Costings for Capital and Operational costs.

9.2. Option 1 – On-Site Bore Supply

9.2.1. Summary

The most likely option for this option is to create a series of bores spaced out around the development to minimise risk on ground settlement and drop in efficiency of groundwater supply. Each bore will have its own extraction pump and filtration unit and be connected to the non-potable supply.

A separate connection from the non-potable supply will be made for the potable supply, which will include a treatment plant, booster pump station and reservoir.

Based on the flow of 5.0 l/s per bore, 10 bores will be required for this option.

9.2.2. Network Reticulation Options

For this option, to limit the on-site treatment requirement, dual reticulation has been selected. Non-potable supply will be utilised for flushing toilets, irrigation and topping up rain-tank supply. Potable water will be utilised for the remaining requirements.

9.2.3. Bulk Servicing Requirements

9.2.3.1. Bore Supply

Each bore shall include for:

- Extraction pump
- Primary Treatment - Filtration unit
- Control & telemetry system

9.2.3.2. Potable Water Supply

The potable water supply infrastructure shall include for:

- Secondary Treatment
- Reservoir
- Booster Pump Station

9.2.3.3. Fire Supply

Fire supply can either be built into the potable supply network or as a separate system from the non-potable supply. It is likely that the Sleepyhead factory will utilise the non-potable supply as it will have its own booster pump station. Some industrial and commercial users may also have their own booster pump stations.

For this assessment it has been assumed that storage and capacity in the booster pumps has been built into the potable supply for the development.

9.2.4. Treatment Requirements

The treatment shall be split between non-potable and potable supply.

9.2.4.1. Non-Potable Treatment

The proposed treatment of the raw water from the bore supply before being discharged into the non-potable network is:

- Filtration to 100 micron from cartridge filters, to remove large particles

9.2.4.2. Potable Treatment

The proposed treatment of non-potable water from the non-potable network before being discharged into the potable network is:

- Dosing and aeration to remove iron/manganese
- Dosing and flocculation followed by sedimentation
- Filtration
- Polishing if required (membrane or ion exchange)
- Disinfection

9.2.5. Security of Supply

For ensure security of supply, it is proposed that redundancy is built into the bore supply. This will be achieved by utilising the peak daily flow as the design flow of the bores.

9.2.6. Preliminary Costings

It is anticipated that development will be levied against this infrastructure upgrade in the form of development growth charges. Commercial arrangements would need to be entered into between the network operator and the developer.

9.2.6.1. Capital Costs

Table 7: Option 1 Costing

Item	Cost
Delivery Infrastructure (extraction & pump station) 10x Bores	Medium
Reservoir & Booster Pump Station	Medium
Treatment (on-site or chlorination boost)	Medium
Bulk Reticulation (bulk supply mains)	Low
Network Reticulation (potable and/or non potable)	High
Development growth charges	Low
Total	**Medium**

9.2.6.2. Operational Costs

The operational costs of this system will be paid for by the lot owners to a privately operated body corporate set up by the developer and would be subject to any commercial agreements entered into.

9.2.7. Staging

The installation of the bores can be staged based on the build out of the development. It is proposed these are installed and utilised during preload operations to ensure settlement due to bore supply is completed prior to construction of subdivision infrastructure.

9.3. Option 2 – Supply from Local Water Bodies

9.3.1. Summary

The most likely option for this option is to draw water from the Waikato River as it has the most abundant supply. Raw water will be pumped and filtered at source to supply non-potable supply to the development. The supply line includes a crossing of State Highway 1 which could be achieved by directional drilling under the highway or including the pipeline in a pedestrian/cycle viaduct over the highway.

A connection from the non-potable supply will be made for the potable supply, which will include a treatment plant, booster pump station and reservoir. The treatment options described below apply to lake supply as well.

9.3.2. Reticulation Options

For this option, to limit the on-site treatment requirement, dual reticulation has been selected. Non-potable supply will be utilised for flushing toilets, irrigation and topping up rain-tank supply. Potable water will be utilised for the remaining requirements.

9.3.3. Bulk Servicing Requirements

9.3.3.1. River Supply

The river supply shall include for:

- Extraction pump station
- Primary Treatment - Filtration unit
- Control & telemetry system
- Fencing, driveway & security systems
- Rising Main, including air valves & scour valves

9.3.3.2. Potable Water Supply

The potable water supply infrastructure shall include for:

- Secondary Treatment
- Reservoir
- Booster Pump Station

9.3.3.3. Fire Supply

Fire supply can either be built into the potable supply network or as a separate system from the non-potable supply. It is likely that the Sleepyhead factory will utilise the non-potable supply as it will have its own booster pump station. Some industrial and commercial users may also have their own booster pump stations.

For this assessment it has been assumed that it is built into the non-potable supply for the development.

9.3.4. Treatment Requirements

The treatment shall be split between non-potable and potable supply.

9.3.4.1. Non-Potable Treatment

The proposed treatment of the raw water from the river supply before being discharged into the non-potable network is:

- Filtration to 100 micron from cartridge filters, to remove large particles

9.3.4.2. Potable Treatment

The proposed treatment of non-potable water from the non-potable network before being discharged into the potable network is:

- Dosing and flocculation followed by sedimentation
- Filtration
- Polishing if required (membrane or ion exchange)
- Disinfection

9.3.5. Security of Supply

For ensure security of supply, it is proposed that a second smaller pipeline is installed for minimum flow rates.

9.3.6. Preliminary Costings

It is anticipated that development will be levied against this infrastructure upgrade in the form of development growth charges. Commercial arrangements would need to be entered into between the network operator and the developer.

9.3.6.1. Capital Costs

Table 8: Option 2 Costing

Item	Cost
Delivery Infrastructure (extraction & pump station)	Medium
Treatment (on-site or chlorination boost)	Medium
Bulk Reticulation (bulk supply mains)	Low
Network Reticulation (potable and/or non potable)	High
Development charges	Low
Total	**Medium**

9.3.6.2. Operational Costs

The operational costs of this system will be paid for by the lot owners to a privately operated body corporate set up by the developer and would be subject to any commercial agreements entered into .

9.3.7. Staging

The treatment plant and booster pump station for potable water can likely be staged utilising a modular system if required

9.4. Option 3 – Rural Farm Supply

9.4.1. Summary

For this option, it is assumed that the water allocation holders with existing infrastructure (i.e. rural farm supply) will provide the development with a connection to site and a bulk water meter.

From that, raw water will be supplied into the non-potable supply to the development.

A connection from the non-potable supply will be made for the potable supply, which will include a treatment plant, booster pump station and reservoir.

9.4.2. Reticulation Options

For this option, to limit the on-site treatment requirement, dual reticulation has been selected. Non-potable supply will be utilised for flushing toilets, irrigation and topping up rain-tank supply. Potable water will be utilised for the remaining requirements.

9.4.3. Bulk Servicing Requirements

9.4.3.1. Non-Potable Supply

It is likely that the rural farm supplier will need to construct the following infrastructure as part of their scope:

- Rising Main / Bulk Water Supply line, inclusive of air valves, scour valves & isolation valves.
- Inline Booster Pump Station
- Bulk supply meter

9.4.3.2. Potable Water Supply

The potable water supply infrastructure shall include for:

- Secondary Treatment
- Reservoir
- Booster Pump Station

9.4.3.3. Fire Supply

Fire supply can either be built into the potable supply network or as a separate system from the non-potable supply. It is likely that the Sleepyhead factory will utilise the non-potable supply as it will have its own booster pump station. Some industrial and commercial users may also have their own booster pump stations.

For this assessment it has been assumed that it is built into the non-potable supply for the development.

9.4.4. Treatment Requirements

It has been assumed that the farm supplied non-potable water will not need any further treatment for use as non-potable demand. Treatment shall be required for the potable supply.

9.4.4.1. Potable Treatment

The proposed treatment of non-potable water from the non-potable network before being discharged into the potable network is:

- Dosing and flocculation followed by sedimentation
- Filtration

- Polishing if required (membrane or ion exchange)
- Disinfection

9.4.5. Security of Supply

For ensure security of supply, it has been assumed that the rural farm supply operator takes on the responsibility of supply and has systems in place if system failure occurs.

9.4.6. Preliminary Costings

The Agreement costing for this option has allowed for likely installation costs for the rural farm supplier to install infrastructure to the development as well as their sign-up fee. Commercial arrangements would need to be entered into between the network operator and the developer.

9.4.6.1. Capital Costs

Table 9: Option 3 Costing

Item	Cost
Delivery Infrastructure (extraction & pump station)	Medium
Treatment (on-site or chlorination boost)	Medium
Bulk Reticulation (bulk supply mains)	Medium
Network Reticulation (potable and/or non potable)	High
Infrastructure development charges	Low
Total	**Medium**

9.4.6.2. Operational Costs

Operational costs will be determined by the water authority operator under agreement with the developer's body corporate which will bill the residents in the form of usage or rates and would be subject to any commercial agreements entered into.

9.4.7. Staging

The treatment plant and booster pump station for potable water can likely be staged utilising a modular system if required

9.5. Option 4 – Te Kauwhata Town Supply

9.5.1. Summary

For this option, it is proposed that a 300mm diameter bulk line be installed from the existing WDC network as shown in Figure 7:

- The reservoir & bulk supply meter at the corner of Wayside Road, Rodda Road & Te Kauwhata Road
- Follow Te Kauwhata Road to Rangiriri Road
- Follow Rangiriri Road to Austen Street where an inline booster pump station is installed to booster flows at the half way point and potentially a chlorination boost plant
- Continue the bulk main down the paper road system from Austen Street to the KiwiRail corridor
- Cross the Te Onetea Stream utilising a directional drill methodology adjacent to the KiwiRail bridge
- Follow the paper road until it joins to the end of Lumsden Road

- Then continue down Lumsden Road until it reaches the proposed development

Depending on the flow and pressure at the development, another inline booster pump station or reservoir and booster pump station may be required.

9.5.2. Reticulation Options

As the treatment is being undertaken by WDC at Te Kauwhata, a single public vested reticulation network is proposed for this option. As the water would be potable, a single supply reticulation will be required for the development site.

9.5.3. Bulk Servicing Requirements

It is anticipated that the bulk infrastructure will be installed by the developer and vested to council. This is anticipated to include:

- 10 km of 300mm diameter watermain with air valves, scour valves and isolation valves.
- An inline booster pump station
- A chlorination booster unit
- A water reservoir & booster pump station

9.5.4. Treatment Requirements

It is anticipated that a single chlorination booster plant at either Rangiriri or Ohinewai will be required for treatment. This should be installed as part of the pump station construction.

9.5.5. Security of Supply

Utilising a reservoir and booster pump station at the development will assist in ensuring that fire demands can be met. A second pipeline is not proposed for this option.

9.5.6. Preliminary Costings

It is anticipated that development will be levied against this infrastructure upgrade in the form of development growth charges. Commercial arrangements would need to be entered into between the network operator and the developer.

9.5.6.1. Capital Costs

Table 10: Option 4 Costing

Item	Cost
Delivery Infrastructure (extraction & pump station)	Medium
Treatment (on-site or chlorination boost)	Low
Bulk Reticulation (bulk supply mains)	High
Network Reticulation (potable and/or non potable)	Medium
Development growth charges Residential Commercial/Industrial	 High High
Total	**High**

Local authority development charges have been estimated. Actual figures are to be confirmed by the local authority.

9.5.6.2. Operational Costs

Operational costs will be determined by the local authority operator and paid for by the residents in the form of usage billing or rates.

9.5.7. Staging

The reservoir and booster pump station for potable water can likely be staged utilising a modular system if required.

9.6. Option 5 – Huntly Town Supply

9.6.1. Summary

For this option, it is proposed that a 300mm diameter bulk line be installed from the existing WDC network as shown in Figure 8:

- The bulk meter connection at the corner of George Drive, Tainui Bridge Road & Tumate Mahuta Drive
- Follow Tumate Mahuta Drive, Venna Fry Lane and Main Street to State Highway 1
- Follow the western side of State Highway 1 to Ohinewai South Road
- An inline booster pump station and/or chlorination boost may be required at this location
- Follow Ohinewai South Road to Tahuna Road
- Cross State Highway 1 adjacent to Tahuna Road by directional drilling under the highway or including the pipeline in a pedestrian/cycle viaduct over the highway.
- Then continue down Tahuna Road until it reaches the proposed development

Depending on the flow and pressure at the development, an inline booster pump station located along the route and a reservoir and booster pump station at the development may be required.

9.6.2. Reticulation Options

As the treatment is being undertaken by WDC at Huntly, a single public vested reticulation network is proposed for this option. As the water would be potable, a single supply reticulation will be required for the development site.

9.6.3. Bulk Servicing Requirements

It is anticipated that the bulk infrastructure will be installed by the developer and vested to council. This is anticipated to include:

- 10 km of 300mm diameter watermain with air valves, scour valves and isolation valves.
- An inline booster pump station
- A chlorination booster unit
- A water reservoir & booster pump station

9.6.4. Treatment Requirements

It is anticipated that a single chlorination booster plant at either the Ohinewai South Road and State Highway 1 or Sleepyhead Estate development will be required for treatment. This should be installed as part of the pump station construction.

9.6.5. Security of Supply

Utilising a reservoir and booster pump station at the development will assist in ensuring that fire demands can be met. A second pipeline is not proposed for this option.

9.6.6. Preliminary Costings

It is anticipated that development will be levied against this infrastructure upgrade in the form of development growth charges. Commercial arrangements would need to be entered into between the network operator and the developer.

9.6.6.1. Capital Costs

Table 11: Option 5 Costing

Item	Cost
Delivery Infrastructure (extraction & pump station)	Medium
Treatment (on-site or chlorination boost)	Low
Bulk Reticulation (bulk supply mains)	Medium/High
Network Reticulation (potable and/or non potable)	Medium
Development growth charges Residential Commercial/Industrial	 High High
Total	**High**

Local authority development charges have been estimated. Actual figures are to be confirmed by the local authority.

9.6.6.2. Operational Costs

Operational costs will be determined by the local authority operator and paid for by the residents in the form of usage billing or rates and would be subject to any commercial agreements entered into.

9.6.7. Staging

The reservoir and booster pump station for potable water can likely be staged utilising a modular system if required.

9.7. Option 6 – Pipeline from Huntly to Te Kauwhata

9.7.1. Summary

This option utilises the same pipeline arrangements as provided in Sections 9.5.1 & 9.6.1, and draws water as required to service the development. It would be part of a supply scheme for the Waikato District that would provide redundancy by connecting the two major water treatment plants or draw from a new centralised treatment plant. The pipeline sizing and booster pump requirements would need to be defined as part of this network. See Appendix D for a potential pipe route.

9.7.2. Reticulation Options

As the treatment is being undertaken by WDC at Te Kauwhata & Huntly, or at a new centralised treatment plant that would serve both these towns, a single public vested reticulation network is proposed for this option.

9.7.3. Bulk Servicing Requirements

It is anticipated that the bulk infrastructure will be installed by the developer and vested to council. This is anticipated to include:

- 20 km of watermain with air valves, scour valves and isolation valves.
- A chlorination booster unit

- A water reservoir & booster pump station

9.7.4. Treatment Requirements

It is anticipated that a single chlorination booster plant at Sleepyhead Estate development will be required for treatment. This should be installed as part of the pump station construction.

9.7.5. Security of Supply

As the pipelines will connect the two existing public networks or a new public supply, security of supply is ensured.

Utilising a reservoir and booster pump station at the development will assist in ensuring that fire demands can be met.

9.7.6. Preliminary Costings

It is anticipated that development will be levied against this infrastructure upgrade in the form of development growth charges. Commercial arrangements would need to be entered into between the network operator and the developer.

9.7.6.1. Capital Costs

Table 12: Option 6 Costing

Item	Cost
Delivery Infrastructure (extraction & pump station)	Medium
Treatment (on-site or chlorination boost)	Low
Bulk Reticulation (bulk supply mains)	High
Network Reticulation (potable and/or non potable)	Medium
Development growth charges Residential Commercial/Industrial	 High High
Total	**High**

Local authority development charges have been estimated. Actual figures are to be confirmed by the local authority.

9.7.6.2. Operational Costs

Operational costs will be determined by the local authority operator and paid for by the residents in the form of usage billing or rates and would be subject to any commercial agreements entered into.

9.7.7. Staging

Potentially there is the ability to stage the pipeline construction so only one direction is required for the initial development and the other direction is completed later. There are also potential options for staging pipelines of different diameters. An agreement with council will need to be formed to outline who completes these different stages.

The reservoir and booster pump station for potable water can likely be staged utilising a modular system if required.

10. Interim Supply Options

As discussed in Section 4.5 and 5.9, the timing of the development (short to medium term) and local authority supply availability (medium to long term) leave a gap at the beginning of the development in supply availability from the local authority. Initial supply options to cover this gap have been established, that would draw from the following options:

Source:

- Bore supply (treated to be potable)
- Rainwater reuse (non potable use)
- Rural Farm Supply (treated to be potable)
- River or lake supply (treated to be potable)

Bulk Reticulation

- Booster pump station and reservoir to deliver to the site as required

Treatment

- Modular treatment plant matched to source water quality. See Section 7.7

Site Reticulation

- Local reservoir and booster pump station
- Dual reticulation if rainwater reuse is developed

The interim supply adopted will be a combination of the above components, appropriate for the selected option developed during preliminary design.

10.1. Interim Staging

In order to service the development ahead of a future long term solution, the following must occur:

- Stage 1 Factory Zone to utilise an existing low flow solution from existing bores, supplemented with rainwater.
- Subdivision Stage 1 requires an interim solution in order to be serviced for water supply, this includes:
    - Preliminary design of interim servicing solution. Sizing and scale depend on Stage 1 Subdivision catchment build up.
    - Water Take Consent
    - Water Take negotiation with current water allocation holders
    - Detailed design of interim servicing solution
    - Building consent for inter servicing solution
    - Construction and commissioning of interim servicing solution.
- Future subdivision stages require upgrades to the interim servicing solution if they are constructed ahead of the long term solution being available. This includes:
    - Preliminary design of interim servicing solution upgrade
    - Review and reconsenting of water take consent if subdivision stage exceeds consent allocation
    - Further negotiations with current water allocation holders if additional allocation is required
    - Detailed design of interim servicing solution upgrade

- Building consent for inter servicing solution upgrade
- Construction and commissioning of interim servicing solution upgrade.

- When the future long term solution is available, then additional works will be required to connect this supply to the development and decommission and remove defunct infrastructure.

10.2. Interim Supply Option A – Bore Supply

10.2.1. Summary

For this interim supply option, the water take from bores from the ground water catchment can supply the sites until a permanent solution is available.

10.2.2. Supply Point

The headworks for this option will include:

- Bore
- Pump
- Sand or cartridge filter (Primary Treatment)

10.2.3. Delivery Infrastructure

A network of non-potable water pipelines from the bores to a header tank reservoir at the treatment plant. Pipelines will be required within the development's roading network.

To ensure Security of Supply, additional bores and alternative pipelines should be provided within this network.

10.2.4. Treatment Requirements

The treatment requirements for this option is:

- Primary Treatment – Sand or cartridge filter at supply point
- Secondary Treatment – Stage 1 – Iron removal
- Secondary Treatment – Stage 2 – S&L or Mena containerised or modular plant
- Tertiary Treatment – Stage 1 – UV
- Tertiary Treatment – Stage 2 - Chlorination

10.2.5. Network Infrastructure

From the treatment plant, a reservoir and booster pump station will be required to provide suitable flows for fire fighting and peak hourly demand.

10.2.6. Network Reticulation

Network reticulation will be single potable water.

10.2.7. Staging

The infrastructure works can be staged based on development flows as demand increases in the following manner:

- Bores – number of bores to meet demand
- Header Tank – size of header tank or number of header tanks can be staged

- Treatment Plant – the modular or containerized treatment plant can be staged in 250m3 to 1000m3 intervals
- Network Infrastructure – the size and number of reservoirs and number of pumps can be staged

This can be staged up to the fully developed requirements.

10.2.8. Upgrade to Public Network

When an incoming water supply is available, the public connection can be made prior to the Chlorination treatment stage. Other infrastructure created can be removed or utilised for private means.

10.3. Interim Supply Option B – Lake Take

10.3.1. Summary

For this interim supply option, the water take from a local lake can supply the sites needs until a permanent solution is available

10.3.2. Supply Point

The headworks for this option will include:

- Mesh Filter
- Extraction Pumps
- Sand or cartridge filter (Primary Treatment)

10.3.3. Delivery Infrastructure

A non-potable water pipeline from the water source to a header tank reservoir at the treatment plant.

The pipeline will be required within the development's roading network.

To ensure Security of Supply, an additional pipeline should be provided.

10.3.4. Treatment Requirements

The treatment requirements for this option are:

- Primary Treatment – Sand or cartridge filter at supply point
- Secondary Treatment - S&L or Mena containerised or modular plant
- Tertiary Treatment – Stage 1 – UV
- Tertiary Treatment – Stage 2 – Chlorination

10.3.5. Network Infrastructure

From the treatment plant, a reservoir and booster pump station will be required to provide suitable flows for fire fighting and peak hourly demand.

10.3.6. Network Reticulation

Network reticulation will be single potable water.

10.3.7. Staging

The infrastructure works can be staged based on development flows as demand increases in the following manner:

- Headworks pumps – number of pumps or size of pumps can be increased to meet demand

- Header Tank – size of header tank or number of header tanks can be staged
- Treatment Plant – the modular or containerized treatment plant can be staged in 250m3 to 1000m3 intervals
- Network Infrastructure – the size and number of reservoirs and number of pumps can be staged

This can be staged up to the fully developed requirements.

10.3.8. Upgrade to Public Network

When an incoming water supply is available, the public connection can be made prior to the Chlorination treatment stage. Other infrastructure created can be removed or utilised for private means.

10.4. Interim Supply Option C – River Supply

10.4.1. Summary

For this interim supply option, the Waikato River take can supply the sites needs until a permanent solution is available

10.4.2. Supply Point

The headworks for this option will include:

- Mesh Filter
- Extraction Pumps
- Pipeline through stop banks
- Sand or cartridge filter (Primary Treatment)

10.4.3. Delivery Infrastructure

A non-potable water pipeline from the water source to a header tank reservoir at the treatment plant.

The pipeline will be required within the development's roading network.

To ensure Security of Supply, an additional pipeline should be provided.

10.4.4. Treatment Requirements

The treatment requirements for this option is:

- Primary Treatment – Sand or cartridge filter at supply point
- Secondary Treatment - S&L or Mena containerised or modular plant
- Tertiary Treatment – Stage 1 – UV
- Tertiary Treatment – Stage 2 – Chlorination

10.4.5. Network Infrastructure

From the treatment plant, a reservoir and booster pump station will be required to provide suitable flows for fire fighting and peak hourly demand.

10.4.6. Network Reticulation

Network reticulation will be single potable water.

10.4.7. Staging

The infrastructure works can be staged based on development flows as demand increases in the following manner:

- Headworks pumps – number of pumps or size of pumps can be increased to meet demand
- Header Tank – size of header tank or number of header tanks can be staged
- Treatment Plant – the modular or containerized treatment plant can be staged in 250m3 to 1000m3 intervals
- Network Infrastructure – the size and number of reservoirs and number of pumps can be staged

This can be staged up to the fully developed requirements.

10.4.8. Upgrade to Public Network

When an incoming water supply is available, the public connection can be made prior to the Chlorination treatment stage. Other infrastructure created can be removed or utilised for private means.

10.5. Interim Supply Option D – Raw Water Supply

10.5.1. Summary

For this interim supply option, the raw water supply from the water allocation holders who have existing water take infrastructure (i.e. farm suppliers) can supply the sites needs until a permanent solution is available.

10.5.2. Supply Point

The headworks for this option will be provided by others, this includes:

- Mesh Filter
- Extraction Pumps
- Pipeline through stop banks
- Sand or cartridge filter (Primary Treatment)

10.5.3. Delivery Infrastructure

A non-potable water pipeline from the water to site with a meter at the termination point will be provided by others. This may also include an inline booster pumps station.

A pipeline from the meter to a header tank reservoir at the treatment plant will be required. The pipeline will be required within the development's roading network. To ensure Security of Supply, an additional pipeline should be provided.

10.5.4. Treatment Requirements

The treatment requirements for this option is:

- Primary Treatment – Sand or cartridge filter at supply point (provided by others)
- Secondary Treatment - S&L or Mena containerised or modular plant
- Tertiary Treatment – Stage 1 – UV
- Tertiary Treatment – Stage 2 – Chlorination

10.5.5. Network Infrastructure

From the treatment plant, a reservoir and booster pump station will be required to provide suitable flows for fire fighting and peak hourly demand.

10.5.6. Network Reticulation

Network reticulation will be single potable water.

10.5.7. Staging

The infrastructure works can be staged based on development flows as demand increases in the following manner:

- Headworks – it is understood that suitable allocation is available for the fully developed flows.
- Header Tank – size of header tank or number of header tanks can be staged
- Treatment Plant – the modular or containerized treatment plant can be staged in 250m3 to 1000m3 intervals
- Network Infrastructure – the size and number of reservoirs and number of pumps can be staged

This can be staged up to the fully developed requirements.

10.5.8. Upgrade to Public Network

When an incoming water supply is available, the public connection can be made prior to the Chlorination treatment stage. Other infrastructure created can be removed or utilised for private means.

10.6. Interim Supply Option E – Rainwater Harvesting

10.6.1. Summary

For this interim supply option, the rain water from the factory can be utilised to supply the sites needs until a permanent solution is available. Due to the frequency of rainfall events and storage provided, this may limit what can be developed as an interim solution.

10.6.2. Supply Point

The headworks for this option includes:

- Mesh Filter at gutters/downpipes
- Gross pollutant trap (GPT) prior to entry to header tank

10.6.3. Delivery Infrastructure

It is anticipated that the header tank will be located adjacent to the factory site and be suitably sized for the anticipated storm event. No further infrastructure will be required as this will be gravity fed from the roof and downpipe system.

10.6.4. Treatment Requirements

The treatment requirements for this option is:

- Primary Treatment – Stage 1 – Mesh Filter / GPT
- Primary Treatment – Stage 2 – Sand or cartridge filter
- Secondary Treatment - S&L or Mena containerised or modular plant
- Tertiary Treatment – Stage 1 – UV

- Tertiary Treatment – Stage 2 – Chlorination

10.6.5. Network Infrastructure

From the treatment plant, a reservoir and booster pump station will be required to provide suitable flows for fire fighting and peak hourly demand.

10.6.6. Network Reticulation

Network reticulation will be single potable water.

10.6.7. Staging

The infrastructure works can be staged based on development flows as demand increases in the following manner:

- Headworks – The factory will be 100,000 m2 when fully developed, based on storm events and frequency of supply this will limit the volume of water required.
- Header Tank – size of header tank or number of header tanks can be staged
- Treatment Plant – the modular or containerized treatment plant can be staged in 250m3 to 1000m3 intervals
- Network Infrastructure – the size and number of reservoirs and number of pumps can be staged

It is likely that this interim solution may only be able to provide for a small quantity of units as there is a risk that the frequency of rainfall events will not be sufficient to maintain the supply.

10.6.8. Upgrade to Public Network

When an incoming water supply is available, the public connection can be made prior to the Chlorination treatment stage. Other infrastructure created can be removed or utilised for private means.

10.7. Interim Supply Option F – 150mm Pipeline from South West

10.7.1. Summary

For this interim supply option, an extension to an existing 150mm watermain could be constructed from the western bank of the Waikato River to the south west of the site. This can only provide low flows and may limit what can be developed as an interim solution.

10.7.2. Supply Point

The headworks for this option will be provided by others.

10.7.3. Delivery Infrastructure

A potable water pipeline from the end of the existing water pipeline should be extended to site. This will include:

- A drilled section under the Waikato River
- Air valves at high points
- Scour valves at low points
- Isolation valves

For security of supply, a second pipeline could be constructed in parallel.

10.7.4. Treatment Requirements

The treatment requirements for this option is:

- Tertiary Treatment– Chlorination Booster

10.7.5. Network Infrastructure

From the treatment plant, a reservoir and booster pump station will be required to provide suitable flows for fire fighting and peak hourly demand.

The intake at the reservoir may have a flow restriction valve so that other users of the pipeline are not adversely affected.

10.7.6. Network Reticulation

Network reticulation will be single potable water.

10.7.7. Staging

It is likely that this will be undertaken as a single stage. The network infrastructure should be constructed so that is it is upgradable to the fully developed flows when a pipeline is available.

10.7.8. Upgrade to Public Network

When an incoming water supply is available, the public connection can be made prior to the Chlorination treatment stage. Other infrastructure created can be removed or utilised for private means.

10.8. Other Interim Supply Options

There is the ability to utilise a combination of the abovementioned supply options to provide for the development. These will be considered in further detail when an interim supply option is required to be designed.

11. Options Assessment

11.1. Long Term Options Assessed

The six long term options considered as part of this assessment are:

- Option 1 – On-Site Bore Supply
- Option 2 – Supply from Local Water Bodies
- Option 3 – Rural Farm Supply
- Option 4 – Te Kauwhata Town Supply
- Option 5 – Huntly Town Supply
- Option 6 – Centralised supply servicing from Huntly to Te Kauwhata

11.2. Cost Comparison

Table 13: Cost Comparison Summary

Option	Description	Cost
1	On-Site Bore Supply, Extraction pumps & filtration, potable water treatment, reservoir & booster pump station.	Medium
2	Supply from Local Water Bodies, Extraction pumps & filtration, potable water treatment, reservoir & booster pump station.	Medium
3	Rural Farm Supply, inline delivery pumps, bulk main, potable water treatment, reservoir & booster pump station	Medium
4	Te Kauwhata Town Supply, inline delivery pumps, bulk main, chlorination booster treatment, reservoir & booster pump station	High
5	Huntly Town Supply, inline delivery pumps, bulk main, chlorination booster treatment, reservoir & booster pump station	High
6	Centralised supply, pipeline from Huntly to Te Kauwhata, inline delivery pumps, bulk main, chlorination booster treatment, reservoir & booster pump station	High

11.3. Options Summary

Table 14: Options Summary Matrix

Option	Complexity	Safety Risk	Consenting Risk	Environment Risk	Capital Cost	Operation Cost
1 Bores	High	Medium	High	Medium	Med	Medium
2 Local water	High	Medium	High	Medium	Med	Medium
3 Rural farm	High	High	High	Medium	Med	Low
4 Te Kauwhata	Medium	High	Medium	Medium	High	Medium
5 Huntly	Medium	High	Medium	Medium	High	Medium
6 Centralised	Medium	High	Medium	Medium	High	Medium

The 6 Options have been assessed utilising the following criteria:

11.3.1. Complexity

This outlines the engineering complexity to design and construct the assets.

- For Options 1-3, the complexity for the developer is high for the construction of treatment facilities.
- For Options 3-6, the complexity is medium for the construction of bulk mains within public space.

11.3.2. Safety Risk

Safety risk is considered for construction and operation activities.

- For Options 3-6, the safety risk is high for the construction of bulk mains within public space.
- For all options, there is a medium safety risk associated with water treatment and fire supply.

11.3.3. Consenting Risk

Consenting risk has been assessed for resource consent for undertaking the works, approvals required by others, and water take consent requirements.

- All options will require resource consent for elements of the works.
- Options 1-2 requires a water take consent which provides a high rating.
- Options 1-3 require on site treatment for potable water which has been given a high risk rating.
- Options 3-6 will require corridor access approvals for working in public roads (local authority and NZTA) and KiwiRail corridors

11.3.4. Environment Risk

Environmental risk has been assessed for impact during construction, water take requirements and for treatment

- All options have a medium risk as all require water take from the region.

11.3.5. Capital Cost

Capital cost has been assessed in 5 areas:

- Network Reticulation Costs
- Delivery Infrastructure Costs – ie pump stations, extraction plant
- Bulk Reticulation Costs – ie bulk water mains
- Treatment Costs – ie treatment plants
- Infrastructure Growth Charges

11.3.6. Operational Costs

Operational costs have been assessed based on public or body corporate operational requirements.

- Options 1-3 will require a body corporate to operate infrastructure which will require a medium level of risk
- Option 3 is low as it is assumed that the rural farm supply will be managed by others.
- Options 4-6 will require local council to upgrade and operate plant as required and therefore has been given a medium risk rating.

11.4. Interim Options Assessed

The six interim options considered as part of this assessment are:

- Interim Option A – Bore Supply
- Interim Option B – Lake Take
- Interim Option C – River Take
- Interim Option D – Raw Water Supply
- Interim Option E – Rainwater Harvesting
- Interim Option F – 150mm Pipeline from South West

All of these interim solutions are viable options, and will depend on the required lifespan of the of the interim plant and other considerations:

- Interim Option E is limited as it requires regular rainfall to supply the site. It is likely to be used in combination with another option
- Interim Option F is limited by the free available supply in the pipeline. There is also construction and maintenance risk for a pipeline under the river.
- Interim Options A to C are limited by their water take consents. Obtaining part of an existing water take consent from a current consent holder would alleviate this limitation.
- Interim Option D requires further discussions with water allocation holders and may have risk around their water take consent renewal.

12. Summary, Conclusions & Recommendations

12.1. Summary

Ambury Property Ltd (APL) is submitting as part of the Structure Plan provisions for the Sleepyhead Estate Precinct. Wood and Partners Consultants Ltd (Woods) have been engaged by APL to prepare an infrastructure assessment report for water supply in support of the Structure Plan submission.

Six main servicing supply options have been investigated as well as interim solutions for the initial stages of this development ahead of a bulk supply being available. They are:

- Option 1 – On-site bore supply with dual reticulation, part of the supply treated to potable standard and the remainder (non potable) used for toilet flushing and irrigation. Rainwater reuse to supplement non potable supply.
- Option 2 – Supply from local water bodies with dual reticulation, part of the supply treated to potable standard and the remainder (non potable) used for toilet flushing and irrigation. Rainwater reuse to supplement non potable supply
- Option 3 – Rural farm supply with dual reticulation, part of the supply treated to potable standard and the remainder (non potable) used for toilet flushing and irrigation. Rainwater reuse to supplement non potable supply.
- Option 4 – Te Kauwhata town supply delivered to an onsite reservoir via a 10km pumped rising main, with chlorine boosting. Boost pumping from the onsite reservoir through a single reticulation network throughout the development. Rainwater reuse to provide for non potable uses.
- Option 5 – Huntly town supply delivered to an onsite reservoir via a 10km pumped rising main, with chlorine boosting. Boost pumping from the onsite reservoir through a single reticulation network throughout the development. Rainwater reuse to provide for non potable uses.
- Option 6 – A Waikato District supply from existing or a new centralised treatment plant, delivering into a new pipeline to service the region. The supply would be delivered to an onsite reservoir with chlorine boosting. Boost pumping from the onsite reservoir through a single reticulation network throughout the development. Rainwater reuse to provide for non potable uses

Six Interim options have also been considered including:

- Interim Option A – Bore Supply
- Interim Option B – Lake Take
- Interim Option C – River Take
- Interim Option D – Raw Water Supply
- Interim Option E – Rainwater Harvesting
- Interim Option F – 150mm Pipeline from South West

The main risks identified are:

- The availability of ground/surface water allocation
- Obtaining consenting approval
    - Cultural / Iwi support
    - Environmental approval
- Water Quality / Treatment

12.2. Conclusions

This assessment and report confirm that the level of development proposed in the Sleepyhead Estate can be serviced for water supply.

The selection of a preferred supply option requires further consultation with stakeholders to determine a short list of preferred options, preliminary design of the options and then selection of the best practicable option.

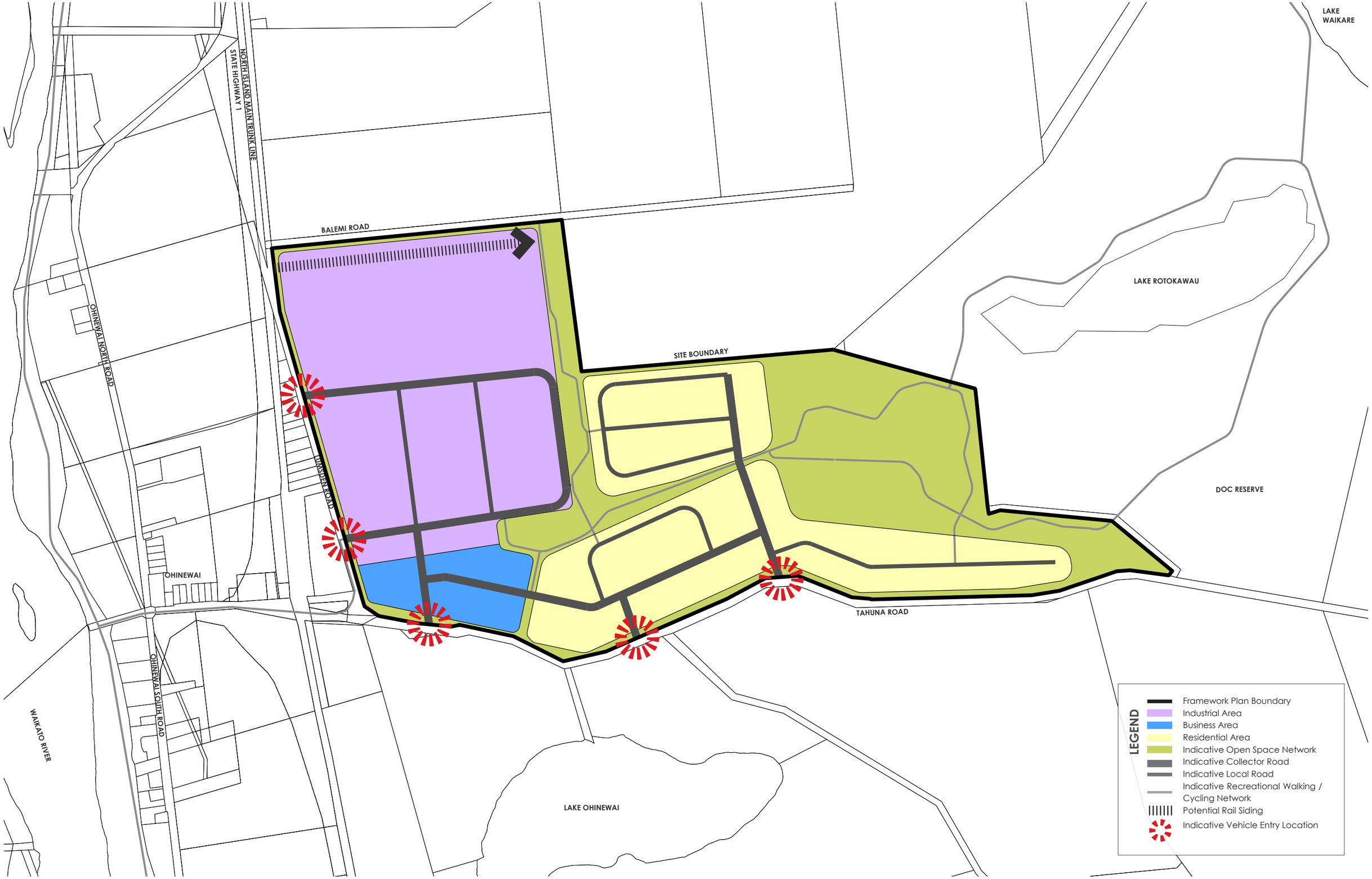
12.3. Recommendations

Six options for the interim supply and six options for the final supply for the Sleepyhead Estate development have been established. These options demonstrate the viability for water supply servicing for the site. On this basis, it is recommended that:

1. The re-zoning submission to the Proposed Waikato District Plan is granted
2. The options are developed through preliminary design to identify a preferred option for implementation.

13. Appendix A – Development Plans

File Ref: 1805_012_Framework_Plan.indd



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0 300m

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SLEEPYHEAD ESTATE

Framework Plan

Date: 10 July 2019 | Revision C

Drawing Number: 1805_012

Plan prepared by Adapt Studio Ltd

Sleepyhead

ADAPT STUDIO

gaze commercial Smart Property Solutions

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1:7,500 @ A3

OHINEWAI STRUCTURE PLAN

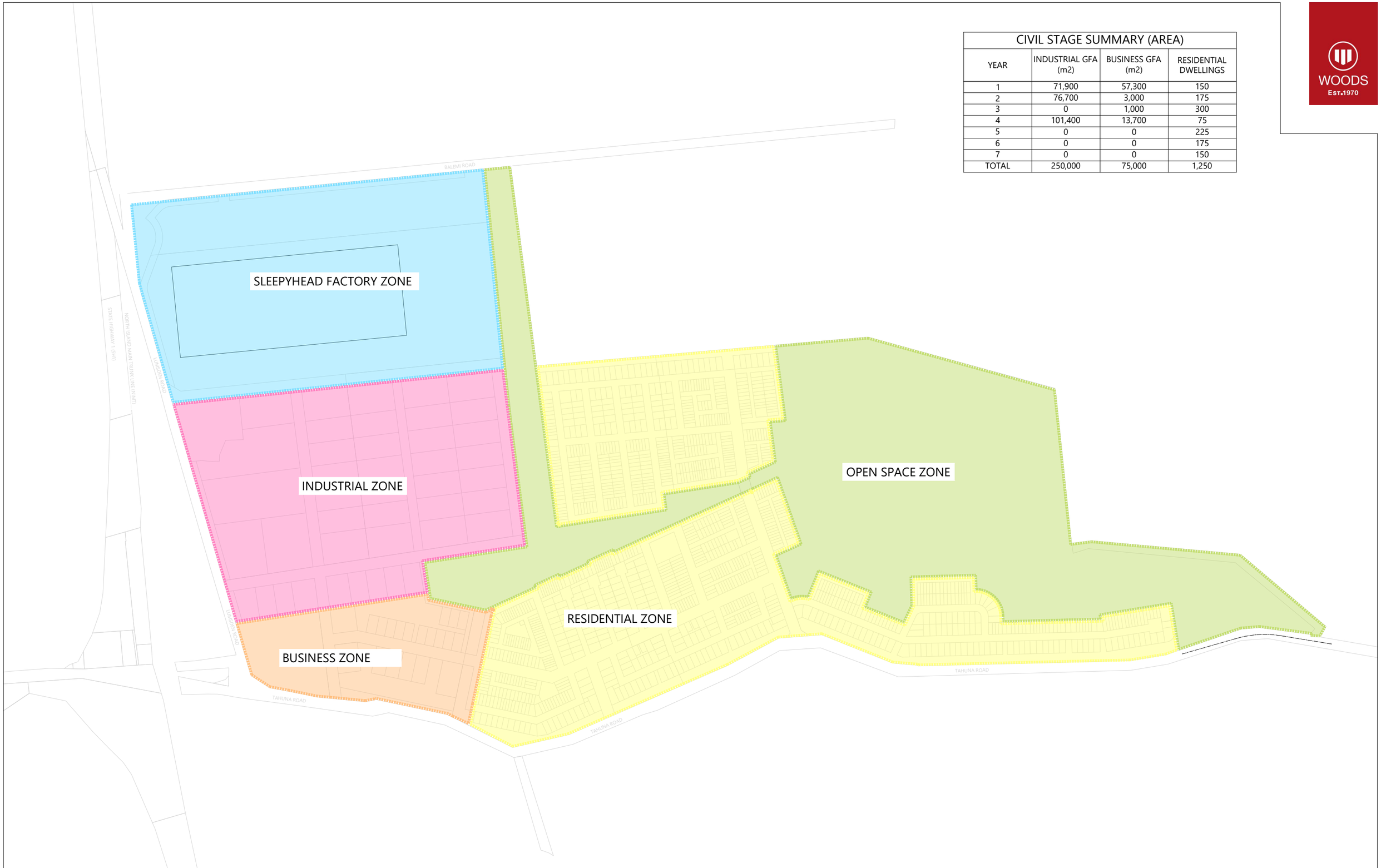
Illustrative Masterplan

Date: 22 November 2019 | Revision K

Drawing Number: 1805_018

Plan prepared by Adapt Studio Ltd for Gaze Property Solutions

CIVIL STAGE SUMMARY (AREA)			
YEAR	INDUSTRIAL GFA (m2)	BUSINESS GFA (m2)	RESIDENTIAL DWELLINGS
1	71,900	57,300	150
2	76,700	3,000	175
3	0	1,000	300
4	101,400	13,700	75
5	0	0	225
6	0	0	175
7	0	0	150
TOTAL	250,000	75,000	1,250



REVISION DETAILS		INT	DATE	SURVEYED	RH
1	ISSUED FOR DISCUSSION	BP	8/07/2019	DESIGNED	-
2	PRECINCTS REVISED	BP	17/10/2019	DRAWN	BP
3	PRECINCTS REWORDED TO ZONES	BP	21/11/2019	CHECKED	BP
4	UPDATED FOR BUSINESS ZONE & STAGING	BP	26/11/2019	APPROVED	

231 TAHUNA ROAD
& 88 LUMSDEN ROAD
OHINEWAI
WAIKATO
WOODS.CO.NZ

the comfort group

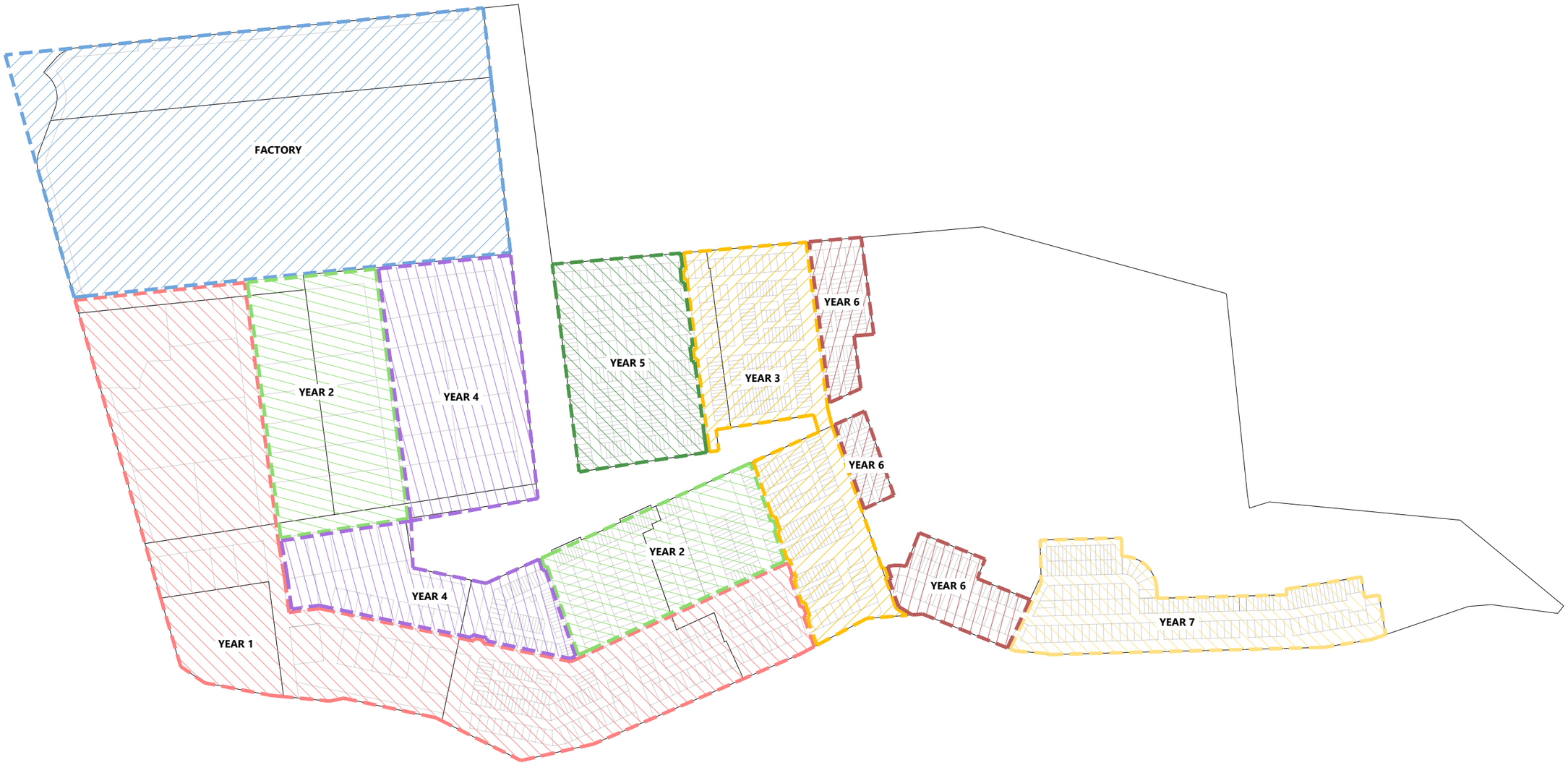
SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

OHINEWAI SERVICING ZONES PLAN

N

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:7500 @ A3, 1:3750 @ A1	4
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	P19-137-00-1005-SK	

WATER & WASTEWATER STAGING			
YEAR	DEVELOPMENT STAGE	PEAK DAILY WATER DEMAND (m^3/d)	PEAK DAILY WASTEWATER FLOWS (m^3/d)
1	RESIDENTIAL, BUSINESS & INDUSTRIAL	1,001	965
2	RESIDENTIAL, BUSINESS & INDUSTRIAL	2,008	1,930
3	RESIDENTIAL & BUISNESS	2,406	2,256
4	RESIDENTIAL, BUSINESS & INDUSTRIAL	3,512	3,344
5	RESIDENTIAL	3,809	3,587
6	RESIDENTIAL	4,092	3,828
7	RESIDENTIAL	4,290	3,990
TOTAL		4,300	4,000



REVISION DETAILS		INT	DATE	SURVEYED	
1	ISSUED FOR INFORMATION	BP	26/11/2019	DESIGNED	
				DRAWN	BP
				CHECKED	BP
				APPROVED	

231 TAHUNA ROAD
& 88 LUMSDEN ROAD
OHINEWAI
WAIKATO

WOODS.CO.NZ

the comfort group

SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

CIVIL WORKS STAGING

N

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:7500 @ A3	1
COUNCIL	WAIKATO DISTRICT COUNCIL	
DWG NO	P19-140-00-1020-SK	

14. Appendix B – Development Demand Calculations

Ohinewai Development - Flows Staging

Water Supply

Sheet #: **1 of 1**
Project #: **P19-140**
By: **MB**
Date: **26-11-19**

Staging		Residential						Business - Assuming Dry Retail					Industrial - Assuming Light Industry					Factory - Assuming Light Industry					Total Flows			
Stage	Date	DUE per Stage	Population	Cumulative Popn	Cumulative ADD l/s	Cumulative PDD l/s	Cumulative PHD l/s	Area (m2)	Cumulative Area m²	Cumulative ADD l/s	Cumulative PDD l/s	Cumulative PHD l/s	Area (m2)	Cum. Area	Cumulative ADD l/s	Cumulative PDD l/s	Cumulative PHD l/s	Stage	Staff	Cumulative ADD l/s	Cumulative PDD l/s	Cumulative PHD l/s	Cumulative ADD l/s	Cumulative PDD m³/day	Cumulative PDD l/s	Cumulative PHD l/s
	2020			0							0	0											0	0	0	0
	2021			0					0	0.00	0.0	0.0		0				1	50	0.04	0.1	0.2	0.04	7	0.1	0
1	2022	150	450	450	1.1	2.3	5.7	57300	57300	0.86	1.7	4.3	71900	71900	3.7	7.5	18.7		50	0.04	0.1	0.2	6	1001	12	29
2	2023	175	525	975	2.5	5.0	12.4	3000	60300	0.91	1.8	4.5	76700	148600	7.7	15.5	38.7	2	650	0.5	1.0	2.4	12	2008	23	58
3	2024	300	900	1875	4.8	9.5	23.9	1000	61300	0.92	1.8	4.6		148600	7.7	15.5	38.7		650	0.5	1.0	2.4	14	2406	28	70
4	2025	75	225	2100	5.3	10.7	26.7	13700	75000	1.13	2.3	5.6	101400	250000	13.0	26.0	65.1	3	1100	0.8	1.7	4.1	20	3512	41	102
5	2026	225	675	2775	7.1	14.1	35.3		75000	1.13	2.3	5.6		250000	13.0	26.0	65.1		1100	0.8	1.7	4.1	22	3809	44	110
6	2027	175	525	3300	8.4	16.8	42.0		75000	1.13	2.3	5.6		250000	13.0	26.0	65.1	4	1500	1.1	2.3	5.6	24	4092	47	118
7	2028	150	450	3750	9.5	19.1	47.7		75000	1.13	2.3	5.6		250000	13.0	26.0	65.1		1500	1.1	2.3	5.6	25	4290	50	124

Notes

1. Factors from Watercare (Auckland) COP for Land Development and Subdivision - July 2018 Chapter 6

2. Residential Occupancy Factors

Bedrooms	Occupancy
1	2
2-4	3
>5	TBC
Unknown	3

2. Residential Flows 220 l/person/ ADD d

3. Residential Peaking Factors

ADD	220	l/p/d. Average Day Demand	
PDD/ADD ratio	2	Peak day demand	
PHD/PDD ratio	2.5	Peak hour demand	

4. Commerical Factors

Type	L/GFA/day	Peak Day	Peak Hour	
Dry retail (no toliet)	1.30	2	2.5	1 person per 50m2 net floor area at 65 L/p/D
Dry retail + toliet	4.33	2	2.5	1 person per 15m2 net floor area at 65 L/p/D
Office Building	4.33	2	2.5	1 person per 15m2 net floor area at 65 L/p/D
Wet retail, food retail	15	2	2.5	15 L/GFA/day of floor area (including dining area)

5. Industrial Factors

Type	L/GFA/day	Peak Day	Peak Hour
Light	4.50	2	2.5
Medium	6.00	2	2.5
Heavy	11.00	2	2.5

6. Sleephead Factory

Type	L/Person/D	Peak Day	Peak Hour
Office	65.00	2	2.5
Factory	65.00	2	2.5
Visitor Centre	65.00	2	2.5

7. Treatment volumes based on peak day demand

Sub-precinct	Number of DUEs	Gross Floor Area (m^2)	Average Day Demand (m^3/d)	Peak Day Demand (l/s)
A – Factory		100,000	97.5	2.3
B – Industrial		250,000	1125	26.0
C – Commercial		71,000	97.5	2.3
D – Residential	1250	4,000	825	19.1
E – Open Space			4	<0.1
Total	**1250**	**425,000**	**2,149**	**49.7**

15. Appendix C – Key Stakeholder Correspondence

15.1. WSL Meeting Minutes

Location	WDC, 15 Galileo Street, Ngaruawahia			
Time & Date	10am	21/10/2019	**Taken by**	Marcel Bear
Attendees	**Initials**	**Name**		**Company**
	SD	Sharon Danks		Watercare Services Ltd
	RP	Richard Pullar		Waikato District Council
	DG	David Gaze		Gaze Properties Ltd
	JO	John Olliver		BBO
	SP	Stuart Penfold		BBO
	BP	Ben Pain		Woods
	MB	Marcel Bear		Woods
Apologies	**Initials**	**Name**		**Company**

1. Introduction

All parties introduced their roles

1) Sharon Danks – Lead for WSL in the Waikato
2) Richard Pullar – WDC representative for Wastewater and overview of Water too
3) David Gaze – Representing the developer Ambury Properties Ltd (APL). Gaze Properties Ltd acting as project managers.
4) John Olliver & Stuart Penfold – planners working for APL for structure plan submissions
5) Ben Pain & Marcel Bear – engineers working for APL for structure plan expert reports

2. Watercare's Role in the Waikato

SD confirmed that from 1st October 2019, WSL began operating Waikato district's water, wastewater and storm water services. Waikato District Council will continue to own all the assets, while WSL will manage the water, wastewater and storm water infrastructure above and below ground.

WSL will move into an office in Te Rapa next week.

3. Existing Infrastructure

3.1. Water Supply

3.1.1. Te Kauwhata WTP

- Growth within Te Kauwhata has absorbed any spare capacity the plant has
- Te Kauwhata WTP being upgraded to 4.5 MLD as an interim upgrade to supply immediate demands for the Lakes Development
- Issues with Te Kauwhata WTP with the plant's design and ownership of the headworks

3.1.2. Huntly WTP

- New pipeline south to connect Hopuhopu, Ngaruawahia, Horotiu and Huntly limits existing capacity
- No spare capacity currently to supply other developments without upgrades

3.2. Wastewater

3.2.1. Te Kauwhata WWTP

- The site is current under an abatement notice, however this was not expanded on what this entailed.
- Consists of an Oxidation Pond arrangement
- A short term solution is being implemented to accommodate the Lakes Development
- A long term plant is likely not to be viable in its present site/configuration due to discharge location and available land area
- Up coming discharge consent renewal will not allow for continued discharge into Lake Waikare

3.2.2. Huntly WWTP

- Huntly WWTP near capacity and low growth within Huntly catchment
- Consists of a Oxidation Pond arrangement
- The site is current under an abatement notice, however this was not expanded on what this entailed.
- Need to implement region wide upgrade strategy to determine whether this plant plays a part
- Up coming discharge consent renewal.

4. Regional Strategy

SD outlined that a regional water supply and wastewater treatment and disposal strategy needs to be developed by WSL in conjunction with WDC and WRC, to service from Meremere to Huntly, and all areas between.

SD noted that there were many possibilities for centralised plants either upgrading existing plants or creating new plants. Some options for locations included:

- Ohinewai
- Hampton Downs
- Springfield Prison
- Huntly

A strategy study is being procured late 2019, to be completed in 2020.

5. Programme

SD indicated that the forward programme for WSL is:

- WSL are in the process of preparing a wastewater/water supply servicing strategy by May 2020 outlining water and wastewater servicing strategies for the region from Meremere to Huntly, including any planned upgrades of existing plants or new proposed infrastructure.

- The intention is that the strategy will feed into the next WDC long term plan process commencing the second half of 2020.
- Implementation of that plan will occur over the next 5-10 years.

6. Implications to Sleepyhead Estate Development

SD/RP indicated that due to the abovementioned programme of works, the development would need to provide interim solutions in order to develop ahead of the planned long term plan.

WDC/WSL would support interim on-site solutions for the development with connections to the network when it came available.

15.2. WRC Meeting Minutes

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SLEEPYHEAD VILLAGE, OHINEWAI

Waikato Regional Council

3 Waters consenting considerations meeting – Notes

PREPARED BY:	Stuart Penfold			
PLACE OF MEETING:	WRC Hamilton	**DATE OF MEETING:**	12 November 2019 230pm – 415pm	
ATTENDEES:	David Gaze	Gaze Commercial (for APL)	Donna Jones	WRC TL Water allocation
	John Olliver	BBO	Brian Richmond	WRC - SW specialist
	Stuart Penfold	BBO	Stuart Beard	WRC – WW specialist
	Ben Pain	Woods	Hugh Keane	WRC TL Industry & Infrastructure
	Brent Sinclair	WRC – Manager Industry & Infrastructure	Cameron King	WRC Water allocation specialist

1. Introductions – around the table
   - **BS** introduced his role and the team leader roles. He is consents manager so has an overall responsibility for consenting and acts as conduit to governance. Important for a project of this size for him to get across the issues and be across the customer requirements.
   - Discussed the need for a WRC project representative to be across the multifaceted project as a single point of contact – consenting and policy. **BS** to advise post meeting if this can be arranged.
   - **BS/ JO** discussed representative from APL on planning and consenting is **JO** at BBO.
   - **DG** is Applicant's representative for overall project management/ governance.
   - Joint Management Agreements may mean in future that iwi are invited to pre-application meetings where Vision and Strategy matters are key.

2. **DG/SP/JO** outlined the development and submission process
   - Consultant reports and AEE due 29th November 2019. Hearing mid 2020.
   - The ability for the development to be serviced is critical and with the potential for options for wastewater, stormwater and water supply dependent on consenting, it is important for the development project team to get feedback on potential options from the WRC regulatory team.
   - While this meeting is primarily concept level, the development project team will seek pre-application meetings for specific applications.

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- Depending on scale of activities, consent applications may be led by different staff.
- **BS** mentioned that WRC policy is involved in Plan Change hearing as submitter. WRC representative to be confirmed.

3. **CK** ran through water allocation matters quickly (in absence of **DG** and **BP**) and reference correspondence to Marcel Bear.
   - No water allocation available, queue for applications
   - Groundwater and surface water viewed the same
   - Can arrange for water allocation transfers between parties who hold valid allocation ('credits') and those who do not.
   - TK Water Association, Wairakei Pastoral have credits.
   - Council can facilitate planning process (via s127) – allocation transfer to be arranged by parties themselves
   - Wairakei Pastoral have a user group that facilitates the relatively straight forward transfers
   - Point was made that restrictions on water takes from the River are only from October to April (May to September not a problem).

4. Discussion around consenting update for Stage 1 earthworks and Factory
   - Stage 1 earthworks lodged, with amended plans shortly being lodged.
   - Stage 1 Factory pre-app suggested in a few months.
   - Haul Road discussed
   - Stage 1 Factory SW would be provided for with temporary stormwater pond

5. Discussion around options for Wastewater
   - High quality effluent discharge to Lake possible, however non-complying activity and cultural effects hurdles
   - Disposal to Waikato River is Discretionary
   - Disposal to land as seen as the ideal, however this is land hungry and not likely to be BPO due to cost/ inability to find land area outside flood zone and with suitable infiltration rates
   - Consent term length dependent on quality of discharge. High quality effluent may achieve 35 year consent.
   - Disposal to demonstrate that discharge is better than existing discharges and the receiving environment for both SW and WW.

6. Stormwater discussion for re-zoning
   - Management options report being developed
   - Options available
   - Drainage scheme acknowledged
   - Disposal to Lakes may need input from DoC, Fish and Game
   - BR noted need to offset any lost flood storage capacity - Flood modeling results will determine whether any mitigation is required
   - SP mentioned iwi's stance on flooding as being a positive

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- Detention requirements to be confirmed – given position in lower catchment, option may be to not detain and release asap to avoid peak flows from upstream catchment (pass flows forward)
- Draft flood modelling and stormwater management reports anticipated end of this week

7. Other matters

- Residual risk was mentioned – meeting have been undertaken with Rick Leifting and others on this. Flooding reporting/ modelling underway and will be included in plan change submission documentation.

15.3. Iwi Hui Minutes

AMBURY PROPERTIES LTD

OHINEWAI DEVELOPMENT

TANGATA WHENUA GOVERNANCE GROUP

MEETING # 4 MINUTES

Meeting	Ohinewai TWGG				
Objectives	Ambury Properties Ohinewai development				
Location	Waahi Whaanui Trust offices, Parry Street, Huntly West				
Date	22 October 2019	Start Time	10.00am	Finish Time	12.00pm
Attendees	Tawera Nikau (Matahuru Marae), Hori Awa (Waahi Whaanui), James Whetu (Whetu Consultancy Group), Aotea Maipi, Robert Tukiri (Waikare Marae) David Gaze (Ambury Properties), Stuart Penfold (BBO), Sam Foster (BBO) Pranil Wadan (Woods), Ben Pain (Woods)				
Apologies	Glenn Tupuhi (Nga Muka), Huki Nepia (Te Riu o Waikato), Taroi Rawiri (Waikato Tainui), Chris Dawson (BBO), John Olliver (BBO), Craig Turner (The Comfort Group)				
Distribution	All members				

Agenda Item	Discussion / Key Points	Action By	Action Date
AP1	Prepare timeline and flow chart / graph of priorities	DG	13 Nov
AP2	TWWG to hui with mana whenua to discuss restoration goals including appropriate planting and to introduce the recognition of historical use of the area.	TWWG	13 Nov?
AP3	Letter of continuation of Stage 1 earthworks process: TWWG are meeting Fri to finalise and provide the following week.	TWWG	30 Oct
AP4	BBO to provide reports relating to Stage 1 earthworks and Factory consents in Dropbox folders.	BBO	Ongoing
AP5	TWWG mandate letter and MOU to be finalized and sent to applicant. To be finalized 25th of Oct and a date organized for signing.	TWWG	1 Nov

Agenda Item	Discussion / Key Points	Action By	Action Date
AP6	CIA or CVA will be required for whole of project. Will not be required for earthworks consent		
AP7	David Gaze to invite Craig and Graham Turner to meeting for signing in co-ordination with TWWG.	DG	1 Nov
AP8	Project team to provide programme chart of project to TWWG	DG	1 Nov
AP9	BBO to provide update on potential alternative Haul Road once known.	SP	1 Nov
AP10	Project team to provide summary of Impact v Status Quo of development, including improvements	BBO	15 Nov
AP11	TWWG to discuss position on provision for stormwater, water supply and wastewater (3 Waters) and provide feedback at next hui	TWWG	20 Nov
AP12	Project team to consult with WRC Freshwater Management Unit	PW	1 Nov

1. Karakia/Mihimihi – Hori Awa

2. Opening
   - MOU is still being worked through by the TWWG
   - TWWG would appreciate a timeline of all stages of the project to understand what is involved across the lifetime of the project.

3. Priority
   a) Stage 1 Earthworks Consent.
   b) MOU for wider project.
   c) Foam Factory Consent – Likely to be lodged in the next 3 – 4 months. Technical Reports will be provided to TWWG.
   d) Re-zoning/ submission to the Waikato District Council Proposed Plan

4. Woods Three Waters presentation
   A. Flooding Assessment
   - See Presentation attached.
   - Questions related to:
     - Can the team provide a stocktake regarding the current situation of the site i.e. flora/fauna/N and P and an idea of where we are going? (AP1)

- TN raised the idea of having tuna (eel) farms within the wetlands. DG to investigate (AP2)
- More detail is requested regarding the displacement of stormwater and flooding. Summary document to be provided to TWGG for discussion with Marae and whanau (AP10).
- MH requested more detail regarding the BPO (Best Practicable Option) (AP10).
- JW outlined the importance that the Waikato River Vision and Strategy is addressed, reminder of focus on "betterment" (AP10).
- AM discussed concerns regarding scouring and erosion (AP10)
- Opportunities for whanau to input into design for Vision and Strategy (AP11)
- MH outlined the importance of Woods project team and T&T as peer reviewers are talking to the right people in WRC i.e Freshwater Management Units (AP12)
- Request to integrate stormwater flooding reports with ecology.

B. Water Supply

- See Presentation attached.
- TWWG to discuss bore supply option and provide feedback (AP11).
- Woods to provide more detail on water supply capacity.

C. Wastewater

- See presentation attached.
- Woods to supply draft reports to TWGG (AP11).

5. Review of last meeting notes and action points
   - Action point update in table included in minutes.

6. Earthworks Resource Consent application

   - Still working on further information response to WDC/WRC.
   - Potential haul road option with farm to address Lumdsen Road community concerns regarding truck movements.
   - Spoil is more than likely coming from Gleeson's Quarry approx. 200,000m^3 for Stage 1 over 4.5 months.
   - SP to keep group updated as this option is developed (AP9).
   - TWWG to provide letter supporting the continuation of process (AP3).

7. Stage 1 Foam Factory consent application update
   - Design is still developing.
   - Reports will be provided as completed (AP4).

8. Lumsden Road Community
   - Still in discussions with neighbours.
9. Information Day – 31 October 2019
   - To be held at Ohinewai Community Hall.

- Provide information of plan change to community.
- TN and HA to attend.
- Possible Marae open day later in the process for iwi.

10. Timeline
    - TWWG requested timeline of all developments (AP8).

11. Any other Business
    - TR and TN have begun discussions on nursery and will prepare feasibility and costings.

The next TWGG meeting will be:

Wednesday 20 November 2019 at 10.00 am at Waahi Whaanui, Parry Street, Huntly West.

K:\145860 Ohinewai Development\07 TWWG management\Meeting notes\Ohinewai TWWG Meeting # 4 Notes 221019 FINAL.docx

SLEEPYHEAD ESTATE

3 WATERS PRESENTATION

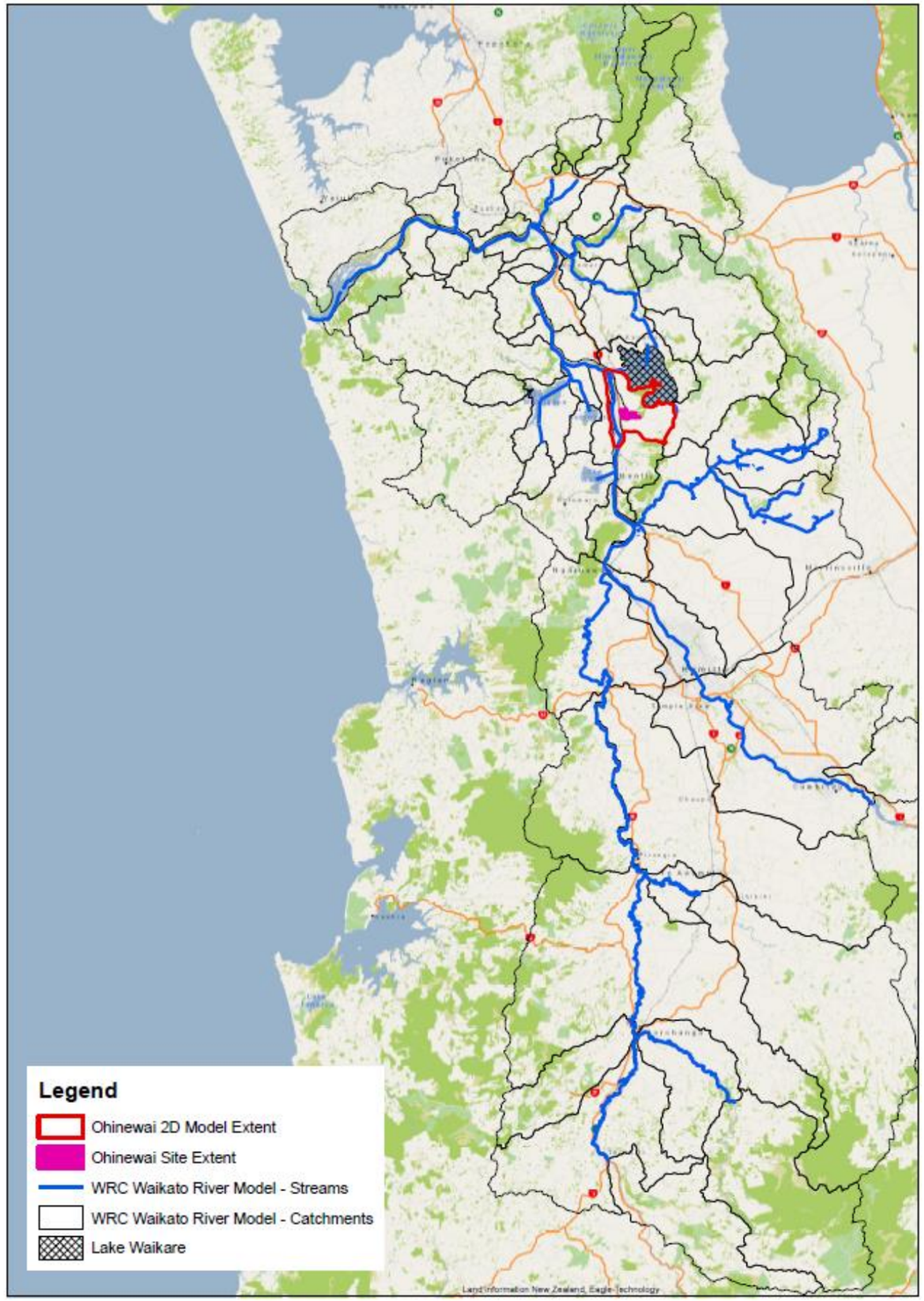
1. STORMWATER
2. WATER SUPPLY
3. WASTEWATER

SLEEPYHEAD ESTATE

STORMWATER

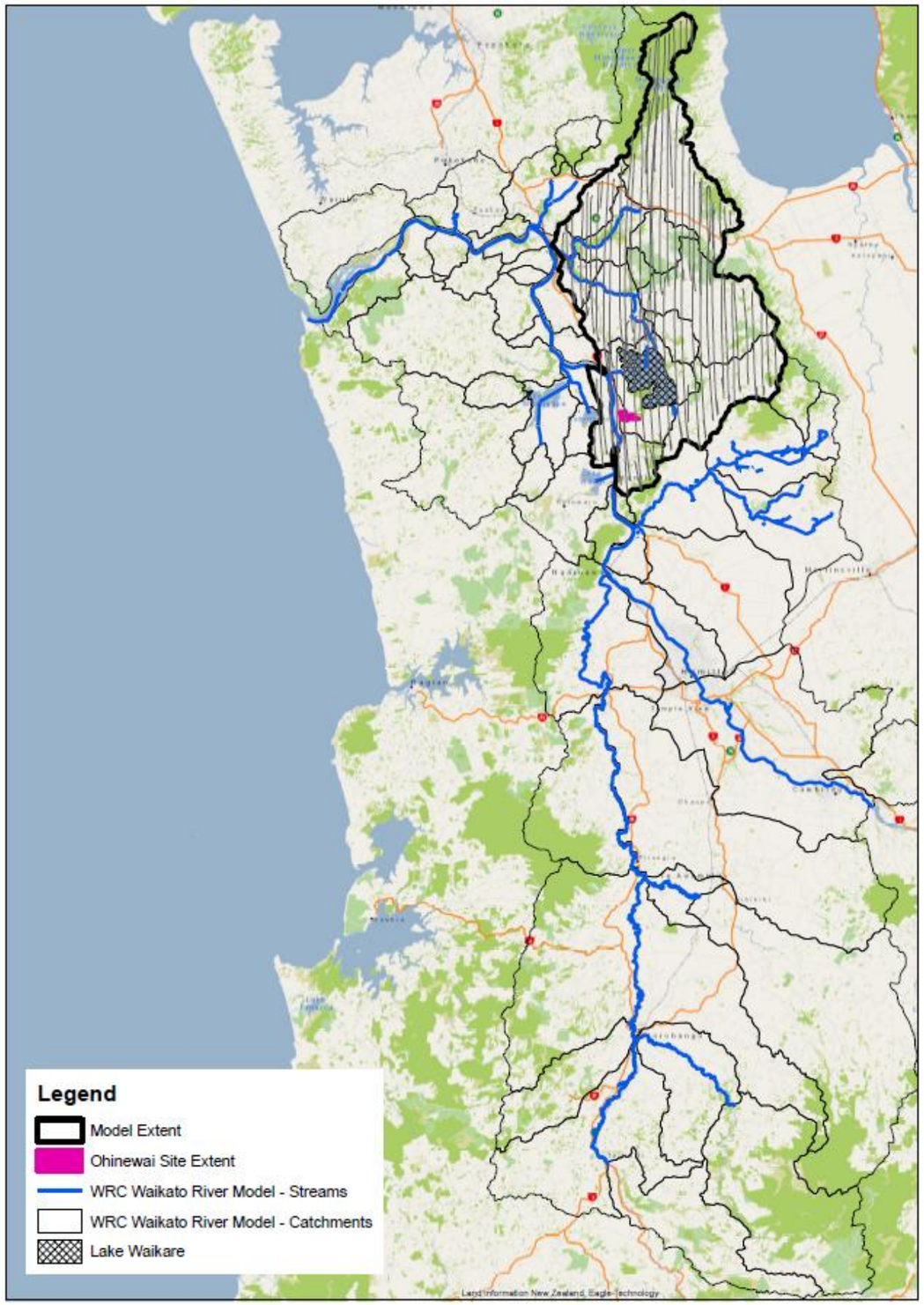
CONTENTS:

a) FLOOD MODELLING
b) STORMWATER MANAGEMENT



FLOOD MODELLING

- Site currently located within an existing floodplain – Due to predominantly the low-lying nature of the existing landform
- The flood modelling is being developed from the base WRC Waikato River model.
  - Large model with a catchment of approximately 6500 km^2 = 650,000 Ha
- We've taken this model and cut it down to 86800 ha using upstream and downstream Boundary conditions
  - <u>Inflow boundary conditions:</u>
    - The Waikato River
    - Inflows from the Matahuru Catchment into Lake Waikare
  - <u>Downstream boundary conditions:</u>
    - Water level boundary at the Te Onetea Control Gate
    - Water level boundary at the Whangamarino Control Gate
- The purpose of the flood model is to get a detailed understanding of the flood risk within the site, to identify these risks and assess the effects of development on adjoining landowners, Lake Waikare and the Whangamarino Wetland



CUT DOWN MODEL EXTENT

- Site currently located within an existing floodplain – Due to predominantly the low-lying nature of the existing landform
- The flood modelling is being developed from the base WRC Waikato River model.
  - Large model with a catchment of approximately 6500KM2 = 650,000Ha
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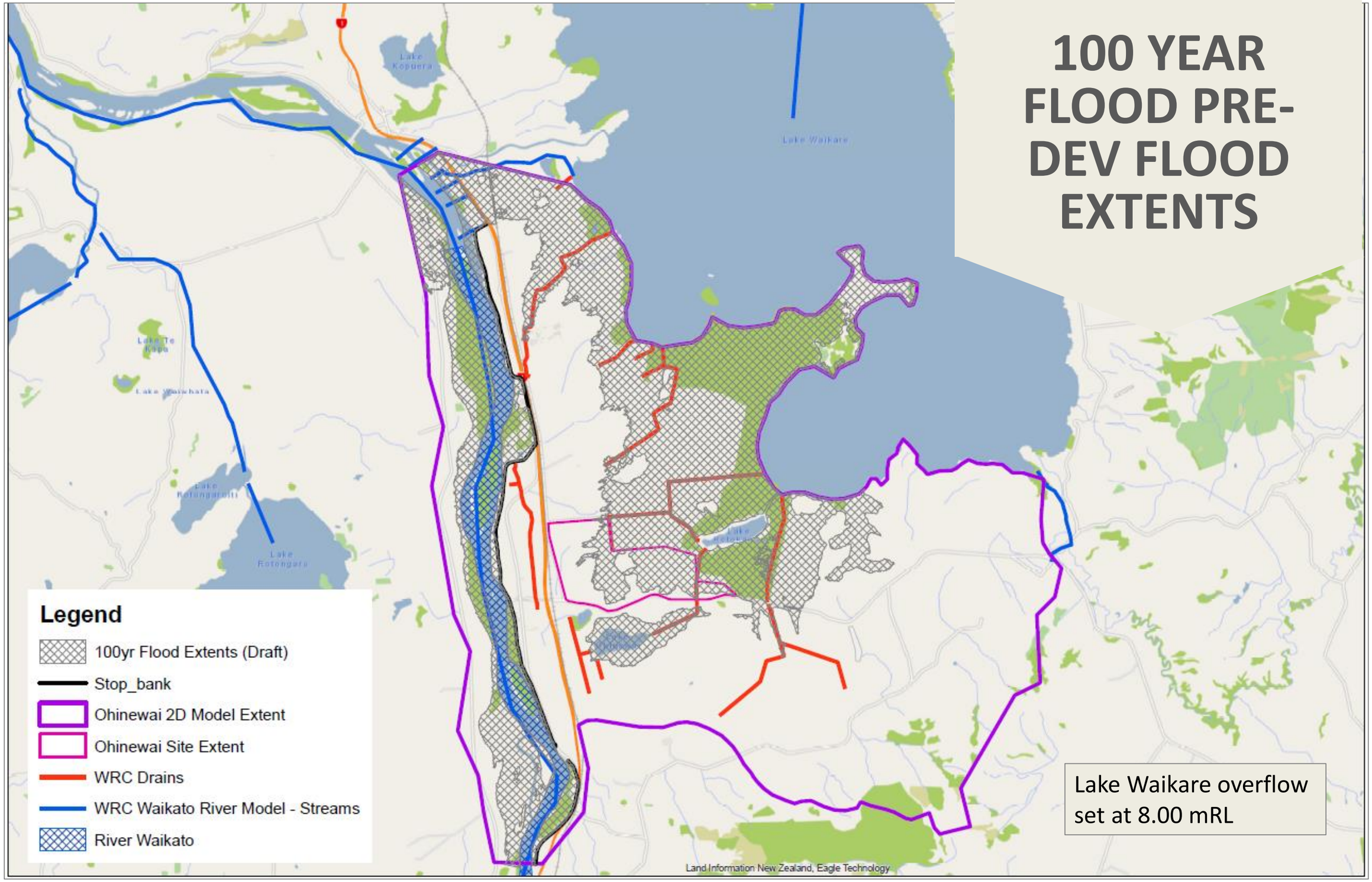
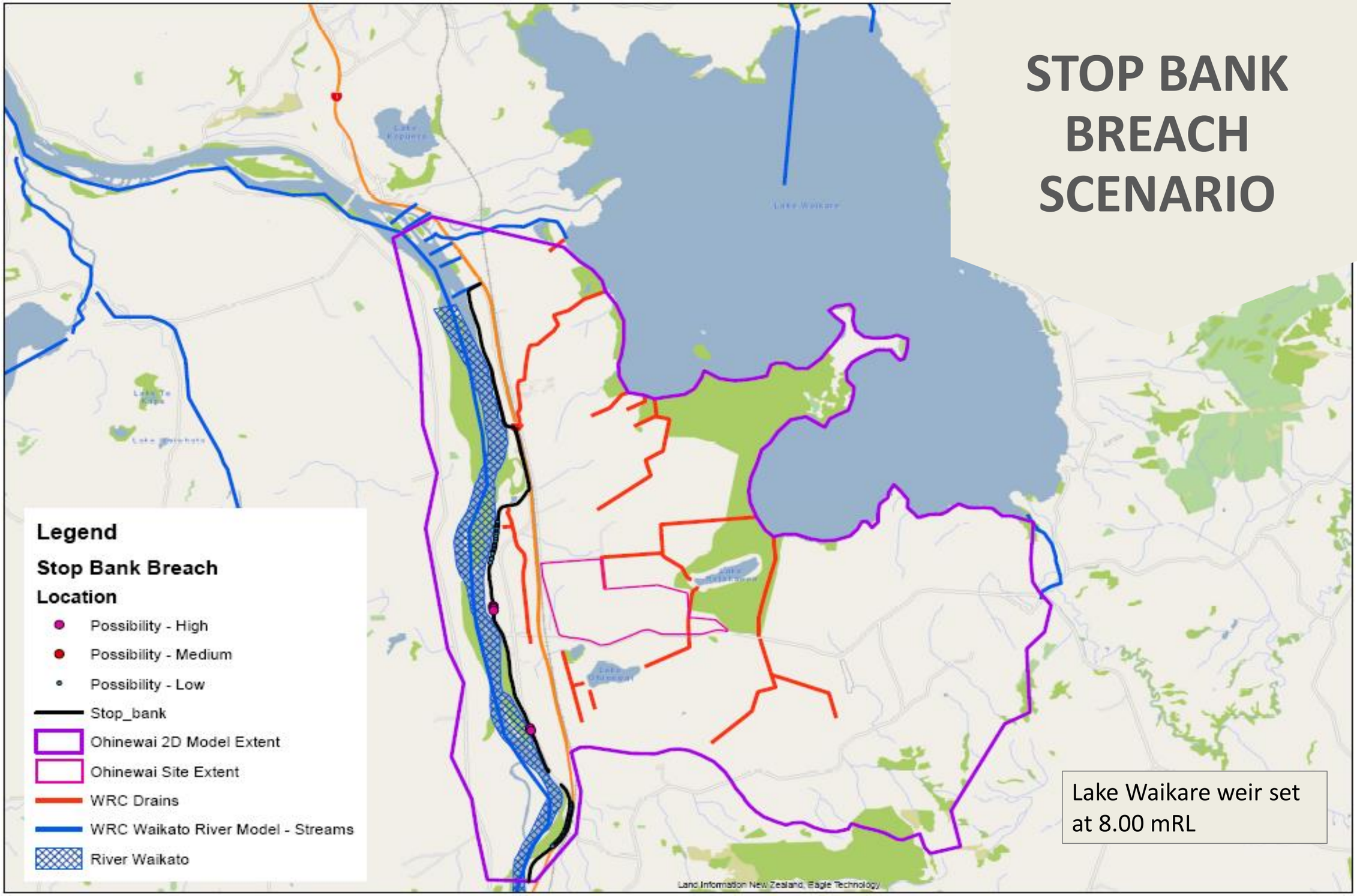
100 YEAR FLOOD PRE-DEV FLOOD EXTENTS

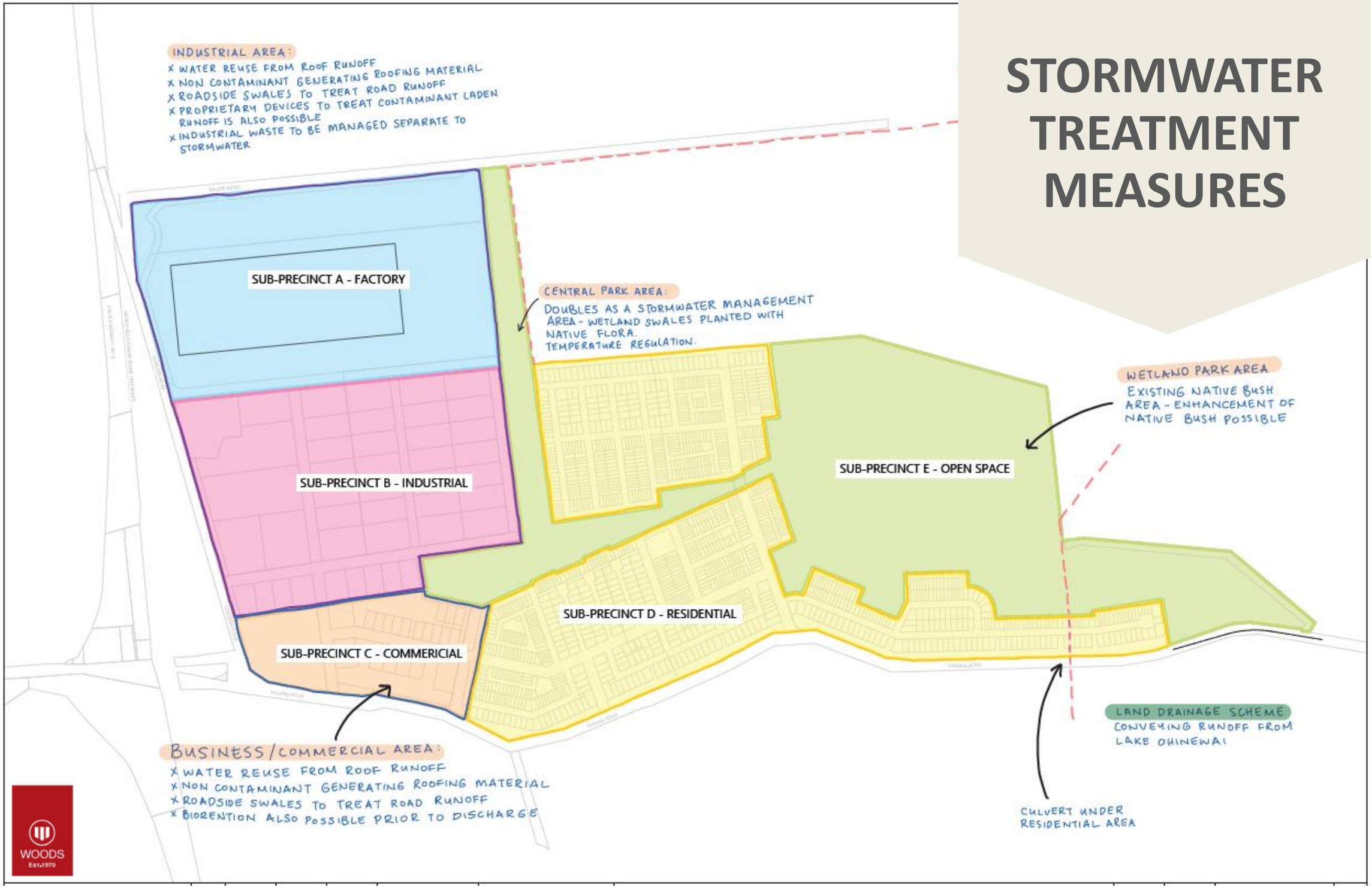


STOP BANK BREACH SCENARIO

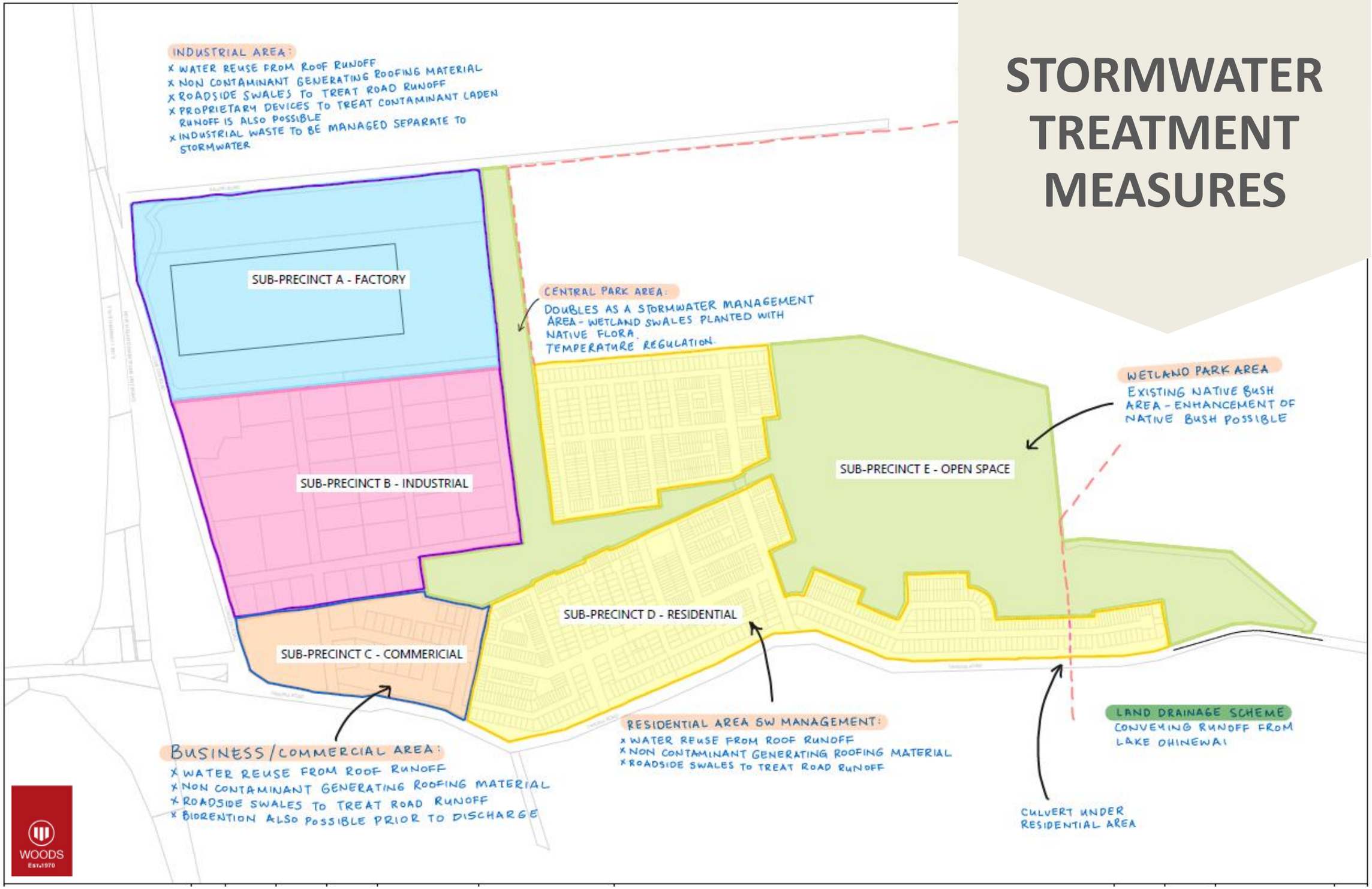


STORMWATER MANAGEMENT ZONES

STORMWATER TREATMENT MEASURES



STORMWATER TREATMENT MEASURES



Stormwater Management Toolbox		
Device	**Typical applications**	**Treatment outcomes**
Rain tanks	Private lots, industrial, commercial	Volume reduction. Contributes to scour protection during smaller rainfall events.
Inert Roofing	Private lots, industrial, commercial	Water quality
Living roofs	Private lots, industrial, commercial	Water quality, Volume reduction. Temperature reduction.
Bioretention devices	Public spaces, carparks	Treatment of runoff from roads or carparks. Removal of metals, sediments, total petroleum hydrocarbons.
Permeable pavement	Private lots, industrial, commercial	Volume reduction, treated as hydraulically neutral
Swales	Public spaces	Treat runoff for metals and sediment.
Filter strips	Public spaces	Sediment removal prior to final discharge. Polishing treatment for runoff. Removes metals and sediment.
Wetland swales	Public spaces	Treatment of runoff for metals and sediment. Temperature reduction.
Wetlands	Public spaces	Flood attenuation. Removal of metals, sediments, total petroleum hydrocarbons, and specific nutrients such as phosphorus and nitrogen.
Proprietary devices	Public or private spaces	Treatment of runoff for specific pollutants such as hydrocarbons or other nutrients. Used only if no other option is feasible.

6.1.3 Low impact design scoring approach

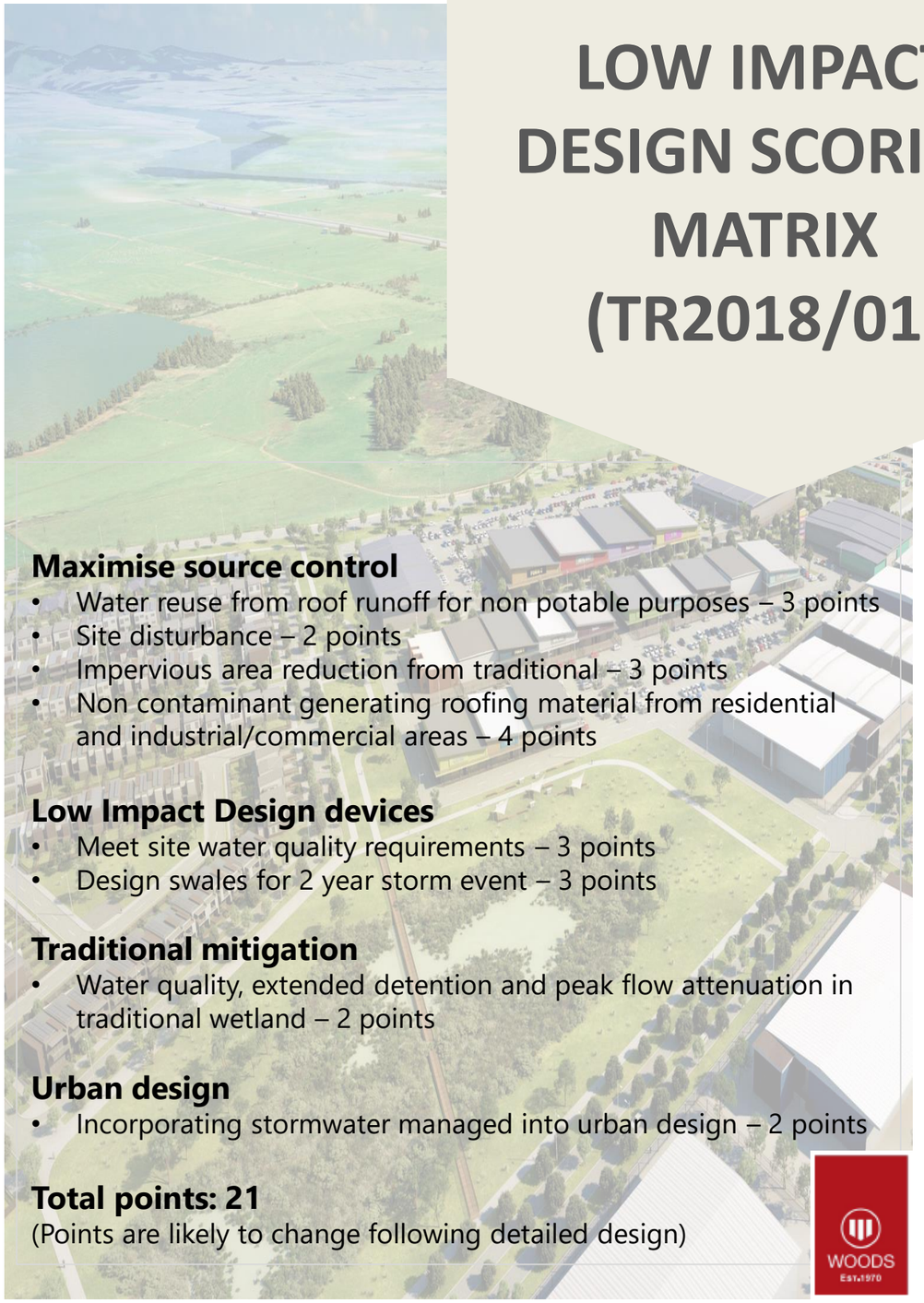
Information contained in the report shall also include a low impact design scoring matrix for which the summation provides an overall score of the design. The scoring is based on Table 6-1 below.

Table 6-1: Low impact design scoring matrix

Implementation elements	Typical components	Maximum Individual score	Total score for each item
Source control maximised	Water re-use	0-4 depending on % of runoff capture	3
	Site disturbance reduced from a conventional development approach	0-3 depending on % of runoff capture	2
	Impervious surfaces reduced from a traditional approach	0-3 depending on % of runoff capture	3
	Use of building or site materials that do not contaminate	0 or 1 for residential 0-3 for commercial or industrial	1/3
	Existing streams and gullies located on site (including ephemeral) are protected and enhanced. The entire stream other than possible crossings shall be protected to qualify for points.	0 or 3	
	Riparian corridors are protected, enhanced or created	0-3	
	Protection and future preservation of existing native bush areas	0-2 depending on percentage of site area	
LID stormwater device/practice used	Infiltration devices to reduce runoff volume	0-6 depending on % of runoff capture	3
	Revegetation of open space areas as bush	0-3 depending on % of site covered	
	Bioretention	0-6 depending on % of runoff capture	
	Swales and filter strips	0-3 depending on % of runoff capture	3
	Tree pits	0-6 depending on % of runoff capture	
Traditional mitigation	Constructed wetlands	0-4 depending on % of runoff capture	2
	Wet ponds	0-1 depending on % of runoff capture	
	Innovative devices	0-1 depending on % of runoff capture	
	Detention ponds (normally dry)	0	
Urban design	Stormwater management is designed to be an integral and well considered part of the urban design.	0–2	2
Total score			19 / 21

RESIDENTIAL
COMMERCIAL

LOW IMPACT DESIGN SCORING MATRIX (TR2018/01)



Maximise source control
- Water reuse from roof runoff for non potable purposes – 3 points
- Site disturbance – 2 points
- Impervious area reduction from traditional – 3 points
- Non contaminant generating roofing material from residential and industrial/commercial areas – 4 points

Low Impact Design devices
- Meet site water quality requirements – 3 points
- Design swales for 2 year storm event – 3 points

Traditional mitigation
- Water quality, extended detention and peak flow attenuation in traditional wetland – 2 points

Urban design
- Incorporating stormwater managed into urban design – 2 points

Total points: 21
(Points are likely to change following detailed design)

WOODS EST.1970

IMPROVING DISCHARGE QUALITY

The stormwater management strategy provides a “best practice” treatment train approach that provides:

- At source treatment (water quality/volume reduction)
- Secondary/tertiary treatment within the central park and wetland park areas.

At source treatment is aimed at reducing the contaminants in runoff and improving water quality. Volume reduction and peak control measures will be employed to reduce scour and erosion.

The central park area will provide additional treatment with dense planting to assist in reducing temperatures prior to discharge.

The wetland park area to allow for treatment and polishing to provide further removal of nutrients/sediments.

Lake Waikare is hyper eutrophic due to the high levels of nitrogen and phosphorus which is linked to the existing land use

The measures outlined in the stormwater management toolbox are aimed at improving the quality of discharge into Lake Rotokawau/Lake Waikare. The Sleepyhead development creates an opportunity to remove 176 Ha from rural production, removing the main source of key contaminants of concern; Nitrogen and Phosphorus.

SLEEPYHEAD ESTATE

WATER SUPPLY

DEVELOPMENT WATER DEMAND

Two water supply concepts:

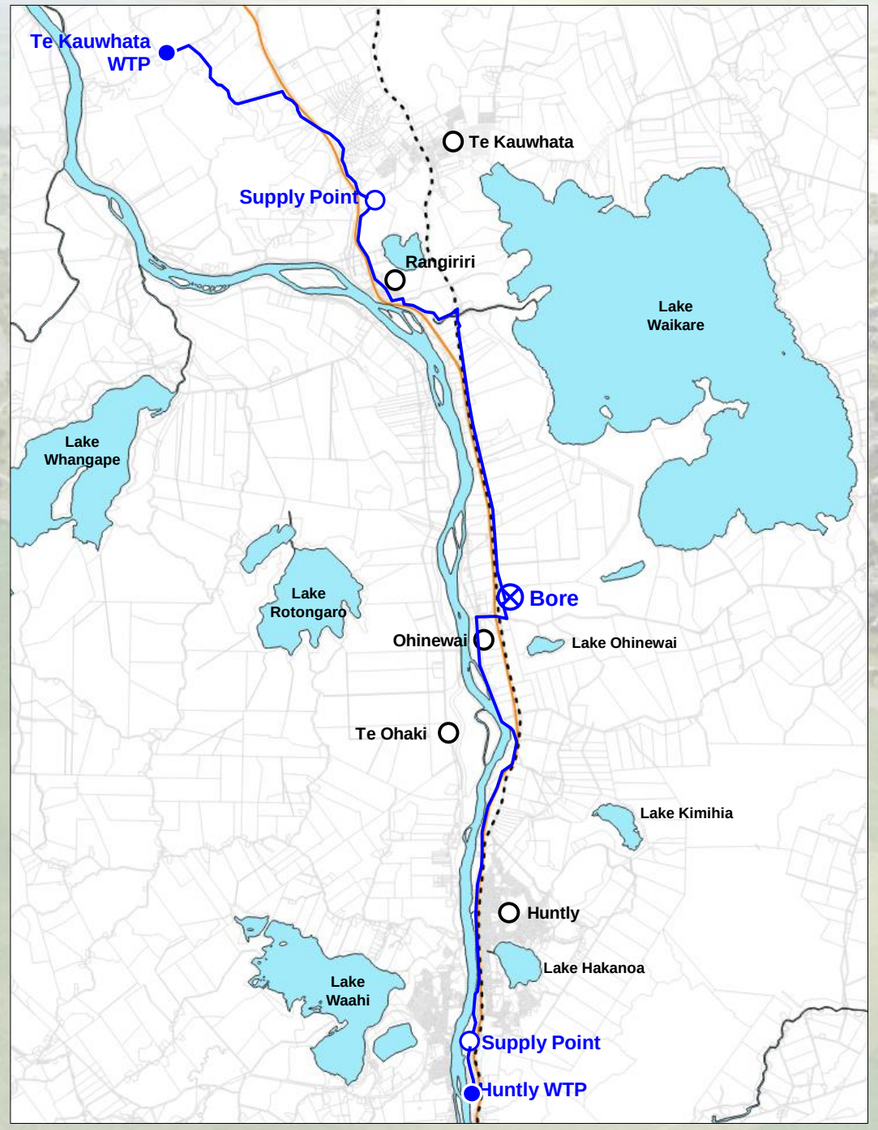
- On-Site or
- Public Infrastructure (WDC)

Average Water Demand 2,150 m^3 / Day

Factory	100,000 m^2
Industrial	250,000 m^2
Commercial	71,000 m^2
Residential	1,250 lots

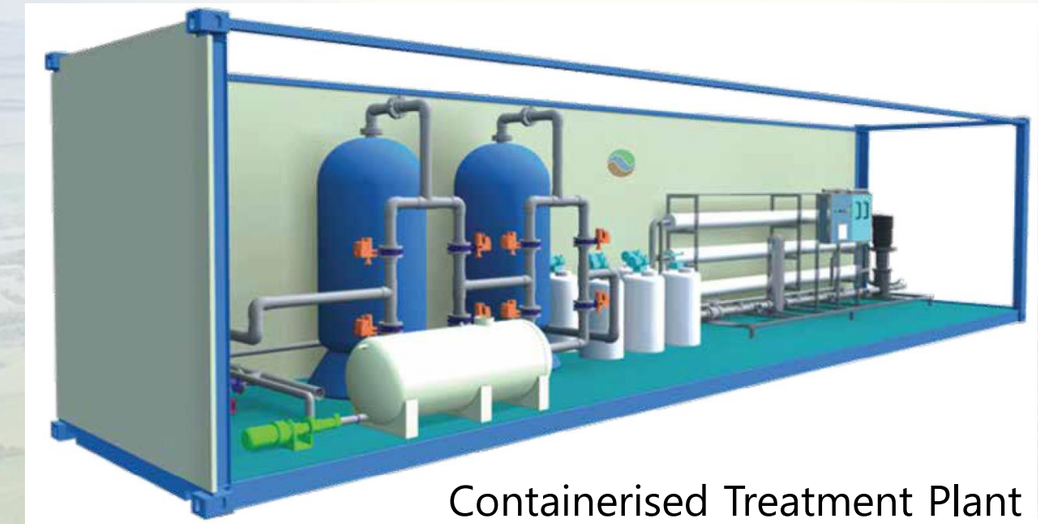
WOODS
Est.1970

WATER SUPPLY OPTIONS



- On-site bores & treatment plant
- Raw water supply from TKWA & treatment plant
- Municipal supply from Te Kauwhata
- Municipal supply from Huntly
- Municipal supply from new WSL/WDC plant

ON-SITE WATER SUPPLY



Containerised Treatment Plant

Supply → Treatment → Potable Distribution

Bore Fields
TKWA Raw Water

Iron Removal
Sedimentation
Filtration
Disinfection

Drinking / Cooking
Showers
Washing
Fire Supply

Raintanks → Filtration → Non-Potable Use

Toilet Flushing
Irrigation

MUNICIPAL WATER SUPPLY

Huntly WTP

Te Kauwhata WTP

WDC Plant ➡ Transmission ➡ Potable Distribution

Transmission Pipeline

Huntly WTP
Te Kauwhata WTP
New Super Plant

Booster Pump Station

Reservoir
Booster Pump Station

Raintanks ➡ Filtration ➡ Non-Potable Use

Toilet Flushing
Irrigation

WATER SUPPLY SUMMARY

There are options for water servicing for the development:

Onsite

- Water drawn from catchment where it is being used
- Packaged plant can be implemented as development progresses or used as interim solution
- High water quality can be achieved

Municipal Plant (WDC/WSL)

- Plants are already established, and upgrades required to meet development demands
- Opportunity to create new regional superplant
- Significant delivery infrastructure (pipelines) needed

SLEEPYHEAD ESTATE

WASTEWATER

DEVELOPMENT WASTEWATER PRODUCED

Two wastewater disposal concepts:

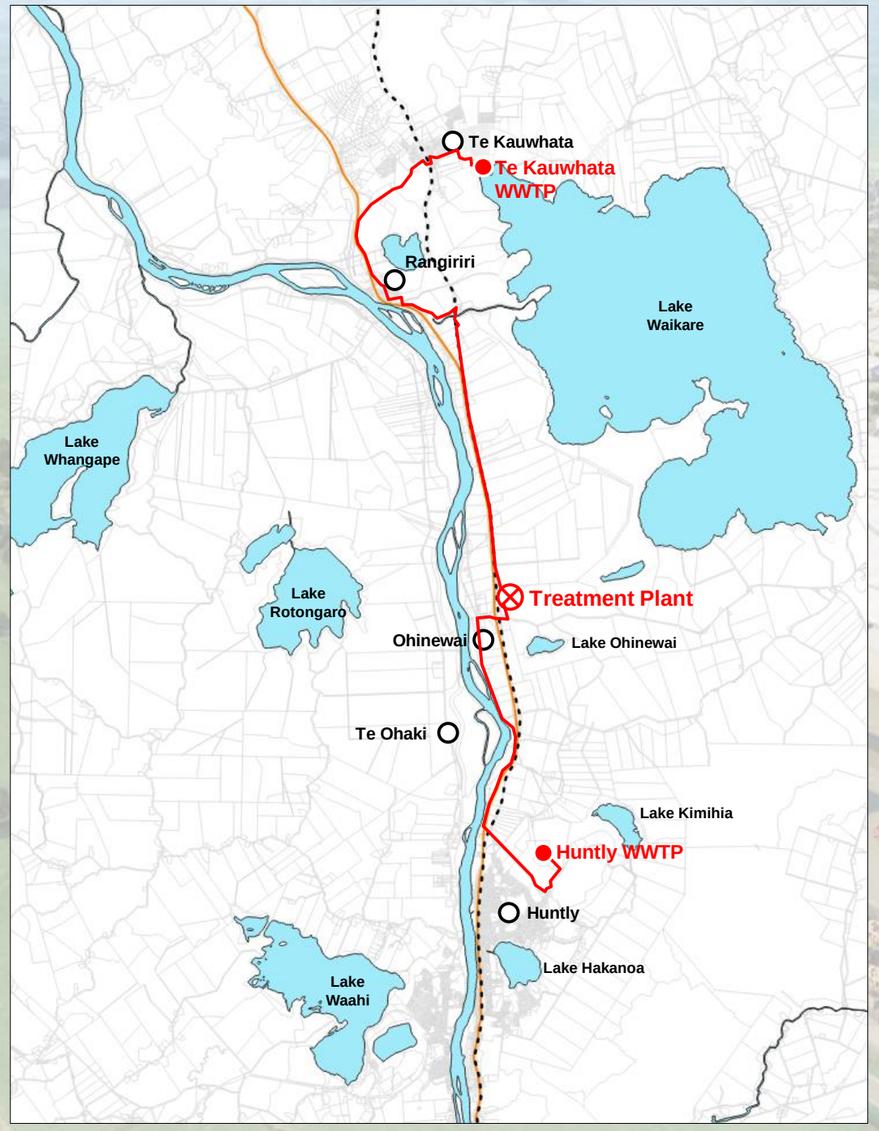
- On-Site or
- Public Infrastructure (WDC)

Average Wastewater Load 2,000 m^3 / Day

Factory	100,000 m^2
Industrial	250,000 m^2
Commercial	71,000 m^2
Residential	1,250 lots

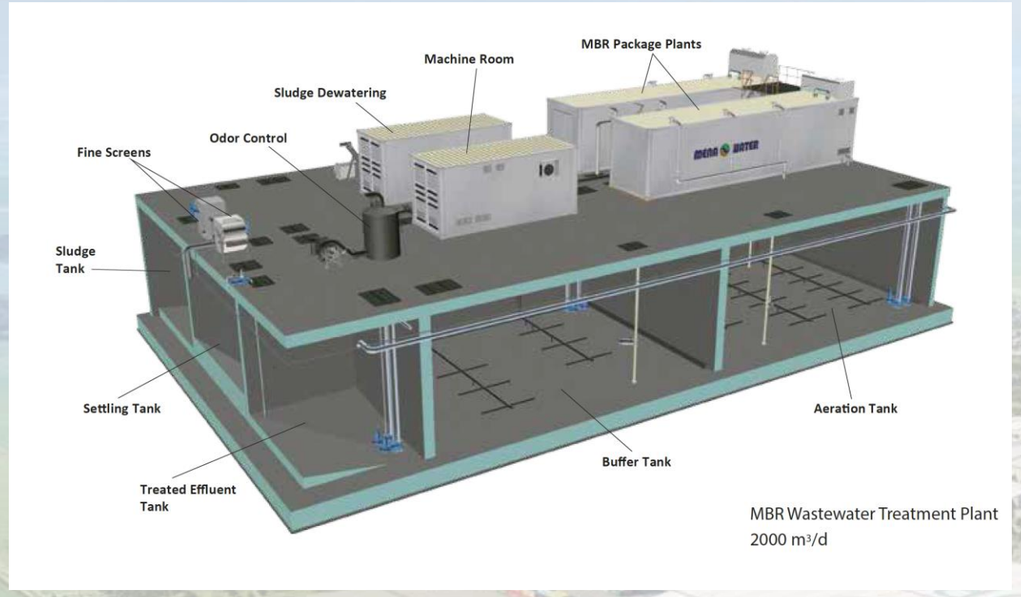
WOODS
Est.1970

WASTEWATER DISPOSAL OPTIONS



- On-site treatment plant
- Pump to Municipal WWTP in Te Kauwhata (upgrade)
- Pump to Municipal WWTP in Huntly (upgrade)
- Pump to new WSL/WDC Municipal WSL/WDC WWTP

ON-SITE WASTEWATER TREATMENT



Containerised Treatment Plant

Collection

On-site network

Pumped/Gravity

Treatment

Membrane Bioreactor (MBR)

De-Nitrifying Beds

Spilling Pond

Discharge

On-Site

De-Nitrifying Beds

Clean Effluent Water

MUNICIPAL WASTEWATER TREATMENT

Collection
On-Site
Pumped/Gravity

Transmission
Pumped
Transmission Main

Treatment
Upgraded treatment plant
New regional super plant

Disposal
River

Huntly WWTP

Te Kauwhata WWTP

WOODS
Est.1970

WASTEWATER SUMMARY

There are options for wastewater servicing for the development:

Onsite

- Wastewater retained from catchment where it is being used
- Packaged plant can be implemented as development progresses or used as interim solution
- High water quality disposal can be achieved

Municipal Plant (WDC/WSL)

- Plants are already established, and upgrades required to meet development flows produced
- Opportunity to create new regional superplant
- Significant delivery infrastructure (pipelines) needed

THANK YOU

Your input & time is appreciated

16. Appendix D – Servicing Option Layout Plans

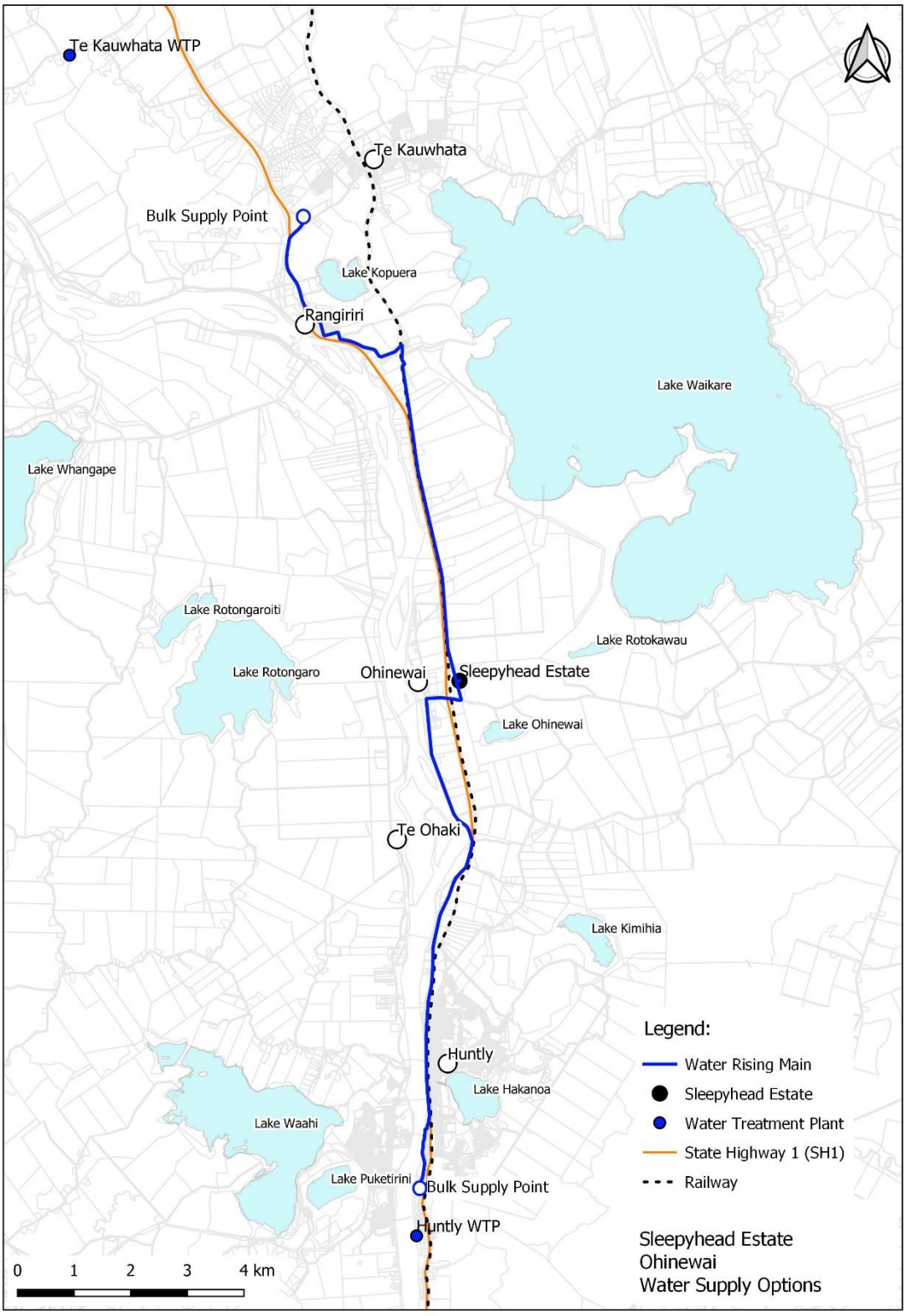


Figure 6: Overall Water Supply Bulk Reticulation Route Options

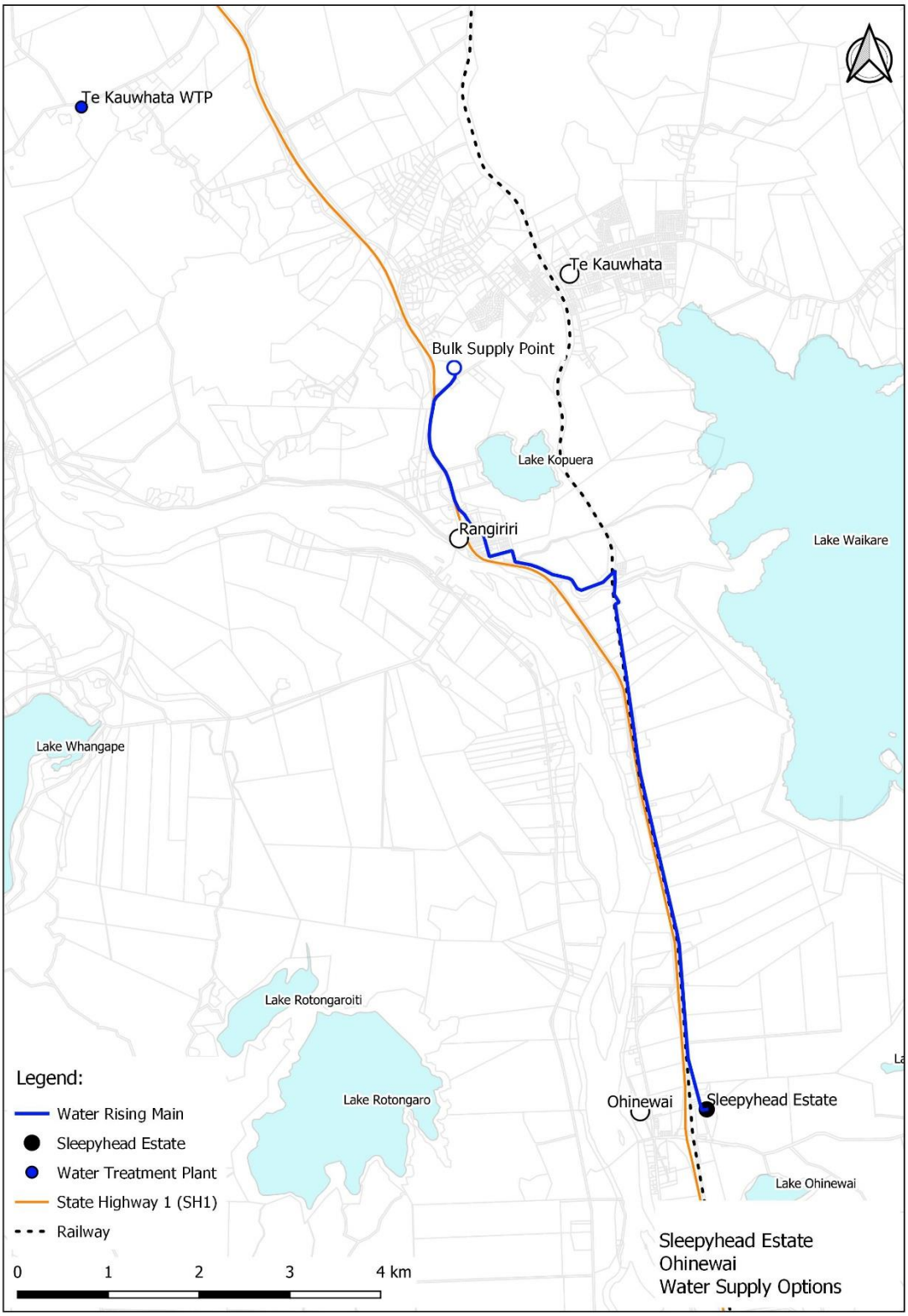


Figure 7: Te Kauwhata Water Treatment Plant Bulk Reticulation Supply Proposed Route

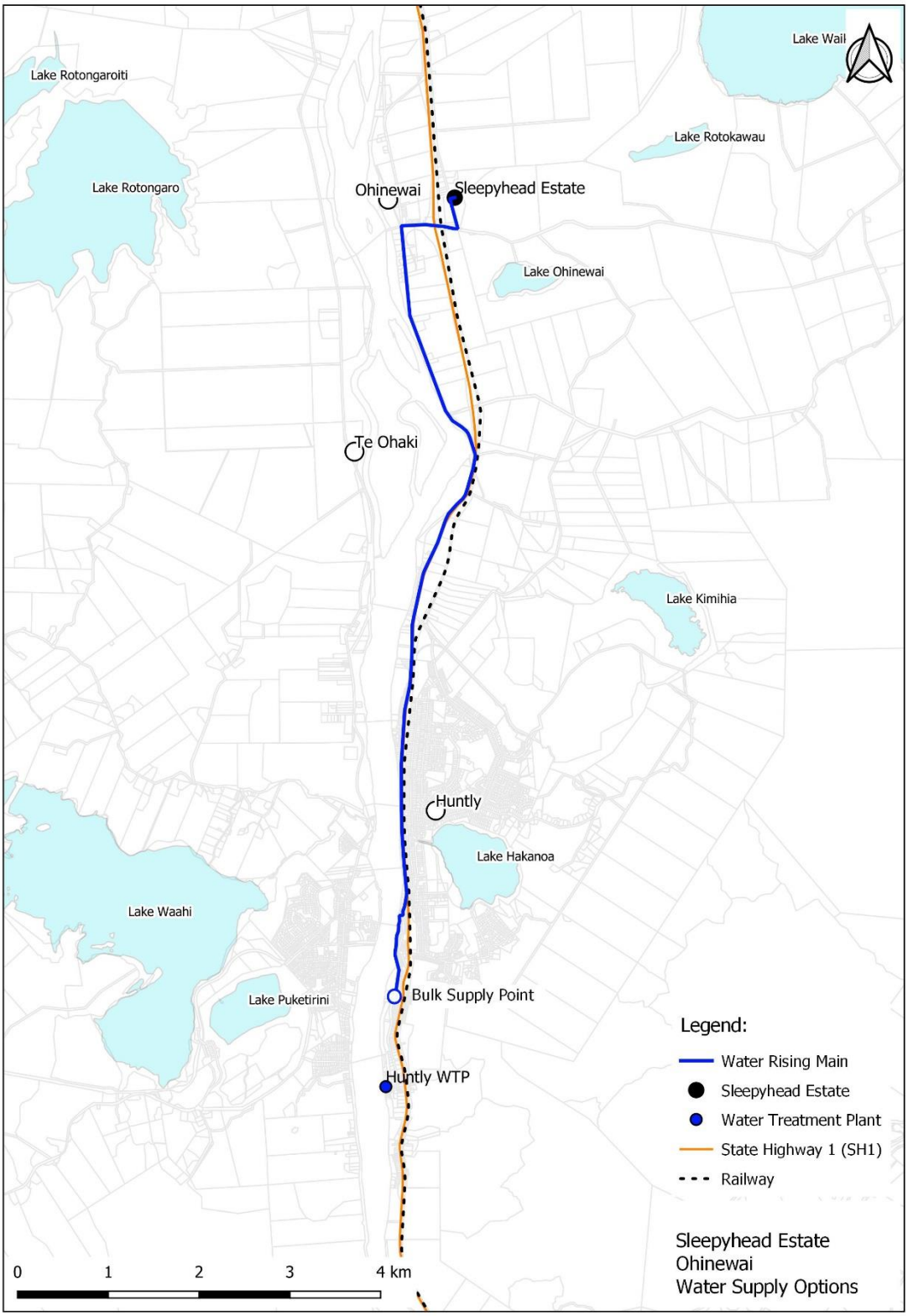


Figure 8: Huntly Water Treatment Plant Bulk Reticulation Supply Proposed Route

17. Appendix E – Supply Details

Waikato District Council

Water Supply Bylaw

2014

Contents

WAIKATO DISTRICT COUNCIL

WATER SUPPLY BYLAW 2014

The Waikato District Council, in exercise of its powers and authorities conferred on it under the Local Government Act 2002 and the Health Act 1956 and their respective amendments, and all other relevant powers, makes the following bylaw.

1. SHORT TITLE, COMMENCEMENT AND APPLICATION

1.1 The bylaw shall be known as the "Waikato District Council Water Supply Bylaw 2014".

1.2 The bylaw shall apply to the Waikato District.

1.3 The bylaw shall come into force on 1 October 2014.

2. REVOCATION

The Waikato District Council Water Supply Bylaw 2009 and the Franklin District Council Water Supply Bylaw 2008 are revoked from the day the new bylaw comes into force.

3. SCOPE

This bylaw shall apply to the Waikato District (within the boundaries of the Waikato District pursuant to the Local Government Act 2002 and any land, building, work, or property under the control of the Council, although situated beyond the Council's district pursuant to the Health Act 1956.

4. PURPOSE

4.1 The purposes of this bylaw are:

(a) Protecting, promoting and maintaining public health and safety;

(b) Promoting the efficient use of water and protect against waste or misuse of water from the water supply system;

(c) Protecting the water supply and water supply system from pollution and contamination;

(d) Managing and protecting from damage, misuse, or loss of land, structures and infrastructure associated with the water supply system; and

(e) Preventing the unauthorised use of land, structures or infrastructure associated with the water supply system.

5. COMPLIANCE WITH OTHER ACTS AND CODES

5.1 This Bylaw is made under the authority of the Local Government Act 2002 for the supply of water to its customers in its capacity as a Water Supply Authority. The supply and sale of water by the Council is subject to:

(a) Statutory Acts and Regulations

(i) Building Act 2004.

(ii) Fire Services Act 1975.

(iii) Health (Drinking Water) Amendment Act 2007.

(iv) Health Act 1956.

(v) Local Government (Rating) Act 2002.

(vi) Local Government Act 2002.

(vii) Resource Management Act 1991.

(b) Relevant Codes and Standards, including:

(i) Drinking Water Standards for New Zealand 2005 (revised 2008).

(ii) OIML R49: Water meters intended for the metering of cold potable water and hot water. Part 1: Metrological and technical requirements; Part 2: Test methods and Part 3: Test report format.

(iii) SNZ PAS 4509: 2008 New Zealand Fire Service Fire Fighting Water Supplies Code of Practice.

(iv) NZS 4503:2005 Hand operated fire-fighting equipment.

(v) NZS 4517:2010 Fire sprinkler systems for houses.

(vi) Backflow Prevention for Drinking Water Suppliers Code of Practice 2006, Water New Zealand.

(vii) Water Meter Code of Practice 2003, Water New Zealand.

(viii) Resource Management (National Environmental Standards for Sources of Human Drinking Water) Regulations 2007.

(ix) Hamilton City Development Manual, or its successor, and any other codes of practice adopted by Council.

6. INTERPRETATION

6.1 When interpreting this Bylaw, use the definitions set out in clause 7 unless the context requires otherwise. Where reference is made in this Bylaw to any repealed enactment, such reference should be taken as a reference to its replacement.

6.2 For the purpose of this Bylaw, the word 'shall' refers to requirements that are mandatory for compliance with this Bylaw, while the word 'should' refers to practices that are advised or recommended.

7. DEFINITIONS

7.1 For the purposes of this Bylaw, unless inconsistent with the context, the following definitions apply:

Advisory Note	A note which further explains a bylaw clause but does not form part of the bylaw.
Air Gap	A vertical air gap between the outlet of the water supply fitting which fills a storage tank, and the highest overflow water level of that storage tank.
Approved	Approved in writing by the Council, either by an authorised officer of the Council or by resolution of the Council.
Authorised Agent	Any person authorised or appointed by the Council to do anything in respect of the water supply system.
Authorised Officer	Any officer of the Council or other person authorised under the Local Government Act 2002 and authorised by the Council to administer and enforce its Bylaws.
Auxiliary Supply	A water supply, other than the Council's system, on or available to a Customer system. These auxiliary supplies may include water from another provider's public potable water supply or any natural source(s) such as a well, spring, river, stream, or "used waters" or "industrial fluids."

Backflow	The unplanned reversal of flow of water or mixtures of water and contaminants into the water supply system.
Backflow Device	Backflow device or air gap that is designed to prevent the return of flow into the Councils water supply system. These devices can include non-return valves, reduce pressure zone devices, and double check valves.
Boundary	Legal boundary of the site, or in the case of more than one premise on a site, it is defined by the notional boundary of a complying unit site area.
Catchment	An area of land which drains to a waterbody from where a public water supply is drawn.
Connection	The valve, meter and associated fittings installed and maintained by the Council on the service pipe or at the point of supply.
Council	The Waikato District Council and includes any officer authorised to exercise the authority of the Council.
Customer	A person who has obtained the right to use or direct the manner of use of water supplied by the Council to any premises.
Detector Check Valve	A check (non-return) valve which has a positive closing pressure and a metered bypass to measure flows typically associated with leakage or unauthorised use of a dedicated fire supply.
Domestic Purpose	Water taken and used for the purpose of providing for individual household use and for human drinking and sanitation needs and for individual household use which includes: (a) Washing down a vehicle; (b) Garden watering by hand using a hand held device;

	(c) Garden watering by any portable sprinkler device.
Development contribution	As defined in the Local Government Act 2002 and the relevant Waikato District Council Development Contributions Policy.
District	The Waikato District.
Extraordinary Supply	A category of on demand supply used for extraordinary use including all purposes for which water is supplied, other than an ordinary supply, and which may be subject to specific conditions and limitations.
Extraordinary Use	Extraordinary use is subject to water alert and emergency provisions and includes: (a) Domestic - spa or swimming pool in excess of 6 cubic metres capacity and fixed garden irrigation systems; (b) Commercial and business; (c) Industrial; (d) Agricultural; (e) Horticultural; (f) Viticultural; (g) Lifestyle blocks (rural supplies); (h) Fire protection systems other than sprinkler systems installed to comply with NZS 4517; (i) Outside of Waikato District (supply to, or within another local authority); (j) Temporary supply; (k) Water use above 15m3/day: a consent from the Regional Council is required; (l) Water carriers; and (m) Auxiliary supply.

Fees and Charges	The fees and charges for water supply set by the Council.
Fire Main Supply	A category of supply from pipework installed for the purpose of fire protection only.
Individual Customer Agreement	An agreement between the Council and a water user that outlines both parties' rights and responsibilities for the supply and use of water.
Industrial Activity	Any industrial activity and includes: (a) All types of processing, manufacturing, bulk storage, warehousing, service and repair activities. (b) Laboratories and research facilities. (c) Trade and industry facilities, being premises accommodating specialised education and training facilities where groups of people are given trade or industry tuition and training on a formal basis.
Level of Service	The measurable performance standards on the basis of which the Council undertakes to supply water to its Customers.
NZS	New Zealand Standard.
On Demand Supply	A supply which is available on demand direct from the point of supply, subject to the agreed level of service.
On Demand Water Supply Area	An area serviced by a Council owned reticulated water supply system as defined in Schedule 3: Water Supply Area Maps, that is intended to supply water to Customers via on demand supplies with firefighting capability.
Ordinary Supply	A category of on demand supply used solely for domestic purposes.

Owner	The person or entity having legal ownership of the premises receiving a supply of water from the Council.
Occupier	The person or legal entity having a legal right to occupy, use all or part of the premises receiving a supply of water from the Council that includes a tenant, lessee, licensee, manager, foreperson or any other person acting in the general management of any premises.
Permit	A permit or written authority issued by an authorised officer.
Person	An individual, corporation sole, or a body of persons whether corporate or otherwise.
Point of Supply	The point on the water pipe leading from the water main to the premises, which marks the boundary of responsibility between the Customer and the Council.
Potable Water	Water that does not contain or exhibit any determinants to any extent that exceeds the maximum acceptable values (other than aesthetic guideline values) specified in the New Zealand Drinking Water Standards applicable at the time.
Premises	Premises include the following: (a) a property or allotment which is held in a separate certificate of title or for which a separate certificate of title may be issued, and in respect of which a building consent has been or may be issued; or (b) a building or part of a building which has been defined as an individual unit by a cross-lease, unit title or company lease and for which a certificate of title is available; or (c) a supplementary building or part of a building which can be defined as an individual unit with an area for food preparation, toilet and bathroom

facilities that can be used as a flat, granny flat or holiday home; or

(d) land held in public ownership (e.g. reserve) for a particular purpose.

Allotment means the same as defined in the Land Transfer Act 1952.

Prescribed charges

Charges applicable at the time of connection may include:

(a) Payment to the Council for the cost of the physical works required to provide the connection.

(b) A development contribution determined in accordance with the Local Government Act 2002.

(c) A financial contribution determined in accordance with the Resource Management Act 1991.

(d) Bacteriological and chemical testing as per the Drinking Water Standards for New Zealand to ensure connection is safe.

(e) Individual agreement charges.

Public Notice

A notice published in:

(a) One or more daily newspapers circulated in the region or district of the Council; or

(b) One or more other newspapers that have at least an equivalent circulation in that region or district to the daily newspapers circulating in that region or district; or

Includes any other public notice that the Council thinks desirable in the circumstances.

Restricted Flow Supply

A type of water supply connection where a small flow is supplied through a flow control device, and storage is provided by

	the Customer to cater for demand fluctuations.
Restrictor	A flow control device installed within the connection to control the flow rate of water to a Customer's premises.
Restricted Water Supply Area	An area serviced by a Council owned reticulated water supply system outside on demand areas, and defined in Schedule 3: Water Supply Area Maps, for specified purposes via restricted flow supplies which do not have firefighting capability.
Service Pipe	The section of water pipe between a water main and the point of supply.
Service Valve	The valve at the Customer end of the service pipe used to control and/or isolate the supply.
Storage Tank	Any tank having a free water surface.
Supply Pipe	The section of pipe between the point of supply and the Customer's premises through which water is conveyed to the premises.
Water Alert Level	Classification system used for applying water conservation restrictions.
Water Carrier	Any individual drinking-water carrier or company registered with the Ministry of Health as a recognised carrier of drinking-water.
Water Supply System	All those components of the water supply network between the point of abstraction from the natural environment and the point of supply. This includes but is not limited to: catchments, wells, infiltration galleries, intake structures, open raw water storage ponds/lakes/reservoirs, falling and rising mains, treatment plants, treated water reservoirs, trunk mains, service mains, rider mains, pump stations and pumps, valves, hydrants, scour lines, service pipes, boundary assemblies,

	meters, backflow prevention devices and tobies.
Water Unit	The basis of measurement for water supply as determined by the Council. One unit is equal to one cubic metre.

8. PROTECTION OF WATER SUPPLY SYSTEM

8.1 Water Supply System

8.1.1 General

Any person who owns or occupies premises in the District must ensure that water is used for and maintained in a manner that ensures no public health hazard or public health nuisance occurs that could affect the public water supply system.

8.1.2 No person to Connect to, or Interfere with a Water Supply System

Except as set out in clauses 8.1.1, 8.1.3 and 8.1.4, no person shall make any connection to, or otherwise interfere with, any part of the water supply system.

8.1.3 Access to System

No person other than the Council and its authorised agents and permit holders shall have access to any part of the water supply system, except to connect to the point of supply, and to operate the service valve.

8.1.4 Fire Hydrants

Only the attending Fire Service/s shall gain access to, and draw water from fire hydrants for the purpose of fighting fires, training, and testing.

8.1.5 Other Users

The right to gain access to, and draw water from the water supply system for uses other than firefighting (for example, flow testing or pipe flushing) shall be restricted to:

(a) The Council or its authorised agents.

(b) Permit holders, being those persons who after having submitted an application to the Council are subsequently approved to draw water from designated tanker filling points or a fire hydrant. Non compliance with any condition of a permit renders the permit invalid.

(c) Without prejudice to other remedies available, the Council may seize and impound any equipment used by an offender to gain access to, or draw water from a fire hydrant, and assess and recover the value of water drawn without authorisation and any other associated costs.

(d) Permit holders shall only use approved blue coloured metered standpipes to draw water from fire hydrants. Those standpipes could either be hired from the Council or permitted users can have their own standpipes approved by the Council.

8.1.6 Unauthorised Access

(a) Without prejudice to any other remedies available, the Council may seize and impound any equipment used by an offender to gain access to, or draw water from a fire hydrant, and assess and recover the value of water drawn without authorisation and any other associated costs.

(b) Where the water supply system becomes contaminated due to unauthorised access, the Council may recover cost of remediation of contamination.

(c) Any person causing damage which occurs to a Council water supply system during unauthorised access shall be liable for the cost of repair and any other costs the Council incurs as a result for the incident.

8.1.7 Working around Buried Services

(a) No person shall carry out any excavation without first reviewing the Council's records of the location of its services.

(b) Where appropriate the Council may in its absolute discretion mark out to within ±0.5m on the ground the location of its services, and nominate in writing any restrictions on the work it considers necessary to protect the integrity of the water supply system. The Council shall charge for this service.

(c) The Council may require the independent supervision of works.

(d) Every person excavating or working around the Council's buried water supply services shall take due care to ensure that the excavation or work is carried out in a manner that does not damage and/or compromise the integrity of the water supply system and in a manner that does not risk public safety.

(e) Every person who fails to reinstate excavation work in accordance with Council specifications shall be liable for the costs incurred by the Council in completing such work.

(f) Any damage which occurs to the Council services shall be reported to the Council immediately. The person causing the damage shall be liable for the cost of repair and any other costs the Council incurs as a result of the damage.

Advisory Note: All excavation and trenching work carried out within the road corridor must be carried out in accordance with the National Code of Practice for Utility Operators' Access to the Transport Corridor.

8.2 Protection of Water Sources

8.2.1 Catchment Classes

Surface water and groundwater catchment areas from which untreated water is drawn for the purposes of water supply may be designated as:

(a) Controlled;

(b) Restricted; or

(c) Open.

These catchments are also subject to National Environmental Standards for Sources of Human Drinking Water.

8.2.2 Controlled Catchments

The following conditions apply:

(a) Entry

Catchment areas which are designated as controlled, or any area held by the Council as a water reserve, shall not be entered by any person except those persons specifically authorised or holding a permit issued by the Council. Within such areas no person shall:

(i) Camp.

(ii) Take or allow to stray any livestock.

(iii) Bathe or wash anything.

(iv) Deposit any dirt, rubbish, or foul material of any kind.

(v) Defecate.

(b) Permits to enter Controlled Catchment Areas

Entry permits shall forbid or control the following activities:

(i) Hunting, trapping, shooting, or fishing.

(ii) Lighting or maintaining any fire.

(iii) Taking any dog or other animal.

(iv) Damaging or destroying any trees, shrubs, or other existing vegetation cover, or interfering with any property.

(v) Carrying of any firearm or weapon of any kind, any trap or any fishing gear which may be used for the hunting or catching of birds, fish or other animals.

(vi) Use of any pesticide or toxic substance for any purpose whatsoever.

(c) Permits to be presented

Unless the Council permits:

(i) No person to whom any permit has been issued shall enter or leave any controlled catchment area or land held by the Council as a water reserve without presenting such a permit for inspection by an authorised officer.

(ii) No permit issued by the Council shall be transferable.

(iii) The Council may at any time, by notice in writing sent by mail to the permit holder, revoke or suspend any permit for such time as stated in the notice.

(d) Interference and obstruction

In any controlled catchment area or any land held by the Council as a water reserve:

(i) Every person shall upon the request of an authorised officer of the Council immediately leave the controlled catchment area or land held by the Council as a water reserve.

(ii) No person shall obstruct or hinder any duly appointed officer of the Council in the exercise of any powers vested in that officer under this bylaw.

8.2.3 Restricted Catchments

Catchment areas which are designated as restricted shall be allowed for certain activities, but shall be as for controlled catchments for other activities. Those activities may include unrestricted entry for:

(a) Tramping;

(b) Hunting;

(c) Trapping;

(d) Shooting;

(e) Fishing.

8.2.4 Open Catchments

In open catchment areas whether designated or not, there will generally be no restriction on activities other than the provisions of the Regional or the District Plan and the National Environmental Standards.

8.2.5 Spillages and Adverse Events

(a) In the event of a spillage, or any event which may compromise potable water or the water supply system, the person responsible for the event shall advise the Council immediately. This requirement shall be in addition to those other notification procedures which are required for other authorities.

(b) Where the owner or occupier of a premise allows or permits any item or items on the premises that may potentially contaminate or leach into the water supply and to accumulate on the premises contained within the catchment, the Council may request the owner or occupier to contain and remove the item or items using a Council approved method and location.

(c) If the item(s) are not removed within the period specified, the Council or its authorised agents may remove the items and recover the costs from the Customer associated with containment, removal and disposal.

9. CONDITIONS OF SUPPLY

9.1 Application for Supply

(a) Any person wishing to:

(i) establish a point of supply,

(ii) seek a change in the level of service,

(iii) change the use of an existing supply,

(iv) make a change to backflow requirements,

(v) increase use to greater than 15 cubic metres per day, or

(vi) use water for any purpose other than ordinary supply,

shall make a written application to Council.

(b) Every application for the supply of water shall be made in writing to the Council on the prescribed form, and accompanied by the prescribed charges. The Customer shall provide all the details required by the Council.

(c) On receipt of an application the Council shall, after consideration of the matters stated in clauses 9.5 and 9.6:

(i) Approve the application and inform the Customer of the type of supply, the level of service, the size of the connection and any particular conditions applicable; or

(ii) Refuse the application and notify the Customer of the decision giving the reasons for refusal.

(iii) The Council may require a Customer to enter into an individual Customer agreement and supply a Water Conservation and Demand Management Plan based on the Customer's water demand requirements.

(d) For the agreed level of service to the Customer, the Council will determine the size of all pipes, fittings and any other equipment, up to the point of supply. The Council or a contractor approved by the Council shall supply and install the service pipe up to the point of supply at the Customer's cost.

(e) No water shall be drawn through a new connection before the Council has deemed the connection to meet the requirements of the Drinking-Water Standards for New Zealand and the Council has provided approval.

(f) The Council may require the Customer to meet all associated costs with the provision of a new connection including upgrade to infrastructure needed to provide the service.

(g) If the Customer is not the owner of the premises, the Customer shall provide written evidence that he/she has the authority to act on behalf of the owner.

(h) An approved application for supply which has not been actioned within twelve months of the date of application will lapse unless a time extension has been received in writing from the applicant and approved by the Council. Any further fees and charges shall be at the discretion of the Council.

9.2 Change of Use

If a Customer seeks a change in the level of service or end use of water supplied to the premises, or the supply changes from an ordinary to an extraordinary type (see clause 9.5) or vice versa, a physical change of location or size, a new application for supply shall be submitted by the Customer for approval by the Council. Any new application for supply under this clause shall be considered as if it is an initial application pursuant to clause 9.1 of this Bylaw.

9.3 Point of Supply

9.3.1 Responsibility for Maintenance

(a) The Council shall own and maintain the service pipe and fittings up to the point of supply. The Customer shall maintain the supply pipe and fittings beyond the point of supply.

Advisory Note: The Council gives no guarantee regarding the serviceability of the valve located on the service pipe. Where there is no Customer stopcock, or where maintenance is required between the service valve and the Customer stopcock, the Customer may use the service valve to isolate the supply. However the Council reserves the right to charge for maintenance of this valve if damaged by such Customer use.

9.3.2 Location

(a) For each individual Customer there shall be only one point of supply, unless otherwise approved.

(b) For both ordinary and extraordinary supplies, the point of supply shall be located outside the boundary of the premises in the position approved by the Council.

(c) Existing points of supply may be located either inside or outside the property boundary. The Council may relocate the point of supply when deemed appropriate or on request from the Customer. The relocation of the point of supply, pipework and fittings from the new point of supply to the existing Customer supply pipe shall be the responsibility of the Council for six months from the time of relocation.

9.3.3 Ownership

Unless otherwise specified in this Bylaw, change of ownership, between the Council and Customer, of water supply pipes and fittings occurs at the point of supply being the point directly after the last fitting which connects the supply pipe to the meter/backflow assembly or the outlet of the meter box.

9.3.4 Single Ownership

(a) For individual customers the point of supply shall be located as shown in Schedule 1 or as or as close as possible where fences, walls, or other permanent structures make it difficult to locate it at the required position. Other positions shall require specific approval from Council.

(b) For each individual customer there shall be only one point of supply, unless otherwise approved by Council.

9.3.5 Multiple Ownership

The point of supply for the different forms of multiple ownership of premises shall be:

(a) In respect of company ownership for a company share/block scheme (Body Corporate): As for individual ownership.

(b) For Leasehold/Tenancy in Common Scheme (Cross Lease), Strata Title, Unit Title and any other form of multiple ownership: Each Customer shall have an individual supply with the point of supply determined by agreement with the Council. In specific cases other arrangements may be acceptable, subject to the Council's approval.

9.4 Access to, and about the Point of Supply

9.4.1 Rights of Access

(a) Where the point of supply is on private property the Customer shall allow the Council access to the point of supply between 7.30am and 6.00pm on any day for:

(i) Meter reading without notice being given.

(ii) Checking, testing and maintenance work, with notice being given when possible.

(b) For works required outside the above hours (such as for night time leak detection), the Council shall give provide notice to the Customer.

(c) Where access is not made available for any of the above times and a return visit is required by the Council or its agents, a fee may be charged in accordance with the Council's approved fees and charges.

(d) Under emergency conditions the Customer shall allow the Council unobstructed access to, and about the point of supply at any hour as per section 173 of the Local Government Act, 2002.

9.4.2 Maintenance of Access

The Customer shall maintain the area in and around the point of supply by keeping it free of soil, growth, or other matter or obstruction which prevents, or is likely to prevent convenient access to the point of supply.

9.5 Types of Water Supply

9.5.1 General

Water supplies shall be classified as either 'on demand' or 'restricted flow' and the use of water from the supply shall be either 'ordinary' or 'extraordinary'.

9.5.2 On Demand Supply

(a) All premises situated within the on demand water supply area shall be entitled to an ordinary supply of water subject to the following conditions:

(i) The exclusion of its use under any restrictions made by the Council under clause 9.8.1;

(ii) Payment of the appropriate charges in respect of supply to that property;

(iii) Any other charges or costs associated with subdivisional development; and

(iv) Any other relevant conditions in section 8 of this bylaw.

(b) Properties located within the on demand water supply area that do not connect to the public water supply may be charged an availability charge.

(c) The Council shall be under no obligation to provide an extraordinary supply of water (see also the provisions of clause 9.8.1).

(d) The Council shall charge for the on demand supply by either:

(i) A targeted rate based on rating unit; or

(ii) The volume passing through a meter per cubic metre; or

(iii) Both (i) and (ii) – These charges are as set by the Council.

(e) For use of a fire protection system complying with NZS 4517 to be classified as an ordinary use, the Customer shall comply with the conditions set under clause 9.8.

9.5.3 Restricted Flow Supply

(a) Restricted flow supply shall be available to premises in restricted supply areas under special conditions set by the Council. Customers receiving a restricted flow supply shall make provision for onsite water storage of a minimum volume of $22m^3$ or equivalent of at least 48 hours of average water use where this is greater than $22m^3$.

(b) This may include for the purposes of:

(i) Rural supply within district.

(ii) Water demand management (including for drought, misuse and non-remedy of water leaks).

(iii) Properties subject to restriction under section 69ZH (Duty to provide information to territorial authority) of Health Act 1956.

(c) The water supply shall be restricted so as to deliver 1.8m^3 per day or the agreed number of water units at a steady flow rate through a water meter.

(d) The Council shall charge for the restricted supply by:

(i) A targeted rate based on rating unit; or

(ii) The volume passing through a meter per m^3; or

(iii) Both (i) and (ii) – These charges are as set by the Council.

(e) All restricted supply storage tanks must include a suitable, testable backflow prevention device located at the boundary.

Advisory Note: For further information on fire safety water sprinkler or storage requirements refer to the SNZ PAS 4509: 2008 New Zealand Fire Service Fire Fighting Water Supplies Code of Practice. Customers may also wish to consult with the New Zealand Fire Service about suitable measures to provide firefighting protection for their properties.

9.6 Meters and Flow Restrictors

All water connections in Waikato District shall be metered or progressed towards metering and be charged in accordance with clause 9.15. Where an extraordinary supply is used for fire protection only, the supply shall not normally be metered.

9.6.1 Installation

(a) Meters for on demand supplies, and restrictors for restricted flow supplies shall be supplied, installed and maintained by the Council, and shall remain the property of the Council.

(b) Where on demand supplies are not metered, and the Council considers water use is unusually high or the premises are used for commercial activity the Council reserves the right to fit a meter at the Customer's cost, and charge accordingly.

9.6.2 Location

Meters and restrictors shall be located in a position where they are readily accessible for reading and maintenance, and if practicable immediately on the Council side of the point of supply.

9.6.3 Accuracy

(a) Meters shall be tested as and when required by the Council.

(b) The flow restrictors shall be accurate to within ±10% of their rated capacity.

(c) Any Customer who disputes the accuracy of a meter or restrictor may apply to the Council for it to be tested. Where a test has been conducted within six months of the request for testing, Council has the discretion as to whether a further test will be carried out. If the test shows non-compliance with the stipulated accuracy, the Customer shall not be charged for the test. If the test shows compliance with the stipulated accuracy, the Customer shall pay a fee in accordance with the Council's current fees and charges schedule. A copy of independent certification of the test result shall be made available to the Customer on request.

(d) Restrictors shall be tested by measuring the quantity of water that flows through the restrictor within a period of not less than one hour, at the expected minimum operating pressure.

9.6.4 Adjustment

(a) If any meter, after being tested, is found to register a greater or lesser consumption than the quantity of water which has actually passed through the meter, the Council shall make an adjustment in accordance with the results shown by such tests, backdated for a period determined by the Council but not exceeding 12 months, and the Customer shall pay a greater or lesser amount according to the adjustment.

(b) Where a meter is under-reading by more than 20% or has stopped, the Council reserves the right to charge for the amount of water assessed as having been used over the past billing period, taking into account any seasonal variations in water demand.

(c) Where a meter is over-reading, the Council shall make appropriate adjustments to the Customer's account, based on a period of similar use and backdated to when it is agreed the over-reading is likely to have occurred.

9.6.5 Estimating Consumption

(a) Should any meter not work or cease to register, or be removed, the Council shall estimate the consumption for the period since the previous reading of such meter, (based on the average of the previous four billing periods charged to the Customer) and the Customer shall pay according to such an estimate.

(b) Where by reason of a large variation of consumption (due to seasonal or other causes), the average of the previous four billing periods would be an unreasonable estimate of the consumption, the Council may take into consideration other evidence for the purpose of arriving at a reasonable estimate, and the Customer shall pay according to such an estimate.

(c) Where the seal or dial of a meter is broken, the Council may declare the reading void and estimate water consumption as described in clause 9.6.5 (a).

(d) Where the Customer concerned is a non-profit organisation, and if metering indicates a significant increase in consumption, which is established as being caused by a previously unknown leak, the Council may estimate consumption as provided for in clause 9.6.5 (a) providing that the Customer repairs the leak with undue delay.

(e) Where an unauthorised connection has been made to the Council's water supply system, the Council will estimate the consumption for the period from when the connection was made. The Council will use the uniform charge for water on a pro rata basis to make the estimation. Where a meter has been installed without approval, the meter reading shall be used as the basis for the estimation provided it complies with the Council's standards for meters and installations. The full consumption registered on the meter shall be payable by the current owner of the property. Estimating and charging for water will be in addition to other legal actions that the Council decides to take for breaches of this bylaw or other acts and regulations.

9.6.6 Incorrect Accounts

(a) Where a situation occurs, other than as described in clause 9.6.5, and the recorded consumption does not accurately represent the actual consumption on a property, the account shall be adjusted using the best information available to the Council. Such situations include, but are not limited to, misreading of the meter, errors in data processing, meters assigned to the wrong account, and unauthorised water supplies.

(b) Where an adjustment is required in favour of the Council or the Customer, the adjustment shall not be backdated more than 12 months from the date the error was detected.

9.6.7 Leaks

It is the Customer's responsibility to detect and fix all leaks from taps and pipes, to stop overflows from cisterns, hot water cylinder exhausts or stock troughs.

(a) There will be no relief available if the leak is from fixtures easily seen, e.g. leaking taps, overflowing cisterns, hot water cylinders, exhausts in stock trough.

(b) Relief is available for the following undetected leaks:

(i) Leak in an underground pipe or fitting under the house. No relief will be given for the second time, because it indicates a faulty system.

(ii) Leak within the meter box repaired by the Council or its contractor.

(iii) The Council reserves the right to approve relief at its discretion.

(c) Half of the excess charges on water accounts (measured over the last two bills) caused by undetected leaks may be remitted where all of the following circumstances exist:

(i) There has been a substantial excess water usage over 50% of the average use over the last two bills; and

(ii) The water usage was from an undetected leak (site inspected and viewed by the Council); and

(iii) A plumber's account is produced by the Customer for the repairs to the water leak.

(iv) If the repair has been made by the property owner (not plumber) a statutory declaration must be completed and repairs inspected by the Council.

(d) In considering remissions of excess charges on water accounts caused by undetected leaks, the Council has to be satisfied that:

(i) <u>The leak has been fixed</u>: Proof will be required to show that the leak was fixed to the satisfaction of the Council.

(ii) <u>The leak will not reoccur</u>: The Council may require a site assessment to determine the adequacy of the system and identify

other factors that the Customer may need to address to limit the occurrence of further leaks in the future.

(iii) Situation monitored where appropriate: The Council may require the owner to monitor the water meter on a regular basis for excess water usage.

Advisory Note: Assessment by the Council on the overall adequacy of the private water system does not remove the responsibility of the owner of the system to maintain the adequacy of the system, and the responsibility of all water usage.

9.6.8 Authority to Grant Relief for Excess Water Usage

Council officers with appropriate delegated authority may grant relief in respect of excess water usage in accordance with 9.6.7.

9.7 Levels of Service and Continuity of Supply

(a) The Council shall provide water in accordance with the level of service set out in Schedule 2.

(b) Due to practical and physical limitations the Council cannot guarantee an uninterrupted or constant supply of water in all circumstances, or the continuous maintenance of any particular water pressure, but shall aim to meet the continuity of supply levels in accordance with clause 9.5, subject to the exemptions contained in clauses 9.8.1 and 9.8.2.

(c) Where works of a permanent or temporary nature are planned which will affect an existing supply, the Council shall consult with, or inform or give notice to all known Customers likely to be substantially affected.

(d) If a Customer has a particular requirement for an uninterrupted level of service (flow, pressure, or quality), it shall be the responsibility of that Customer to provide any storage, back-up facilities, or equipment necessary to provide that level of service.

9.8 Demand Management

(a) The Customer shall comply with any water alert or emergency restrictions enacted by the Council to manage high seasonal or other demands. Such restrictions shall be advised by public notice. Even when such restrictions apply, the Council shall take all practicable steps to ensure that an adequate water supply for human drinking water or sanitation is provided to each point of supply.

(b) Where required by rules in a District Plan, owners must maintain devices that have been installed for the purposes of water demand management

and in accordance with an associated integrated catchment management plan.

9.8.1 Water Alert and Emergency Restrictions

(a) Natural hazards (such as floods, droughts or earthquakes) or accidents which result in disruptions to the supply of water shall be deemed an emergency and shall be exempted from the levels of service requirements.

(b) During a water alert and/or emergency the Council may restrict or prohibit the use of water for any specified purpose, for any specified period, and for any or all of its Customers. Such restrictions shall be advised by public notice.

(c) Any restrictions must be adhered to until further notice.

(d) The Council may after serving notice and taking all practicable steps to contact a Customer, restrict and or meter the supply to reduce unnecessary and unauthorised water use and wastage where it deems necessary.

9.8.2 Maintenance and Repair

(a) In accordance with the Local Government Act s193 and Health Act 1956, the Council shall endeavour to notify the Customer of a scheduled maintenance shutdown of the supply before the work commences. Where immediate action is required and notification is not practical, the Council may shut down the supply without notice.

(b) Where a Customer has assets restricting the maintenance of a Council water supply system, the Council shall not be responsible for damage caused to the asset in order to maintain the Council water supply system.

(c) It is the responsibility of the Customer to maintain all supply pipes and water assets within their property in a serviceable and safe condition.

(d) The Council may recover the costs of repairs or maintenance to private supply pipes and water assets.

9.9 Liability

The Council shall endeavour to meet the level of service requirements of clause 9.5, but shall not be liable for any loss, damage or inconvenience which the Customer (or any person using the supply) may sustain as a result of a reduced level of service of, or interruptions to, the water supply.

9.10 Fire Protection Connection

9.10.1 Connection Application

Any proposed connection for fire protection shall be the subject of a specific application (on the standard Council form) made to the Council for approval. Any such connection shall be subject to the conditions specified by the Council.

9.10.2 Design of Fire Protection Systems

In discussion with the Council, it shall be the Customer's responsibility to ascertain and monitor whether the supply available is adequate for the intended purpose.

9.10.3 Fire Protection Connection Metering

Where the supply of water to any premises is metered the Council may allow the supply of water for the purposes of firefighting to be provided in a manner which bypasses the meter provided that:

(a) The drawing of water is possible only in connection with the sounding of an automatic fire alarm or the automatic notification of the fire brigade; or

(b) A Council approved detector check valve has been fitted on the meter bypass.

Any unmetered connection provided to supply water to a fire protection system shall not be used for any purpose other than firefighting and the testing of the fire protection system unless the fire protection system is installed in accordance with NZS 4517.

Where a fire connection has been installed (or located) so that it is likely or possible that water may be drawn from it by any person for purposes other than firefighting, the Council may require the supply to be metered, at the Customer’s expense.

9.10.4 Type of Fire Hose Reels

Where the supply of water to any premises is metered, fire hose reels shall be connected only to the metered supply, not to the fire protection system. The water supply to fire hose reels shall comply with the requirements of NZS 4503:2005 Hand operated fire-fighting equipment.

9.10.5 Charges

Water used for the purpose of extinguishing fires shall be supplied free of charge. Where the fire protection connection is metered and water has been used for firefighting purposes, the Council shall estimate the quantity of

water so used, and credit to the Customer's account an amount based on such an estimate.

9.10.6 Ongoing Testing and Monitoring

Customers intending to test fire protection systems in a manner that requires a draw-off of water must obtain the approval of the Council beforehand. Water used for routine flushing and flow testing does not constitute waste but the quantity of water used may be assessed and charged for by the Council.

9.11 Backflow Prevention

9.11.1 Customer Responsibility

It shall be the Customer's responsibility (under the Health Act 1956, the Building Act 2004 and clause G12 Water Supplies of the Building Regulations 1992) to take all necessary measures together on the Customer's side of the point of supply to prevent water which has been drawn from the Council's water supply from returning to that supply. These measures include:

(a) Backflow prevention either by providing an adequate air gap, or by the use of an appropriate backflow prevention device; and/or

(b) The prohibition of any cross-connection between the Council water supply and

(i) Any other water supply (potable or non-potable)

(ii) Any other water source

(iii) Any storage tank

(iv) Any other pipe, fixture or equipment containing chemicals, liquids, gases, or other non-potable substances.

Advisory Note: Fire protection systems that include appropriate backflow prevention measures would generally not require additional backflow prevention, except in cases where the system is supplied by a non-potable source or a storage tank or fire pump that operates at a pressure in excess of the Council's normal minimum operating pressure.

9.11.2 Unmanaged Risk

Notwithstanding clause 9.11.1, the Council (consistent with the Health (Drinking Water) Amendment Act 2007) may fit a backflow prevention device on the Council side of the point of supply where the Customer cannot demonstrate that the risk of backflow is adequately managed.

9.12 Council Equipment and Inspection

9.12.1 Care of Water Supply System

The Customer of the premises shall not damage or tamper with any part of the water supply system, including but not limited to pipe-work, valves, meters, restrictors, chambers, and backflow prevention devices. The Council reserves the right to recover the cost of such damage from the Customer.

9.12.2 Inspection

Subject to the provisions of the Local Government Act 2002, the Customer shall allow the Council or its agents, with or without equipment, access to any area of the premises for the purposes of determining compliance with this Bylaw.

9.13 Plumbing System

9.13.1 The Customer's plumbing system shall be designed, installed and maintained, both in its component parts and its entirety, to ensure it complies with the Building Act 2004 and the New Zealand Building Code and is compatible with the water supply service as listed in Schedule 2.

9.13.2 Quick-closing valves, pumps, hydraulically driven equipment or any other equipment which may cause pressure surges or fluctuations to be transmitted within the water supply system, or compromise the ability of the Council to maintain its stated levels of service, shall not be used on any piping beyond the point of supply. In special circumstances such equipment may be approved by the Council at its discretion.

9.14 Prevention of Water Loss and Waste

9.14.1 The Customer shall not allow water to run to waste from any pipe, tap, or other fitting, nor allow the condition of the plumbing within the property to deteriorate to the point where leakage or wastage occurs.

9.14.2 The Council provides water for consumptive use, not as an energy source. The Customer shall not use water or water pressure directly from the supply for driving lifts, machinery, eductors, generators, or any other similar device, unless specifically approved by the Council.

9.14.3 The Customer shall not use water for a single pass cooling system or to dilute trade waste prior to disposal, unless specifically approved by the Council.

9.14.4 Where a Customer ignores advice from the Council to repair an on-going leak, the Council may after serving notice, repair the leak and charge the Customer all associated cost as provided in the Local Government Act 2002.

Advisory Note: The Waikato District Plan sets out water saving measures required for water supply connections.

9.15 Payment

9.15.1 The Customer shall be liable to pay for the supply of water and related services in accordance with the Council's rates, fees and charges prevailing at the time.

9.15.2 The Council may recover unpaid water rates in respect of the supply of water as prescribed in the Local Government (Rating) Act 2002 from the owner of a premises, the occupier of a premises, or both.

9.16 Transfer of Rights and Responsibilities

9.16.1 The Customer shall not transfer to any other party the rights and responsibilities set out in this bylaw.

9.16.2 A supply pipe shall serve only one Customer, and shall not extend by hose or any other pipe beyond that Customer's property.

9.16.3 Any water which the Customer draws from the Council supply shall not be provided to any other party without the prior approval of the Council.

9.16.4 Individual Customer agreements shall not be transferred unless approval by a Council Authorised officer has been obtained in writing.

9.17 Change of Ownership

9.17.1 In the event of a premises changing ownership the Council shall record the new owner as being the Customer at those premises. Where premises are metered the outgoing Customer shall give the Council ten working days notice to arrange a final meter reading.

9.17.2 The Council reserves the right to reassess the conditions of supply when a change of ownership occurs.

9.17.3 The owner of the premises at the time of the consumption is responsible for any water charges.

9.18 Disconnection at the Customer's Request

The Customer shall give 10 working days notice in writing to the Council of a requirement for disconnection of the supply. Disconnection shall be at the Customer's cost.

10. BREACHES

10.1 Breaches of conditions of supply

10.1.1 The following are deemed breaches of the conditions to supply water.

(a) An incorrect application for supply which fundamentally affects the conditions of supply;

(b) Failure to meet any obligations placed on the Customer under all Codes and Standards specified in clause 5 of this Bylaw;

(c) An act or omission including but not limited to any of the following:

(i) Failure by the Customer to meet and comply with the conditions of supply;

(ii) Any tampering or interference with Council equipment/assets, either directly or indirectly;

(iii) Failure to pay the appropriate charges by the due date;

(iv) Frustration of the Council's ability to adequately and effectively carry out its obligations;

(v) Failure to repair a leak, or in any way wilfully allowing water to run to waste, or to be misused;

(vi) The fitting of quick-closing valves, pumps, or any other equipment which may cause pressure surges or fluctuations to be transmitted within the water supply system, or compromise the ability of the Council to maintain its stated levels of service (subject to clause 9.5 of this Bylaw);

(vii) Failure to prevent backflow;

(viii) Failure to maintain, inspect backflow;

(ix) Using water or water pressure directly from supply for driving lifts, machinery, educators, generators, or any other similar device, unless specifically approved by the Council;

(x) Using water for a single pass cooling or heating system, or to dilute trade waste prior to disposal, unless specifically approved;

(xi) Extending by hose or any other pipe a private water supply beyond that Customer's property;

(xii) Providing water drawn from the Council supply to any other party without approval of the Council;

(xiii) Unauthorised removal of flow restrictors.

(d) A person commits a breach of this Bylaw who:

(i) Permits or allows any condition to exist or continue to exist contrary to this bylaw;

(ii) Fails to comply with any lawful notice of direction given under this bylaw;

(iii) Where required, fails to obtain written approval or having obtained written approval fails to abide by the conditions (if any);

(iv) Obstructs or hinders any authorised officer in the performance of any duty to be discharged by that officer under or in excess of any power conferred by this bylaw;

(v) Interferes with any part of the water supply system without a permit;

(vi) Withdraws water from a fire hydrant without authorisation from the Council for any other purpose than fire protection;

(vii) Fails to comply with water use restriction or prohibitions introduced by the Council for any specific purpose;

(viii) Fails to meet any obligations placed on the Customer through any permit conditions;

(ix) Fails to meet any obligations placed on Customer through an individual Customer agreement;

(x) Other than the Council or its authorised agents, who accesses the water supply system without a valid permit breaches this bylaw.

10.1.2. In the event of a breach of any provision of this bylaw, the Council shall serve notice on the Customer advising the nature of the breach, the steps to be taken, and required timeframe to remedy the breach to the satisfaction of the Council beyond timeframe indicated. If the Customer persists with the breach the Council reserves the right to:

(a) Reduce the flow rate of water to the Customer without notice. Reinstatement of full supply shall be re-established only after the Customer completes payment of the appropriate fee and remedy of the breach to the satisfaction of the Council.

(b) Install a water meter. The Customer will also be charged for the ongoing supply of water as per Council's fees and charges for water supply as determined by Council from time to time.

(c) For extraordinary supply – disconnect the water supply for all purposes other than domestic water use.

(d) If the breach is such that the Council is required to disconnect the supply for health or safety reasons, disconnection may occur immediately and without further notice to the Customer.

10.1.3 If the breach is such that in the opinion of the Council is required to disconnect the supply for health or safety considerations, such disconnection shall be carried out forthwith.

10.2 Interference with equipment

Any tampering or interfering with Council equipment, either directly or indirectly, shall constitute a breach. Without prejudice to its other rights and remedies, the Council shall be entitled to estimate (in accordance with clause 9.6.5 of this Bylaw) and charge for the additional water consumption not recorded or allowed to pass through where a meter or restrictor has been tampered with, and recover any costs incurred.

11. OFFENCES AND PENALTIES

11.1 A person who fails to comply with the requirements of this Bylaw commits a breach of this Bylaw and is liable to a penalty under the Local Government Act 2002.

11.2 A person who fails to comply with the requirements of this Bylaw in relation to a high level water alert and/or emergency is in breach of clause 10.1 of this Bylaw, commits an offence and will be liable to a penalty.

12. SCHEDULES

The following schedules can be amended through a Council resolution.

Schedule 1: Examples showing Single/Manifold Connection

Schedule 2: Table 1 Compatibility Features

Schedule 3: Water Supply Area Maps

This bylaw was made pursuant to a resolution passed by the Waikato District Council on 8 September 2014 after completion of the special consultative procedure under section 86 of the Local Government Act 2002.

The Common Seal of the Waikato District Council was hereto affixed in the presence of:

Mayor

Chief Executive

Schedule 1: Examples showing Single/Manifold Connection

Example 1 – With Street Frontage

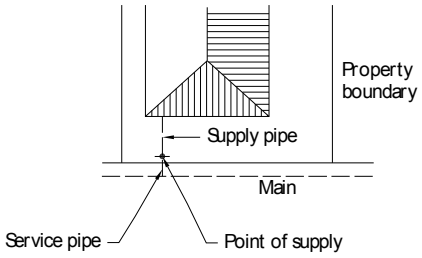


Figure 1: Point of supply inside property boundary

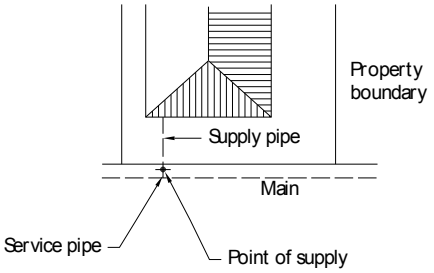


Figure 2: Point of supply outside property boundary

Example 2 – Rear lots on right of way (up to 2 customers)

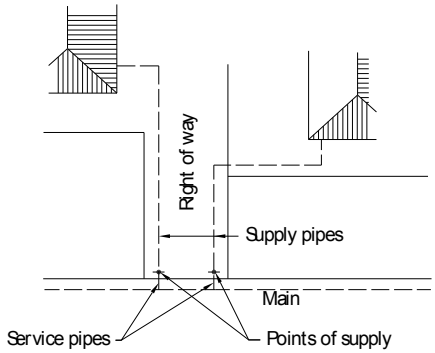


Figure 1: Point of supply inside property boundary

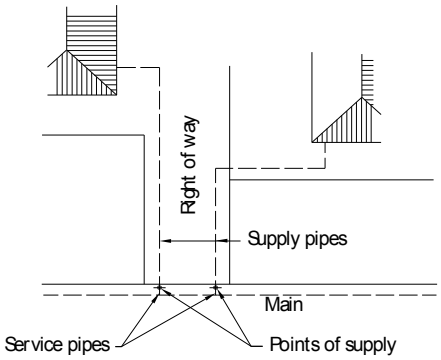


Figure 2: Point of supply outside property boundary

Example 3 – Rear lots on right of way (3 or more customers)

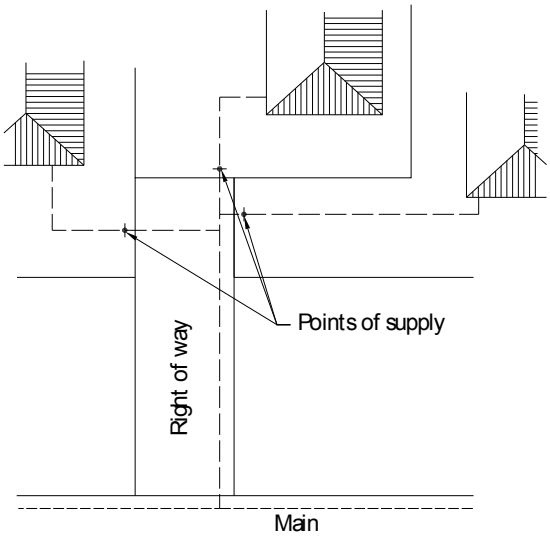


Figure 1: Point of supply inside property boundary

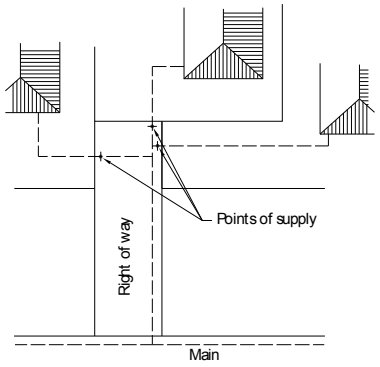


Figure 2: Point of supply outside property boundary

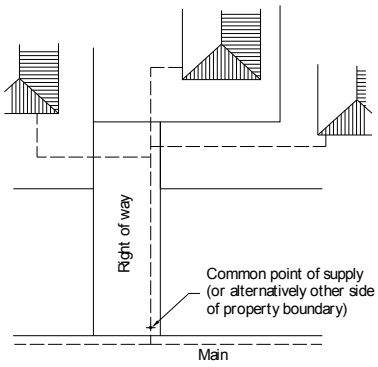
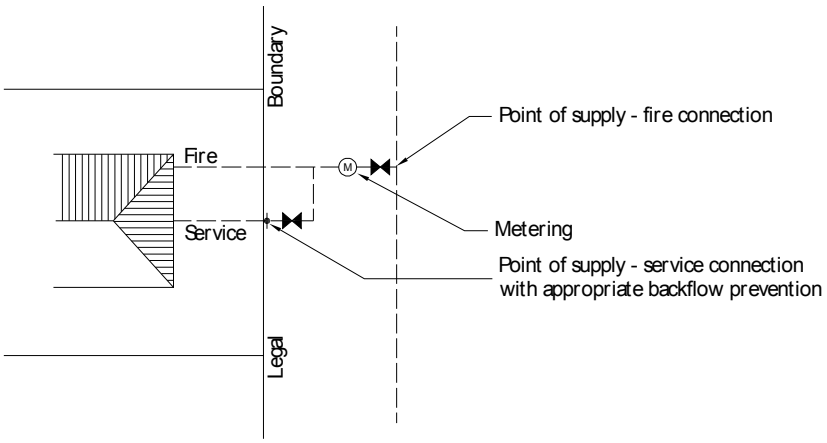
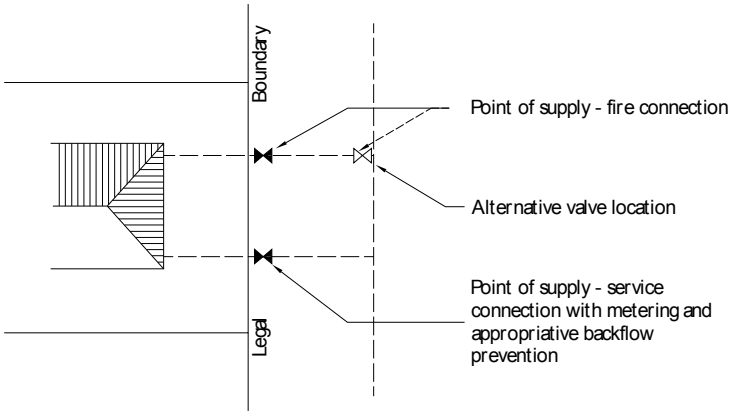


Figure 3: Common point of supply

Example 4 – Industrial, commercial, domestic fire and service connections (including schools)

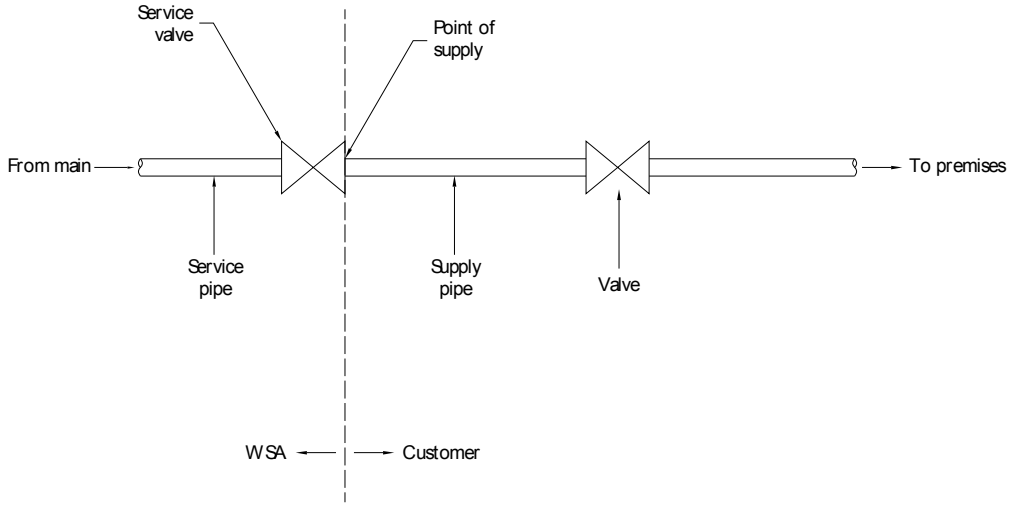


Combined fire and service connection

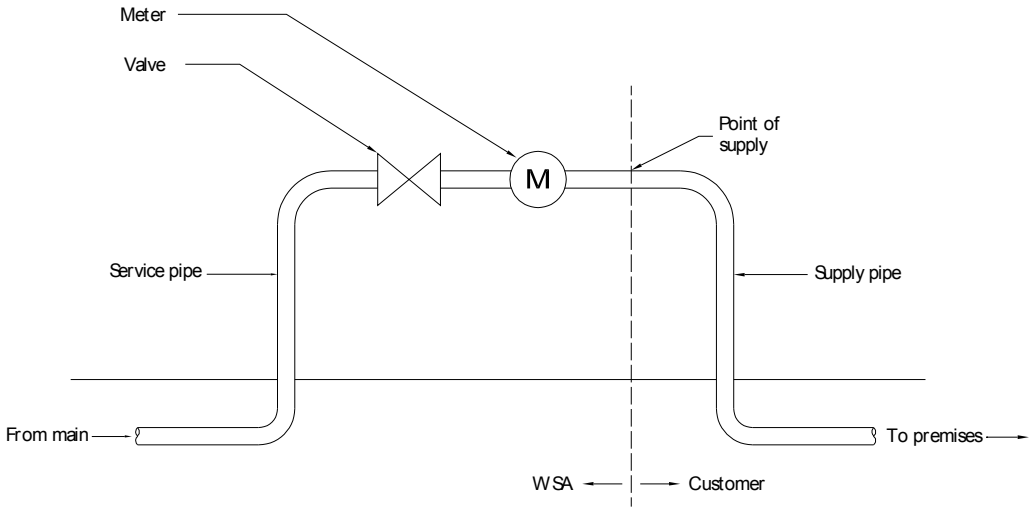


Separate fire and service connection

Examples of typical component layout at point of supply



Example 5 - Domestic unmetered supply

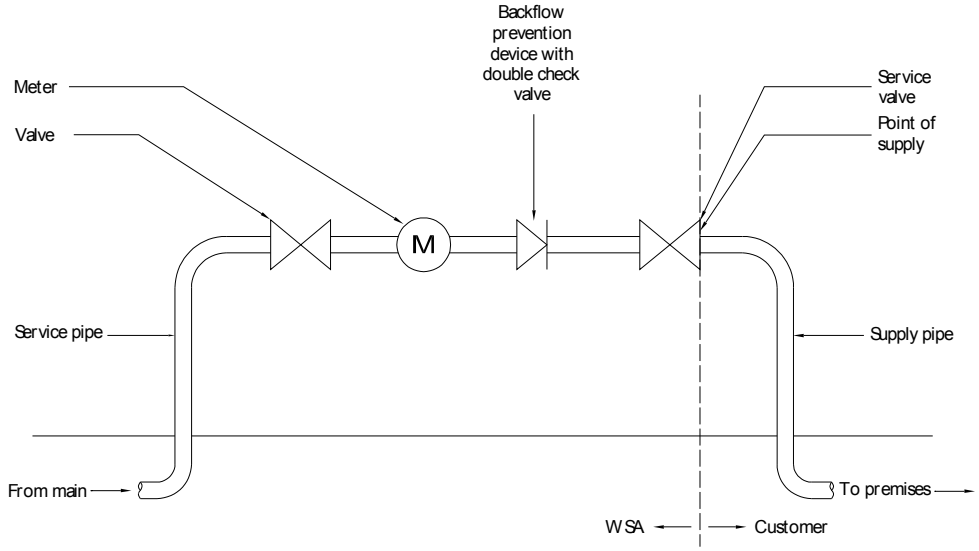


Example 6 - Domestic metered supply

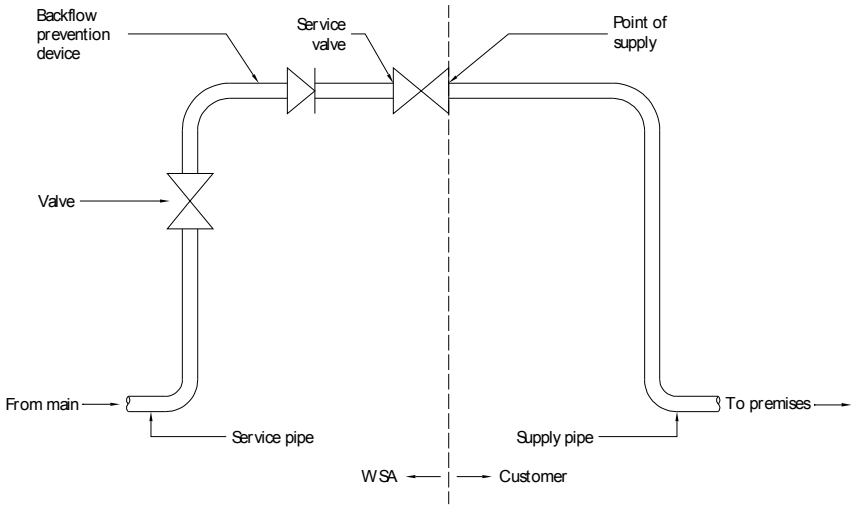
Note:

(1) Point of supply is tail piece of boundary box, meter, or service valve regardless of property boundary.

(2) The New Zealand Building Code may require the Customer to install additional backflow prevention devices within the site, which will remain the responsibility of the Customer.



Example 7 – Metered supply with backflow prevention device owned by Council.

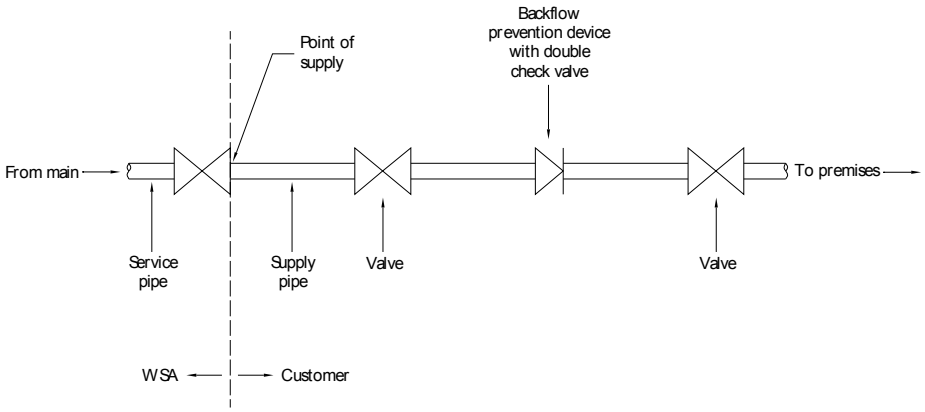


Example 8 – Unmetered supply with backflow prevention device owned by Council.

Note:

(1) Point of supply is tail piece of boundary box, meter, or service valve regardless of property boundary.

(2) The New Zealand Building Code may require the Customer to install additional backflow prevention devices within the site, which will remain the responsibility of the Customer.



Example 9 - Unmetered supply with backflow prevention device owned by the customer

Schedule 2: Table 1 Compatibility Features

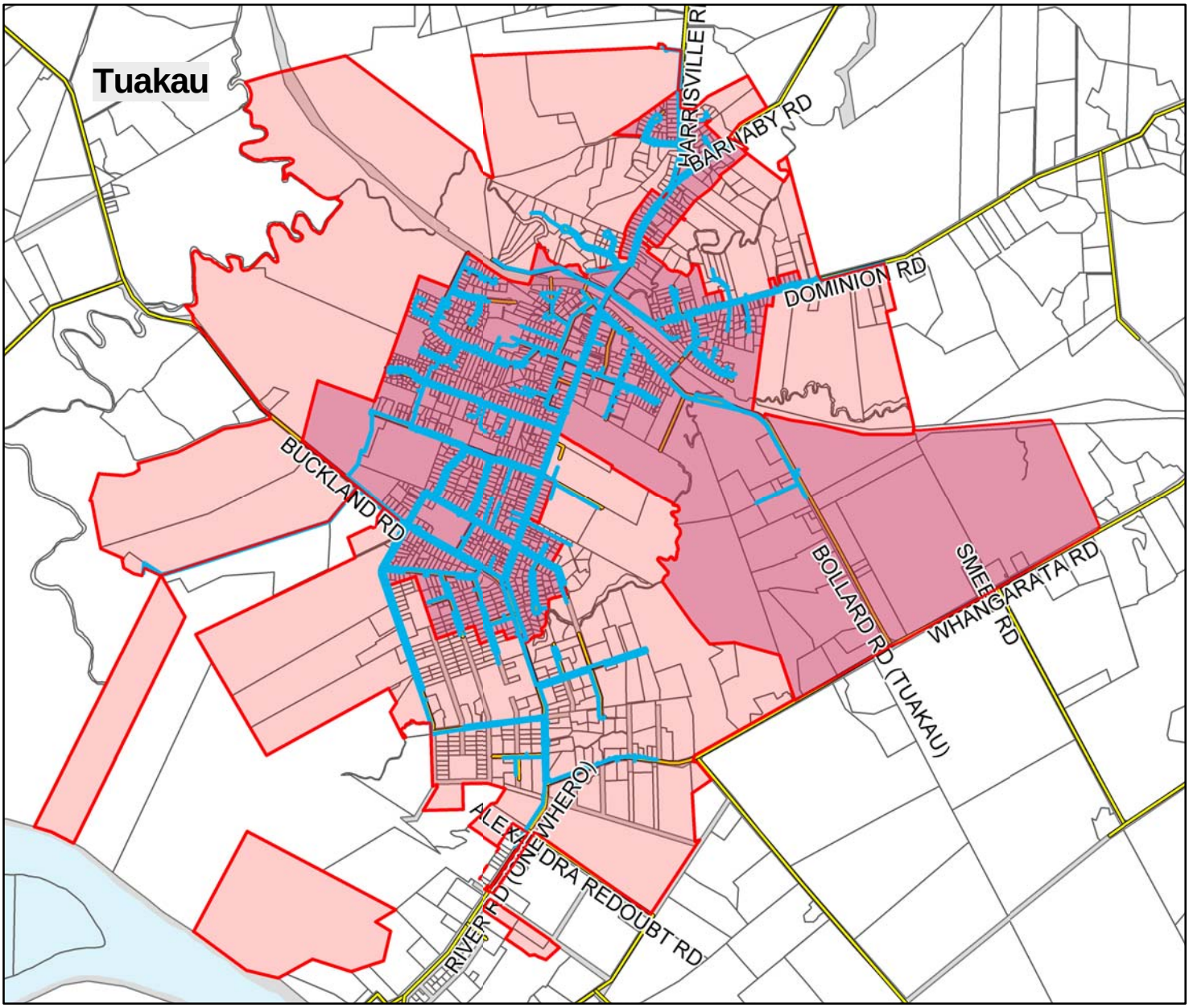
Specific features of the Council supply which need to be taken into account are contained in Table 1 below.

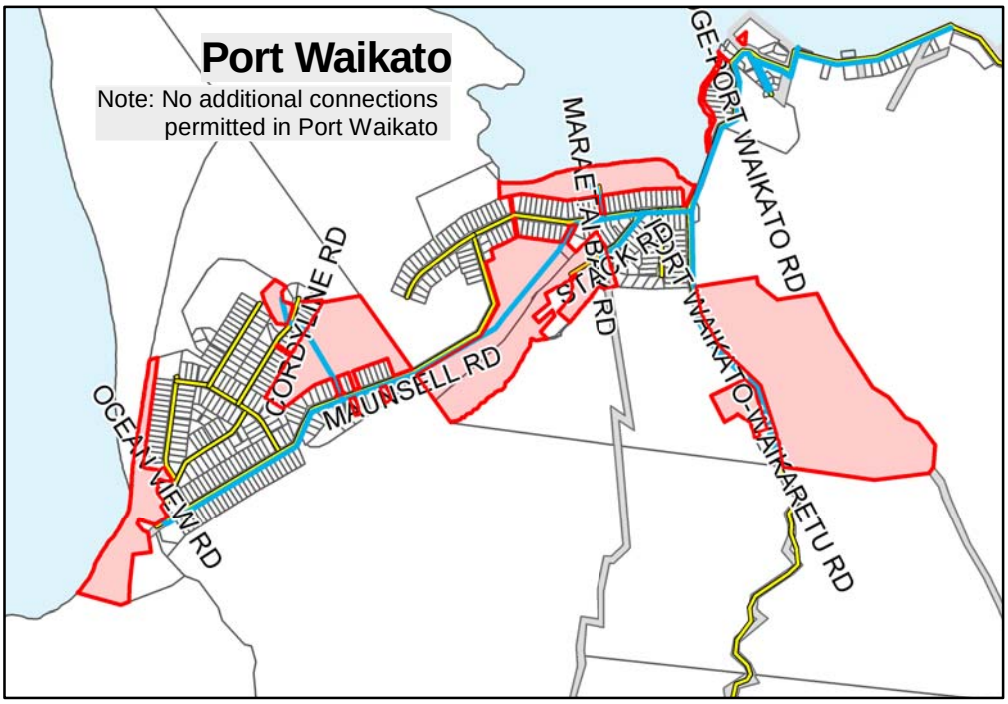
Table 1 - Compatibility features

Feature	**Value**
Maximum pressure	100 metres head (1,000 kPa)
Minimum pressure*	10 metres head (100 kPa)
Normal operating pressure	20-30 metres head (200 - 300 kPa)
Free available chlorine	Up to 1.5 g/m^3

*Minimum pressure refers to on demand water supplies only

Schedule 3: Water Supply Area Maps





Legend

- Water Supply Area
- WSA On Demand
- WSA Restricted
- Water Supply ine
- State Highway
- Road
- Road Reserve
- Property
- Water Body

Waikato District Council

Water Supply Area

Tuakau and Port Waikato

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Datum:	2000
Revision No:	1.0HB12265

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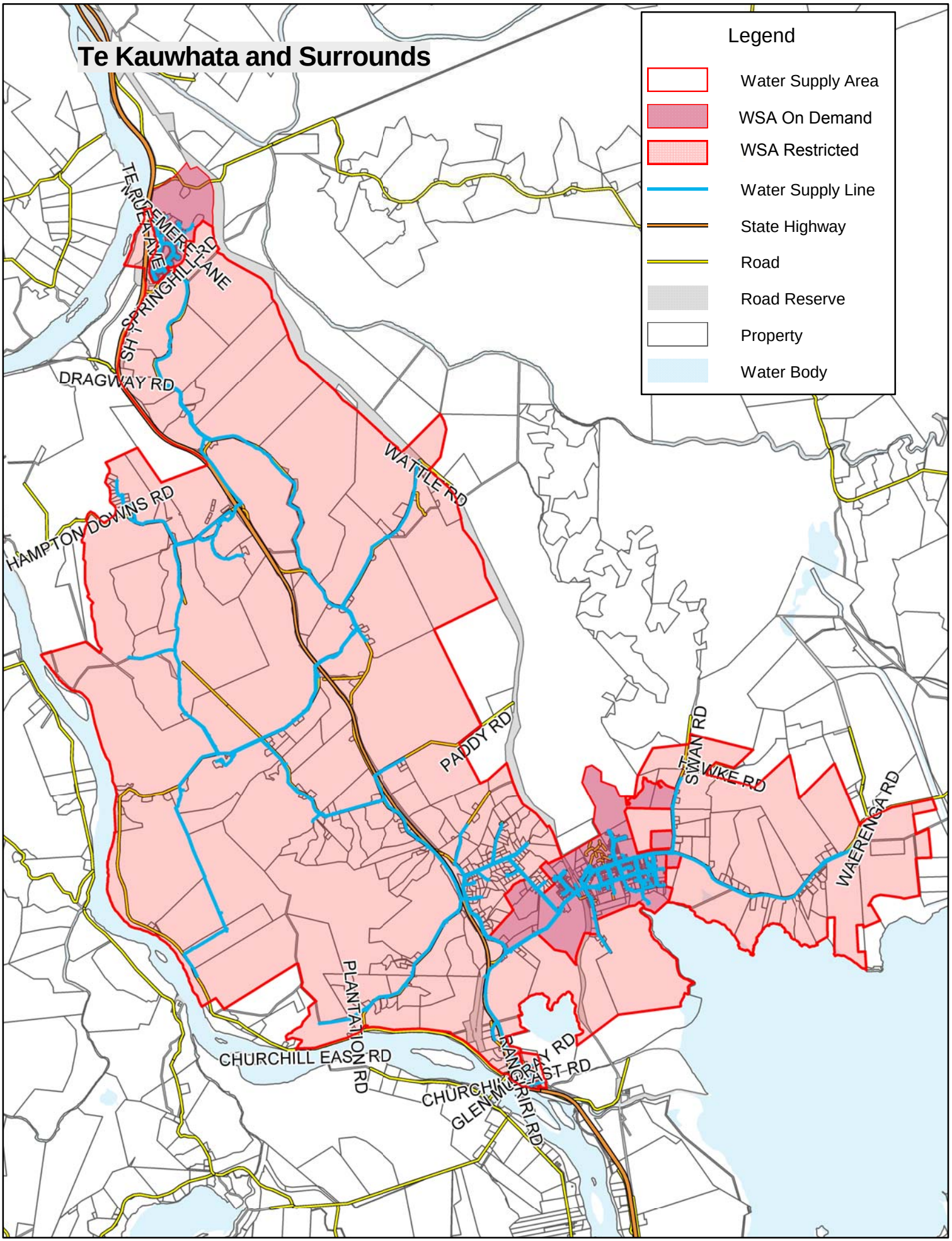

Waikato District Council

Water Supply Area

Te Kauwhata and Surrounds

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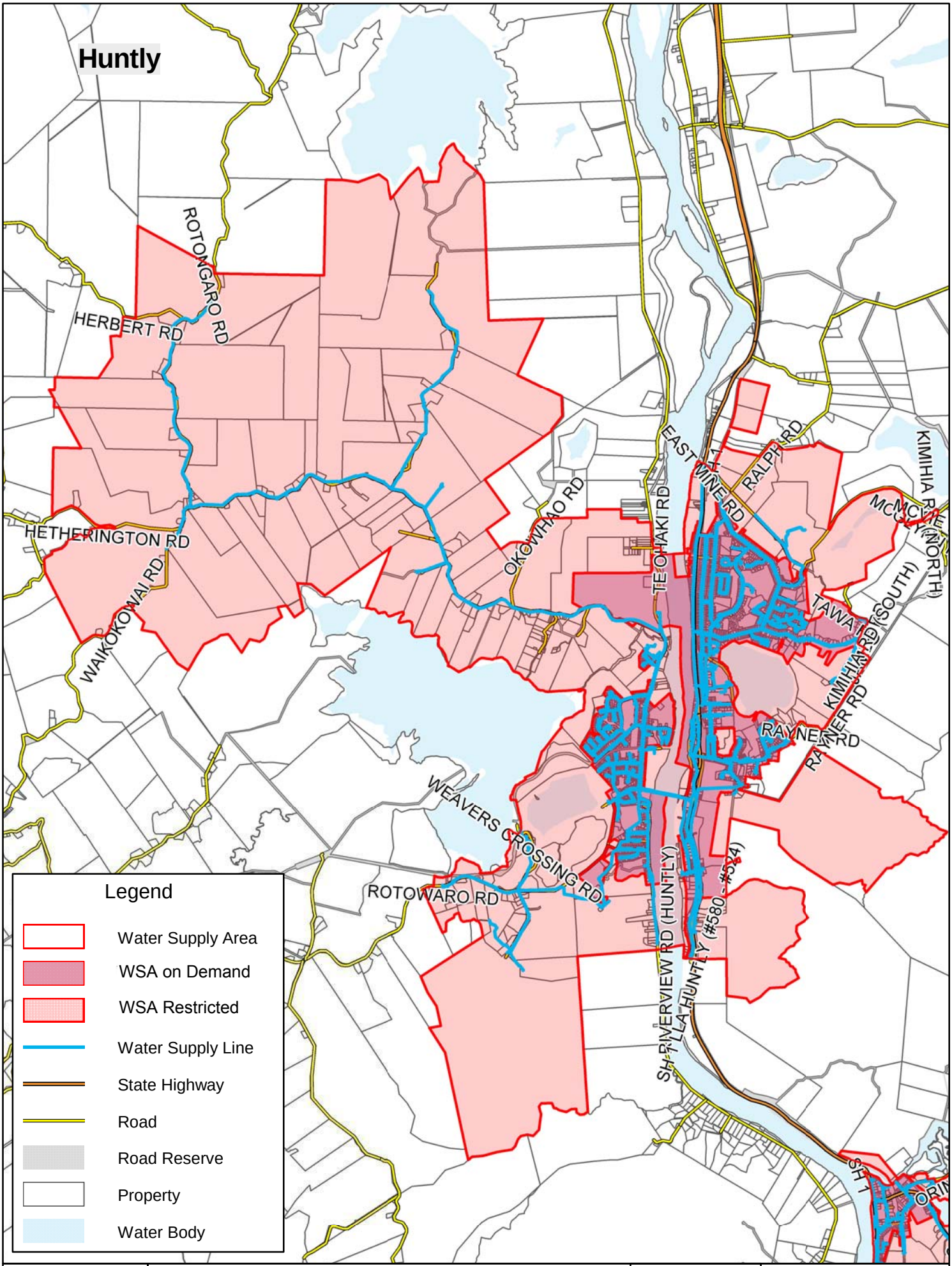

Waikato District Council

Water Supply Area

Huntly

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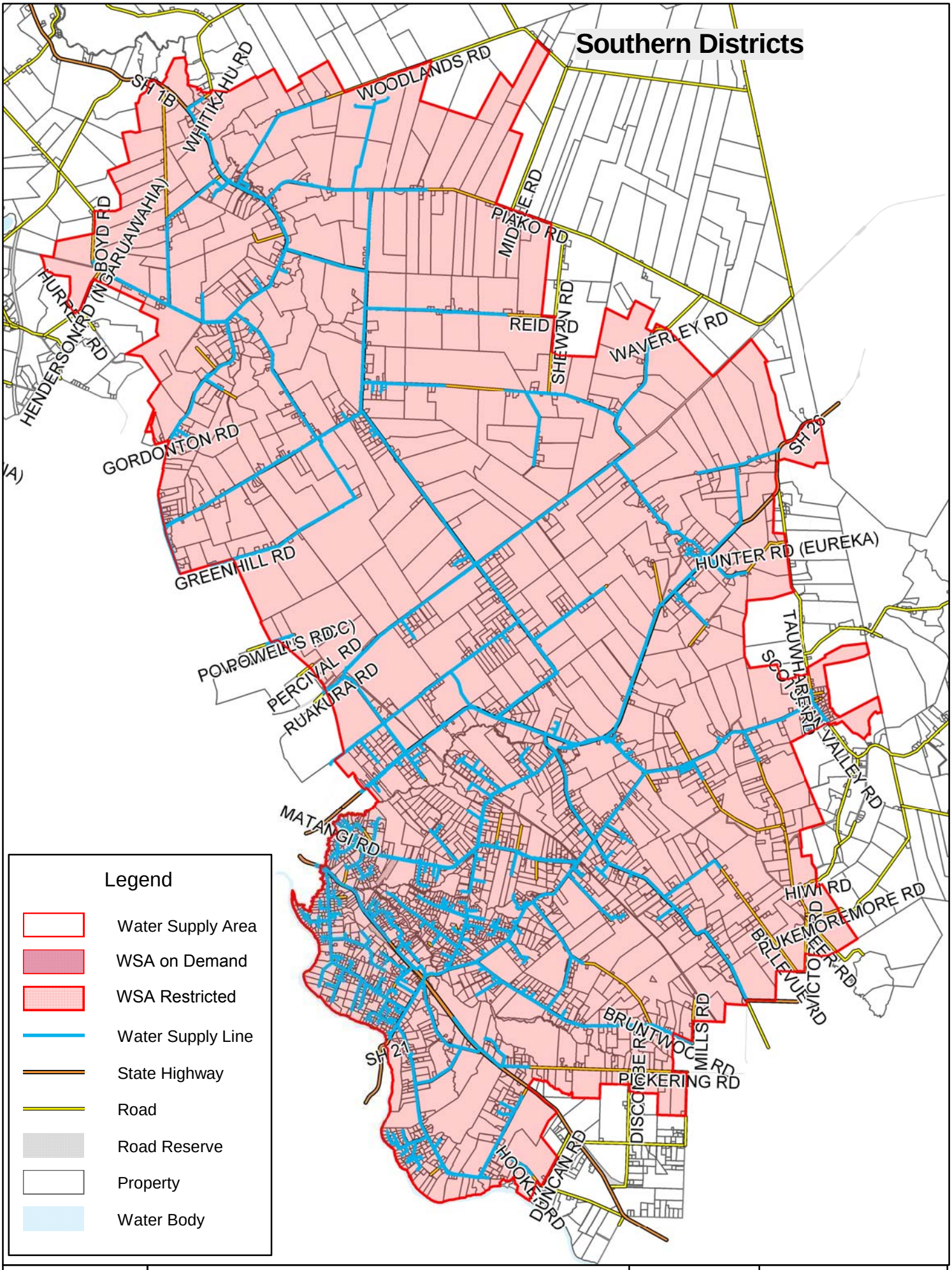

Waikato DISTRICT COUNCIL

Water Supply Area

Southern Districts

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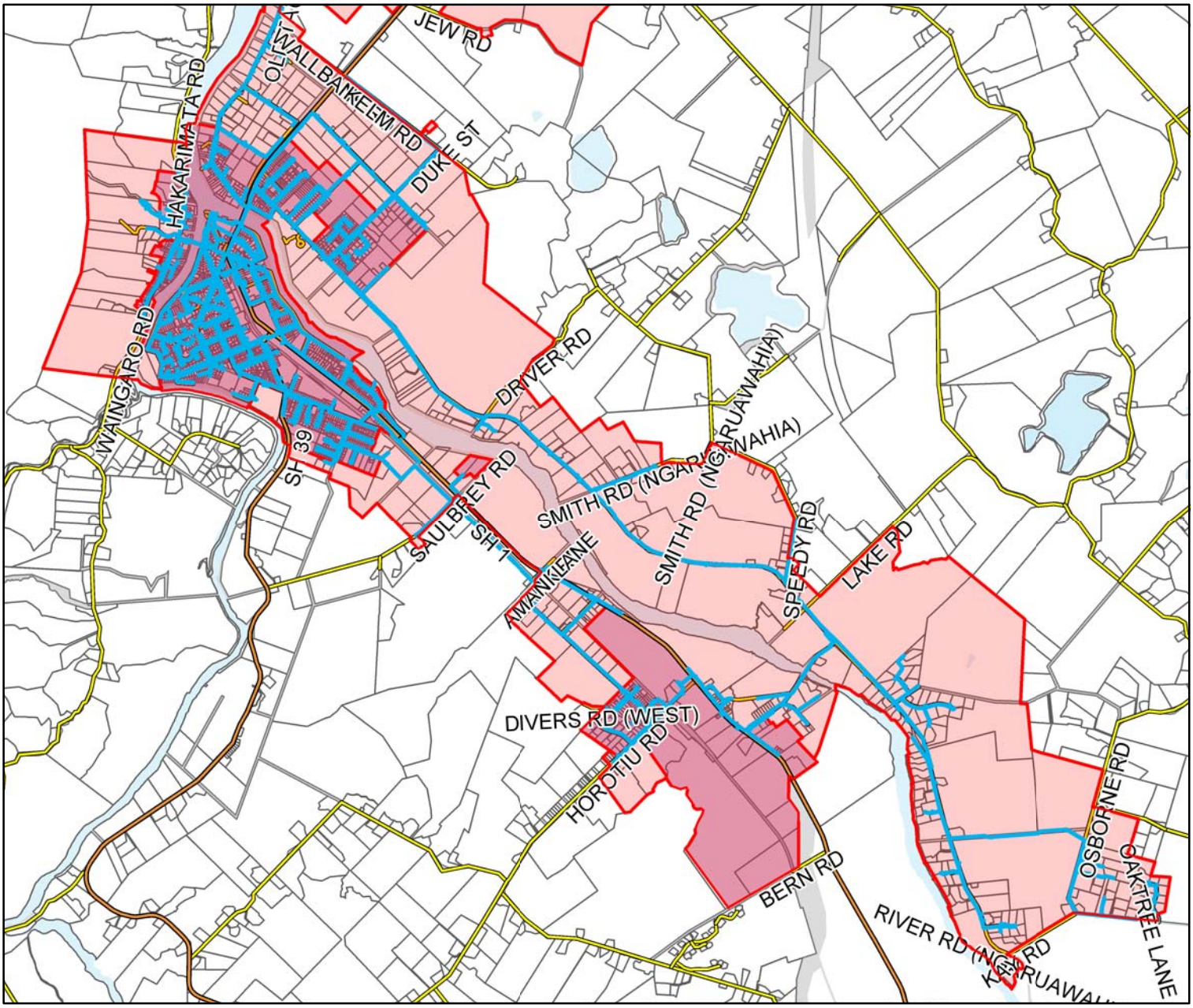

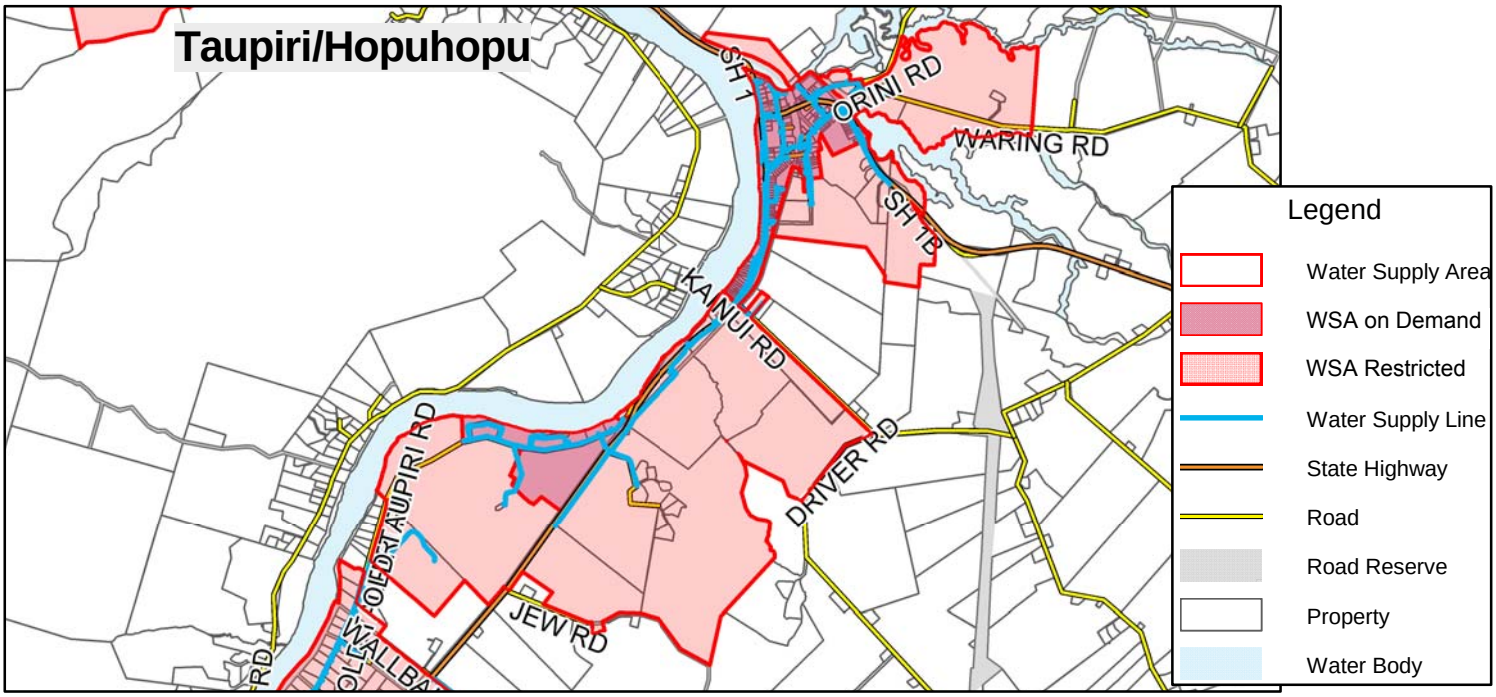

Waikato District Council

Water Supply Area

Ngaruawahia, Taupiri & Hopuhopu

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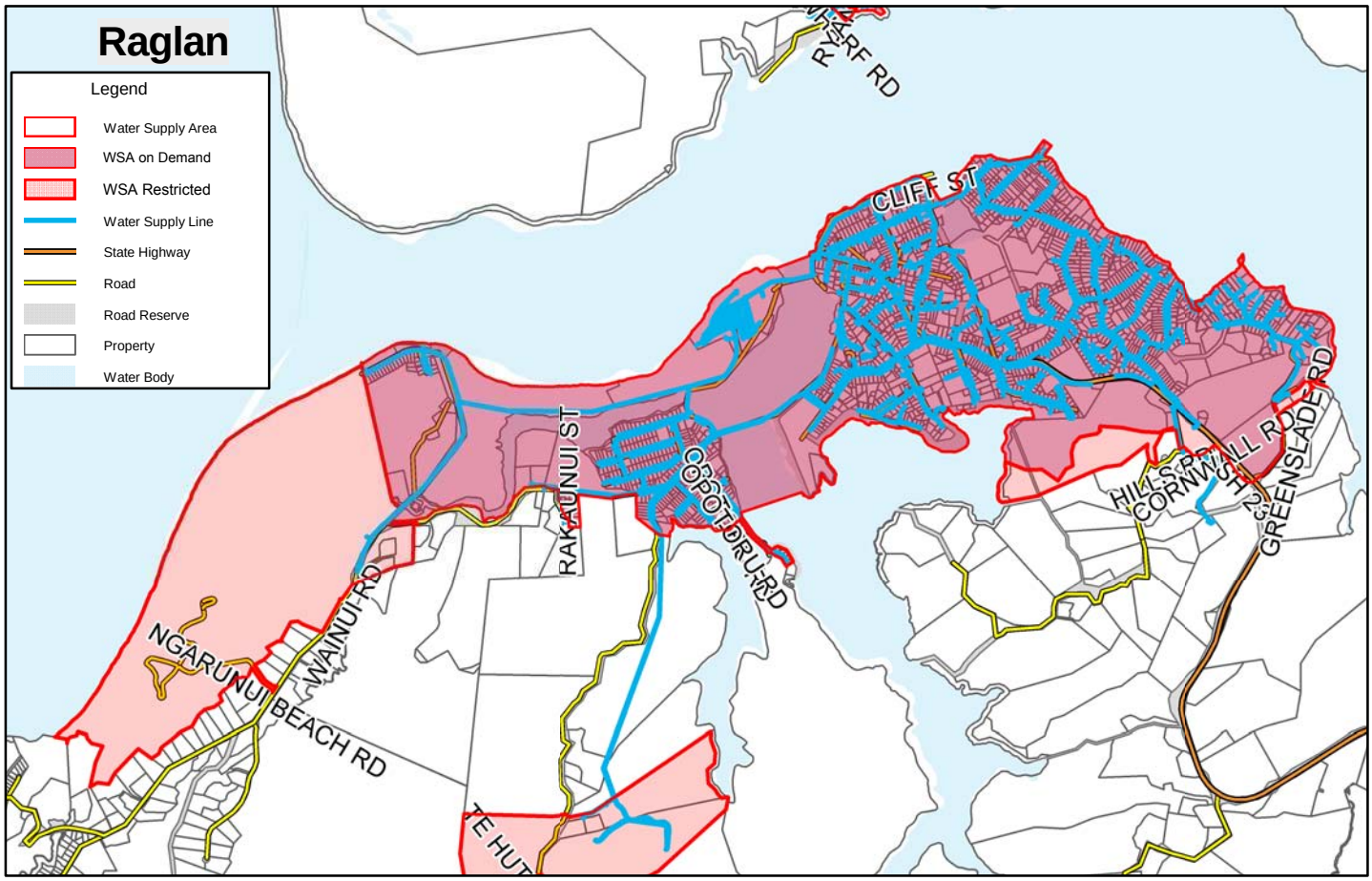

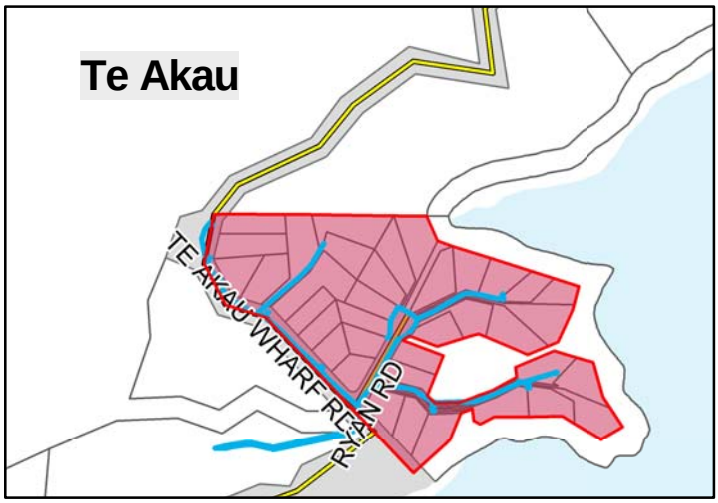

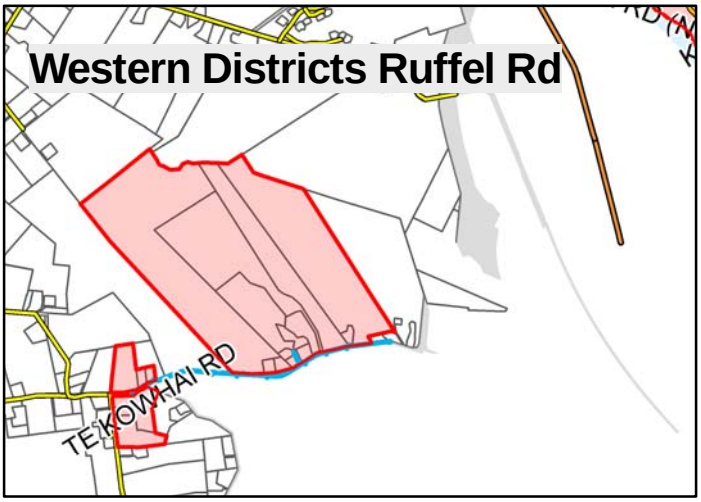

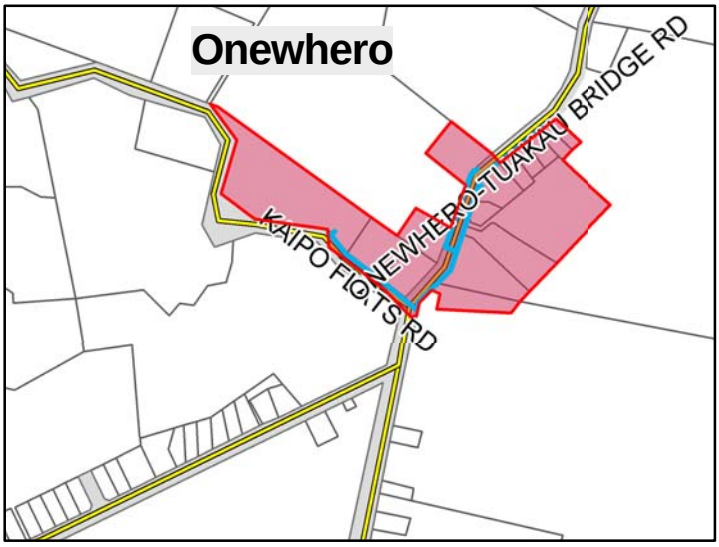

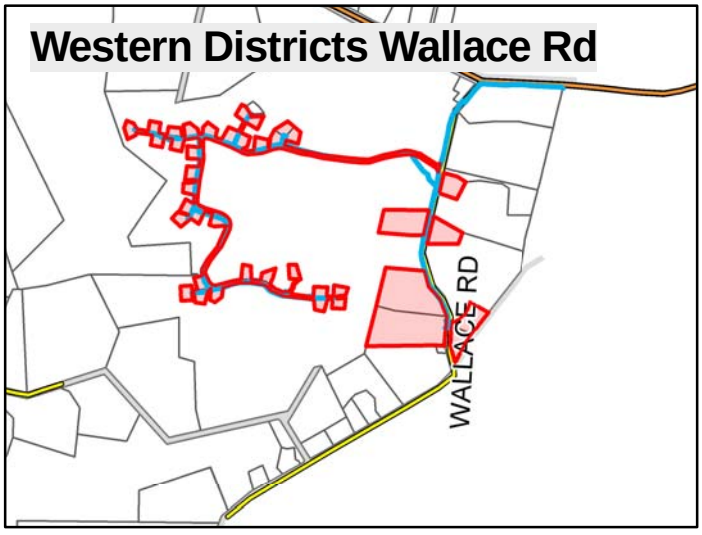

Waikato DISTRICT COUNCIL

Water Supply Area

Raglan, Te Akau, Western Districts & Onewhero

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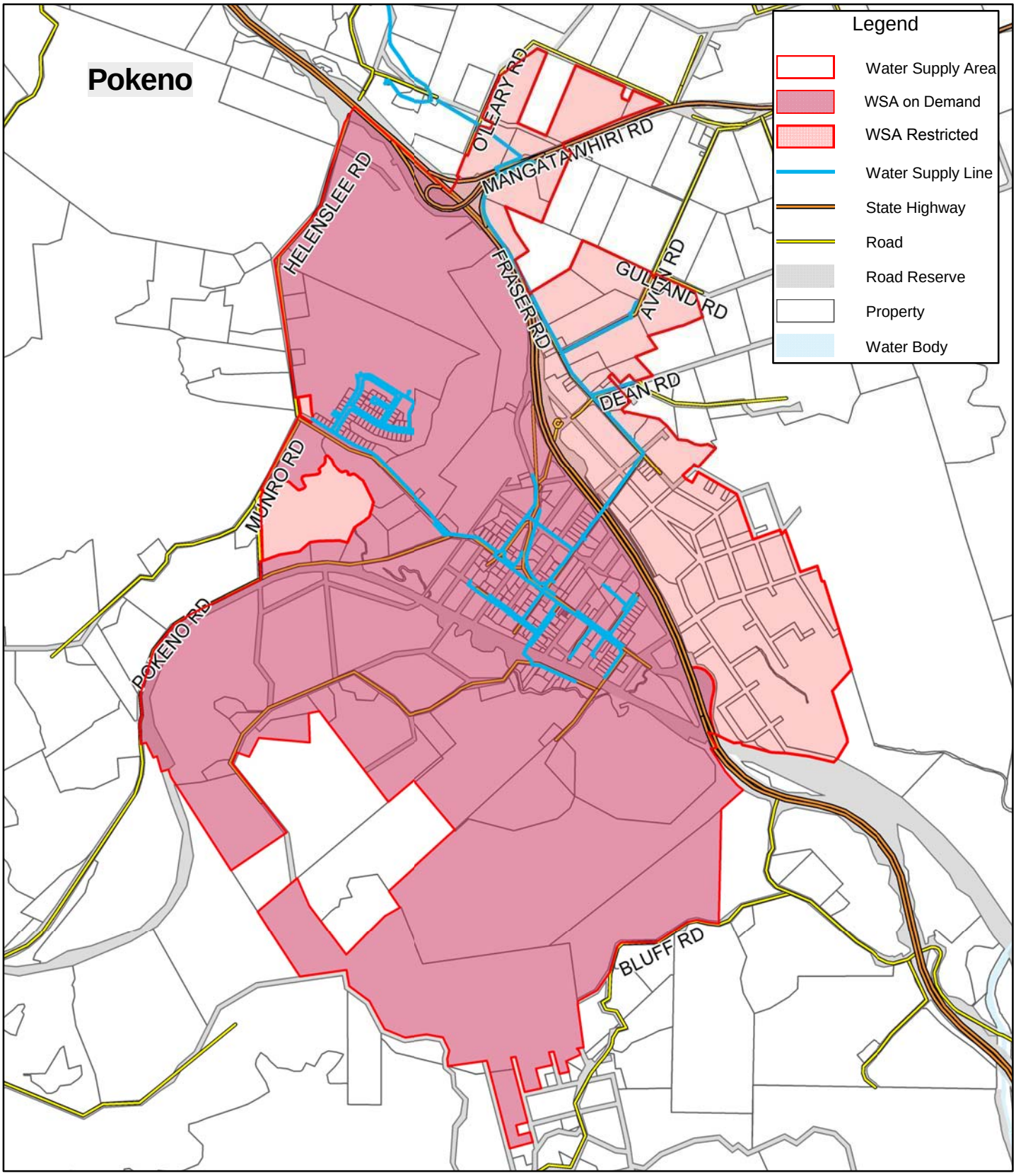

Waikato DISTRICT COUNCIL

Water Supply Area

Pokeno

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18. Appendix F – Bulk Infrastructure Details

AQUAFORCE™ e-HV

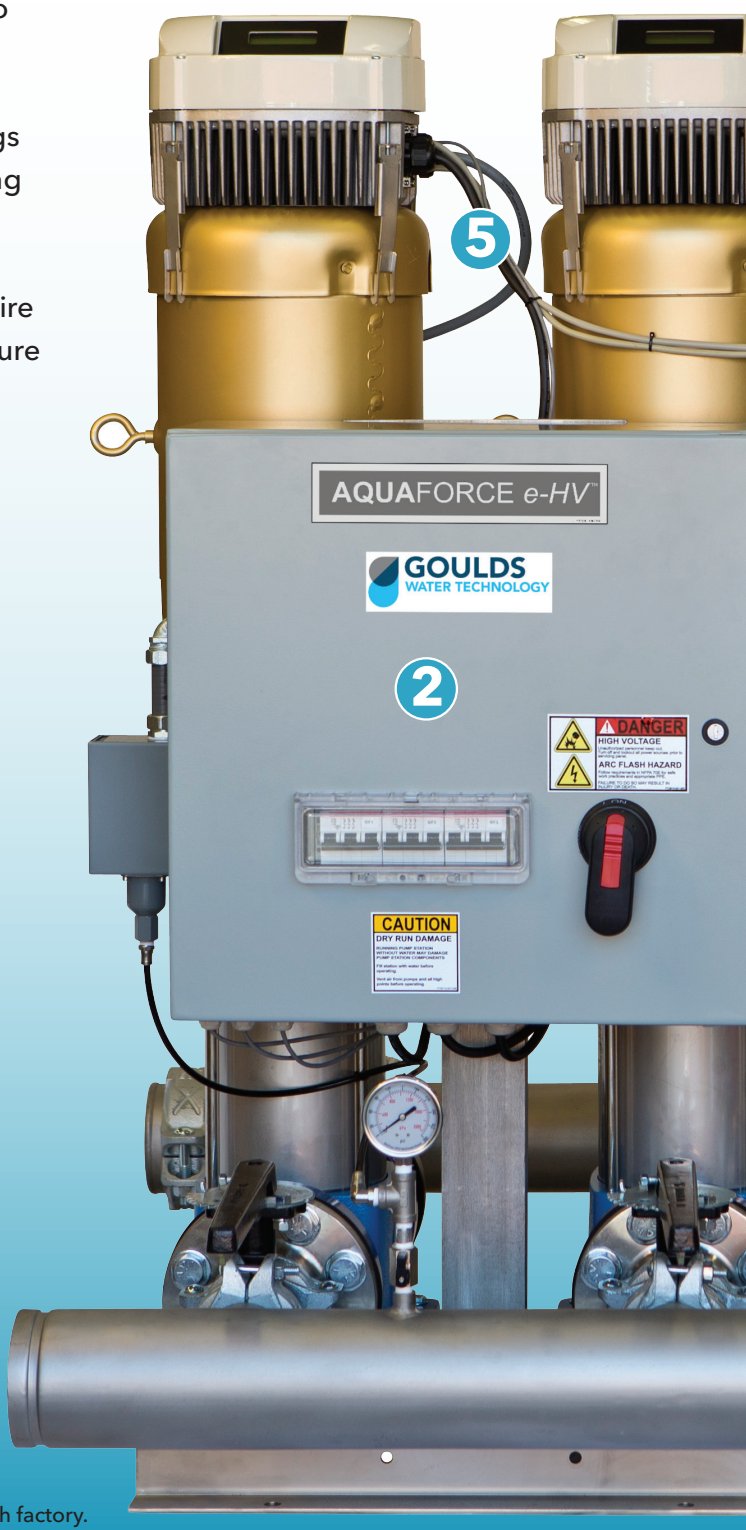
PUMP STATIONS

GOULDS WATER TECHNOLOGY
a xylem brand

BRAFEHV R3

AQUAFORCE e-HV
Pump Stations

Introducing the **AQUA**FORCE e-HV packaged booster system from Goulds Water Technology. The 40% more compact **AQUA**FORCE e-HV booster systems utilize our standard e-SV mutli-stage pumps in two to four pump arrangements up to 780 GPM and 600 feet. Every e-HV station is provided with rugged 304SS base and framing, common 304SS grooved suction and discharge manifolds with required pump fittings and is fully NSF/ANSI 61 & 372 certified for potable drinking water. Each pump is outfitted with a master Hydrovar Variable Speed Pump Control/Drive with individual pump disconnects ensuring full redundancy for systems that require no downtime. Each station is fully tested for flow and pressure and comes programmed ready to install.



GENERAL

- •ASHRAE 90.1 Compliant
- • NSF/ANSI 61 & 372 Certified
- • UL CQCZJ
- • cUL
- • UL508A
- • NEC

WATER PRESSURE BOOSTING APPLICATIONS.

- • Commercial Office Buildings
- • Hotels, Inns, Resorts
- • Condos & Apartments
- • Rural Boosting Stations
- • Schools
- • Hospitals
- • Data Centers
- • HVAC Applications
- • Industrial & Plant
- • Irrigation

NOTE: Specifications / equipment are subject to change without notice. Verify with factory.

Features that make a difference

1. HydroVar Variable Speed Pump Control
The e-HV comes standard with Xylem's proven HydroVar Pump Control/VFD for pressure boosting applications. Standard NEMA 1, mutli-master configuration make the e-HV the obvious choice for your critical applications.

2. Individual Pump Disconnects
With integrated through the door pump circuit breakers located in a NEMA 12 station disconnect enclosure, the e-HV allows for ease of service without the need to shut down the entire Booster package.

3. Premium Efficient
The e-HV utilizes off the shelf TEFC Premium Efficient NEMA Frame motors, eliminating the need for special order motor/drive combination units.

4. Stainless Steel
Corrosion? Not with e-HV. With a standard 304SS base and framing you can feel confident in placing the e-HV in any location. And as always the 304SS grooved suction and discharge manifolds allow for simple installation into any piping system.

5. Compact
By utilizing items such as our HydroVar with molded wiring harnesses, eSV pumps with minimal spacing and optimized pump trim, we have been able to deliver the same performance in a package that takes up 40% less space.

For complete system capabilities and detailed specifications go to www.gould.com

Testing and quality control.

From design to fabrication, and assembly to shipping, our systems pass through several quality checkpoints right up to the very moment they leave our facility. Every stage of the manufacturing process must be completed before a system can be released to the customer. To provide further control of product performance, we have two major test areas: the test pit and the booster testing station. Pressure tests are conducted up to 500 PSI to assure system integrity.

Certified to be safe and reliable.

A lot of hard work, experience and knowledge goes into our product. The best tools are equipped and the best processes are in place to ensure that the systems we produce meet the specification and exceed our customer expectation.

Quality, safety and reliable = Peace of Mind.

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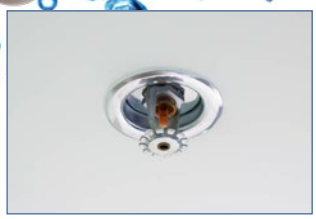
Aquatech Pressmain

Water Technology Pressure Maintained

AQUAMATIC AMV-DS



COMBINED DOMESTIC SUPPLY & SPRINKLER BOOSTER SET

WRAS APPROVED PRODUCT

bsi. ISO 9001 Quality Management ISO 14001 Environmental Management

FM 33090 EMS 598248

Designed and manufactured to meet the requirements of British Standard 9251:2014 (Fire sprinkler systems for domestic and residential occupancies)

CE PED (Pressure Equipment Directive) Compliant BSI Certificates CE 95657 & 95658

bsi.

MADE IN BRITAIN

IE5 PREMIUM EFFICIENCY

AQUAMATIC AMV-DS

COMBINED SPRINKLER BOOSTER SET WITH ENHANCED CONTROLS

OVERVIEW

The Aquamatic AMV-DS range of quality assured cold water pressure booster sets, is designed to increase the pressure of the cold/hot water services within a building and feed the sprinkler system efficiently when triggered. The range incorporates efficient inverter driven variable speed pumps, which continually vary the motor speed to match the changing flow demand pattern, whilst maintaining a constant system duty pressure. This mode of operation, adjusting the pump's motor speed to the building's flow requirements, reduces the power consumption dramatically when compared to fixed speed motor control.

Our AMV-DS 2, 3, 4, 5 and 6 pump sets are manufactured to allow all of the pumps to run together if required. So pumps may be sized with or without a standby pump. All are programmed to run in staged cascade operation as the flow demand increases and similarly as demand decreases. All pumps are assembled on a common base frame with a Microprocessor, control panel and all necessary valves and fittings to ensure ease of installation and efficient, reliable operation.

Features

- Energy Efficient Variable Speed motors to IE5 grade (0.75kW to 2.2kW motors exceed EuP IE4 grade)
- '2020Plus' Microprocessor/Transducer Control for long term reliability and accuracy with 'REPRESS' hydraulic shock system protection
- Automatic Cascade Control for all pumps
- User Friendly Keypad & illuminated 2 line LCD Display for 'Plain English' information for both system status and system pressure
- Electronic Low Water Cut-Out for pump dry running protection, with auto re-start upon water restoration
- All pumpsets are WRAS approved and are ECA Energy Technology Listed Product
- BMS Volt Free Enhanced package fitted as standard
- Built to Latest CE Requirements and in accordance with ISO9001 and designed and manufactured to meet the requirements of BS 9251
- 304 Stainless steel pipework as standard
- Dedicated tanks designed and manufactured to meet the requirements of BS 9251 and LPS scheme approved

SPECIFICATION

Cold Water Pressure Booster Pump Set arranged for operation as duty pump with assist standby pump(s) all under efficient variable speed motor control via Aquatech Pressmain 2020Plus microprocessor control panel requiring single/three phase electrical supply (as appropriate – see below). Complete with interconnecting wiring, lockable isolating valves and all necessary valves and fittings which form the suction and discharge manifolds. All complete on a steel base frame.

Designed, manufactured and tested in accordance with ISO9001 quality assurance procedures, using PED and WRAS approved components suitable for potable water specification. Designed and manufactured to meet the requirements of BS 9251 and all relevant European Community Directives as required by UK law and CE marked.

Automatic variable speed pump motor control by Aquatech Pressmain 2020Plus microcontroller for long term reliability and accurate pressure measurement by 392 transducer. Automatic alternations of all pumps to even run times with adjustable pump running time. Sequential pump starting to avoid overloading electric supply. Hand/off/auto switches for each pump on panel fascia. Motor overload protection. Electronic low water protection, interlocked door isolator, RS232/485 serial communication port. Data logging function, indicators for pumps run, hand, off and auto. "User Friendly" fascia mounted keypad for entering/retrieving data and system parameters, with illuminated 2 line LCD display for pressure, faults and information in plain English.

Also indicating: Power on, System Working Pressure, System status, twin Low and High Water Level in feed tank (where fitted - see page 4), Low System Pressure, High System Pressure, Pump Hours run, Pump Failed, Transducer Failed and service reminder. Our 2020plus enhanced micro software also features the RE-PRESS power restoration electronic safety system, offering the end user a controlled system refill following electrical supply failure, protecting against hydraulic shock.

In addition to the above there is the "BMS Enhanced" package fitted which gives 8 volt free relay outputs, pump tripped lights on panel fascia. The above equipment is complete with all necessary terminals, labels and interconnections, enclosed in a sheet steel, dust and damp proof housing with lockable door to IP55.

Finish

Pump bodies are finished in electrophoresis coating. Panel is powder coated. Stainless steel pipework is left unpainted for effect.

Control Pressure Vessel

To assist with the constant pressure controls a suitably sized WRAS flow through design pressure vessel is provided complete with a flowjet combined isolating and drain valve.

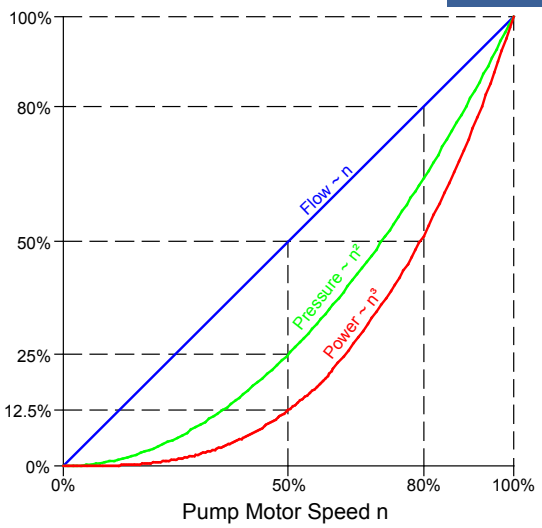
Flowjet – Flow through, shut-off and discharge valve

VARIABLE SPEED PUMPING PRINCIPLE

The basic concept is to alter the pump speed to match exactly the required demand of water to the system, using the principle that flow rate is directly proportional to pump speed. The electricity consumed by the pump motor is proportional to the cube of the pump speed. It can be shown (Fig. 1) that a 20% reduction in flow rate from the peak demand will reduce the power consumed by the motor by 50%. As the flow demand continues to decrease further savings in pump motor power consumption can be achieved.

Not only does this produce a saving in electricity consumption but it also provides other benefits such as reduced strain on the pumpset and system components by excessive pressure and water hammer, smoother and quieter operation through "ramped" acceleration and deceleration of the pump. Also constant pressure output is available where over-pressure could have an adverse effect on the system such as when refurbishing old buildings using the existing pipework or where calorifiers have a limited pressure rating.

FIG. 1



AMV-DS OPTIONAL FEATURES & ANCILLARIES

Pipework Material Options
Aquatech Pressmain will supply 304 Stainless steel pipework manifolds as standard, however we can provide Galvanised, ABS, UPVC, 316 Stainless Steel or Copper from the HY-AV & BTE product ranges.

Flexible Connections
Made from EPDM rubber and WRAS approved for potable water applications, this spherical bellows type flexible coupling joint will absorb pipe movements, isolate vibration, reduce system noise. Gaskets are not required and the joints are easily and speedily installed.

Anti Vibration Mountings
When fitted this turret type mount will isolate the pump package from the ground or floor-mounting surface. The mounting will arrest and reduce pump rotation starting inertia and associated vibration being transmitted through the ground or floor-mounting surface, which could potentially cause a noise problem.

High & Low Level Feed Tank Alarm Probe: LWP3
Up to two high and two low LWP3 tank probes can be connected to the 2020Plus control panel. This probe is available for side and top mounting and provides a visual warning of tank high level via the control panel fascia. BMS link is also provided via the shared level volt free output.

GRP Weather Proof Enclosure
Where internal plant room space is at a premium or where a unit needs to be remotely located this fully encapsulated 25mm pre-insulated GRP enclosure may provide the ideal solution. It is supplied with an internal frost stat, heater, natural vents and access door with Yale lock.

Acoustic Attenuation Enclosure
Although the standard package meets stringent EC noise levels, this enclosure is specifically designed for noise sensitive applications. Typically an insertion loss of approximately 30dB(A) can be achieved in most applications. Enclosures are supplied complete with naturally ventilated acoustic louvres, removable panels for easy pump maintenance and glazed vision panel for viewing pump controls fascia.

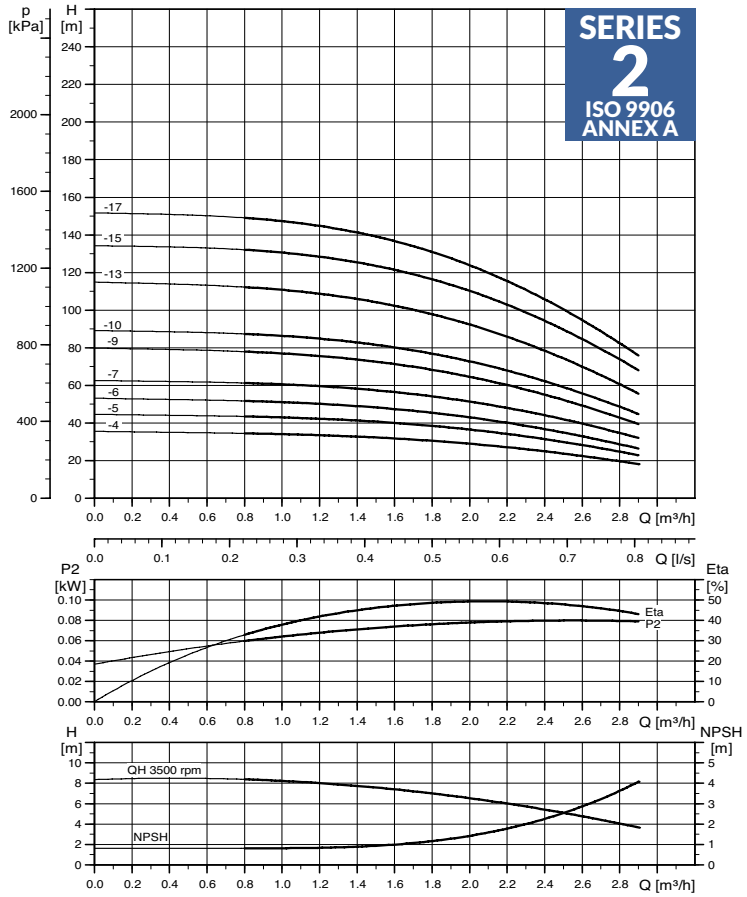
Remote Alarm Panel
Suitable for wall mounting where indications of warning and alarm conditions are required remote from the unit's location.

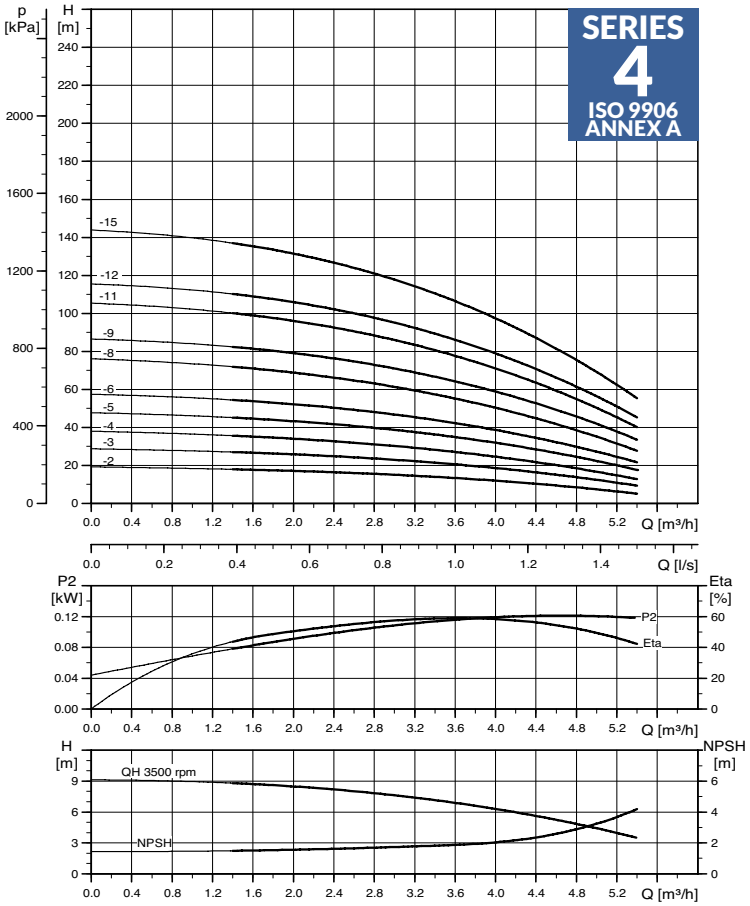
Distribution Manifolds
Prefabricated with our proven in-house copper extrusion method. Can be assembled with any number of individual stabbings and combination of isolating, non-return, double check valve & water meters to suit the building installation requirements.

Control Panel Options
In addition to the standard features listed we can provide and are not limited to the following options; Emergency Stop Button; Pump run volt free contacts; Individual pump isolators; Anti-Condensation panel heater; Volt meter & switch; 4-20ma pressure output.

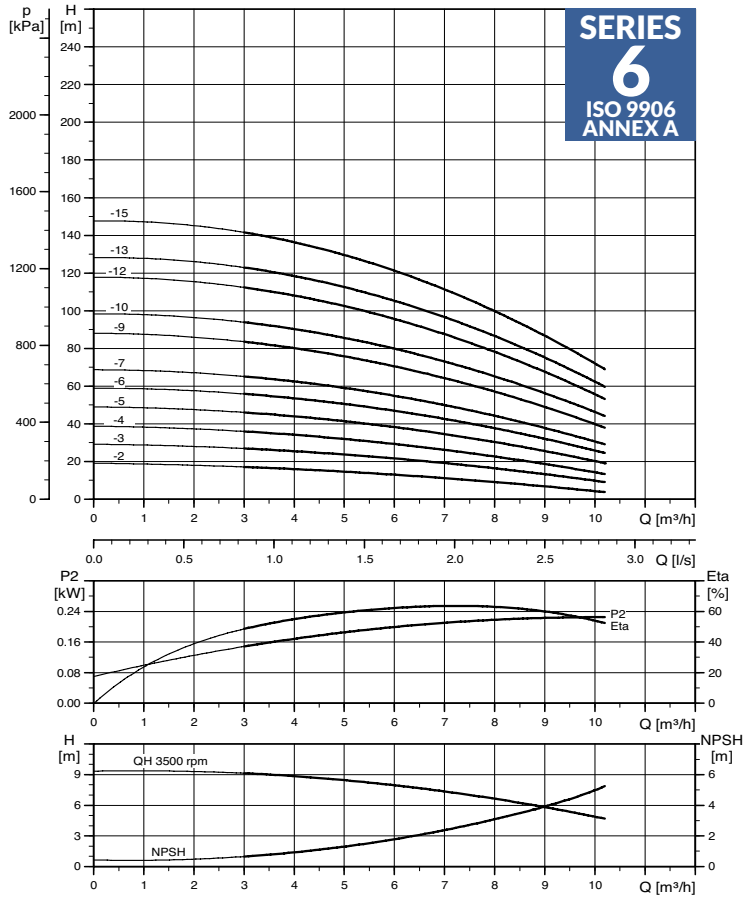
Aquavent
Designed to help assist with the draining down and refilling of pressure boosted water supply pipework by helping to prevent damaging pressure shocks from occurring. Whether a system pipework is drained down intentionally for maintenance or unintentionally as a result of the pressure booster set stopping, either by power interruption or a low water condition there is the potential of pressure shocks when the pressure booster restarts.

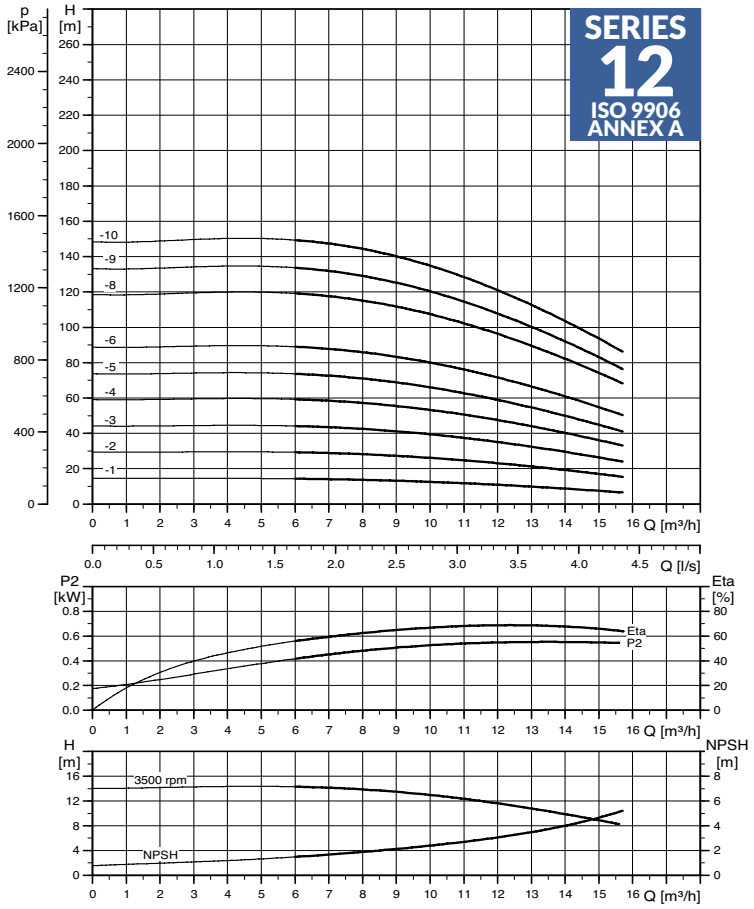
INDIVIDUAL PUMP SELECTION CURVES SERIES 2 & 4



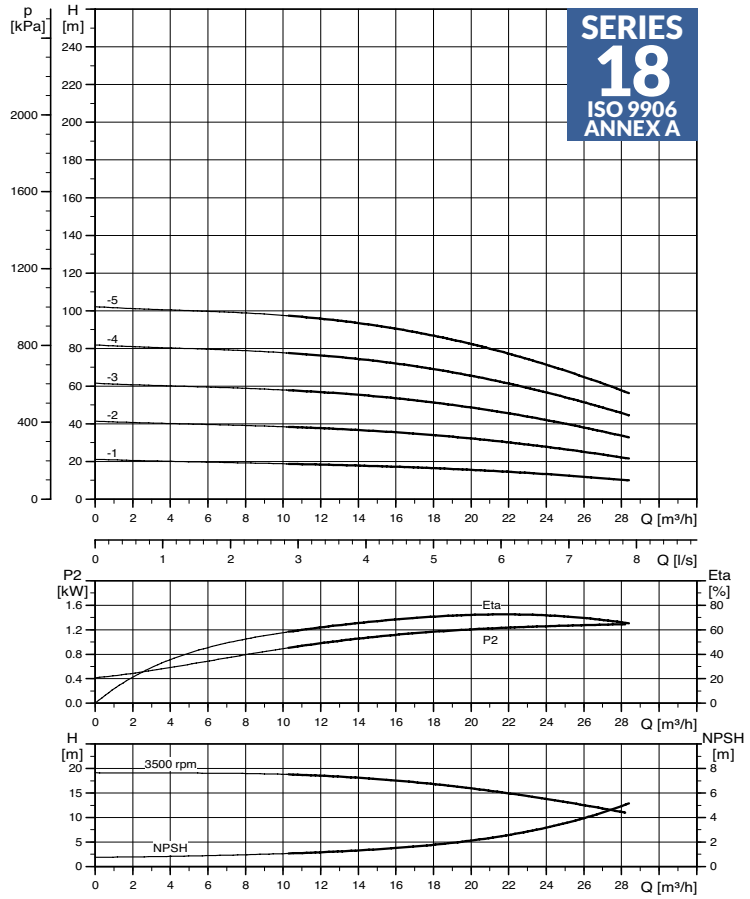


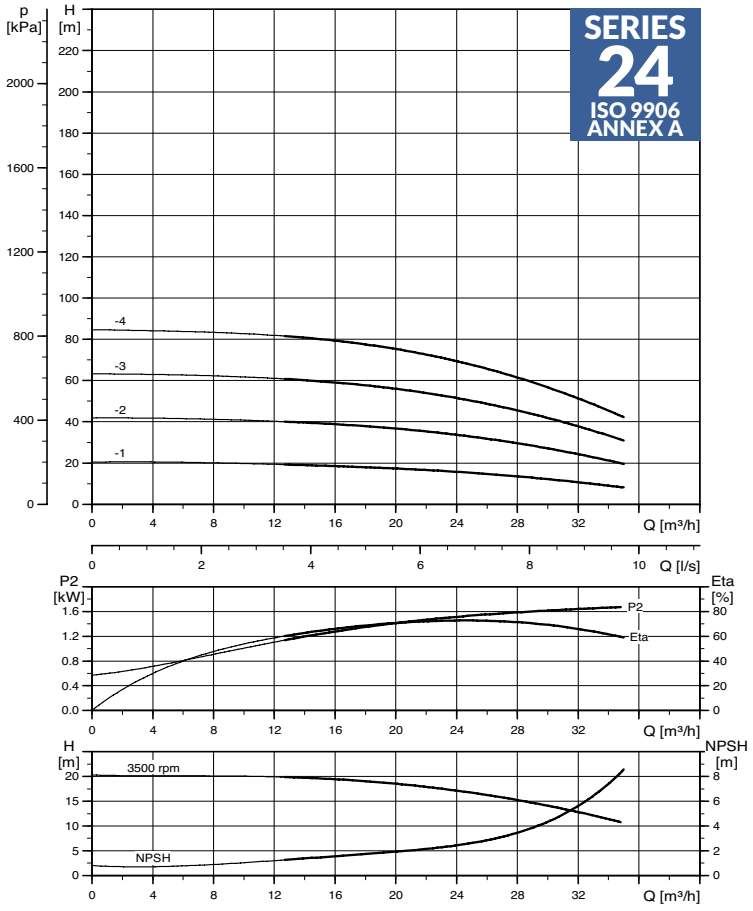
INDIVIDUAL PUMP SELECTION CURVES SERIES 6 & 12



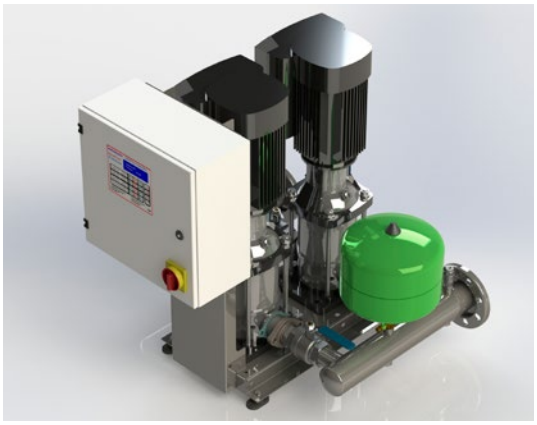


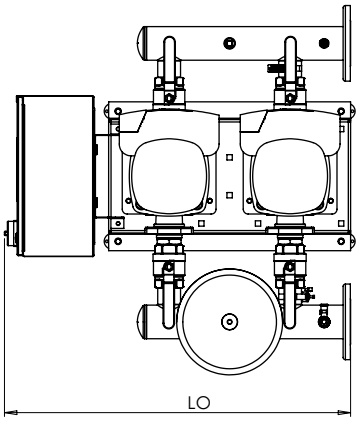
INDIVIDUAL PUMP SELECTION CURVES SERIES 18 & 24

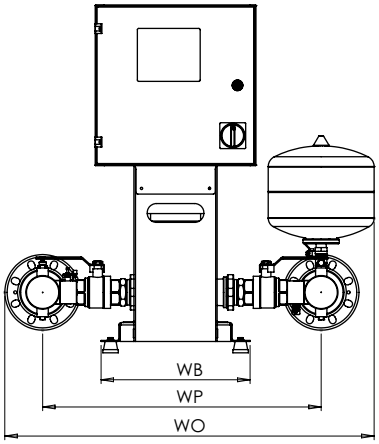


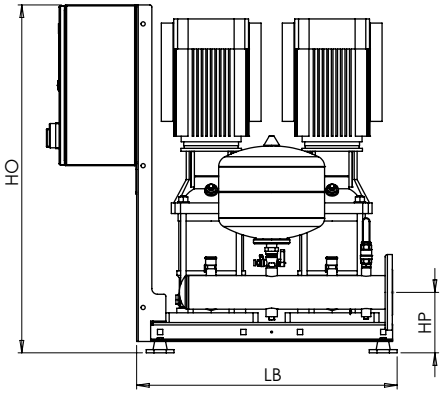


TWO PUMP MODEL AMV2-DS DIMENSIONS





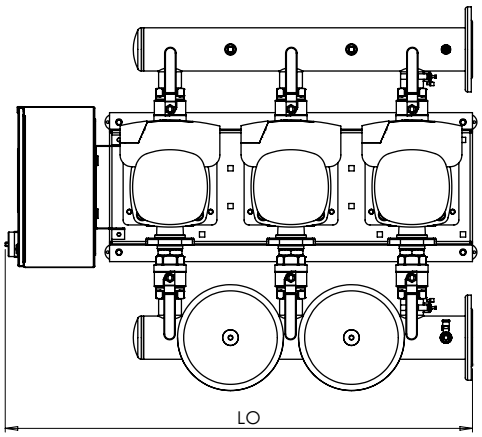


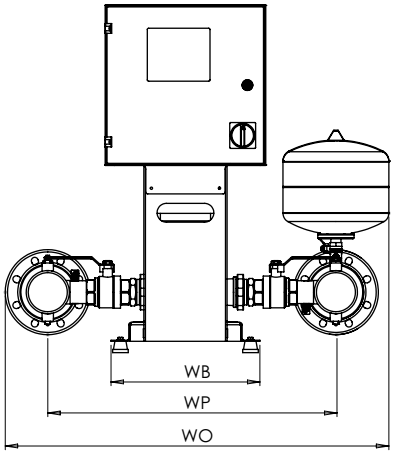


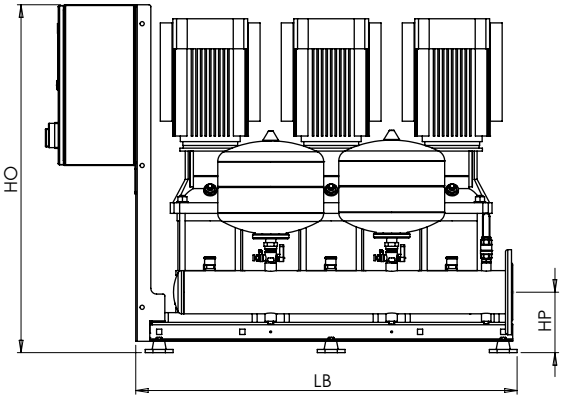
AQUAMATIC AMV2-DS VARIABLE SPEED FLOW-THROUGH COLD WATER BOOSTER

PUMP TYPE	kW PER PUMP	FULL LOAD CURRENT 1Ph 240V AMPS	FULL LOAD CURRENT 3Ph 415V AMPS	TOTAL DRY WEIGHT OF UNIT (KG)	SOUND LEVEL dB(A)	BOOSTER SET DIMENSIONS [+/- 10mm]							FLANGE SIZE	VESSEL(S)	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 1PH 230V	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 3PH 400V
						LO	WO	HO	HP	LB	WB	WP				
2-4	0.37	6.6	3.6	111	58	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	71A 1 H 0.37	71A 2 10.37
2-5	0.55	8.6	4.2	113	58	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
2-6	0.55	8.6	4.2	113	58	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
2-7	0.75	11	5	121	58	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
2-9	0.75	11	5	121	58	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
2-10	1.1	15	6.2	127	58	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
2-13	1.1	15	6.2	127	58	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
2-15	1.5	19.4	7.6	161	64	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
2-17	1.5	19.4	7.6	161	64	920	870	920	130	690	400	645	DN50 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
4-2	0.37	6.6	3.6	109	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	71A 1 H 0.37	71A 2 10.37
4-3	0.55	8.6	4.2	111	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
4-4	0.55	8.6	4.2	111	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
4-5	0.75	11	5	117	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
4-6	0.75	11	5	117	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
4-8	1.1	15	7.5	123	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
4-9	1.1	15	6.2	123	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
4-11	1.5	19.4	7.6	157	64	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
4-12	2.2	N/A	10	167	64	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
4-15	2.2	N/A	10	167	64	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
6-2	0.55	8.6	4.2	111	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
6-3	1.1	15	6.2	121	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
6-4	1.1	15	6.2	121	58	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
6-5	1.5	19.4	7.6	153	64	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
6-6	2.2	N/A	10	167	64	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
6-7	2.2	N/A	10	167	64	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
6-9	2.2	N/A	10	167	64	920	870	920	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
6-10	3	N/A	14.4	147	70	920	870	969	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	100LC2-D1
6-12	3	N/A	14.4	147	70	920	870	969	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	100LC2-D1
6-13	4	N/A	18.2	173	75	920	870	1114	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	132SC2-D1
6-15	4	N/A	18.2	173	75	920	870	1114	130	690	400	655	DN50 PN16	1X 12 LTR	N/A	132SC2-D1
12-1	0.75	11	5	145	58	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
12-2	1.5	19.4	7.6	183	64	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
12-3	2.2	N/A	10.0	193	64	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	90LD 212.2
12-4	3	N/A	14.4	173	70	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	100LC2-D1
12-5	3	N/A	14.4	173	70	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	100LC2-D1
12-6	4	N/A	18.2	197	75	920	920	950	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SC2-D1
12-8	5.5	N/A	24	237	80	920	920	1091	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SD2-D1
12-9	5.5	N/A	24	237	80	920	920	1091	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SD2-D1
12-10	7.5	N/A	31.6	241	72	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SD2-D1
18-1	1.5	19.4	7.6	185	64	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
18-2	3	N/A	14.4	171	70	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	100LC2-D1
18-3	4	N/A	18.2	195	75	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SC2-D1
18-4	5.5	N/A	24.0	231	80	920	920	1011	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SD2-D1
18-5	7.5	N/A	31.6	241	72	920	920	1056	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SD2-D1
24-1	2.2	N/A	10.0	193	64	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	90LD 212.2
24-2	4	N/A	18.2	193	75	920	920	920	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SC2-D1
24-3	5.5	N/A	24.0	229	80	920	920	966	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SD2-D1
24-4	7.5	N/A	31.6	239	72	920	920	1011	160	690	400	655	DN80 PN16	1X 12 LTR	N/A	132SD2-D1

THREE PUMP MODEL AMV3-DS DIMENSIONS



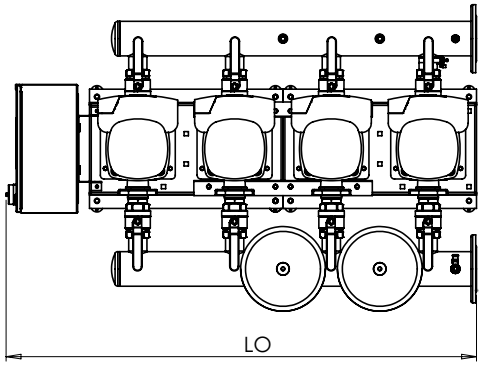


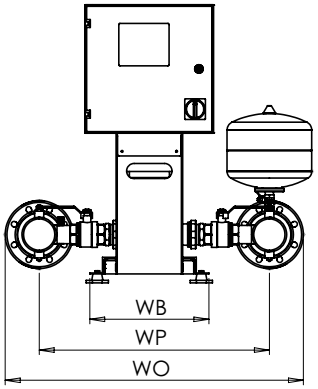


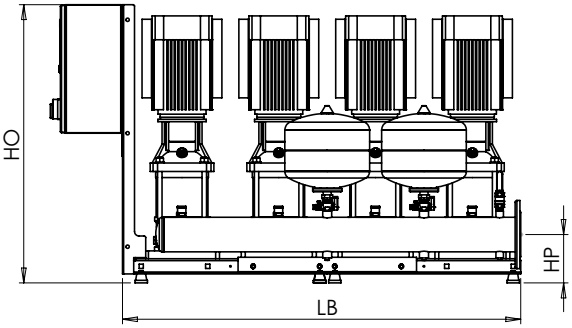
AQUAMATIC AMV3-DS VARIABLE SPEED FLOW-THROUGH COLD WATER BOOSTER

PUMP TYPE	kW PER PUMP	FULL LOAD CURRENT 1Ph 240V AMPS	FULL LOAD CURRENT 3Ph 415V AMPS	TOTAL DRY WEIGHT OF UNIT (KG)	SOUND LEVEL dB(A)	BOOSTER SET DIMENSIONS [+/- 10mm]							FLANGE SIZE	VESSEL(S)	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 1PH 230V	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 3PH 400V
						LO	WO	HO	HP	LB	WB	WP				
2-4	0.37	8.9	4.4	152	58	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	71A 1 H 0.37	71A 2 10.37
2-5	0.55	11.9	5.3	155	58	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
2-6	0.55	11.9	5.3	155	58	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
2-7	0.75	15.5	6.5	167	58	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
2-9	0.75	15.5	6.5	167	58	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
2-10	1.1	21.5	8.3	176	58	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
2-13	1.1	21.5	8.3	176	58	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
2-15	1.5	28.1	10.4	227	64	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
2-17	1.5	28.1	10.4	227	64	1240	870	920	130	1010	400	645	DN50 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
4-2	0.37	8.9	4.4	149	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	71A 1 H 0.37	71A 2 10.37
4-3	0.55	11.9	5.3	152	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
4-4	0.55	11.9	5.3	152	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
4-5	0.75	15.5	6.5	161	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
4-6	0.75	15.5	6.5	161	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
4-8	1.1	21.5	8.3	170	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
4-9	1.1	21.5	8.3	170	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
4-11	1.5	28.1	10.4	221	64	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
4-12	2.2	N/A	14	236	64	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
4-15	2.2	N/A	14	236	64	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
6-2	0.55	11.9	5.3	152	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
6-3	1.1	21.5	8.3	167	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
6-4	1.1	21.5	8.3	167	58	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 11.1
6-5	1.5	28.1	10.4	215	64	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
6-6	2.2	N/A	14	236	64	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
6-7	2.2	N/A	14	236	64	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
6-9	2.2	N/A	14	236	64	1240	870	920	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	90LD 212.2
6-10	3	N/A	20.6	206	70	1240	870	969	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	100LC2-D1
6-12	3	N/A	20.6	206	70	1240	870	969	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	100LC2-D1
6-13	4	N/A	26.3	245	75	1240	870	1114	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	132SC2-D1
6-15	4	N/A	26.3	245	75	1240	870	1114	130	1010	400	655	DN50 PN16	1X 12 LTR	N/A	132SC2-D1
12-1	0.75	15.5	6.5	217	58	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	80A 2 H 0.75	80A 2 10.75
12-2	1.5	28.1	10.4	274	64	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
12-3	2.2	N/A	14.0	289	64	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	90LD 212.2
12-4	3	N/A	20.6	259	70	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	100LC2-D1
12-5	3	N/A	20.6	259	70	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	100LC2-D1
12-6	4	N/A	26.3	295	75	1240	1020	950	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SC2-D1
12-8	5.5	N/A	35	355	80	1240	1020	1091	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
12-9	5.5	N/A	35	355	80	1240	1020	1091	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
12-10	7.5	N/A	46.4	361	72	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
18-1	1.5	28.1	10.4	277	64	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	90SC 2 H 1.5	90SC 2 11.5
18-2	3	N/A	20.6	256	70	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	100LC2-D1
18-3	4	N/A	26.3	292	75	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SC2-D1
18-4	5.5	N/A	35.0	346	80	1240	1020	1011	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
18-5	7.5	N/A	46.4	361	72	1240	1020	1056	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
24-1	2.2	N/A	14.0	289	64	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	90LD 212.2
24-2	4	N/A	26.3	289	75	1240	1020	920	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SC2-D1
24-3	5.5	N/A	35.0	343	80	1240	1020	966	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
24-4	7.5	N/A	46.4	358	72	1240	1020	1011	160	1010	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1

FOUR PUMP MODEL AMV4-DS DIMENSIONS



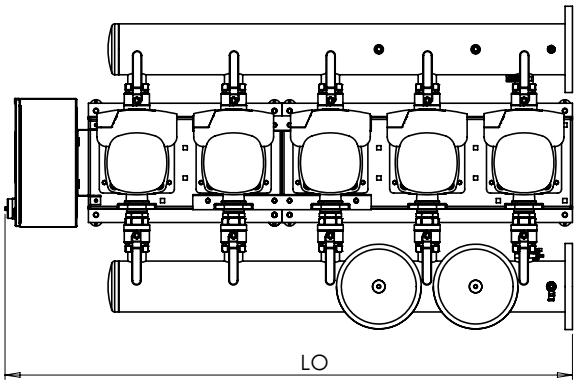


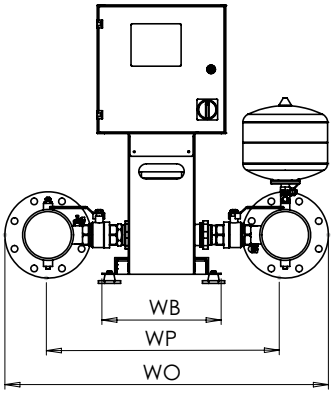


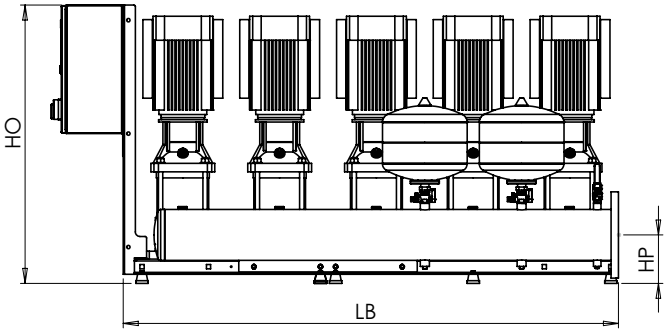
AQUAMATIC AMV4-DS VARIABLE SPEED FLOW-THROUGH COLD WATER BOOSTER

PUMP TYPE	kW PER PUMP	FULL LOAD CURRENT 1Ph 240V AMPS	FULL LOAD CURRENT 3Ph 415V AMPS	TOTAL DRY WEIGHT OF UNIT (KG)	SOUND LEVEL dB(A)	BOOSTER SET DIMENSIONS [+/- 10mm]							FLANGE SIZE	VESSEL(S)	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 1PH 230V	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 3PH 400V
						LO	WO	HO	HP	LB	WB	WP				
2-4	0.37	11.2	5.2	194	58	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	71A 1 H 0.37	71A 2 10.37
2-5	0.55	15.2	6.4	198	58	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
2-6	0.55	15.2	6.4	198	58	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
2-7	0.75	20	8	214	58	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
2-9	0.75	20	8	214	58	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
2-10	1.1	28	10.4	226	58	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 1 1.1
2-13	1.1	28	10.4	226	58	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 1 1.1
2-15	1.5	36.8	13.2	294	64	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 1 1.5
2-17	1.5	36.8	13.2	294	64	1560	900	920	130	1330	400	665	DN65 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 1 1.5
4-2	0.37	11.2	5.2	190	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	71A 1 H 0.37	71A 2 10.37
4-3	0.55	15.2	6.4	194	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
4-4	0.55	15.2	6.4	194	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
4-5	0.75	20	8	206	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
4-6	0.75	20	8	206	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	80A 2 H 0.75	80A 2 10.75
4-8	1.1	6.5	7.5	218	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 1 1.1
4-9	1.1	28	10.4	218	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 1 1.1
4-11	1.5	36.8	13.2	286	64	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 1 1.5
4-12	2.2	N/A	18	306	64	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	90LD 2 12.2
4-15	2.2	N/A	18	306	64	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	90LD 2 12.2
6-2	0.55	15.2	6.4	194	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	71A 2 H 0.55	71A 2 10.55
6-3	1.1	28	10.4	214	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 1 1.1
6-4	1.1	28	10.4	214	58	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	80B 2 H 1.1	80B 2 1 1.1
6-5	1.5	36.8	13.2	278	64	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	90SC 2 H 1.5	90SC 2 1 1.5
6-6	2.2	N/A	18	306	64	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	90LD 2 12.2
6-7	2.2	N/A	18	306	64	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	90LD 2 12.2
6-9	2.2	N/A	18	306	64	1560	900	920	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	90LD 2 12.2
6-10	3	N/A	26.8	266	70	1560	900	969	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	100LC2-D1
6-12	3	N/A	26.8	266	70	1560	900	969	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	100LC2-D1
6-13	4	N/A	34.4	318	75	1560	900	1114	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	132SC2-D1
6-15	4	N/A	34.4	318	75	1560	900	1114	130	1330	400	655	DN65 PN16	1X 12 LTR	N/A	132SC2-D1
12-1	0.75	20	8	275	58	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	80A 2 H 0.75	80A 2 10.75
12-2	1.5	36.8	13.2	351	64	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	90SC 2 H 1.5	90SC 2 1 1.5
12-3	2.2	N/A	18.0	371	64	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	90LD 2 12.2
12-4	3	N/A	26.8	331	70	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	100LC2-D1
12-5	3	N/A	26.8	331	70	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	100LC2-D1
12-6	4	N/A	34.4	379	75	1560	1020	950	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SC2-D1
12-8	5.5	N/A	46	459	80	1560	1020	1091	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
12-9	5.5	N/A	46	459	80	1560	1020	1091	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
12-10	7.5	N/A	61.2	467	72	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
18-1	1.5	36.8	13.2	355	64	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	90SC 2 H 1.5	90SC 2 1 1.5
18-2	3	N/A	26.8	327	70	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	100LC2-D1
18-3	4	N/A	34.4	375	75	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SC2-D1
18-4	5.5	N/A	46.0	447	80	1560	1020	1011	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
18-5	7.5	N/A	61.2	467	72	1560	1020	1056	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
24-1	2.2	N/A	18.0	371	64	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	90LD 2 12.2
24-2	4	N/A	34.4	371	75	1560	1020	920	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SC2-D1
24-3	5.5	N/A	46.0	443	80	1560	1020	966	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1
24-4	7.5	N/A	61.2	463	72	1560	1020	1011	160	1330	400	765	DN100 PN16	2X 12 LTR	N/A	132SD2-D1

FIVE PUMP MODEL AMV5-DS DIMENSIONS

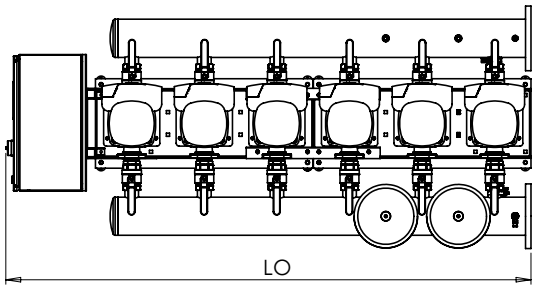


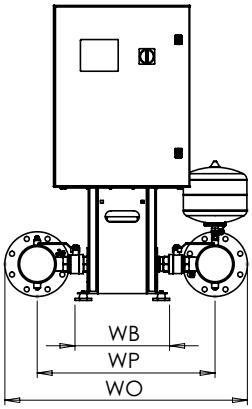


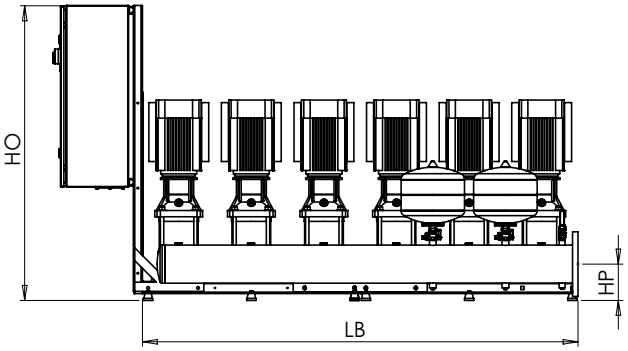


AQUAMATIC AMV5-DS VARIABLE SPEED FLOW-THROUGH COLD WATER BOOSTER																
PUMP TYPE	kW PER PUMP	FULL LOAD CURRENT 1Ph 240V AMPS	FULL LOAD CURRENT 3Ph 415V AMPS	TOTAL DRY WEIGHT OF UNIT (KG)	SOUND LEVEL dB(A)	BOOSTER SET DIMENSIONS [+/- 10mm]							FLANGE SIZE	VESSEL(S)	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 1PH 230V	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 3PH 400V
						LO	WO	HO	HP	LB	WB	WP				
12-1	0.75	24.5	9.5	392	58	1880	1075	920	160	1650	420	785	DN150 PN16	2X 12 LTR	80A 2 H 0.75	80A 2 I 0.75
12-2	1.5	45.5	16	487	64	1880	1075	920	160	1650	420	785	DN150 PN16	2X 12 LTR	90SC 2 H 1.5	80B 2 I 1.1
12-3	2.2	N/A	22	512	64	1880	1075	920	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	90LD 2 I 2.2
12-4	3	N/A	33	462	70	1880	1075	920	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	100LC2-D1
12-5	3	N/A	33	462	70	1880	1075	920	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	112MC2-D1
12-6	4	N/A	42.5	547	75	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	112MC2-D1
12-8	5.5	N/A	57	647	80	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	132SC2-D1
12-9	5.5	N/A	57	647	80	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	132SC2-D1
12-10	7.5	N/A	76	657	72	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	132SD2-D1
18-1	1.5	45.5	16	492	64	1880	1075	920	160	1650	420	785	DN150 PN16	2X 12 LTR	90SC 2 H 1.5	80B 2 I 1.1
18-2	3	N/A	33	457	70	1880	1075	920	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	100LC2-D1
18-3	4	N/A	42.5	542	75	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	112MC2-D1
18-4	5.5	N/A	57.0	632	80	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	132SC2-D1
18-5	7.5	N/A	76.0	657	72	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	132SD2-D1
24-1	2.2	N/A	22.0	512	64	1880	1075	920	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	90LD 2 I 2.2
24-2	4	N/A	42.5	537	75	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	112MC2-D1
24-3	5.5	N/A	57.0	627	80	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	132SC2-D1
24-4	7.5	N/A	76.0	652	72	2000	1075	1500	160	1650	420	785	DN150 PN16	2X 12 LTR	N/A	132SD2-D1

SIX PUMP MODEL AMV6-DS DIMENSIONS







AQUAMATIC AMV6-DS VARIABLE SPEED FLOW-THROUGH COLD WATER BOOSTER																
PUMP TYPE	kW PER PUMP	FULL LOAD CURRENT 1Ph 240V AMPS	FULL LOAD CURRENT 3Ph 415V AMPS	TOTAL DRY WEIGHT OF UNIT (KG)	SOUND LEVEL dB(A)	BOOSTER SET DIMENSIONS [+/- 10mm]							FLANGE SIZE	VESSEL(S)	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 1PH 230V	ETL RECLAIM MODEL NUMBER FOR EACH MOTOR 3PH 400V
						LO	WO	HO	HP	LB	WB	WP				
12-1	0.75	29	11	475	58	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	80A 2 H 0.75	80A 2 I 0.75
12-2	1.5	54.2	18.8	589	64	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	90SC 2 H 1.5	80B 2 I 1.1
12-3	2.2	N/A	26	619	64	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	90LD 2 I 2.2
12-4	3	N/A	39.2	559	70	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	100LC2-D1
12-5	3	N/A	39.2	559	70	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	112MC2-D1
12-6	4	N/A	50.6	631	75	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	112MC2-D1
12-8	5.5	N/A	68	751	80	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	132SC2-D1
12-9	5.5	N/A	68	751	80	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	132SC2-D1
12-10	7.5	N/A	90.8	763	72	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	132SD2-D1
18-1	1.5	54.2	18.8	595	64	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	90SC 2 H 1.5	80B 2 I 1.1
18-2	3	N/A	39.2	553	70	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	100LC2-D1
18-3	4	N/A	50.6	625	75	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	112MC2-D1
18-4	5.5	N/A	68.0	733	80	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	132SC2-D1
18-5	7.5	N/A	90.8	763	72	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	132SD2-D1
24-1	2.2	N/A	26.0	619	64	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	90LD 2 I 2.2
24-2	4	N/A	50.6	619	75	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	112MC2-D1
24-3	5.5	N/A	68.0	727	80	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	132SC2-D1
24-4	7.5	N/A	90.8	757	72	2300	1075	1500	160	1970	420	785	DN150 PN16	2X 12 LTR	N/A	132SD2-D1

AQUAMATIC AMV-DS SERIES INSTALLATION GUIDANCE NOTES

ELECTRICAL

Units are designed for a 240 volt AC 1Phase 50Hz electrical supply for motors up to 1.5 kW and 415 volt AC 3phase 50 Hz electrical supply for motors above 1.5 kW. Electrical design and equipment conforms to BSEN 60204-1-1993 regulations, it is important that all subsequent wiring and protection equipment reflects this.

HYDRAULIC

The design of this unit enables it to be located in any position in a plant room with the minimum of inconvenience to pipe-work layout. Installer to fit isolating valves on break tank supply and riser to system. Note: Additional check valve/s should not be fitted on the suction or discharge pipework.

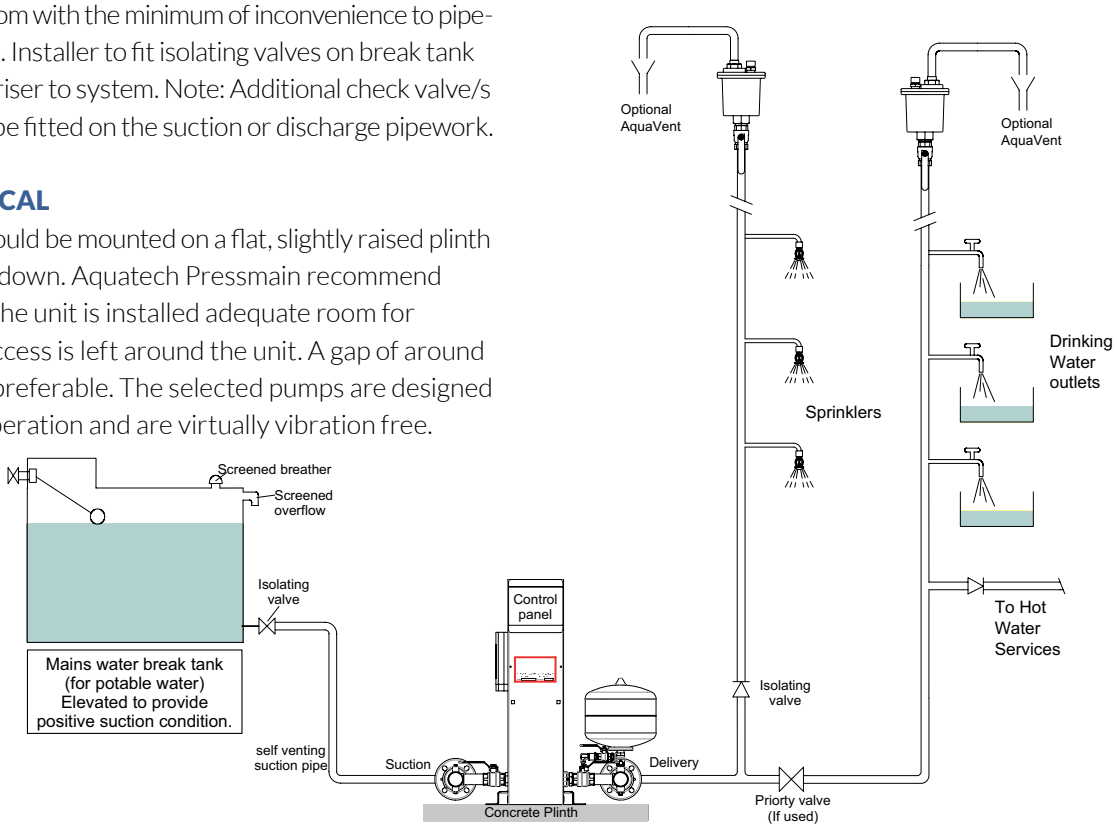
MECHANICAL

The unit should be mounted on a flat, slightly raised plinth and bolted down. Aquatech Pressmain recommend that when the unit is installed adequate room for servicing access is left around the unit. A gap of around 500mm is preferable. The selected pumps are designed for quiet operation and are virtually vibration free.

COMMISSIONING

Following electrical, hydraulic and mechanical installations as above, all units should be commissioned by Aquatech Pressmain service team.

TYPICAL PIPEWORK ARRANGEMENT using variable speed cold water pressure booster set feeding hot & cold water services.



CONSTRUCTION STANDARDS FOR AMV-DS PRESSURE BOOSTER SETS

COMPONENT	MODEL/SERIES	STANDARDS/CLASS	REMARKS
Pumps	2 to 24	Vertical Multi-stage	WRAS Approved
Mechanical Seal	Carbon / Ceramic	DIN 24960	WRAS Approved
Motor for Pumps	TEFC	IP55, Class F Insulation	IE5
Isolating & Non Return Valves	Ball valve / Locking handle	PTFE Ball Seat	WRAS Approved
Suction & Discharge Manifolds	Stainless Steel EN1057 (304)	Entire unit WRAS Approved	Approval Number 0710086
Control Panels	2020Plus Series	IP55, BSEN 60204 part1:1998 89/3366/eec	CE Marked
Microprocessor	2020Plus	93/68/EEC	Designed In House
Hydraulic Accumulators	Flow through	PED 97/23/EC	WRAS Approved
Quality System	ISO 9001	BSI Registered	CERT No. FM33090

Aquatech Pressmain

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Datasheet No: 126 Issue No: 1 Date: 01/01/19

19. Appendix G – Treatment Details

19.1. MENA Water FZC

STEWART & CAVALIER LTD
ENGINEERS
Te Awamutu

Ref. RB6875-19

1st October 2019

Woods
PO Box 6752
Wellesley St
Auckland 1141

Attention: Marcel Bear

Dear Marcel

RE: Sleepyhead (Ohinewai) Water & Waste Water Treatment Plants

Water Treatment Plant

For simplicity, we have offered conventional treatment. If the Waikato River is the raw source, then this is by far the most cost-effective treatment method. We have submitted pricing for this process ONLY at this stage. Should the Boron levels, or for that matter any other dissolved impurity exceeds MAV, then there will be a necessity for a polishing stage after the conventional system. This will more than likely consist of a Reverse Osmosis Membrane Plant, or perhaps an Ion exchange system

As discussed, the Huntly WTP just upstream has a conventional sedimentation and gravity sand filtration treatment plant.

With the various sized plants available, the treatment system can grow as the development grows. Initially, it might be worth considering a MWSD-20, which has a discharge volume of 500 m^3 per day. As the requirement grows, another MWSD-20 could be added. Following this, two MWSD-40 units could be added for a total capacity of 3000 m^3 per day.
As indicated on the attached literature, the MWSD-20 is housed in a 20' ISO shipping container, and the MWSD-40 in a 40' ISO shipping container. There are also other size configurations that may be considered to meet the necessary 3000 m^3 per day.

Our Budget Estimate: $2,250,000.00 + GST

The following items are excluded from our scope of supply at this stage:

- Raw water transfer pumps
- Treated water transfer pump
- Treated or Raw Water storage tanks
- Any civil works

Waste Water Treatment Plant

For wastewater treatment, if we assume 80% of potable water goes to sewer then capacity of the WWTP is about 2400 m^3 per day. This doesn't allow for storm water tyreatment, which may need consideration.

Initially, you could consider an MR300-U MBR plant, then add a modified MR600-U. The combined capacity of these two systems will be 1000 m^3 per day. We could then add an MR1000-U to increase the capacity to 2000 m^3 per day. Final stage could be an MR1000-U (or MR600-U). Again, as with the Water treatment System, there are other size combinations available, should the staged growth be different.

The final proposed configuration of one MR300-U (20' container), one MR600-U (40' container) and two MR1000-U (40' container). Included in the budget price is the supply of a shipping container housed sludge dewatering system.

The U suffix on the end of the part numbers for the MBR plants indicate that part of the treatment, in the form of process tanks, is external to the main process in the shipping containers. As discussed during our meeting, these additional tanks can either be above or below ground.

Our Budget Estimate: $9,500,000.00 + GST

The following items are excluded from our scope of supply at this stage:

- Raw sewage transfer pumps (if required)
- Treated effluent transfer pumps (if required)
- External Process Tanks
- Any civil works

Each container usually comes completely self-contained, including any chemical dosing and control system. It is worth considering a common point for some of these items, to allow a more cost effective and simple approach. The modular system offered for both processes will benefit the staged growth of the project, as well as offer multiple treatment trains while any one of the components of the system undergoes preventative or periodic maintenance.

Yours faithfully
STEWART & CAVALIER LIMITED

Ross Burrell
Sales Engineer

STEWART & CAVALIER LTD

ENGINEERS

Te Awamutu

Company Brief

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1317 Alexandra Street Te Awamutu
Phone 07 871 7062
Fax 07 871 7574
stewcav.co.nz
admin@stewcav.co.nz

STEWART & CAVALIER LTD
ENGINEERS
Te Awamutu

ABOUT US

Stewart and Cavalier Limited was formed back in 1954 by two engineers, Alan Stewart and Sid Cavalier. They saw a need for a company to service the fast growing farming, dairying and transport industries around the Waikato Area.

1969 saw the Cavalier shareholding purchased by local engineer Merv Mexted but the name remained the same.

Since that time the company has evolved to become a major player in the engineering industry. Today we maintain a staff of around 40 experienced trades-people at our Te Awamutu base in the heart of New Zealand's dairying country.

Our vision is to continue building our business by listening to our customers, having fun with our customers and helping add value to our customers business. We do this by using the ideas of our people, by continually developing new technology, and by pursuing "World Best Practice".

The Company has developed and implemented a comprehensive quality management programme which complies with the ISO 9001:2015 Standard, and we have held Registered Supplier status since September 1995. This international recognition is our stamp of quality for past, present and future clients.

We recognise our greatest resource as being the skills of our engineering trades personnel to achieve a high level of productivity, job satisfaction and client approval. Current available company work output for all staff is 8,000 to 10,000 hours per month. Plus, a 24 hour 7 day a week call out service.

Stewart & Cavalier Ltd is totally committed to a work-safe environment. Safety and first aid courses are regularly undertaken and a comprehensive manual on safety and health plays a

big part in how we do business. We currently enjoy Tertiary Level Accreditation to the ACC WSMP (Workplace Safety Management Practices).

We operate a manufacturing workshop area in excess of 2000 square metres serviced by overhead gantry cranes. There are rolling, forming, guillotining and profile cutting facilities and a comprehensive CNC machine shop for turning, milling etc in-house.

Our stainless steel division produces sheetmetal work, tank fabrication, pressure vessels and pipework for the food processing industry. Site installation work and plant relocation is undertaken throughout New Zealand.

Stewart & Cavalier has kept pace with a market demanding versatility and innovation by developing resources to anticipate and meet these requirements.

STEWART & CAVALIER LTD
ENGINEERS
Te Awamutu

KEY PERSONEL

Brad Sharp – Site Manager – Stewart & Cavalier

Qualifications and Training

- MENA Water Factory Trained Plant Installation Project Manager
- Tradesman Fitter Welder
- AS/NZS2980 All Position Welding Ticket
- Current BFA Holder 6400, 6401, 6402
- NZS2865 Confined Space 18037
- Permit Receiver 17588
- Work Authority 16284
- Permit Holder - Fonterra
- Permit Holder - Mighty River Power
- Permit Holder – Genesis
- First Aid US6401/6402
- Fire Equipment Handling US3271
- Hazard Identification US17602
- Work at Heights US17600, 25045
- Generation Permit WAC 301/302

Experience and Capability

With 7 years' experience in supervisory roles and more than 15 years' experience in general engineering and fabrication work, Brad Sharp brings meticulous attention to fine detail, excellent communication skills, and a positive attitude to his role as a Mechanical Maintenance Fitter.

As a Supervisor, he leads his team by example and takes pride in working to the highest standards of quality and health and safety. He is excellent at keeping a close watch on the progress of his team.

In recent years during his employment at Stewart & Cavalier, he has worked for a number of clients including as a Mechanical Maintenance Fitter or Supervisor for:

STEWART & CAVALIER LTD
ENGINEERS
Te Awamutu

Genesis Energy at Huntly

Nitrogen supply pipework; cabinet steam drain pipework; Huntly Boiler Drain Lines and Tundishes; Huntly Chiller Water supply Pipework; Huntly Nitrogen Supply line Unit 5; Huntly Ammonia Lines

Genesis Energy at Tokaanu

Tokaanu Blast Wall

NZSM Taharoa

Recycled Water Storage Project.

Fonterra (Hautapu, Te Rapa, Te Awamutu)

General maintenance, stainless steel fabrication and installation.

Mighty River Power

Maraetai Design and Build Roof Platform.

Omya Lime Works

Installation of new plant upgrade and general engineering.

Te Kuiti Meats

Stainless steel fabrication and installation, and general engineering.

STEWART & CAVALIER LTD
ENGINEERS
Te Awamutu

Ross Burrell – Sales & Service Engineer – Stewart & Cavalier

Ross has been involved with the Water Industry for 23 years, with the sales and service of many facets of water treatment, particularly in the application of chemical dosing systems for water treatment. An electronics service technician by trade, Ross has a good understanding or chemical dosing control systems, and their application in optimisation of water treatment systems, utilising both compound loop, and set point control philosophies, and optimisation through chemical dosing, process loop configuration, instrumentation calibration, and fine tuning. Including…

- Streaming Current Detectors for Coagulant Dosing Optimisation
- Polymer Blending Systems & batch dosing systems
- Potentiostatic FAC Chlorine Analysers for Disinfection Set-point Dosing
- ORP Analysers for Ozone for Disinfection Set-point Dosing
- pH Analysers for correction Set-point Dosing
- Turbidity Analysers for water quality Monitoring

Over the years Ross has had a pivotal role in optimisation of chemical dosing of several potable water plants, to name a few…

Public Works Department, Labasa, Fiji. ($ 3.2 million)

This project was a green field site, a plant design with a robust treatment philosophy to cope with three different raw water sources, and massive turbidity shifts from the low teens to 700 or more NTU. The plant design was a dual train containerised system with a two-stage treatment process, an up flow clarifier, and multimedia gravity feed sand filter. Streaming Current Technology was used to control primary coagulant dosing to achieve coagulant charge neutralisation, and an automated Polymer blending system was used to activate long chain emulsion polymers to minimise operator input and necessary time on site.

Ross' involvement included chemical dosing design, overseeing the chemical dosing installation, and plant commissioning. Ross' spent several weeks on site to fine tune the plant to achieve treated water turbidity of 0.1 and less.

Fonterra – Hawera. ($ 850 thousand)

This project was an expansion of the existing water treatment plant(s) on site. The new plant was to utilise a new and relatively unknown water source to site. Large turbidity shifts were experienced during periods of high rainfall. The plant design incorporated a dual train containerised system with a two-stage treatment process, an up flow clarifier, and multimedia gravity feed sand filter. Streaming Current Technology was used to control primary coagulant dosing to achieve coagulant charge neutralisation, and an automated Polymer blending system was used to activate long chain emulsion polymers to minimise operator input and day to day monitoring.

Ross' involvement included chemical dosing design, overseeing installation, and commissioning.

Coca-Cola Amatil, Auckland. ($ 380 thousand)

The bottling plant in Mt Wellington, Auckland uses town water to provide make up water in the production lines for product. During times of reticulation maintenance of council distribution networks, a barrier was necessary to maintain product make-up water quality. Instead of Aluminium based salts, Ferric Chloride was chosen by the client to eliminate any possibility of Aluminium residuals in the treated water. Supply and installation of a new dual stage potable water plant. The plant design incorporated a single train containerised system with a two-stage treatment process, an up flow buoyant media clarifier, and multimedia gravity feed sand filter. Streaming Current Technology was used to control primary coagulant dosing to achieve coagulant charge neutralisation, and an automated Polymer blending system was used to activate long chain emulsion polymers to minimise operator input and day to day monitoring.

Ross' involvement included chemical dosing design, overseeing installation, and commissioning to meet Australian Drinking Water Standards.

Coca-Cola Amatil, Sydney. ($ 120 thousand)

Optimisation of an existing blanket clarifier, installation of Streaming Current Technology, pH correction (pre and post clarification), and turbidity analysers to meet necessary site standards. Ross Project Managed the installation of the dosing control and monitoring and commissioned the new system.

North-East Water Authority, Victoria, Australia. ($ 600 thousand)

Supply and installation of a new dual stage potable water plant

The plant design incorporated a single train containerised system with a two-stage treatment process, an up flow buoyant media clarifier, and multimedia gravity feed sand filter. Streaming Current Technology was used to control primary coagulant dosing to achieve coagulant charge neutralisation, and an automated Polymer blending system was used to activate long chain emulsion polymers to minimise operator input and day to day monitoring.

Ross' involvement included chemical dosing design, overseeing installation, and commissioning to meet Australian Drinking Water Standards.

Fonterra – Waitoa. ($ 250 thousand)

Optimisation of an existing Lamella Plate clarifier with the installation of Streaming Current Technology, and pH correction. The existing Patterson Candy filter floor and nozzles were removed and replaced with upgraded technology, and triple media sand filters to increase treated water quality. A new PLC was installed to automate the filter operation. New turbidity analysers were installed to more accurately monitor treated water quality site standards.

Ross Project Managed the installation of the dosing control and monitoring and commissioned to new system.

STEWART & CAVALIER LTD
ENGINEERS
Te Awamutu

MENA WATER

New German MBR Technology Now in New Zealand Makes Previously Uneconomic Subdivisions Viable.

Executive Summary

Proven Technology that has been mainstream in Europe for decades for the treatment of wastewater is now available in New Zealand with the first large scale development underway in Whitford, South of Auckland.

Stewart and Cavalier, a long standing Te Awamutu based engineering company have teamed up with MENA WATER, the German maker of MBR technology based package plants and are building the first New Zealand plant sold to a private developer.

MENA WATER package plants can be used on a small scale or for large subdivisions and for entire cities. The plants are very compact compared to the current 20th century technology used in this country and have a number of other significant advantages. The two main advantages are:

1- Developers can now put very cost effective plants into an area where development was previously impossible because there was insufficient capacity available from the municipal scheme or costs of connection or building a new sewage treatment plant were too high.
2- MENA WATER MBR plants produce a very high quality effluent which is virtually free of any suspended solids, microbes and viruses, making it safe for discharge to environment or reuse in application that do not require potable water quality.

MBR treatment plants have been expensive systems in the past but with the development in the technology and improvements in the components quality and durability, the cost of building and operating this type of wastewater treatment plants has dramatically dropped.

The fact that MBR treatment plants produce the best effluent quality make them the number one choice in the developed countries and now even more and more MBR treatment plant are built in developing countries.

Lack of proper infrastructure is an obstacle in front of many developers in New Zealand. While existing infrastructure are struggling to keep up with the growth in the country many development projects have to be delayed or even cancelled as there is no sewage treatment plant to serve the development area.

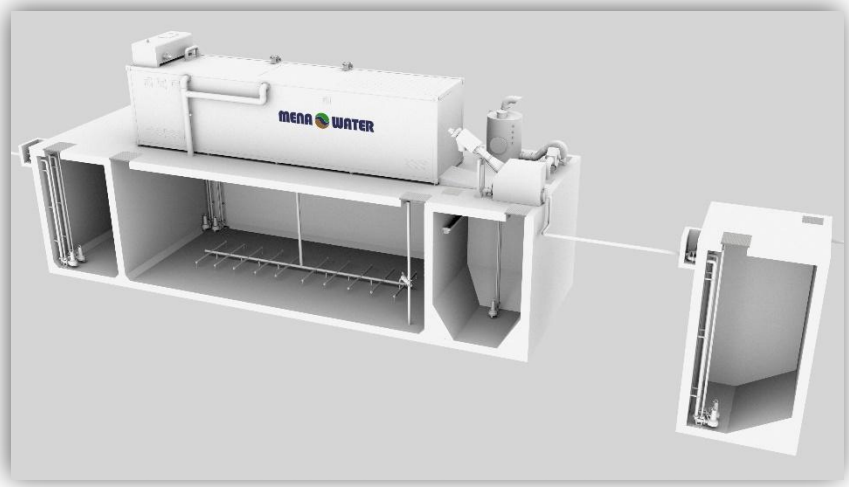
Conventional wastewater treatment plants are very expensive to build and have a lengthy construction time and often are not economical when they only serve a limited number of dwellings and with ever tightening environmental standards, they are sometimes unable to cope and require expensive upgrades.

They are usually built far from cities and towns so transferring sewage to the plants requires a complex collection network with multiple lifting and transfer stations that must be maintained fit for operation at all-time resulting in high operation and maintenance costs.

For a country the size of New Zealand with many small towns and cities that have a population of less than 20,000 or new residential development projects that cannot easily be connected to a sewage network, a decentralized wastewater treatment plant is an ideal solution.

MBR treatment technology is one of the most recent and advanced technologies for wastewater treatment which occupies an area less than 1/3rd of the area a conventional treatment plant occupies and produces a very high quality treated effluent which is suitable for recycling and reuse in applications that do not require potable water quality such as wash-down water, irrigation water, firefighting water etc.

MENA WATER state of the art containerized MBR plants are taking wastewater treatment package plants to the next level of cost reduction and simplicity in plant construction and operation.



Membrane modules, being the heart of the treatment plant are housed in a standard ISO shipping container next to the plant machine room where key mechanical equipment is located.

Plant control panel is fitted in the same container as well, inside an air conditioned compartment.

Raw sewage is pumped to the treatment plant inlet works where physical treatment stage happens as a screen removes large solid material from water and the primary settling tank removes oil and grease, sand and other non-organic solids from water.

Biological treatment stage happens in underground tanks where dissolved organic contamination and nutrients such as Nitrogen and Phosphorus are removed from water.

Finally, ultra-filtration membranes act as a physical barrier, separating any solid material from water and produce a very high quality effluent which is virtually free of any suspended solid materials, bacteria and microbes.

The membrane container sits on ground level and above the biological treatment tanks. This arrangement gives very quick and easy access to the equipment of the treatment plant that operators need to have access to during plant operation and maintenance.

The membrane container with all the items and equipment inside it is a pre-fabricated and shop-tested unit which is ready for operation as soon as it arrives at installation site.

Power is supplied to all equipment in the plant from the control panel in the container.

The treatment plant is controlled by a Siemens PLC and operators can access the control system via a touch screen HMI fixed on control panel door.

A GSM modem allows operators to monitor the plant from anywhere via a PC, tablet or a smart phone and in case of faults in the process an alarm SMS will be sent to plant operators and manager.

MENA WATER is a German engineering and manufacturing company and a member of Huber technology group. Our containerized MBR plants are designed and built based on German standards. German and European made equipment are used in fabrication of the units and all tanks and mechanical equipment in contact with wastewater are made of stainless steel.

The container is clad with Aluminium sheets, giving it a nice clean look that fits well in surrounding environment.

The wide range of plant capacities make it very easy for customers to choose the size of plant suitable for them based on current and future inflow.

MENA WATER Containerised MBR plants are available with the following capacities:

	MW-MR25	MW-MR75	MW-MR150	MW-MR300	MW-MR450	MW-MR600	MW-MR1000
Capacity (m^3/day)	25	75	150	300	450	600	1,000
Houses Served *	40	125	250	500	750	1,000	1,665
Footprint (m x m)	8 x 3	12 x 4	14 x 5	14 x 6	16 x 7	20 x 7	25 x 7

* 200 L per person per day, 3 residents in each house

During the last 10 years, MENA WATER has installed and commissioned more than 50 package MBR plants in Europe, Africa and the Middle East with plant capacities ranging from 10 to 5,400 m^3/day.

Our products and services are provided to our esteemed clients in New Zealand through our local business partner, Stewart & Cavalier Engineers.

STEWART & CAVALIER LTD
ENGINEERS
Te Awamutu

MENA WATER

With more than 60 years' experience in electro-mechanical engineering projects and a vast knowledge of local regulations and requirements, Stewart & Cavalier Engineers are able to do turn-key projects and manage the work at every stage, delivering the plant to the client ready for operation.

At the moment, we are fabricating a 150 m^3/day package MBR plant which will serve a new residential development in Whitford, Auckland.

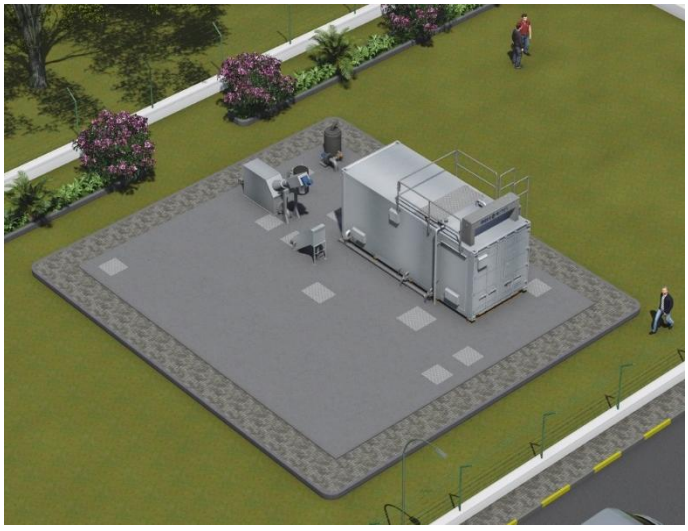
'Whitford Manor Estate' is an exclusive development project with about 150 stand-alone sections, terraced houses and 'Manor House' apartments.

Each dwelling has its own sewage pumping station and via a pressurized sewer network, raw sewage is delivered to the MBR plant which is located on a small section inside the development area.

The plant has enough capacity to receive wastewater from about 70 existing dwellings from Whitford Village as well, serving about 220 dwellings in total.

The treatment occupies a 12 x 10 m section. Plant buffer tank, primary settling tank, biological treatment tanks and effluent tank are all underground reinforced concrete tanks. An odour control system is provided to eliminate any chances of foul odour spreading in the area.

A standard 20' cladded shipping container located on top of the tanks houses the membrane filtration unit, sludge dewatering unit, machine room and control system.



The design of this wastewater treatment system has been fully consented by Auckland City Council and the treated effluent of this MBR plant has such a high quality, that it can be discharged safely to a stream at the boundary of the development area.

In addition to the wastewater treatment plant, MENA WATER is also supplying a Reverse Osmosis unit for the treatment of underground water to produce potable water. While the main source of drinking water for the development is rain water, the RO plant is a backup system that produces potable water during low rain season.

For further information and enquiries, please contact:

Ross Burrell (Stewart & Cavalier Engineers Ltd.)

027 533 4966

rossb@stewcav.co.nz

STEWART & CAVALIER LTD
ENGINEERS
Te Awamutu

MENA WATER SYSTEMS

Following are a selection of Mena Water Sales Brochures for general information. We look forward to discussing the options available in more detail.

The enclosed information on the MBR systems are sized incorporating a flat sheet style membrane module, there is the option of using hollow fibre membrane modules also. The hollow fibre option provides more surface area per module, and higher flux rates. The result is a higher nett flow throughput for a container or module size, and therefor an overall smaller footprint.

There are two types of MBR modular system, there is a “U” version where the process tanks that are part of the MBR process are apart from the container that houses the control systems, and membrane modules. These are normally underground, which makes the above ground installation extremely compact. However, it is not mandatory that these process tanks be below ground if an above ground installation is preferred.

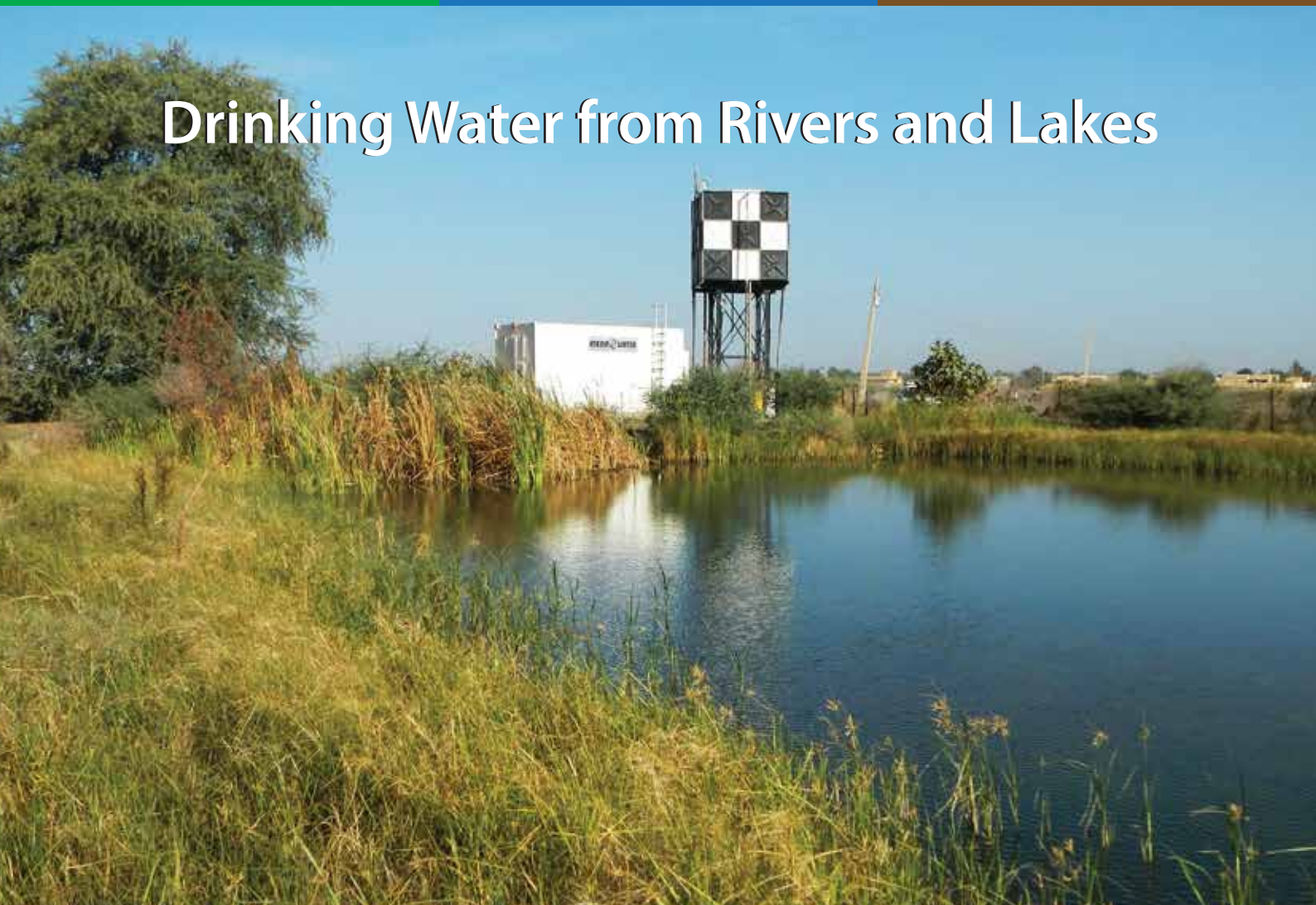
The second type is an “I” version, where the complete process is integrated into one or more ISO shipping containers, pre factory installed and tested. This makes the system truly plug and play for more temporary installations, or where the complete treatment process is likely to be moved. It also significantly reduces the amount of site civil work required to get the system operational.

MENA WATER

OUR AIM - YOUR CONFIDENCE

Package Treatment Plant

for Potable Water



SafeDrink plants are easy extendible

MENA-Water SafeDrink – Safe Drinking Water

MENA-Water drinking water plant SafeDrink is a cost effective package plant that meets WHO and other international treated water standards. It is easy to operate, consumes less energy and can be delivered in short notice.

DESCRIPTION

SafeDrink is a containerized plant that combines all the necessary components for coagulation, flocculation, clarification, filtration and disinfection in a compact system. Its versatile design makes it ideal for potable water treatment and industrial process water and also can be used as advanced treatment of wastewater or to reduce suspended solids, phosphorus and other contaminants like heavy metal.

COAGULATION

Coagulating chemicals are injected in the pipe to be mixed with the raw water. Coagulants promote collisions between the small suspended particulates, called colloids, enabling them to form large flocs that settle easily in the clarifier leaving behind clear water with very low turbidity.

FLOCCULATION

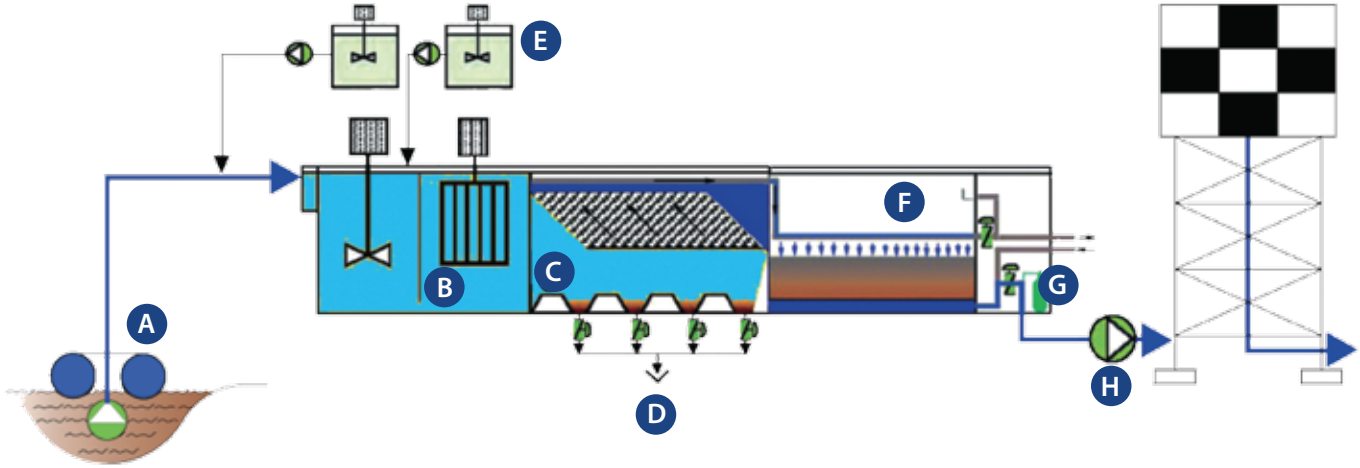
The coagulated water enters the flocculation area. A coagulant aid or polymer can be added to strengthen the floc bonding. Slow stirring motion forms collision between the forming precipitates and the remaining contaminant particles to form larger flocs.

CLARIFICATION

The coagulated and flocculated water is evenly distributed at the bottom of the lamella settler using well designed distribution laterals. The large surface area of the tube settler causes the flocs to settle by gravity to the bottom thickening zone.

The sludge is periodically withdrawn through an automatic valve. Clarified water is collected from the clarifier surface through perforated tubes.

A - Raw Water Intake
B - Flocculation Unit
C - Clarification Unit (Settler)
D - Sludge Discharge
E - Chemical Dosing Unit
F - Sand Filter
G - Disinfection Unit
H - Water Supply Pump



FILTRATION

Clarified water enters the high rate gravity filter for removal of the remaining finer solid particles. Based on the application, the filter media can be dual media or multi-media. The water passes through the layers of the media and passes an underdrain system.

The filter is backwashed intermittently depending on the influent turbidity of the raw water.

DISINFECTION

Disinfection can be with liquid or gas chlorine. Ultra violet disinfection also can be used.

FEATURES

- Pre-engineered complete system in ISO containers.
- Small foot print.
- Simple operation and low maintenance requirements.
- Low energy consumption.
- Working on gravity sand filter and lamella settler principle.
- Higher throughputs possible through modular arrangement of units.
- European quality components.
- Fast delivery and start-up due to the mobile concept.
- Very good price-performance ratio.
- Highly stable process that produces quality water even during peaks.
- Effectively removes turbidity, suspended solids, color, odor and TOC.
- Produces highly pure water that meets WHO Drinking Water standards.

APPLICATIONS

- Potable water for cities and villages.
- Process water treatment.
- Grey water treatment.

OPTIONAL EQUIPMENT TO CUSTOMIZE THE SYSTEM

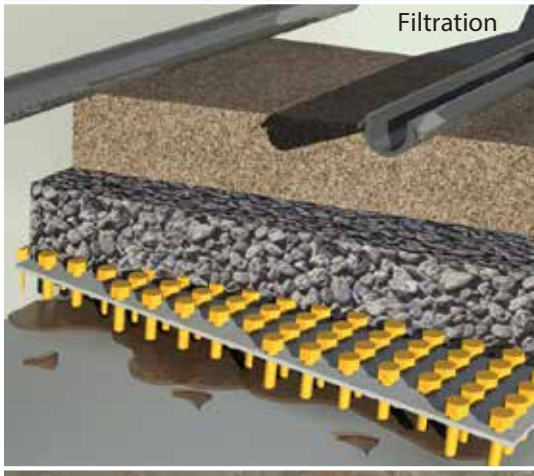
Many options can be provided to suit the site, such as

- Pre-settling unit for highly turbid water
- Pontoon to carry the feeding pumps
- Power generator
- Storage tanks as ground or elevated tower
- Portable small Laboratory for water quality testing
- Containerized operator rooms
- Skid mounted pumps alternatives as self-priming

Standard sizes for SafeDrink Package Plants

MODEL	MWSD 20	MWSD 40	MWSD 60	MWSD 100
Capacity in m^3/d	500	1000	1500	2500
Arrangement	20' container	40' container	40' container	40' container

Other sizes on demand



MENA WATER

OUR AIM - YOUR CONFIDENCE

MENA WATER FZC

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Member of German Water Partnership

Pot_En 1117

MENA WATER

OUR AIM - YOUR CONFIDENCE

Mobile Reverse Osmosis Units

for Purified Water Needs

Quick & Reliable Solutions

MENA-Water – Plug & Play Reverse Osmosis

We provide containerized or skid mounted plants. Reverse Osmosis Systems are capable of removing dissolved salts and other impurities such as bacteria, sugars, proteins, dyes and constituents with large molecular weight.

Our plants are designed, engineered, pre-assembled, factory tested with highest quality standards to provide easy and quick shipping, installation in small foot print area and for limited site installation work to save your money and time.

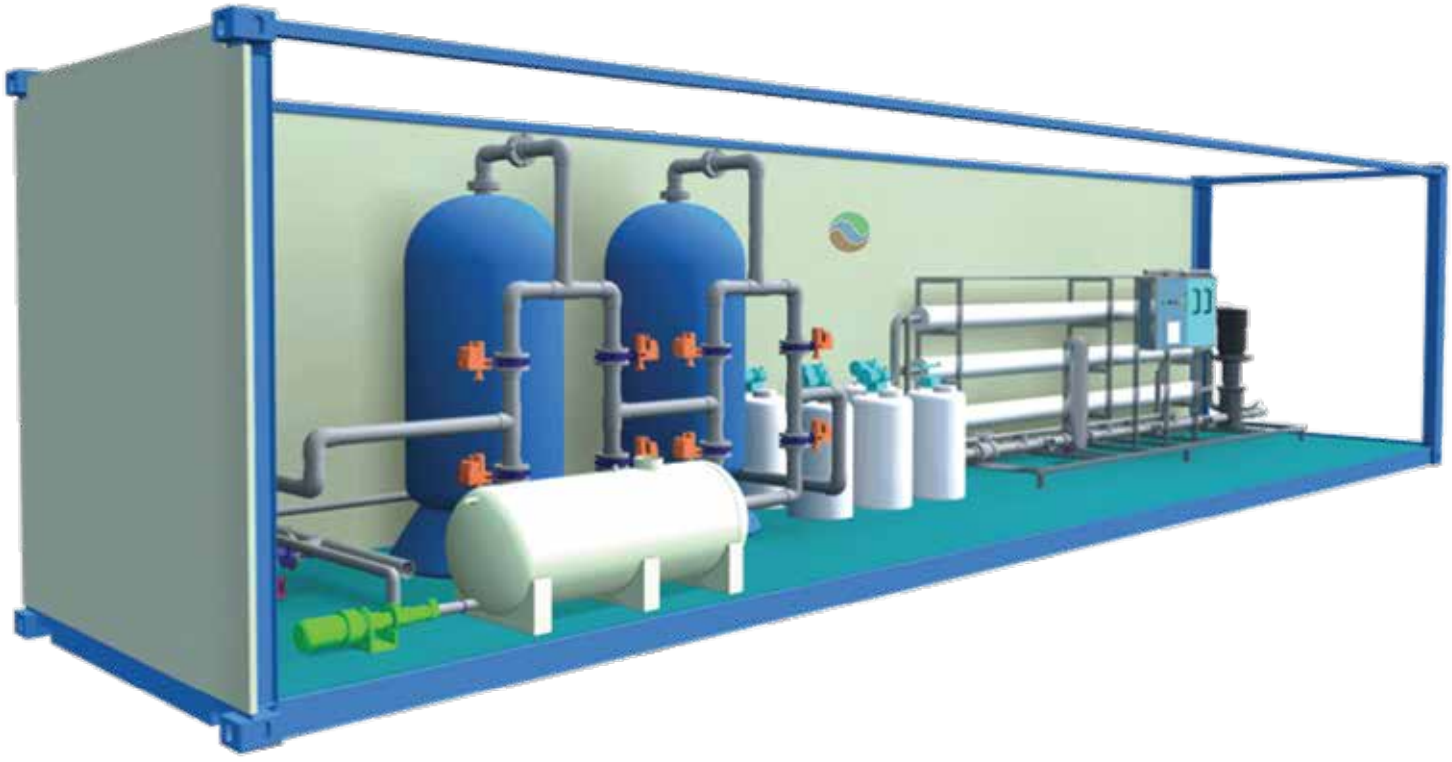
The high quality material and components from leading manufacturers are selected in order to provide quality products or long live time of plant and smooth operation.

Our system is suitable to purify and treat seawater, high brackish, brackish, and even industrial or municipal water when treated with the Membrane Bioreactor (MBR) prior to the Reverse Osmosis (RO).

STANDARD FEATURES

- Filtration and chemical pre-treatment
- 8" & 4" TFC energy-saving membranes
- Membrane FRP pressure vessels
- Corrosion resistant high pressure pumps
- PLC electrical control panel for auto control from HMI
- Panel mounted flow meters, TDS, pH, ORP meter/controller
- Low and high pressure switches
- Post chlorination and pH adjustment
- Automatic feed shut-off valves
- Pump throttling & concentrate valves
- SS316 liquid filled pressure gauges
- Corrosion resistant high pressure piping
- Corrosion resistant steel frame
- Auto-flush system
- Blending: feed/product
- Sample valves

Our standard range is up to 2500 m^3/d in one container, while for bigger capacity customized sizes are possible.



OPTIONAL FEATURES

- Double pass plants for lower permeate TDS
- Higher recovery plants
- TDS monitoring/controller on feed line
- Clean-in place (CIP)
- Additional pre-treatment
- Supply with 60Hz possible
- Ozonation system / UV sterilizers
- Post de ionizer (DI) polishers

OPERATION SPECIFICATIONS

- Feed turbidity <1 NTU
- Feed SDI : 3-5
- Feed water oxidant content
- Iron tolerance < 0.05 ppm
- Bacteria free
- Operate at higher TDS by lowering recovery
- Nominal salt rejection up to 99.8 %
- Max. feed water temperature: 42°C
- Hardness over 1 grains per gallon requires water softener or antiscalant

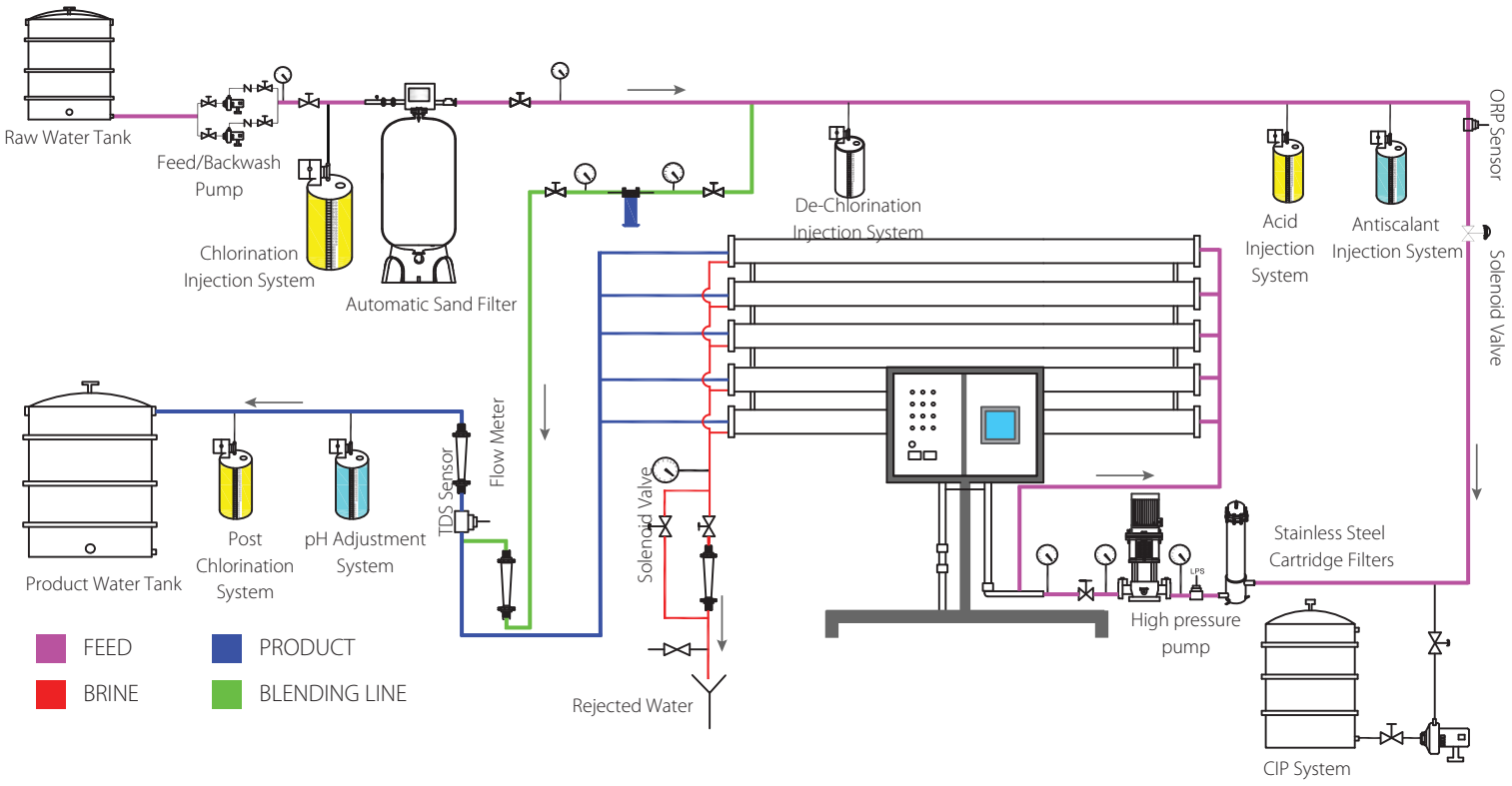
APPLICATIONS

- Drinking Water
- Food Industries
- Industrial Effluent Recycling
- Medical (Kidney Dialysis)

INDUSTRIAL WATER RECYCLING

RO in combination with MBR is the ideal solution for water recycling in many industries.

If waste water is treated with membrane bioreactor (MBR), then it is suitable (SDI <3) to be followed by Reverse Osmosis system (RO) for valuable resource of high quality recycled water to reduce fresh water and disposals costs.



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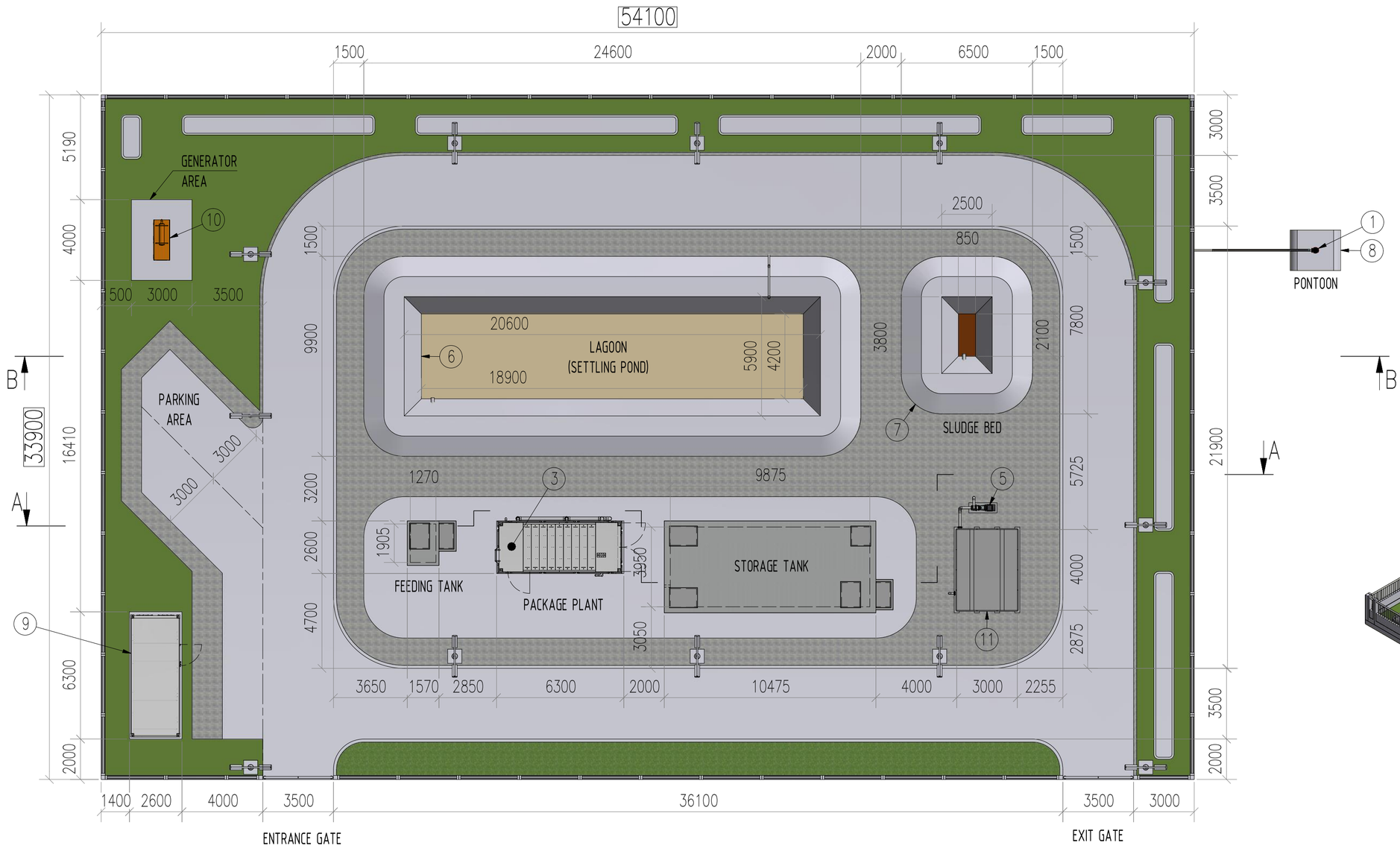
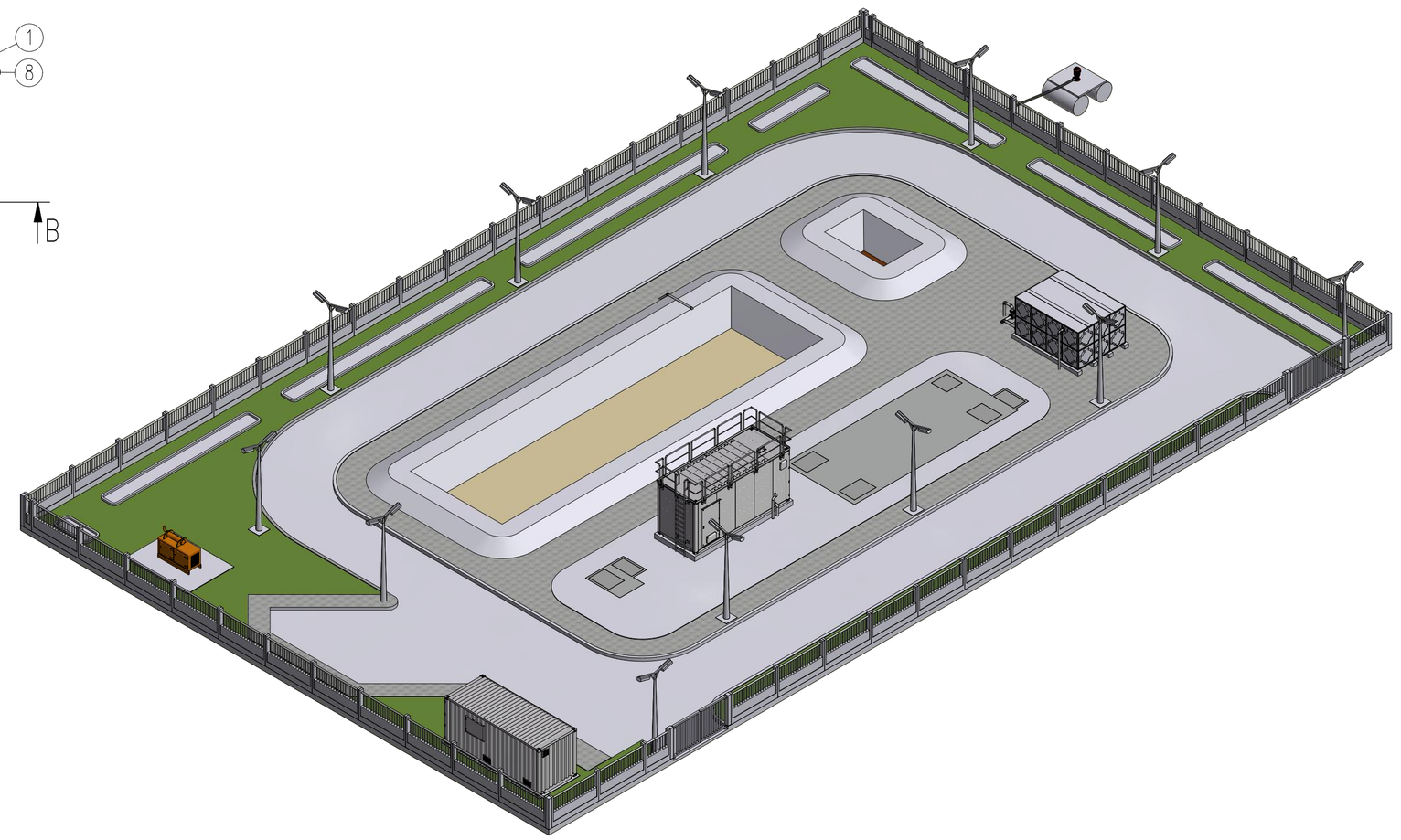
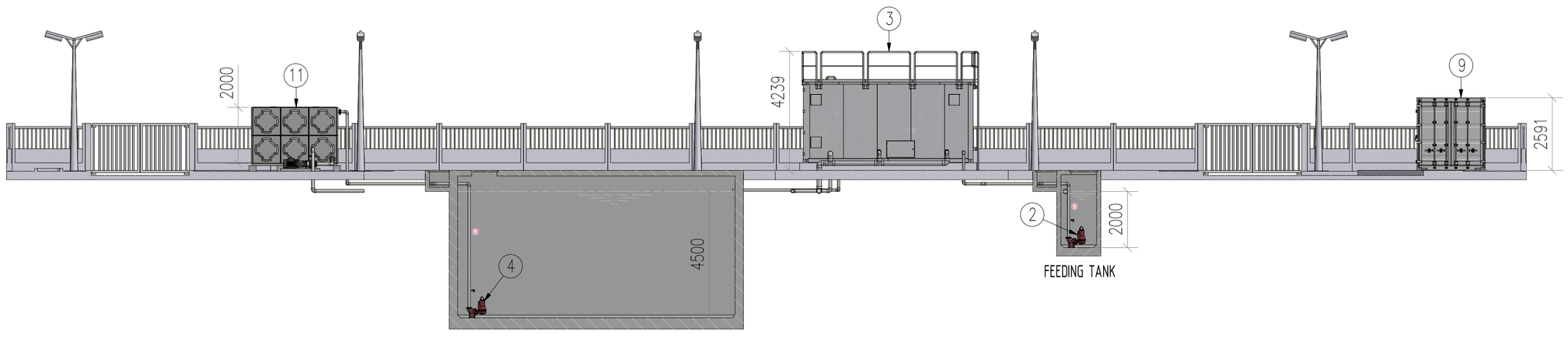
RO_En 1217



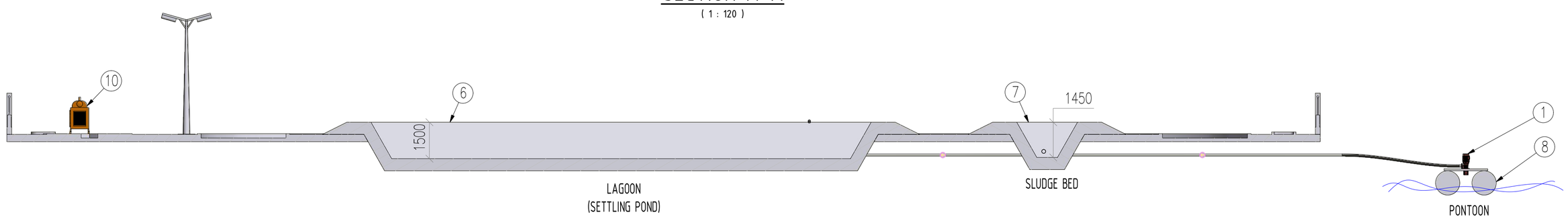


PLAN VIEW



SECTION A-A

(1 : 120)



SECTION B-B

(1 : 120)

NOTE:
1. ALL DIMENSIONS IN MILLIMETER (mm) UNLESS OTHERWISE SPECIFIED.

ITEM	QTY	DESCRIPTION	REMARKS
11	1	TREATED WATER STORAGE TANK	OPTIONAL
10	1	GENERATOR	OPTIONAL
9	1	OFFICE CONTAINER	OPTIONAL
8	1	PONTOON	OPTIONAL
7	1	SLUDGE BED	
6	1	LAGOON	
5	1	BACKWASH PUMP (BP)	
4	2	DISCHARGE PUMP (DP)	
3	1	MW-SD20 PACKAGE PLANT	
2	2	FEEDING PUMP (FP)	
1	1	TRANSFER PUMP (TP)	

EQUIPMENT LIST

Surface Treatment:		Tolerance Unless Specified: ISO 2768-c	Projection:	Material:
Created: J.T	Date: 29.JAN.2019	Approved: Y.K	Scale: N.T.S.	Rev.: V0	Project-No.: PMA-XX-20XX Order No.:

MENA WATER
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E-mail: info@mena-water.com Website: www.mena-water.com

Title: MENA-Water Safe Drink

Drawing No.: PL-MW-SD20-GD-1-(2)

Sheet Size: A1

Sheet No.: 1 of: 1

19.2. Smith & Loveless NZ Ltd

Ben Pain

From: jgill@sandlnz.co.nz
Sent: Tuesday, 3 September, 2019 11:12 AM
To: Marcel Bear
Cc: Ben Pain
Subject: RE: P19-140 - Ohinewai water supply and wastewater treatment process options
Attachments: Aqua Fer EM Intro Section.pdf; S13-18-M100_A - Aqua-Fer WTP GA - Plan.pdf; General Info & Specifications.pdf; S13-18-M101_A - Aqua-Fer WTP GA - Elevation.pdf; S13-18-M200_A - Aqua-Fer WTP - PID.pdf; 9389-A1 Sydney AQUA-FER.pdf

Marcel

Sorry – got sidetracked !

So for water treatment we have 2 options depending on whether bore or river water source

1. BORE WATER

   We would use our AQUA-FER™ Packaged Plant – this incorporates aeration and chem dosing for iron / manganese removal, as well as sedimentation / filtration / disinfection

   Based on 500m3/day modules (like the wastewater system) – we would use multiples of our IQ100 Model – see attached specs and dwgs for general arrangement / footprint

2. RIVER WATER

   For River Water we would use our AQUA-4™ Packaged Plant – incorporating chem dosing / flocculation / sedimentation / filtration / disinfection

   As per above – Model Q100

Sorry – I don't have the nice presentation format for the WTPs – just our general attached catalogue info

I will get back to you with budget pricing on everything today / tomorrow

Regards

JOE

From: Marcel Bear <marcel.bear@woods.co.nz>
Sent: Monday, 2 September 2019 5:29 PM
To: jgill@sandlnz.co.nz
Cc: Ben Pain <ben.pain@woods.co.nz>
Subject: RE: P19-140 - Ohinewai water supply and wastewater treatment process options

Hi Joe

We got the WW and pump emails, but not the water supply info/email.

Please send it through.

Thanks

AQUA-FER™ SERIES COMPACT IRON REMOVAL WATER TREATMENT PLANTS

INTRODUCTION

The Smith & Loveless, Inc. **AQUA-FER™** Type LV and HV factory manufactured water treatment plants are specifically designed for the reduction or removal of soluble ferrous iron or manganous manganese found in ground water and anaerobic reservoir supplies.

The treatment process combines aeration, chemical oxidation, sedimentation and filtration in a compact modular package with the aerator mounted on the top section of the structurally reinforced tank unit. The two largest size plants have separate sedimentation and filter tanks to facilitate handling, transportation, and installation and for optimum design utilization of space. The tanks for all sizes are completely fabricated, and coated at the factory; no field welding is required and simple field pipe interconnection by the contractor makes them ready for service.

The treatment plant aerator may be optionally mounted remote from the tank on exterior roofs or platforms where available space may be a consideration. A variety of aerator/degasifier options are available, contact the factory for particulars and recommendations.

A designer should be asked to consider the numerous benefits that are provided by the factory manufactured a package water treatment plant such as space requirements, installation time, and equipment reliability and installed costs. The **AQUA-FER™** Type LV and HV are specifically designed for many years of maintenance free, efficient operation.

The standard selection tables outlined by the index may be used for preliminary plant recommendations with the final plant choice based on a carefully reviewed water analysis. A water sample may be required by the factory for additional tests on certain applications prior to final total treatment plant recommendations.

AQUA-FER ™ SERIES TYPE LV COMPACT IRON REMOVAL WATER TREATMENT PLANTS

TREATMENT PLANTS				
Model Number (1)	**IQ-25**	**IQ-50**	**IQ-100**	**IQ-150**
Rated Capacity GPM	25	50	100	150
Tank Length (2)	7'-0"	7'-0"	10'-0"	12'-0"
Tank Width (2)	3'-0"	6'-0"	8'-0"	10'-0"
Tank Height	10'-0"	10'-0"	10'-0"	10'-0"
Shipping Weight (3)	4,400 lbs.	6,700 lbs.	10,300 lbs.	12,400 lbs.
Operating Weight (4)	20,000 lbs.	38,000 lbs.	69,000 lbs.	100,000 lbs.
PLANT DESIGN DATA				
Detention Residence Time	30 min.	30 min.	30 min.	30 min.
Number of Filters	1	2	2	2
Area Per Filter	9 sq. ft.	9 sq. ft.	17 sq. ft.	25 sq. ft.
Total Filter Area	9 sq. ft.	18 sq. ft.	34 sq. ft.	50 sq. ft.
Filtration Rate GPM/Sq. Ft.	2.8	2.8	3.0	3.0
Backwash Rate (5)	135 GPM	135 GPM	255 GPM	375 GPM
Backwash Volume (6)	945 gallons	1,890 gallons	3,570 gallons	5,250 gallons
TANK CONNECTION DATA				
Inlet	3"	3"	4"	4"
Outlet	3"	3"	4"	4"
Washwater/Waste	4"	4"	6"	6"
Sludge Draw Off	3"	3"	4"	4"
Overflow	4"	4"	6"	6"

1. Tanks as listed are typically applied as single unit systems. Each unit includes a top mounted aerator that is described elsewhere in this section. Multiple units can be used as appropriate.
2. Tank lengths and widths are normal with slight variance for the top structural. The Smith & Loveless, Inc. tanks utilize formed vertical reinforcements as appropriate providing for maintenance free walls with no exterior projections.
3. Shipping weight is approximate based on basic tank (heaviest piece) only. Aerator and other components are shipped separately for field assembly by the purchaser as applicable.
4. Operating weight is approximate based upon a typical unit assembly, special components, or features, could modify this listing accordingly.
5. The backwash rate is nominal based upon 15 GPM/Sq. Ft.
6. The backwash volume is nominal based upon 15 GPM/Sq. Ft. applied rate for 7 minutes.

REFER TO PAGE 2 FOR ADDITIONAL INFORMATION FOR THIS SERIES OF WATER TREATMENT PLANTS.

AQUA-FER ™ SERIES TYPE LV COMPACT IRON REMOVAL WATER TREATMENT PLANTS

All units listed on Page 1 have common features or requirements as follows:

A. Each tank unit has a separate baffled detention section designed to prevent short-circuiting and an aerator mounting structural assembly for field attachment of this component.

B. Each filter section is provided with a non-corroding type of manifold and lateral collection system.

C. Each tank filter section has provided 15 inches of support gravel and 30 inches of dual filter media as standard. A combination of other media and support material are optionally available. All media is shipped separately in marked cubic foot bags or containers for purchaser field placement.

D. Filter inlet isolation valves are electrically actuated to avoid the need to climb to the tank top area to operate these units. All other valves are manually actuated unless the treatment plant is provided for fully automatic operation where all valves would be electrically actuated. Refer to separate valve data sheet.

E. A control air type compressor with drive, refrigerated dryer, regulator and other accessories is required for pneumatically actuated plant units. The compressor shall be capable of delivering a minimum of 6 cfm at 80 psig control air.

F. The treatment tanks in the table are designed for a gravity flow to below grade clearwell storage. An optional design permits a pumped outlet to above ground storage.

G. Component accessories, such as pumps and chemical feed equipment, are detailed by separate applicable data pages.

H. All tanks are prepared and coated in accordance with technical data sheet SFD-10-375. The exterior bottom of all tanks are not prepared or coated, and shall be installed by the purchaser on a mastic coated level base surface.

I. Automatic controls furnished with standard plants do not include MCC (motor control center) previsions. Safety switches, breakers, and magnetic motor starters shall be furnished by the purchaser. MCC equipment can be provided as an option at added cost.

J. The standard treatment plant systems are designed for indoor installation.

K. A minimum of 4 feet of clearance is required above each tank unit. Service clearance as a minimum should be provided for all tank wall areas.

L. Numerous other options are available, for information consult the factory.

AQUA-FER™ SERIES TYPE HV COMPACT IRON REMOVAL WATER TREATMENT PLANTS

Model Number (1)	IQ-200	IQ-300	IQ-500 (2)	IQ-700 (2)
TREATMENT PLANTS				
Rated Capacity GPM	200	300	500	700
Tank Length (3)	14’-0”	21’-0”	19’-0” Det 26’-0” Fil	26’-0” Det 30’-0” Fil
Tank Width (3)	11’-6”	11’-6”	12’-0” Det 6’-6” Fil	12’-0” Det 8’-0” Fil
Shipping Weight (4)	15,500 lbs.	20,600 lbs.	14,900 lbs. Det 16,500 lbs. Fil	16,700 lbs. Det 19,600 lbs. Fil
Operating Weight (5)	135,000 lbs.	205,000 lbs.	147,000 lbs. Det 176,000 lbs. Fil	201,000 lbs. Det 246,000 lbs. Fil
PLANT DESIGN DATA				
Detention Residence Time	30 min.	30 min.	30 min.	30 min.
Number of Filters	2	3	4	4
Area per Filter	34.5 sq. ft.	35 sq. ft.	42.25 sq. ft.	60 sq. ft.
Total Filter Area	69 sq. ft.	105 sq. ft.	169 sq. ft.	240 sq. ft.
Filtration Rate GPM/Sq. Ft.	2.9	2.9	2.9	2.9
Backwash Rate (6)	518 GPM	525 GPM	634 GPM	900 GPM
Backwash Volume (7)	7,252 gallons	11,025 gallons	17,745 gallons	25,200 gallons
TANK CONNECTION DATA				
Inlet	6”	6”	6”	8”
Outlet	6”	6”	8”	8”
Washwater/Waste	8”	8”	10”	10”
Sludge Draw Off	4”	6”	4” (8)	4” (8)
Overflow	8”	8”	10”	12”

1. Tanks as listed are typically applied as single unit systems. Each unit includes a top mounted aerator that is described elsewhere in this section. Multiple units can be used as appropriate.
2. These models have two separate tanks, detention and filter, for ease of handling, installation, and for designer’s utilization of space. Detention tanks have open tops; covers are available at added cost as an option.
3. Tank lengths and widths are nominal with slight variances for the top structural. The Smith & Loveless, Inc. tanks utilize formed vertical reinforcements providing for maintenance free walls with exterior projections.
4. Shipping weight is approximate based on basic tank(s) (heaviest piece) only. Aerator and other components are shipped separately for field assembly by the purchaser as applicable.
5. Operating weight is approximate based on typical unit assembly, special components, or features, could modify this listing accordingly.
6. The backwash rate is nominal based upon 15 GPM/sq. ft.
7. The backwash volume is nominal based upon 15 GPM/sq. ft. applied rate for 7 minutes.
8. Drain size only, sludge collection manifolds and laterals are not provided on large tank units. Accumulated sludge is periodically manually flushed down with tank out of service similar to large basin fixed plants.

REFER TO PAGE 2 FOR ADDITIONAL INFORMATION FOR THIS SERIES OF WATER TREATMENT PLANTS.

AQUA-FER™ SERIES TYPE hV COMPACT IRON REMOVAL WATER TREATMENT PLANTS

All units listed on Page 1 have common features or requirements as follows:

A. Each tank unit has a separate baffled detention section designed to prevent short circuiting and an aerator mounting structural assembly for field attachment of this component.

B. Each filter section is provided with a non-corroding type of manifold and lateral collection system.

C. Each tank filter section has provided 15 inches of support gravel and 30 inches of dual filter media as standard. A combination of other medias and support material are optionally available. All media is shipped separately in marked cubic foot bags or containers for purchaser field placement.

D. Filter inlet isolation valves are electrically actuated to avoid the need to climb to the tank top to operate these units. All other valves are manually actuated unless the treatment plant is provided for fully automatic operation where all valves would be electrically actuated. Refer to separate valve data sheet.

E. A control air type compressor with drive, refrigerated dryer, regulator and other accessories is required for pneumatically actuated plant units. The compressor shall be capable of delivering a minimum of 6 cfm at 80 psig control air.

F. The treatment tanks in the table are designed for a gravity flow to below grade clearwell storage. An optional design permits a pumped outlet to above ground storage.

G. Component accessories such as pumps and chemical feed equipment are detailed by separate applicable data pages.

H. All tanks are prepared and coated in accordance with technical data sheet SFD-10-375. The exterior bottom of all tanks are not prepared, or coated, and shall be installed by the purchaser on a mastic coated level base surface.

I. Automatic controls furnished with standard plants do not include MCC (motor control center) provisions. Safety switches, breakers and magnetic motor starters shall be furnished by the purchaser. MCC equipment can be provided as an option at added cost.

J. The standard treatment plant systems are designed for indoor installation.

K. A minimum of 4 feet of clearance is required above each tank unit. Service clearance as a minimum should be provided for all tank wall areas.

L. Numerous other options are available, for information consult the factory.

WATER TREATMENT SYSTEMS
SECTION INDEX
AQUA-4® SURFACE WATER TREATMENT PLANTS

Chemical Data:

Specifications:

Drawings:

AQUA-4® SURFACE WATER TREATMENT PLANTS

INTRODUCTION

The Smith & Loveless, Inc. **AQUA-4®** Type LC, MC and HC factory manufactured water treatment plants are specifically designed for the reduction or removal of turbidity, color, taste and odor, iron and manganese from surface water supplies such as rivers, lakes and reservoirs.

The treatment process combines chemical coagulation, mechanical flocculation, tube settler sedimentation and filtration, in a compact module or package with variable speed axial flow flocculators mounted on the top section of the structurally reinforced tank units. The type LC modular treatment plants are typically shipped fully assembled with mounted valves, pumps and controls as applicable and have single stage flocculation. The type MC modular treatment plants are two separate treatment trains combined in a single tank unit with components typically shipped separately for field attachment and interconnection. Each type MC treatment section has two-stage flocculation. The largest type HC modular treatment plants are single train tanks normally applied in pairs with components shipped separately for field attachment and interconnection. Each type HC treatment plant has two-stage flocculation. The tanks for all configurations and sizes are completely fabricated and finish coated at the factory, no field welding is required. Simple field assembly of separate supplied components and the associated interconnection as applicable by the contractor make a system ready for service.

Typically, surface water treatment plants are designed for automatic operation with only periodic attention to satisfy maintenance of chemical solutions and to check equipment. Manually operated plant units are available as an option where this would be appropriate.

Design consultants should be requested to consider the numerous benefits, which are provided by factory manufactured water treatment plants. Considerations would include those of space required, installation time, equipment reliability and installed costs. The **AQUA-4®** type LC, MC and HC modular systems are specifically designed for many years of trouble-free, efficient operation.

The standard selection tables outlined by the index may be used for preliminary plant recommendations with the final plant choice based on a carefully reviewed water analysis. A water sample may be required by the factory for additional tests on certain applications prior to final total treatment plant recommendations.

AQUA-4® TYPE LC
SURFACE WATER TREATMENT PLANTS

Model Number (1)	Q-10	Q-20	Q-60	Q-100
Rated Capacity GPM	10	20	60	100
Tank Length (2)	7'-0"	7'-0"	8'-6"	14'-6"
Tank Width (2)	2'-0"	3'-6"	7'-6"	7'-6"
Tank Height	7'-1"	7'-1"	7'-1"	7'-1"
Shipping Weight (3)	2,500 lbs.	3,500 lbs.	7,200 lbs.	8,200 lbs.
Operating Weight (4)	8,100 lbs.	13,200 lbs.	31,600 lbs.	49,400 lbs.
PLANT DESIGN DATA				
Flocculation Residence Time	19 Min.	17 Min.	18 Min.	18 Min.
Sedimentation Rate GPM/Sq. Ft.	2.5	2.9	2.7	2.6
Filtration Rate GPM/Sq. Ft.	3.4	3.8	4.0	3.8
Filter Area Sq. Ft.	3.0	5.25	15	26.25
Backwash Rate (4)	45 GPM	79 GPM	225 GPM	394 GPM
Backwash Volume (5)	315 Gallons	553 Gallons	1,575 Gallons	2,758 Gallons
TANK CONNECTION DATA				
Inlet	1-1/4"	1-1/2"	2"	3"
Outlet	2"	2"	4"	6"
Wash Water/Waste	3"	4"	6"	6"
Sludge Draw Off	2"	2"	3"	4"

1. Tanks as listed are single treatment section vessels typically applied as individual units. Multiple tank installations are an available option.
2. Tank lengths and widths are nominal with slight variance for the top structural. The Smith & Loveless, Inc. tanks utilize formed vertical reinforcements providing for maintenance-free walls.
3. Shipping weight is approximate and includes the face piping.
4. Operating weight is approximate, based on a typical unit assembly filled with water.
5. The backwash rate is nominal based on 15 GPM/sq. ft.
6. The backwash volume is nominal based on 15 GPM/sq. ft. applied rate for 7 minutes.

All Type LC units have common features or requirements as follows:

A. Each tank has a flocculator capable of independent energy gradient “G” adjustment.

B. Each filter section is provided with a non-corroding type of manifold and lateral collection system.

C. Each filter section has provided 15 inches of support gravel and 30 inches of dual filter media as standard. A combination of other medias and support material is optionally available. All media is shipped separately in marked cubic foot bags or containers for purchaser field placement.

D. Automatic operating valves are provided for each plant.

E. The treatment units in the table are designed for pumping to ground level storage tanks.

F. All tanks are prepared and coated as described in the Smith & Loveless specifications.

G. Automatic controls furnished with standard plants do not include MCC provisions. Safety switches, breakers, and magnetic motor starters shall be furnished by the purchaser, MCC (motor control center) equipment can be provided as an option.

H. The standard treatment plant systems are designed for indoor installation.

I. A minimum of 4 feet of clearance is required above each tank unit. Service clearance as a minimum should be provided for all tank wall areas.

J. Chemical feed equipment is not included in the standard package, but can be provided as an option.

AQUA-R® TYPE MC
SURFACE WATER TREATMENT PLANTS

Model Number (1)	DQ-200	DQ-280	DQ-350
Rated Capacity GPM	200	280	350
Tank Length (2)	21'-6"	23'-6"	29'-6"
Tank Width (2)	10'-0"	12'-0"	12'-0"
Tank Height	8'-1"	8'-1"	8'-1"
Shipping Weight (3)	18,800 lbs.	21,700 lbs.	24,000 lbs.
Operating Weight (4)	112,400 lbs.	148,100 lbs.	181,300 lbs.
PLANT DESIGN DATA			
Flocculation Residence Time	20 Min.	20 Min.	20 Min.
Sedimentation Rate GPM/Sq. Ft.	2.9	2.8	2.9
Filtration Rate GPM/Sq. Ft.	4.0	3.9	3.9
Filter Area Sq. Ft.	25/50	36/72	45/90
Backwash Rate (5)	375 GPM	540 GPM	675 GPM
Backwash Volume (6)	2,800 Gallons	3,900 Gallons	4,900 Gallons
Surface Agitator Rate	20 GPM @ 50 PSI	27 GPM @ 50 PSI	34 GPM @ 50 PSI
TANK CONNECTION DATA			
Inlet	4"	4"	4"
Outlet	6"	6"	8"
Wash Water/Waste	6"	8"	8"
Surface Agitator	2"	2"	2"
Sludge Draw Off	4"	4"	4"
Overflow	6"	8"	8"

1. Tanks as listed consist of two treatment sections that can operate independently, manufactured in a single unit.
2. Tank lengths and widths are nominal with slight variance for the top structural. The Smith & Loveless, Inc. tanks utilize formed vertical reinforcements providing for maintenance free walls.
3. Shipping weight is approximate based on the basic tank (heaviest piece) only. Components are shipped separately for field assembly by the Purchaser.
4. Operating weight (filled with water) is approximate based on typical unit assembly. Special components or features could modify this listing.
5. The backwash rate is nominal based on 15 GPM/sq. ft.
6. The backwash volume is nominal based on 15 GPM/sq. ft. applied rate for 7 minutes and surface agitation for a duration of 4 minutes.
7. The two-section treatment plant has two (2) connections for each listed function.

All Type MC units have common features or requirements as follows:

A. Each tank unit has two (2) separate treatment sections, each having two (2) separate and distinct flocculators, each capable of energy gradient “G” adjustment.

B. Each tank filter section is provided with a non-corroding type of manifold and lateral collection system.

C. Each tank filter section has provided 15 inches of support gravel and 30 inches of dual filter media as standard. A combination of other medias and support material are optionally available. All media is shipped separately in marked cubic foot bags or containers for purchaser field placement.

D. Automatic valves can be provided as an option. The automatic valves for a standard plant are pneumatically actuated. The operating insert butterfly type valves are shipped separately for simple assembly in inter-connection piping, which is furnished and installed by the Purchaser.

E. A control air type compressor with drive, refrigerated dryer, regulator and other accessories can be provided as an option. The compressor shall be capable of delivering a minimum of 6 cfm at 80 psig control air.

F. The Type MC treatment tanks are designed for a gravity flow to below grade clearwell storage. An optional design permits a pumped outlet to above ground storage.

G. Component accessories, such as pumps and chemical feed equipment can be provided as an option.

H. All tanks are prepared and coated as described in the Smith & Loveless, Inc. specifications.

I. Automatic controls furnished with standard plants do not include MCC (motor control center) provisions. Safety switches, breakers, and magnetic motor starters shall be furnished by the purchaser. MCC equipment can be provided as an option.

J. The standard treatment plant systems are designed for indoor installation.

K. A minimum of 4 feet of clearance is required above each tank unit. Service clearance as a minimum should be provided for all tank wall areas.

AQUA-4® TYPE HC
SURFACE WATER TREATMENT PLANTS

Model Number Single Tank (1)	Q-175	Q-280	Q-350	Q-700
Rated Capacity GPM	175	280	350	700
Tank Length (2)	20'-0"	29'-0"	34'-6"	53'-6"
Tank Width (2)	9'-6"	10'-0"	10'-0"	11'-6"
Tank Height	8'-1"	8'-1"	8'-1"	10'-1"
Shipping Weight (3)	15,800 lbs.	18,100 lbs.	21,700 lbs.	31,800 lbs.
Operating Weight (4)	100,500 lbs.	152,700 lbs.	176,600 lbs.	390,000 lbs.
PLANT DESIGN DATA				
Flocculation Residence Time	20 Min.	20 Min.	20 Min.	20 Min.
Sedimentation Rate GPM/Sq. Ft.	2.8	2.8	2.9	3.6 (5)
Filtration Rate GPM/Sq. Ft.	3.7	3.5	3.9	4.0
Filter Area Sq. Ft.	47.5	80.0	90.0	166.75
Backwash Rate (5)	715 GPM	1,200 GPM	1,350 GPM	2,500 GPM
Backwash Volume (6)	5,300 Gallons	8,600 Gallons	9,700 Gallons	17,900 Gallons
Surface Agitator Rate	66 GPM @ 50 PSI	42 GPM @ 50 PSI	50 GPM @ 60 PSI	86 GPM @ 80 PSI
TANK CONNECTION DATA				
Inlet	4"	6"	6"	10"
Outlet	8"	10"	12"	12"
Wash Water/Waste	8"	10"	12"	14"
Surface Agitator	2"	2"	2"	2"
Sludge Draw Off	6"	6"	6"	6"
Overflow	8"	10"	12"	14"

1. Tanks as listed are typically applied with two or more units. Rated capacity would change accordingly. A suffix letter added to the model number would indicate tank unit multiples, i.e., D=two, T=three, Q=4.
2. Tank lengths and widths are nominal with slight variance for the top structural. The Smith & Loveless, Inc. tanks utilize formed vertical reinforcements providing for maintenance free walls.
3. Shipping weight is approximate based on the basic tank (heaviest piece) only. Components are shipped separately for field assembly by the purchaser.
4. Operating weight (filled with water) is approximate based on typical unit assembly. Special components or features could modify this listing.
5. The backwash rate is nominal based on 15 GPM/sq. ft.
6. The backwash volume is nominal based on a 15 GPM/sq. ft. applied rate for 7 minutes and surface agitation for a duration of 4 minutes.

All Type HC units have common features or requirements as follows:

A. Each tank unit has two (2) separate and distinct flocculators, each capable of independent energy gradient "G" adjustment.

B. Each tank filter section is provided with a non-corroding type of manifold and lateral collection system.

C. Each tank filter section has provided 15 inches of support gravel and 30 inches of dual filter media as standard. A combination dual filter media is standard. A combination of other medias and support material are optionally available. All media is shipped separately in marked cubic foot bags or containers for purchaser field placement.

D. Automatic valves can be provided as an option. The automatic valves for a standard plant are pneumatically actuated. The operating insert butterfly type valves are shipped separately for simple assembly in inter-connection piping, which is furnished and installed by the Purchaser.

E. A control air type compressor with drive, refrigerated dryer, regulator and other accessories can be provided as an option. The compressor shall be capable of delivering a minimum of 6 scfm at 80 psig control air.

F. The Type HC treatment tanks are designed for a gravity flow to below grade clearwell storage. An optional design permits a pumped outlet to above ground storage.

G. Component accessories, such as pumps and chemical feed equipment, can be provided as an option.

H. All tanks are prepared and coated as described in the Smith & Loveless, Inc. specifications.

I. Automatic controls furnished with standard plants do not include MCC (motor control center) provisions. Safety switches, breakers, and magnetic motor starters shall be furnished by the Purchaser. MCC equipment can be provided as an option.

J. The standard treatment plant systems are designed for indoor installation.

K. A minimum of 4 feet of clearance is required above each tank unit. Service clearance as a minimum should be provided for all tank wall areas.

AQUA-4® TYPE LC
DIMENSIONS FOR DRAWINGS 31C7 AND 31D3

	Q-10	Q-20	Q-60	Q-100
A	7’-0”	7’-0”	8’-6”	14’-6”
B	2’-0’	3’-6”	7’-6”	7’-6”
C	7’-1”	7’-1”	7’-1”	7’-1”
D	(1)	(1)	(1)	(1)
E	4’-7”	4’-7”	4’-7”	4’-7”
F	2”	2”	6-1/4”	6-1/2”
G	5-1/4”	5-1/4”	6-1/4”	6-1/2”
H	1-1/4” FNPT	1-1/2” FNPT	2” FNPT	3” FNPT
I	1” FNPT	1-1/4” FNPT	2” FNPT	2-1/2” FNPT
J	3” FLGD	4” FLGD	6” FLGD	6” FLGD
K	(1)	(1)	(1)	(1)
L	2” FNPT	2” FNPT	3” FLGD	4” FLGD
V1	1-1/4”	1-1/2”	2”	3”
V2	1”	1-1/4”	2”	2-1/2”
V2/2	1”	1-1/4”	2”	2-1/2”
V3	3”	4”	6”	6”
V4	1”	1-1/4”	1-1/2”	1-1/2”
V5	1-1/2”	2”	3”	4”
V6	2”	2”	3”	4”

1. Dimensions and sizes will vary based upon pump manufacturer and type selected for project. Establishment of this data to be by factory upon specific application.

2. This data applies only to the drawings outlined for standard two pump Model Q-10, Q-20, Q-60, and Q-100 treatment plant units.

AQUA-4® TYPE MC
DIMENSIONS FOR DRAWING 31D6

	DQ-200	DQ-280	DQ-350
A	21’-6”	23’-6”	29’-6”
B	10’-0”	12’-0”	12’-0”
C	8’-1”	8’-1”	8’-1”
D	5’-0”	6’-0”	6’-0”
E	2’-6”	3’-0”	3’-0”
F	8’-6”	10’-3”	12’-6”
G	1’-1”	1’-4”	1’-4”
H	4’-7”	4’-7”	4’-7”
I	7-3/4”	7-3/4”	8-3/4”
J	6-3/4”	6-3/4”	6-3/4”
K	4” Line	4” Line	4” Line
L	6” FLGD	8” FLGD	8” FLGD
M	6” PE	8” PE	8” PE
N	2” FNPT	2” FNPT	2” FNPT
O	6” FLGD	6” FLGD	8” FLGD
P	4” FLGD	4” FLGD	4” FLGD
V1	4”	4”	4”
V2	3”	4”	4”
V3	6”	8”	8”
V4	2”	2”	2”
V5	6”	6”	8”
V6	4”	4”	4”

AQUA-4® TYPE HC
DIMENSIONS FOR DRAWING 31D7

	Q-175	Q-280	Q-350	Q-700
A	20’-0”	29’-0”	34’-6”	53’-6”
B	9’-6”	10’-0”	10’-0”	11’-6”
C	4’-9”	5’-0”	5’-0”	5’-9”
D	6”	6”	6”	6”
E	3’-10-1/2”	5’-7-1/2”	6’-7-12”	9’-3”
F	7’-4-1/2”	7’-4-1/2”	8’-4-1/2”	13’-9”
G	1’-7”	1’-6”	1’-3”	3’-0”
H	4’-7”	4’-7”	4’-7”	4’-7”
I	8-1/2”	9-1/2”	10-1/2”	10-1/2”
J	7-3/4”	7-3/4”	7-3/4”	7-3/4”
K	4” LINE	6” LINE	6” LINE	10” LINE
L	8” FLGD	10” FLGD	12” FLGD	14” FLGD
M	8” PE	10” PE	12” PE	14” PE
N	2” FNPT	2” FNPT	2” FNPT	2” FNPT
O	8” FLGD	10” FLGD	12” FLGD	12” FLGD
P	6” FLGD	6” FLGD	6” FLGD	6” FLGD
R	8’-1”	8’-1”	8’-1”	10’-1”
V1	4”	6”	6”	10”
V2	4”	6”	6”	8”
V3	8”	10”	12”	14”
V4	2”	2”	2”	2”
V5	6”	6”	8”	10”
V6	6”	6”	6”	6”

AQUA-4® FILTER MEDIA PLACEMENT

The Smith & Loveless, Inc. standard support gravel and dual media course placement and quantities are as follows:

DESCRIPTION	NO.	THICKNESS	GRADATION	QUANTITY CU. FT./SQ. FT.	WEIGHT/LBS.
Bottom/Base Course	1	6”	1-1/2” x 3/4”	1/2	50
Second Course	2	3”	3/4” x 1/2”	1/4	25
Third Course	3	3”	1/2” x 1/4”	1/4	25
Top Gravel Course	4	3”	1/4” x #10	1/4	25
Filter Sand	5	12”	0.45-0.55 mm	1	100
Anthracite Cap	6	18”	0.80-1.00 mm	1-1/2	84
Totals	--	45”	--	3-3/4	309

1. Estimating quantities should include approximately 10% extra material for each grade to allow for handling, transit, etc., losses.

2. Any size filter can be estimated by multiplying the surface plan area by the above quantities, which are based upon one square foot.

AQUA-4® SURFACE WATER TREATMENT PLANTS APPLICATION NOTES

GENERAL

The application of surface water treatment plants depends on a number of considerations that are determined by the consulting engineer.

The most obvious parameters include the "Q" (design flow), raw water analysis, plant configuration such as pumped or gravity filtered water outlet, overall scope of controls, accessory components, etc. If special water conditions exist such as taste and odor, or color, this should be specifically considered. Field jar tests of the raw water to be treated are most desirable to ensure final plant performance.

Additionally, there may be special regulatory requirements that the factory may not be aware of such as residence times, sedimentation area, filter area and GPM/sq. ft. permitted for the media type selected. The sales representative will do all possible to obtain this data prior to any preliminary or firm proposal. The selection tables for all Type LC, MC and HC treatment plants will provide assistance as relates to the standard modular plants.

The selection of a standard modular plant will depend on one or more of the briefly outlined conditions, which follow.

TURBIDITY

The average surface water supply turbidity typically will be within a range of from 10 to 50 NTU (Nephelometric Turbidity Units) requiring alum dosages, which do not exceed 50 to 60, mg/l.

It is possible to encounter supplies with high average turbidities ranging from 80 to 150 NTU that will require surprisingly low alum dosages which are often less than 50 mg/l.

The combination of 60° tube settlers and periodic sludge draw-off which is standard with all Smith & Loveless, Inc. **AQUA-4®** surface water treatment plants makes operation at higher feed levels possible.

COLOR

A color condition in surface waters normally results from organic matter impacted from decaying plant accumulations. Water of this type is often low in turbidity, alkalinity and hardness. The treatment process for this condition requires close pH control. Floc, which is formed is light and is very fragile with slow settling rates. More residence time in the sedimentation section is required than in a standard plant. The factory should be consulted on all color reduction applications.

Normal alum dosages should be experienced up to 100 APHA (American Public Health Association) units increasing with higher levels. Laboratory tests are suggested for all color conditions.

TASTE & ODOR

The taste and odors, which are typically encountered in surface water supplies, can be successfully treated with activated carbon for adsorption and potassium permanganate for oxidation, either singly or in combination. Carbon is fed, either at the coagulation point, or directly to the filter, which is considered by numerous authorities as the most desirable feed location.

Laboratory tests are recommended for all taste and odor conditions.

IRON AND MANGANESE

This is not a common condition for surface waters, but where it may be experienced, the treatment process can be established to accommodate reduction or removal.

Laboratory tests are recommended for all iron and manganese conditions.

SOFTENING

The **AQUA-4®** package surface water treatment plant in its standard form is not primarily designed for softening, although it will tolerate some partial softening requirements. Calcification of the filter bed is a concern with softening applications, and the factory should be consulted on all such plants prior to specific recommendations to any prospective purchaser.

Additional data may be found in the General Information Section of your Water Treatment Catalog.

AQUA-4® DESIGN NOTES

1. An accurate raw water analysis is of the utmost importance. This analysis must include any changes to the raw water due to change of season (i.e. summer to winter) or change in source to ensure proper design of the treatment zones and chemical feed system.

2. The inlet structure must include a barscreen with a maximum opening of 2" and provisions for chemical feed if iron and/or manganese removal is required.

3. A presedimentation lagoon or micro-strainer is recommended if the source water has an influent turbidity in excess of 150 NTU.

4. If multiple units are installed, each unit must have a separate raw water inlet rate-of-flow control valve that maintains the volume to each plant to correspond to its flow rating. The design loading of the units remaining on line must not be exceeded when one unit is in backwash.

5. The chemical feed to the treatment units must be flow paced. This includes operation during backwash when the influent feed rate to the entire plant may be decreased. Separate chemical feed systems for each filter recommended.

6. Sufficient storage volume must be provided to allow continuous operation for a minimum of 8 hours per day. Starting and stopping the flow of water to the treatment plant will increase the effluent turbidity.

7. Following backwash, the turbidity of the finished water will increase for a short time while the filter is being reconditioned. A means of discharging the finished water during this time (approximately 15 minutes) is recommended to ensure the finished water does not exceed 0.5 NTU.

8. Inclusion of a clearwell in the design of the treatment plant is necessary to provide adequate backwash volume and chlorine contact time.

9. Booster pumps must not pump directly from the filter underdrain if the clearwell is located at a higher elevation than the filter as this will pull turbidity through the filter causing the finished water to exceed 0.5 NTU.

10. Prechlorination must not be used for disinfection purposes since chlorine addition prior to sedimentation escalates trihalomethane (THM) formation, which must be avoided.

11. All type LC plants utilizing a float-actuated inlet valve (V1) require a minimum water pressure at the valve of 10 psig at design flow.

12. All type MC and HC plants require a minimum inlet pressure of 10 ft. head for controlling flow, with a maximum of 80 ft. head.

13. All type LC plants are based on a pumped filter outlet. The pump at design flow is provided with a discharge head of 10 ft. from the base elevation of the tank. Higher head pumps are available as an option.

14. All type MC and HC plants, except the Q-700 with gravity filter outlet, require 7'-0" free space between the base of the tank and the maximum clearwell water level height. The Q-700 requires 5'-0" free space between the base of the tank and the maximum clearwell water level height.

15. Smith & Loveless, Inc. **AQUA-4®** treatment plant design does not require wasting all of the pretreated water in the sedimentation zone when backwashing. A minimum amount of water is washed from this area when sludge is drawn off periodically according to standard operator adjustable interval and duration time cycles. No siphons requiring special sumps are necessary with the **AQUA-4®** systems.

16. The volume of backwash water required per filter is outlined by the standard selection tables. Tank or clearwell stored volume should allow for this reserve and must be equipped with a low-level signal device that would interconnect with the treatment system backwash control panel to shut down the backwash if the volume reaches the low reserve condition. The Buyer normally furnishes this switch, unless

specifically outlined as part of a Smith & Loveless, Inc. factory proposal to be included with plant accessories.

17. The Buyer also typically furnishes additional switches to start and stop the overall treatment process based upon stored volume. This can be furnished where applicable as an option.

18. All type MC and HC plants are equipped with two level switches, one for a high water level alarm circuit and the other for low water level cutoff to avoid exposing filter bed under an abnormal operating condition.

19. Treatment plant filter outlet valves (V2) for gravity discharge units should be furnished with fail-safe closure on loss of either electrical power or pneumatic air.

20. Treatment plant backwash water to filter inlet valves (V5) should be furnished with operator adjustable open or close speed control blocks.

21. Dual plant treatment systems must have a separate raw water inlet rate-of-flow control valve that reduces the volume for a single plant to correspond to its flow rating when either unit shuts off for backwash. The Buyer normally would supply this valve, but Smith & Loveless, Inc. can provide it as an option.

22. All type LC plants are furnished with operational face pipe, fittings, electrical conduit and wiring as standard. All interconnection pipe, valves, fittings, conduit, wire, etc. will be furnished and installed by the Buyer.

23. All type MC and HC plants have tank face connections only for field valve, fitting or pipe attachment by the Buyer. Smith & Loveless, Inc. **DOES NOT INCLUDE** interconnection pipe, fittings, supports, conduit, wiring, air pipe or tubing, incidental valves, water meters, etc.

24. Pumps are included with all type LC plants, but are not normally included for type MC and HC plants. However, pumps are available for any plant as an option.

25. All plants are provided with rotary surface agitators as standard. The Buyer shall provide for a high pressure service with a supply as listed by the selection tables. This source can be the pressure system, but anti-backflow provisions must be made to comply with local regulations.

26. Plant considerations that are to be provided by the Buyer as defined by the design consultant should cover the following:

    a. A raised base pad should be furnished for each tank to avoid standing water against the structure. This pad should be level to within ½ inch with field sealing and grout provisions to bring the tank level to within 1/8 inch. The base may be required to establish the free space requirements of Item 14.

    b. A discharge sump for each tank (interconnected with multiple tank installations) should be provided capable of receiving the backwash to waste flows without flooding.

    c. Floor drains are recommended between the tank units and near pumps and chemical feed systems.

    d. Service water and supply hose is recommended in the chemical feed mixing area.

27. Review all notes on the applicable selection table in additional to the design notes herein to ensure a thorough and complete understanding of a plant.

STANDARD DESIGNATIONS
AQUA-4® ACCESSORY COMPONENTS

GENERAL INFORMATION

Designations listed are for single plant systems as outlined and as applicable. Multiple tank systems would have a suffix modification based upon the assigned number, i.e.: tank number 1 valve V1 would be shown as V1/1, tank number 2 valve V1 would be shown as V1/2, etc. Smith & Loveless, Inc. will employ these standard designations for all types of water treatment plants with valves, pumps, etc.

VALVE DESIGNATIONS

NUMBER DESCRIPTION

V1	Inlet, raw water to process unit
V2	Outlet, filtered water to system
V3	Outlet, wash water to waste
V4*	Inlet, auxiliary scour for filter *(W = Water/A = Air)
V5	Inlet, backwash water to filter
V6	Outlet, sludge draw-off
V7	Outlet, tank drain down, air scour only

Many systems will have other valve requirements beyond the specific functions previously outlined. When additional valves are provided, these would be identified with the numbers V8 and up, each with a detailed legend of the valve's location and purpose.

PUMP DESIGNATIONS

NUMBER DESCRIPTION

P1	Filtered water to storage/system
P2	Backwash water to filter underdrains

Multiple pumps for the same designated service would be the same as for valves, i.e.: two tank systems each with a filter pump, tank number 1 pump P1 would be shown as P1/1 and tank number 2 pump P1 would be shown as P1/2, etc. Additional special pump units would be identified with the numbers P3 and up, each with a detailed legend of the pump's location and purpose.

Chemical feed pumps shall be designated CP1, CP2, CP3, etc., each with a detailed legend of the pump's location and purpose.

ADDITIONAL COMPONENT DESIGNATIONS

F1	Flocculator, first stage
F2	Flocculator, second stage
MX1 thru MX4	Rapid mixers as applicable
MX5 and up	Chemical solution tank mixers, each with a detailed legend of the mixer's location and purpose
A1 and Up	Air scour supply blowers as applicable

The intent of the foregoing standards is to permit clear and concise communication of exact component function and location.

AQUA-4® TYPE MC & HC OPERATING VALVES APPLICATION NOTES

The following standard will be used when Smith & Loveless, Inc. provides the operation valves for the type MC and HC units.

A standard treatment type HC tank system is provided with (6) and a type MC with twelve (12) automatic operating valves designed as follows:

V1 Inlet.
V2 Outlet.
V3 Wash water to waste.
V4 Surface agitator inlet.
V5 Backwash water inlet.
V6 Sludge draw-off.

Multiple tanks or treatment trains would have the designation modified with a suffix number, i.e.: V1/1 inlet tank number 1, V1/2 inlet tank number 2, etc. Smith & Loveless, Inc. will employ these standard designations throughout all descriptions and instructions.

Where additional valves for an installation are specified to be furnished with a plant system, these would be designated V7 and up, each with a detailed outline of the valve's location and purpose.

All automatic operating valves, except for V4, which is described later, are wafer insert pattern butterfly, resilient-seated, general purpose type with standard materials and valve types are available as options.

Actuators for the automatic valves, except for V2 and V4, which are described later, are pneumatic of the rotary actuator type and are furnished with integral NEMA 4 air solenoids for actuator operation. Each solenoid valve has manual override selection and the V5 backwash inlet valves have field adjustable operating speed control blocks. Fail-safe spring return closure on loss of air or electricity is available as an option if required.

The designated V2 valves for gravity design treatment plants control the filter outlet to storage and are provided with direct acting spring opposed diaphragm actuators. The actuator is provided with top mounted positioners that receive an air signal from the tank level

controller. The valve is standard with fail-safe operation.

A NEMA 4 solenoid is included for on-off operation of the valve. Valve V2 for pumped design plants is provided with the same nomenclature as Valve V1.

The designated V4 valves are diaphragm actuated wye-pattern globe type with threaded connection bodies. NEMA 4 solenoid valves are included with each valve.

A vast number of options are available for actuators and accessories. Consult the factory for any special considerations that may be required.

Additional valves, such as manual isolation, manual rate setting, flow control, etc. are available as options. Consult the factory for any special requirements that may exist.

Valve size and treatment tank model reference is as follows:

Model Number	Q-175	Q-280	Q-350	Q-700	DQ-200	DQ-280	DQ-350
V1-Inlet	4”	6”	6”	10”	4” (2)	4” (2)	4” (2)
V2-Outlet	4”	6”	6”	8”	4” (2)	4” (2)	4” (2)
V3-Wash water	8”	10”	12”	14”	6” (2)	8” (2)	8” (2)
V4-Surface Agitator	2”	2”	2”	2”	2” (2)	2” (2)	2” (2)
V5-Backwash Water	6”	6”	8”	10”	4” (2)	4” (2)	4” (2)
V6-Sludge Draw-off	6”	6”	6”	6”	4” (2)	4” (2)	6” (2)

APPLICATION DETAIL
TUBE SETTLERS 60° PVC

Smith & Loveless, Inc. has successfully used 60° tube settlers for many years on packaged surface water treatment plants with the most applied module height being 3'. Additionally, stack applications have been employed with excellent results.

The advantages of tube settlers are as follows:

1. Increased Solids Capture (25% - 60% less solids or tubidity)
2. Reduced Chemical Use (30% - 50% less)
3. Increased Flows (200% - 500% more)
4. Reduced Basin Time (50% - 60 % less)

TUBE MODULE DIMENSIONS

	TWO FOOT	THREE FOOT
MODULE HEIGHT	20"	30"
TUBE AXIS LENGTH	23.1"	34.7"
AVAILABLE BOTTOM AREA	16SF/SF/PLAN AREA	24 SF/SF/PLAN AREA
HORIZONTALLY PROJECTED BOTTOM AREA	8SF/SF/PLAN AREA	12SF/SF/PLAN AREA

Standard tube settler module width is 24" with a length range of 3'-0" to 15'-0" with the nominal length being 12'-0".

MANUFACTURER'S RATED HYDRAULIC LOADING SCHEDULE (GPM/SQ.FT. PLAN AREA)

	WATER TREATMENT	WASTEWATER	METAL HYDROXIDES
RANGE (2 FT.)	2.0 – 3.0	1.0 – 1.5	1.0 – 1.4
AVERAGE (2 FT.)	2.5	1.25	1.2
RANGE (3 FT.)	3.0 – 4.0	1.5 – 2.0	1.5 – 2.1
AVERAGE (3 FT.)	3.5	1.75	1.8

FILTER MEDIA FOR STANDARD GRAVITY AND PRESSURE FILTERS

GENERAL INFORMATION

Filters, manufactured by Smith & Loveless, Inc., are provided with support gravel and filter media required by each specific project's specifications. Filter media is shipped separately from recognized suppliers of these materials depending on geographical location of the project.

Filter media selection is based on numerous hydraulic and economic factors related to each individual installation. The higher filter rates permitted with approved and proven innovative plants provide designers with numerous choices in preparing specific specifications. The cost factors for the filter media selected may be an important consideration and should be carefully evaluated.

All suitable configurations of monomedia, dual-media and tri-media can be furnished as appropriate.

Gravel and filter media are shipped separately in 1 cubic foot bags or containers on pallets for field placement in filter chambers or vessels by the purchaser. A large installation may require the use of special volume containers or bulk loaded trucks and rail cars, as appropriate. Shipments of this type would be specifically outlined by the sales proposal. Garnet is shipped in 100 pound bags for handling and placement as previously outlined.

Weight*/Volume/Specific Gravity reference for the basic materials is as follows:

Anthracite	50 lbs./cu. ft.	S.G.	1.5
Sand/Gravel	100 lbs./cu. ft.	S.G.	2.6
Garnet	150 lbs./cu. ft.	S.G.	4.2

*Weight is bulk density.

Media supplied by Smith & Loveless, Inc. conforms to American Water Works Association Standards AWWA B100-80, or subsequent revisions thereof.

ANTHRACITE MEDIA FOR STANDARD GRAVITY AND PRESSURE FILTERS

The use of anthracite coal mechanically prepared aggregate for use in the filtration process of water has become increasingly popular since the first significant applications circa 1930.

Anthracite filter media has been used singly and in combination with other media, such as sand (referred to as dual-media) and with sand garnet (referred to as tri-media, or mixed media). The anthracite typically furnished for filter use is a select type of hard coal having a desired level of fracture content that is processed to achieve size classification and particle shape.

The industry accepted advantages of anthracite include the jagged surfaces, angular cubical shapes, increased porosity and a specific gravity that is less than sand. These all enhance filter operation in a number of ways that most designers today routinely use to the benefit of their completed installations.

Where it is appropriate and permitted by area regulatory agencies, higher loading rates for anthracite in dual-media and tri-media filter beds is possible. The higher rates are typical for packaged types of water treatment plants, which are often classified as innovative.

Experience has shown that filter runs with anthracite media are much improved over sand alone, thereby providing an increase in operating efficiency that is readily apparent.

Anthracite has further demonstrated the ability to resist a buildup of numerous coatings and to more readily give up those that do adhere when working with difficult water conditions.

There are standards that provide liberal guidelines on anthracite for filter application, one of which is the MOH hardness. The higher this classification, the harder and purer the material, free of ash, sulfur and volatile matter.

The grindability index is a measure of difficulty with which a material can be ground into a powder, and the more dense durable anthracite grains should be less than 30 on this scale. The importance of this is reflected in aggressive backwash and scour procedures leading to granular collisions and abrasion, which can affect the original size and shape of the media particles.

Smith & Loveless furnishes the highest quality anthracite filter media available for all applications.

Anthracite has a bulk density weight of 56 lgs./cu. ft. and a nominal specific gravity of 1.5.

GENERAL INFORMATION
WATER TREATMENT CHEMICALS

Inorganic chemicals generally used for water treatment are listed in the following tables with a description of the most common application. This does not imply that other uses are not suitable, as many of the chemicals can be applied for other purposes.

CHEMICALS MOST USED

Aluminum Sulfate (Filter Alum)	[$Al_2 (SO_4)_3$ 14.3H_2O]	Coagulation
Hypochlorite (Chlorine) (1)		
a) Calcium	[$Ca(C10)_2$ 2H_2O)]	Disinfection
b) Sodium	[NaC10]	Disinfection
Polymer		Coagulation
Sodium Hydroxide (Caustic)	[NaOH]	pH Adjustment
Potassium Permanganate	[$KMnO_4$]	Oxidation
Soda Ash	[Na_2CO_3] or [Na_2O]	Softening and pH adjustment

OTHER CHEMICALS USED

Activated Carbon	[C] (slurry)	Taste and Odor
Calcium Oxide (lime)	[CaO] (slurry)	Softening
Ferric Chloride	[$FeCl_2$]	Coagulation
Sulfuric Acid	[H_2SO_4]	pH Adjustment

References for detailed application and feed amounts should be reviewed in chemical feed equipment instruction data and from textbooks related to this important part of water treatment. No personnel should be assigned to chemical mixing or feeding that are not fully trained and certified.

1. Chlorine gas (Cl_2) is typically used for disinfection on most of the larger treatment plants.

CHEMICAL FEED DATA AND SOLUTION TANK VOLUME

SOLUTION TANK SIZE	100 GAL	200 GAL	400 GAL	500 GAL
CHEMICAL DESCRIPTION	CHEMICAL FEED/LBS/DAY			
Alum [$Al_2 (SO_4)_3 \cdot 14.3H_2O$]	To 100	To 140	To 250	To 300
Hypochlorite (Calcium) [$Ca(C10)_2 \cdot 2H_2O$)]	To 5	To 10	To 20	To 25
Hypochlorite (Sodium) [NaC10]	To 5	To 10	To 20	To 25
Polymer	To 1	To 2	To 4	To 5
Caustic (Sodium Hydroxide) [NaOH]	To 50	To 100	To 200	To 250
Potassium Permanganate [KM_nO_4]	To 50	To 100	To 200	Over 200
Soda Ash [Na_2CO_3] or [Na_2O]	To 100	To 140	To 280	To 350

The requirement for all feed chemicals should be carefully calculated for each specific application allowing a margin for unforeseen conditions, which may exist.

If the alum feed rate is projected to be greater than 40 mg/l, it is recommended that the use of liquid alum and a fiberglass bulk storage tank be considered in lieu of a 500 gallon solution tank and dry alum.

Hypochlorite generators or gas chlorine feeders should be considered for all larger plants in lieu of solution tanks and dry chemicals.

AQUA-4®
CHEMICAL FEEDER, SOLUTION TANK AND MIXER SELECTION TABLE

PLANT SIZE/GPM

Description	10	20	60	100	175	280	350	700
Alum Feed Pump Size	24 GPD	24 GPD	60 GPD	60 GPD	35 GPH	35 GPH	35 GPH	35 GPH
Max. Feed PPM	100	100	100	100	100	100	100	100
Solution Tank Size	30 gal.	30 gal.	50 gal.	100 gal.	400 gal.	400 gal.	500 gal.	500 gal.
Mixer Size	(1)	(1)	(1)	(1)	1/3 HP	1/3 HP	1/2 HP	1/2 HP
Polymer Feed Pump Size	24 GPD	24 GPD	24 GPD	60 GPD	(2) 35 GPH	(2) 35 GPH	(2) 35 GPH	(2) 35 GPH
Max. Feed PPM	1	1	1	1	1	1	1	1
Solution Tank Size	30 gal.	30 gal.	50 gal.	50 gal.	100 gal.	200 gal.	200 gal.	400 gal.
Mixer Size	1/4 HP	1/4 HP	1/3 HP	1/3 HP	1/3 HP	1/3 HP	1/3 HP	1/2 HP
Soda Ash Feed Pump Size	24 GPD	24 GPD	60 GPD	120 GPD	35 GPH	35 GPH	35 GPH	35 GPH
Max. Feed PPM	96	48	35	40	186	120	84	47
Solution Tank Size	30 gal.	30 gal.	50 gal.	100 gal.	(3)	(3)	(3)	(3)
Mixer Size	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Hypochlorite Feed Pump Size	24 GPD	24 GPD	600 GPD	60 GPD	(5)	(5)	(5)	(5)
Max. Feed PPM	4	4	4	4	4	4	4	4
Solution Tank Size	30 gal.	30 gal.	50 gal.	50 gal.	(X)	(X)	(X)	(X)
Mixer Size	(6)	(6)	(6)	(6)	(X)	(X)	(X)	(X)

1. Mixers are not normally furnished for small alum solution tanks, although they are available as an option.
2. Dual tank and dual chamber treatment systems should have one (1) separate polymer feed pump for each individual unit.
3. Solution tank size selection to be based upon calculated specific soda ash feed requirements.
4. Mixers are not normally furnished for soda ash solution tanks. They are optional available, if required.
5. The larger high capacity (HC) treatment plants will typically utilize either hypochlorite generators or gas chlorine feed systems. A gas feed normally would be provided with a 0-50 PPD rotameter. Other rotameter ranges are optionally available.
6. Mixers are not normally furnished for hypochlorite solutions. They are optionally available, if required.

X. Not applicable.

SPECIFICATIONS FOR
AQUA-4® TYPE LC – SINGLE TANK
SURFACE WATER TREATMENT PLANT

GENERAL

There shall be furnished and installed _____ Smith & Loveless, Inc. Factory-Built **AQUA-4®** Type LC water treatment plant(s) as shown on the drawings and specified herein. The principal components shall include the modular outer tank; (optional chemical blending equipment); flocculation equipment; sedimentation equipment; filtration media and appurtenances; process valves and unit face piping; automatic controls; (optional chemical feed and accessory equipment) as specified.

The basic plant shall be shipped in one piece, ready for placement on a foundation slab. Field welding shall not be required. Mechanical subassemblies and filter media shall be provided separately, consistent with normal shipping procedures.

PERFORMANCE AND DESIGN

The treatment plant shall have a rated design capacity of _____ GPM. At this capacity, high quality potable water shall be produced in accordance with accepted standards. The basic treatment process shall be for turbidity removal, utilizing a chemical coagulant and coagulant aid.

MODULAR OUTER TANK

The tank wall and floor sections shall be minimum 1/4-inch thick carbon steel, suitably stiffened by formed reinforcements or continuously welded structural components. Steel plate shall meet or exceed ASTM A-36 specifications. Individual compartments, as well as the outer walls, shall be designed to withstand the full internal hydrostatic pressure without external support. A double bulkhead shall be provided to separate filtered and unfiltered water, with a provision for free drainage between bulkheads.

CHEMICAL BLENDING
☐ (OPTIONAL ITEM – CHECK IF REQUIRED)

Treatment chemicals shall be injected into an inlet pipe section equipped with baffles for hydraulically induced blending of the chemicals with the incoming raw water.

FLOCCULATION

Single cell flocculation shall be provided with a minimum total retention time of _____ min. at design flow. Each cell shall be equipped with an independent, vertical axial flow mechanical flocculator driven by a _____ HP, 5:1 minimum range infinitely variable speed gear reducer. Flow straightening vanes shall be provided to prevent vortexing and assure establishment of a uniform particle contact/floc formation regime. The flocculator design shall provide for a velocity gradient $G = 80\ sec^{-1}$.

SEDIMENTATION

The sedimentation/clarification zone shall have its entire surface equipped with 60^0 tube settlers of heavy 20-mil minimum PVC material. The minimum horizontally projected bottom area shall be not less than 12 sq. ft./sq. ft. of plan area. Flow shall be uniformly introduced in the lower chamber section through a low velocity, orificed distribution header. The upper chamber section shall include a complete launder system, with overflow leveling provisions.

Sludge removal shall be accomplished through a system of orificed suction laterals manifolded to a single sludge draw-off header. Sludge removal shall be automatic, timer-controlled, entirely independent of the function of the filter. Draw-off shall be possible only with the plant in an "ON" operating mode.

FILTRATION

Each tank filtration zone shall be a single separate chamber with a total area provided to establish the maximum application rate

at _____ gpm/sq. ft., except during backwash. The filter shall be provided with a wash water trough having adjustable aluminum weirs. The filter underdrain shall be the header-lateral type manufactured entirely of non-corroding materials.

The filter media shall be made up of a 12 inch thick layer of filter grade sand, sized 0.45 - 0.55 mm, with a uniformity coefficient not to exceed 1.6 and a top layer of 18 inches thick anthracite, sized 0.80 - 1.00 mm, with a uniformity coefficient not to exceed 1.6. A 15-inch deep media support bed shall be provided, comprised of gravel layers as follows.

Bottom Course Grade	1-1/2" to 3/4"	6" thick
Second Course Grade	3/4" to 1/2"	3" thick
Third Course Grade	1/2" to 1/4"	3" thick
Top Course Grade	1/4" to #10 mesh	3" thick

All sand, anthracite and gravel for the filters shall be furnished separately and properly identified.

SURFACE AGITATION

The filter shall be equipped with a _____ type surface agitation assembly to augment the backwash procedure. All components shall be manufactured entirely of non-corroding materials.

VALVES AND FITTINGS

All tank process control valves, internal pipe and fittings and operational face piping shall be furnished by the water treatment plant Manufacturer. Automatic valves for line sizes 3-inch and larger shall be insert wafer-type butterfly design. Automatic valves for line sizes smaller than 3 inches shall be of the ball or globe design. All valves shall be heavy-duty commercial service design, with tight-shut "OFF" capability.

AUTOMATIC CONTROLS

The treatment plant Manufacturer shall furnish process controls in a NEMA 12 enclosure, complete with contact switches, relays, timers, programmers and other electrical devices necessary for automatic operation of the plant facility. All items shall be completely assembled and mounted. All internal wiring shall be brought to a numbered terminal strip. All relays and timers shall be of the plug-in type. All components shall be selected to provide long, satisfactory service in a humid atmosphere.

The control panel shall be designed to automatically start and stop the plant raw water pumps and the chemical feed equipment, based on a signal from the finished water storage level. The panel shall also provide for automatically backwashing each filter chamber, based on a pre-selected head loss. Additionally, the panel will include adjustable timers to provide for automatically wasting sludge form the sedimentation chamber. Control provisions shall be made for switching to a manual operational mode.

The control panel shall be mounted on the treatment tank at the factory. Interconnecting wiring and conduit between the panel and tank mounted components shall be completed at the factory, prior to shipment.

All external control sensors furnished by the plant Manufacturer shall be installed by the Purchaser.

The electrical service to the plant control panel shall be _____ phase, _____ cycle, _____ volt, _____ wire.

CHEMICAL FEED

☐ (OPTIONAL ITEM – CHECK IF REQUIRED)

Equipment shall be provided for mixing and feeding aluminum sulfate coagulant and polyelectrolyte coagulant aid. The water treatment plant Manufacturer shall furnish corrosion-resistant tanks, mixers and metering pumps appropriate to the service.

CORROSION PROTECTION

After welding, all interior carbon steel surfaces shall be SSPC SP-10 prepared to near white metal and protected immediately by the plant Manufacturer. All exterior carbon steel surfaces shall be steel grit blasted to SSPC SP-6. Interior surfaces shall be protected with a high-build epoxy polyamide finish coating. This coating shall be FDA approved for potable water service and shall be factory applied to a minimum 6-10 mil dry film thickness prior to shipment. Exterior surfaces shall be finish coated with **VERSAPOX**® prior to shipment. The dry **VERSAPOX** coating shall be a minimum 6-10 mil thickness.

All stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated.

A touch-up kit shall be provided by the Manufacturer for repair of any mars or scratches occurring in the **VERSAPOX** coating during installation.

INSTALLATION

The Purchaser shall install the factory-built water treatment plant(s) and equipment in accordance with the Installation Instructions provided by the Manufacturer. The Manufacturer shall provide these instructions prior to shipment. Installation shall specifically include, but not be limited to, the following:

1. All excavation, backfilling, grading and fencing.
2. Construction of the concrete foundation and all necessary concrete pads.
3. Furnishing and installing all exterior piping not provided by the Manufacturer.
4. Furnishing and installing the electric power service, service wiring, conduit and main disconnect switch.
5. Installation of all equipment, including placement of the tank(s).
6. Field touch-up painting as required. **VERSAPOX** touch-up paint to be furnished by the Manufacturer.
7. Unloading, washing, scraping and installation of the filter media.
8. Unloading and installation of the gravel for the filter bed.
9. Providing all necessary freezing and environmental protection.
10. Unloading and transporting equipment from the mainline carrier to the job site, when applicable.
11. Furnishing and installing all influent pumps, when applicable.
12. Furnishing and installing all meters, recorders, alarms, sensors and other accessories not specifically designated as furnished by the water treatment plant Manufacturer.
13. Furnishing and installing all chemical feed and blending equipment, unless provided by the Manufacturer of the water treatment plant.

OPERATION AND MAINTENANCE INSTRUCTIONS

The Manufacturer shall provide a complete and detailed Operation and Maintenance Manual. This manual shall include detailed operation and maintenance procedures for all components of the water treatment plant(s), and auxiliary equipment he provides.

MANUFACTURER'S INSURANCE

ALL EQUIPMENT MANUFACTURERS, either direct or subcontractors to the general or mechanical contractors, SHALL HAVE in effect at TIME OF BID, CONTRACT AWARD, CONTRACT PERFORMANCE, and WARRANTY TERM, PRODUCT AND COMPREHENSIVE LIABILITY INSURANCE, INCLUDING SUDDEN AND ACCIDENTAL POLLUTION COVERAGE, in the amount of FIVE MILLION DOLLARS ($5,000,000) through an insurance company with a minimum rating of A+ (SUPERIOR) XV according to the BEST'S INSURANCE REPORTS. All policies must be written on an OCCURRENCE BASIS. Policies written on a CLAIMS MADE BASIS are not acceptable. The CERTIFICATE OF INSURANCE attesting to the specified coverage issued by the responsible carrier naming the ENGINEER OF RECORD and the OWNER as ADDITIONAL INSURED, must be presented to the named additional insured prior to contract award. A FAILURE TO COMPLY with this requirement BY THE BIDDER will require DISQUALIFICATION of the BID and CONTRACT AWARD.

STARTUP

The Manufacturer shall provide the services of a factory-trained representative for a maximum period of _____ days on-site to assist with the initial startup, and to instruct the Owner's operating personnel in the operation and maintenance of the equipment.

WARRANTY

The Manufacturer of the equipment shall warrant for one (1) year from date of startup, not to exceed eighteen (18) months from date of shipment, that all equipment he provides will be free from defects in material and workmanship.

In the event a component fails to perform as specified, or is proven defective in service during the warranty period, the Manufacturer shall repair or replace, at his discretion, such defective part. He shall further provide, without cost, such labor as may be required to replace, repair or modify major components. After startup service has been performed, the labor to replace accessory items shall be the responsibility of others.

The repair or replacement of those items normally consumed in service such as seals, grease, light bulbs, etc., shall be considered as part of routine maintenance and upkeep.

It is not intended that the Manufacturer assume responsibility for contingent liabilities or consequential damages of any nature resulting from defects in design, material, workmanship or delays in delivery, replacement or otherwise.

MANUFACTURED EQUIPMENT
OPTION 1 (STANDARDIZATION) [DELETE THIS LINE FROM FINAL SPEC TEXT]

The specifications and drawings detail Smith & Loveless equipment and represent the minimum standard of quality for both equipment and materials of construction. The contractor shall prepare his bid on the basis of the particular equipment and materials specified for the purpose of determining the low bid.

The owner has standardized on the named equipment in order to optimize their operation, maintenance, and safety programs, provide for interchangeability of costly equipment items, reduce stocking levels required for necessary spare parts and provide increased flexibility in the utilization of their facility. Equipment substitutions, since incompatible with the Owner's standardization program, will not be considered.

OPTION 2 (BASE BID WITH BID SUBMITTAL) [DELETE THIS LINE FROM FINAL SPEC]

The specifications and drawings detail Smith & Loveless equipment and represent the minimum standard of quality for both equipment and materials of construction. The contractor shall prepare his bid on the basis of this equipment for the purpose of determining the low bid without consideration of a possible substitute.

Substitution of other makes may be considered if the equipment proposed for substitution is superior or equal in quality and efficiency to the standards of quality named in the specifications and this is demonstrated to the satisfaction of the engineer.

Contractors wishing to offer a deduct for substitute equipment shall include the following submittal information with their proposal.

BID SUBMITTAL

This submittal shall include all necessary information for the proper determination of the acceptability of the proposed substitution, and shall not necessarily be limited to the following:

A. Complete description of the equipment, system, process, or function, including a list of system components and features, drawings, catalog information and cuts, Manufacturer's specifications, including materials description.
B. Performance data and curves, and horsepower requirements.

C. Outside utility requirements, such as water, power, air, etc.
D. Functional description of any internal instrumentation and control supplied including list of parameters monitored, controlled, or alarmed.
E. Addresses and phone numbers of nearest service centers and a listing of the Manufacturers or Manufacturer's representatives services available at these locations, including addresses and phone numbers of the nearest parts warehouses capable of providing full parts replacement and/or repair services.
F. A list of five installations in the state where similar equipment by the Manufacturer is currently in similar service; include contact name, telephone number, mailing address of the municipality or installation, engineer, Owner, and installation contractor; if five installations do not exist, the list shall include all that do exist, if any.
G. Detailed information on site, architectural, structural, mechanical, plumbing, electrical, and control, and all other changes or modifications to the design and construction work necessary to adapt the equipment or systems to the arrangement shown and/or functions described on the drawings and in the technical specifications. This shall include plan view and section sketches illustrating any additional space requirements necessary to provide the minimum adequate clear space within and around the equipment for operation and maintenance, as shown on the drawings and specified.
H. All differences between the specifications and the proposed substitute equipment shall be clearly stated in writing under a heading of "differences".
I. Other specific submittal requirements listed in the detailed equipment and material specifications.

EVALUATION

Approval of the substitution to bid as an alternate shall in no way relieve the contractor from submitting the specified shop drawings for approval or complying fully with all provisions of the specifications and drawings.

If substituted equipment is accepted. The contractor shall, at his own expense, make any changes in the structures, piping, electrical, etc., necessary to accommodate the equipment. If engineering is required due to substitution of alternate equipment, the contractor shall pay for all engineering charges.

To receive final consideration, copies of the Manufacturers' quotations for the equipment may be required to document the savings to the satisfaction of the engineer. It is the intent that the owner shall receive the full benefit of the savings in cost of equipment and the contractor's bid price shall be reduced by an amount equal to the savings. In all technical and other evaluations, the decision of the engineer is final.

TYPICAL BID FORM
[ADD TO BID FORM AS APPLICABLE TO ABOVE SELECTED OPTION]

OPTION 1

For reasons of standardization, bids shall be based on the named equipment. Alternate bids will not be allowed.

OPTION 2

Bids shall be based on the named equipment. Alternate/substitute equipment may be offered as a deduct, provided all conditions of the "manufactured equipment" section are met.

Alternate/Substitute Manufacturer _____.

Deduct $_____.

SPECIFICATIONS FOR AQUA-4® TYPE MC/HC – SINGLE TANK SURFACE WATER TREATMENT PLANT

GENERAL

There shall be furnished and installed _____ Smith & Loveless, Inc. Factory-Built **AQUA-4™** Type (MC) (HC) water treatment plant(s) as shown on the drawings and specified herein. The principal components shall include single tank, (single train) (dual train) modular construction; (optional chemical blending equipment); flocculation equipment; sedimentation equipment; filtration media and appurtenances; (optional process valves and unit face piping); automatic controls; (optional chemical feed and accessory equipment) as specified.

The basic plant shall be shipped in once piece ready for placement on a foundation slab. Field welding shall not be required. Mechanical subassemblies, (optional process valves and unit face piping), and filter media shall be provided separately, consistent with normal shipping procedures.

PERFORMANCE AND DESIGN

The treatment plant shall have a rated design capacity of _____ GPM. At this capacity, high quality potable water shall be produced in accordance with accepted standards. The basic treatment process shall be for turbidity removal, utilizing a chemical coagulant and coagulant aid.

MODULAR OUTER TANK

The treatment plant shall consist of (one) (two) process train(s) in a single tank as shown on the drawings. The tank wall and floor sections shall be minimum 1/4-inch thick carbon steel, suitably stiffened by formed reinforcements or continuously welded structural components. Steel plate shall meet or exceed ASTM A-36 specifications. Individual compartments, as well as the outer walls, shall be designed to withstand the full internal hydrostatic pressure without external support. A double bulkhead shall be provided to separate filtered and unfiltered water, with a provision for free drainage between bulkheads.

CHEMICAL BLENDING
☐ (OPTIONAL ITEM – CHECK IF REQUIRED)

Treatment chemicals shall be injected into an inlet pipe section, equipped with baffles for hydraulically induced blending of the chemicals with the incoming raw water.

FLOCCULATION

Two-chamber tapered flocculation shall be provided for each tank unit, with a minimum total retention time of _____ min. at design flow. Each chamber shall be equipped with an independent, vertical axial flow mechanical flocculator, driven by a _____ HP, 5:1 minimum range infinitely variable speed gear reducer. Flow straightening vanes shall be provided to prevent vortexing and assure establishment of a uniform particle contact/floc formation regime. Chamber No. 1 shall be furnished to provide for a velocity gradient G = 80 sec^{-1}. Chamber No. 2 shall be supplied for G = 40 sec^{-1}.

SEDIMENTATION

Sedimentation/clarification shall have its entire surface equipped with 60° tube settlers of heavy 20 mil minimum PVC material. The minimum horizontally projected bottom area shall be not less than 12 sq. ft./sq. ft. of plan area. Flow shall be uniformly introduced in the lower chamber section through a low velocity, orificed distribution header. The upper chamber section shall include a complete launder system having adjustable aluminum weir plates.

Sludge removal shall be accomplished through a system of orificed suction laterals manifolded to a single sludge draw-off header. Sludge removal shall be automatic, timer-controlled, entirely independent of the function of the filters. Draw-off shall be possible only with the plant in an "ON" operating mode.

FILTRATION

Filtration shall be a separate chamber with a total area provided to establish the maximum application rate at _____ gpm/sq. ft., except during backwash. The filter shall be equipped with rotary surface agitation as shown on the drawings and wash water troughs, having adjustable aluminum weir plates. The filter underdrain shall be the header-lateral type manufactured entirely of non-corroding materials.

The filter media shall be made up of a 12 inch thick layer of filter grade sand, sized 0.45 - 0.55 mm, with a uniformity coefficient not to exceed 1.6 and a top layer of 18 inches thick anthracite, sized 0.80 - 1.00 mm, with a uniformity coefficient not to exceed 1.6. A 15-inch deep media support bed shall be provided, comprised of gravel layers as follows.

Bottom 6"	1-1/2" to 3/4"
Next 3"	3/4" to 1/2"
Next 3"	1/2" to 1/4"
Top 3"	1/4" to #10 mesh

All sand, anthracite and gravel for the filter shall be furnished separately and properly identified.

VALVES AND FITTINGS
☐ (OPTIONAL ITEM – CHECK IF REQUIRED)

All tank process control valves, internal pipe and fittings and operational face piping shall be furnished by the water treatment plant Manufacturer. Automatic valves for line sizes 3-inch and larger shall be insert wafer-type butterfly design. Automatic valves for line sizes smaller than 3 inches shall be of the ball or globe design. All valves shall be heavy-duty commercial service design, with tight-shut "off" capability. Face piping shall be assembled in the field by the purchaser.

AUTOMATIC CONTROLS

The treatment plant Manufacturer shall furnish process controls in a NEMA 12 enclosure, complete with contact switches, relays, timers, programmers and other electrical devices necessary for automatic operation of the plant facility. All items shall be completely assembled and mounted. All internal wiring shall be brought to a numbered terminal strip. All relays and timers shall be of the plug-in type. All components shall be selected to provide long, satisfactory service in a humid atmosphere.

The control panel shall be designed to automatically start and stop the plant raw water pumps and the chemical feed equipment, based on a signal from the finished water storage level. The panel shall also provide for automatically backwashing each filter chamber, based on a pre-selected head loss. Additionally, the panel will include adjustable timers to provide for automatically wasting sludge from the sedimentation chamber. Control provisions shall be made for switching to a manual operational mode.

The control panel shall be furnished to the project site, separately crated, for mounting by the contractor.

External control sensors shall be furnished (by the plant Manufacturer) (by the purchaser) for installation by the purchaser.

The electrical service to the plant control panel shall be _____ phase, _____ cycle, _____ volt, _____ wire.

AIR COMPRESSOR
☐ (OPTIONAL ITEM – CHECK IF REQUIRED)

A compressor pack, Quincy or equal, shall be furnished for pneumatic control requirements. The compressor shall be single-stage, automatic type, completely shop assembled, with ASTM Code receiver, filter, gauges and safety equipment. The compressor shall be rated for the specific plant design requirements. A refrigerated compressed air dryer shall be furnished for mounting adjacent to the compressor.

CHEMICAL FEED
☐ (OPTIONAL ITEM – CHECK IF REQUIRED)

Equipment shall be provided for mixing and feeding aluminum sulfate coagulant and polyelectrolyte coagulant aid. The water treatment plant Manufacturer shall furnish corrosion-resistant tanks, mixers and metering pumps appropriate to the service.

CORROSION PROTECTION

After welding, all interior carbon steel surfaces shall be SSPC SP-10 prepared to near white metal and protected immediately by the plant Manufacturer. All exterior carbon steel surfaces shall be steel grit blasted to SSPC SP-6. Interior surfaces shall be protected with a high-build epoxy polyamide finish coating. This coating shall be FDA approved for potable water service and shall be factory applied to a minimum 6-10 mil dry film thickness prior to shipment. Exterior surfaces shall be finish coated with **VERSAPOX®** prior to shipment. The dry **VERSAPOX** coating shall be a minimum 6-10 mil thickness.

All stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated.

A touch-up kit shall be provided by the Manufacturer for repair of any mars or scratches occurring in the **VERSAPOX®** coating during installation.

INSTALLATION

The Purchaser shall install the factory-built water treatment plant(s) and equipment in accordance with the Installation Instructions provided by the Manufacturer. The Manufacturer shall provide these instructions prior to shipment. Installation shall specifically include, but not be limited to, the following:

1. All excavation, backfilling, grading and fencing.
2. Construction of the concrete foundation and all necessary concrete pads.
3. Furnishing and installing all exterior piping not provided by the Manufacturer.
4. Furnishing and installing the electric power service, service wiring, conduit and main disconnect switch.
5. Installation of all equipment, including placement of the tank(s).
6. Field touch-up painting as required. **VERSAPOX** touch-up paint to be furnished by the Manufacturer.
7. Unloading, washing, scraping and installation of the filter media.
8. Unloading and installation of the gravel for the filter bed.
9. Providing all necessary freezing and environmental protection.
10. Unloading and transporting equipment from the mainline carrier to the job site, when applicable.
11. Furnishing and installing all influent pumps, when applicable.
12. Furnishing and installing all meters, recorders, alarms, sensors and other accessories not specifically designated as furnished by the water treatment plant Manufacturer.
13. Furnishing and installing all chemical feed and blending equipment, unless provided by the Manufacturer of the water treatment plant.
14. Furnishing and installing all process control valves, internal pipe and fittings, unless provided by the Manufacturer of the water treatment plant.
15. Installation of all face piping and process control valves.

OPERATION AND MAINTENANCE INSTRUCTIONS

The Manufacturer shall provide a complete and detailed Operation and Maintenance Manual. This manual shall include detailed operation and maintenance procedures for all components of the water treatment plant(s), and auxiliary equipment he provides.

MANUFACTURER'S INSURANCE

ALL EQUIPMENT MANUFACTURERS, either direct or subcontractors to the general or mechanical contractors, SHALL HAVE in effect at TIME OF BID, CONTRACT AWARD, CONTRACT PERFORMANCE, and WARRANTY TERM, PRODUCT AND COMPREHENSIVE LIABILITY INSURANCE, INCLUDING SUDDEN AND ACCIDENTAL

Sydney Harbour Tunnel Gets "Iron"-ic Ugrade with S&L AQUA-FER™

The Sydney Harbour Tunnel has experienced difficulty with groundwater infiltrating the tunnel and posing problems with residue build-up and collecting debris before it finally discharges into the bay. In particular, the groundwater contains a high degree of ferric content that necessitated further treatment before discharge.

In order to complete project in a timely manner and qualified specifications, Haden Engineering chose the Smith & Loveless **AQUA-FER**™, a proven, pre-engineered aeration and filtration process. Model IQ-50 Unit was selected to meet the design flows of 260 kL/day (peak) and slightly more than 43 k/L (average). The required iron concentration is less than 1 mg/L prior to discharge.

The Smith & Loveless **AQUA-FER**™ is a strategic choice for the application because it is specifically designed to remove soluble ferrous iron from groundwater and anaerobic reservoir supplies. The pre-engineered system integrates aeration, chemical oxidation, sedimentation and filtration. The following is system description of the unit applied in the Sydney Harbour Tunnel.

How it Works

Water collected from a sump, which contains soluble iron, is pumped into a surge tank at flows up to 31 lps. From the surge tank the water is pumped to the aerator and adjusted to pH 8 through the addition of sodium hydroxide (NaOH) prior to the aerator. The surge tank level will be maintained through proportional control of the speed of the two aerator feed pumps. The controls will allow for normal flow of 0.2-0.5 lps with a single pump running, up to a maximum intermittent flow of up to 3 lps with both pumps on line. The system is rated for a flow of 260 kld.

After the aerator, water passes into the oxidation/coagulation tank. If required, a suitable oxidizing agent will be added to the water after the aerator to assist in complete oxidation of the soluble iron. The iron oxidation will result in formation of ferric hydroxide floc particles in this tank. Some settling will occur, and will be removed periodically by pumping to a sludge holding tank.

Overflow from the oxy/coag tank flows by gravity through the mixed media filter and into the clear well tank. Two filters are included in the system. The level above the filter media will fluctuate depending on the accumulation of solids and the flow rate. The level will be maintained at a minimum that is just over the media by the use of an over flow pipe on the outlet of the filter into the clear well. As solids accumulate, the level will rise to a preset level, at which point a filter will be backwashed.

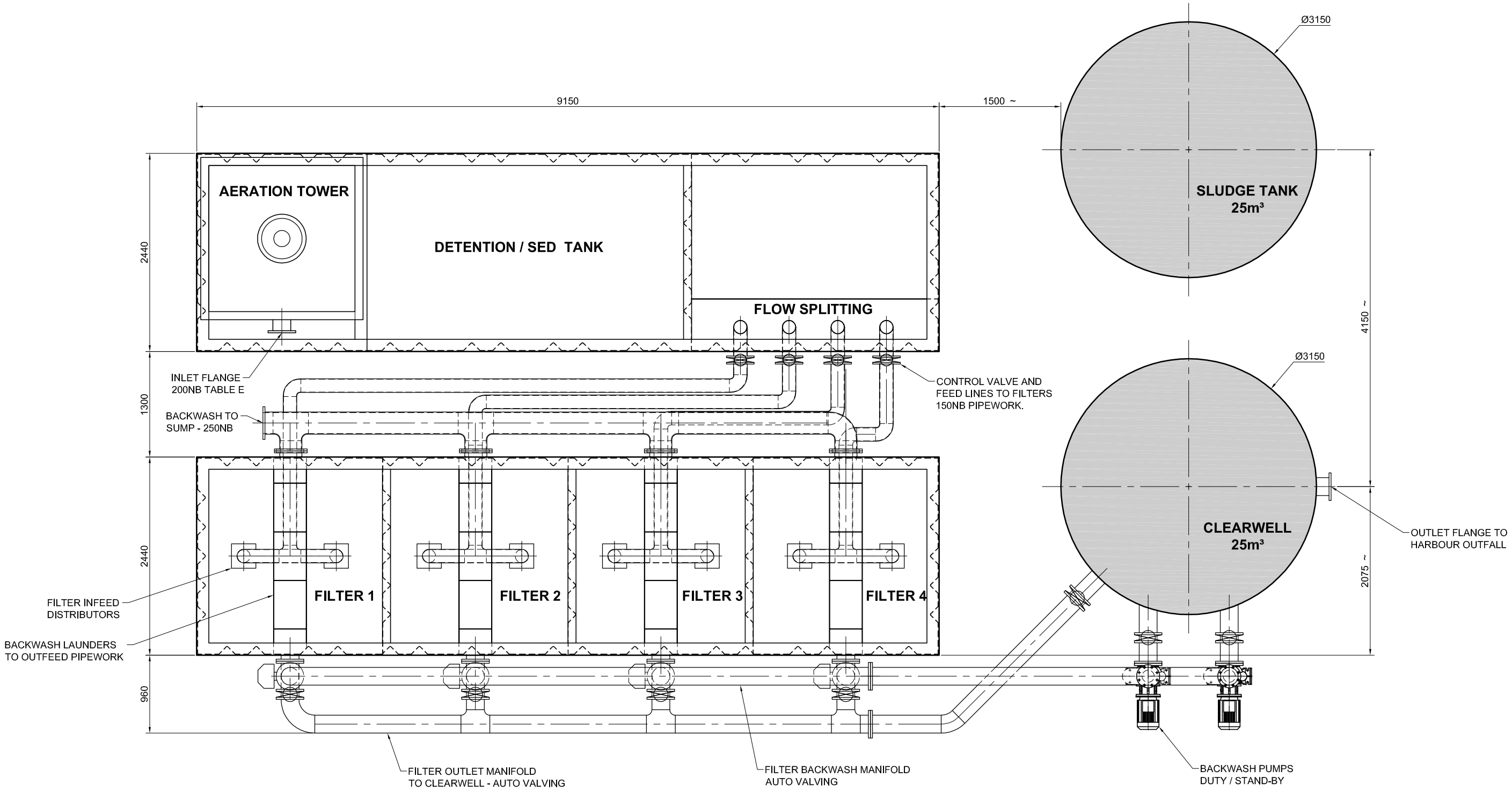
Filtered water will accumulate in the clear well to be used as a backwash supply. Excess water will overflow by gravity.

The Smith & Loveless **AQUA-FER** ™ *integratres aeration, chemical oxidation, sedimentation and filtration in one complete, pre-engineered system. Situated underneath the air intake louvre adjacent to the world-famous Sydney Harbour Bridge, this particular system works to reduce iron levels from collected groundwater in the Sydney Harbour Tunnel to less than 1 mg/L before discharge.*

For more, contact us at www.smithandloveless.com

E-mail: joegill@xtra.co.nz • Phone: (09) 488-6701 • FAX: (09) 488-6702

SMITH & LOVELESS REPRESENTATIVE CONTACT: JOE GILL, GENERAL MANAGER P.O. BOX 31-616, 18 FENWICK AVENUE, MILFORD, AUCKLAND 1000 NZ



PLAN

(SLUDGE TANK PIPEWORK AND
PUMPS NOT SHOWN IN GA)

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				APPROVED BY:	DATE:		
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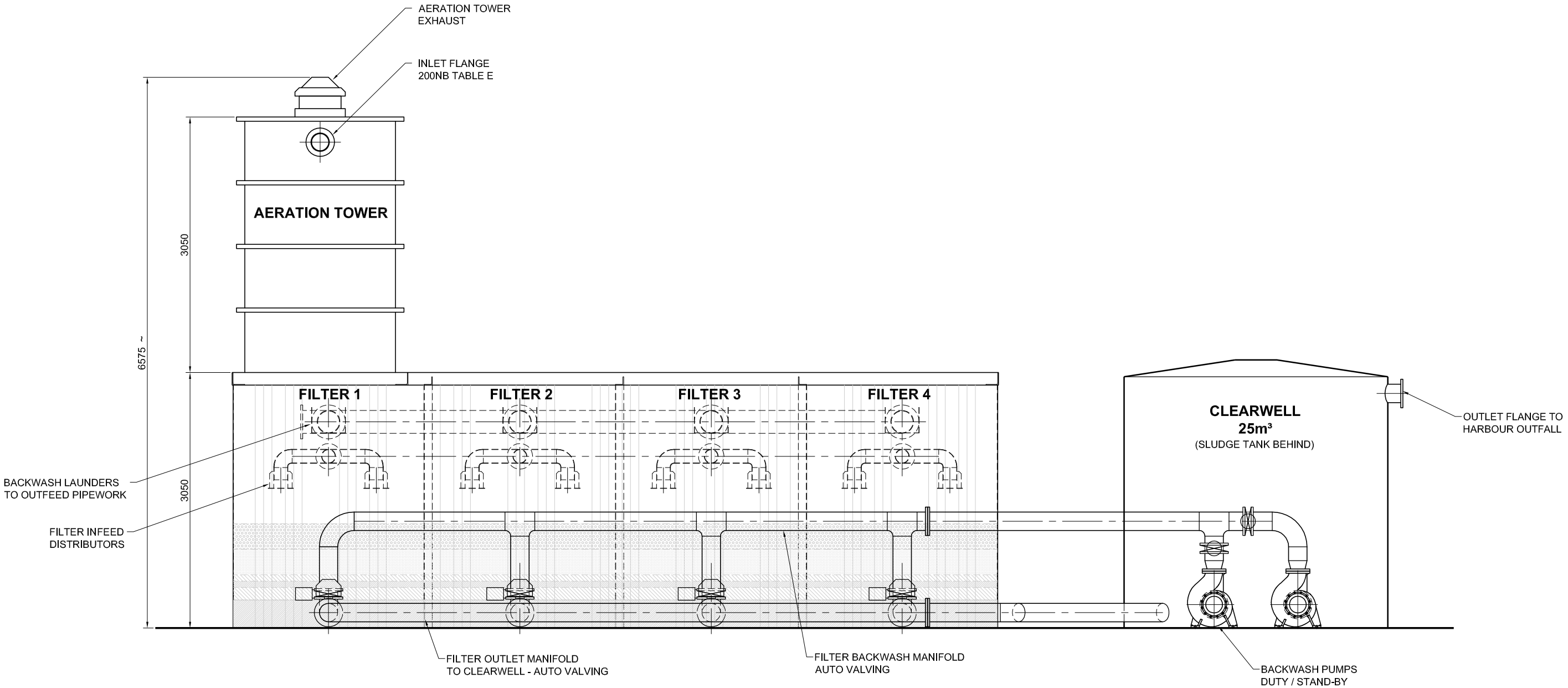
LET	ECN NO	DATE	BY APPV'D			FILE NAME S13-18.dwg	PLOT SCALE
ORIGINAL ISSUE						SERIAL NO	DWG NO S13-18 - M100 REV A

Smith & Loveless NZ



ELEVATION

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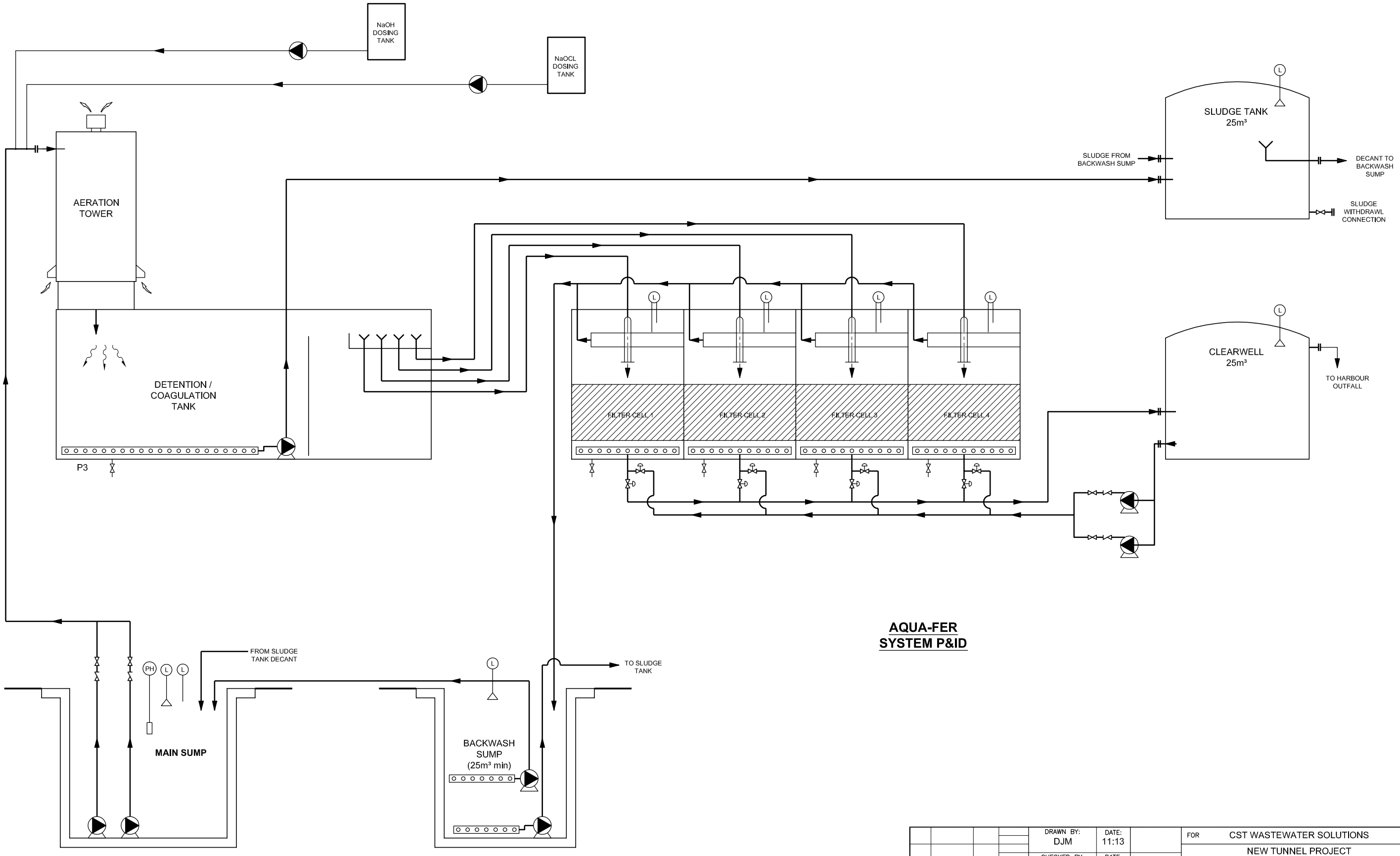
ORIGINAL ISSUE							SERIAL NO / DWG NO S13-18 - M101 / REV A

Smith & Loveless NZ



AQUA-FER SYSTEM P&ID

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				APPROVED BY:	DATE:		P & ID SCHEMATIC
LET	ECN NO	DATE	BY APPV'D	SCALE: NTS	CODE:		SIZE A1 / WT. / FILE NAME S13-18.dwg / PLOT SCALE
ORIGINAL ISSUE							SERIAL NO / DWG NO S13-18 - M200 / REV A

Smith & Loveless NZ

19.3. Chlorination Details

Water New Zealand

INTERIM GOOD PRACTICE GUIDANCE NOTE

Supply of Chlorine for Use in Drinking-Water Treatment

September 2016

Second Edition

The first edition of this document titled “Standard for the Supply of Chlorine for Use in Drinking Water Treatment” was prepared for the Water Supply Managers' Group of the New Zealand Water & Wastes Association and the Ministry of Health by Opus International Consultants Ltd in 1997.

The document was subsequently reviewed in 2016. During the review it emerged further work is required to determine an appropriate limit for chlorate and perchlorate levels in sodium hypochlorite. Results of this work will be completed by June 2018 and used to update this guide. In the interim water operators using sodium hypochlorite are advised to; conduct periodic testing of chlorate levels in drinking water to ensure they meet limits outlined in the Drinking Water Standards, and follow the steps outlined in sections 2.3.2 and 2.3.3 to minimise chlorate and perchlorate formation.

Acknowledgements:
Water New Zealand would like to acknowledge the Technical Review Committee for their contribution to the development of this revision of the Guide: Andrew van Bussell of Rangitikei District Council, Craig Freeman of Filtec, Duncan Leigh of Chemiplas, Graeme Colquhoun of Ixom, Jason Colton of h2ope, Tom Surrey of Watercare, Phil Eberhard of Aquacare and Chris Nokes of ESR on behalf of Ministry of Health.

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Contents

1 GENERAL

1.1 Scope

This Guide covers requirements for ensuring liquefied chlorine gas (commonly known as liquid chlorine) sodium hypochlorite and calcium hypochlorite are of a suitable quality for use in drinking water treatment.

This Guide does not cover:

- Chlorine products for use in swimming pool water treatment or other applications.
- Environmental protection or health and safety measures associated with the use of chlorine including labelling, site and storage, transportation, packaging or disposal requirements.
- Operational procedures for using chlorine.

1.2 Purpose

The main purpose of this Guide is to provide purchasers, manufacturers and suppliers with the minimum physical, chemical and testing requirements for chlorine to meet safe limits for drinking water supplies. The requirements align with requirements for drinking-water safety outlined in the *Drinking Water Standards for New Zealand* (Ministry of Health, 2008).

1.3 Application

This Guide can be referenced in specifications for purchasing and receiving liquefied chlorine gas, sodium hypochlorite and calcium hypochlorite, and can be used as a guide for testing the physical and chemical properties of samples of them. The stipulations of this Guide apply when this document has been referenced and only to the above chemicals when used for the treatment of drinking water. It does not cover the use of any other product.

The guide does not cover information requirements, packaging, equipment, transportation, disposal, safety or issues. Requirements for these aspects of water treatment chemical use are stipulated under New Zealand law and contained in the *Water Treatment Chemicals (Corrosive) Group Standard 2006* (Environmental Protection Authority, 2006).

1.4 Legal Requirements

This Guideline is not intended to address supplier or operators legal responsibilities and should be considered alongside other requirements of New Zealand law. Principle relevant legislation that relates to the supply and use of chlorine in drinking water supplies is:

- The Hazardous Substances and New Organisms (HSNO) Act 1996 (Ministry for the Environment, 2015)
- Health (Drinking Water) Amendment Act 2007 (Ministry of Health, 2008)
- Land Transport Act 1998 (Ministry of Transport, 2012)
- Health and Safety at Work Act 2015 (Ministry of Business, Innovation, and Employment, 2015)

- Resource Management Act 1991 (Ministry for the Environment, 2015)

There may also be other legislation that needs to be complied with.

Legislated requirements for protecting the environment and the health and safety of people and communities from the use of hazards associated with chlorine are outlined in the HSNO Act. HSNO hazard classification and controls specific to chlorine can be found in the *Controls for Approved Hazardous Substances Database* available on the Environmental Protection Authority website: http://www.epa.govt.nz/

They are also contained in the *Water Treatment Chemicals (Subsidiary Hazard) Group Standard 2006* (Environmental Protection Authority, 2006).

1.5 Uses in Water Treatment

Chlorine products are oxidising agents used for disinfection of water supplies. Chlorination can also reduce colour, tastes and odours in water and oxidise metallic substances to facilitate their removal during filtration, known as pre-chlorination.

Liquefied chlorine gas, sodium hypochlorite and calcium hypochlorite are the chlorine products commonly used in treatment of drinking-water supplies for this purpose.

1.6 Manufacture of Chlorine Compounds

1.6.1 In New Zealand chlorine gas for use in drinking-water treatment is manufactured at Kinleith in a membrane cell chlor-alkali plant. The process is an electrolytic one, but with a titanium anode separated from a steel cathode by a cation exchange membrane. The electrolyte used is very pure brine (solution of NaCl).

Chlorine gas is produced at the anode, and sodium hydroxide produced at the cathode. Chlorine gas is collected, dried, compressed and cooled to a point where it liquefies. Cylinders are filled so that liquid chlorine occupies about 90% of the cylinder when the temperature is about 60°C.

1.6.2 Sodium hypochlorite solutions for use in drinking-water treatment in New Zealand are manufactured at Kinleith, Tasman and Timaru by passing chlorine gas through a solution of caustic soda (known as the Lavel process). Generation of sodium hypochlorite is achieved by using brine solutions and purpose built generating plants on-site and in Timaru. The strength of sodium hypochlorite generated in Timaru is typically 0.95% free available chlorine (FAC).

The strength of sodium hypochlorite produced on-site is about 0.8% FAC. This Guide is not intended to cover on-site generation.

1.6.3 Calcium hypochlorite is generally produced by passing chlorine gas through a solution of calcium hydroxide (lime slurry). This produces calcium hypochlorite, calcium chloride and water. The calcium hypochlorite is dried by a special process with the inert calcium chloride substantially removed before packaging. All calcium hypochlorite used in New Zealand is imported.

1.7 Description of Chlorine Compounds

1.7.1 **Liquefied chlorine gas (Cl_2)** is a greenish-yellow gas/amber liquid with a pungent and irritating odour. As a greenish-yellow gas, the chlorine is present at a concentration many times greater than the level dangerous to humans. Chlorine gas at low concentrations is colourless, but may still be present at toxic concentrations. It is about 2.5 times heavier than air so will seek the lowest level in an area of leakage.

Chlorine gas is acidic and oxidising. It is corrosive to metals and other substances, particularly when moisture is present.

Chlorine gas is a respiratory irritant. A tolerance to odour can be built up by regular exposure and therefore the sense of smell should not be relied upon to detect harmful levels. High concentrations (above 90 mg/m^3) in air cause coughing, laboured breathing and irritation of the eyes. At very high concentrations the difficulty in breathing may cause death by suffocation due to build-up of liquid in the lungs. Liquefied chlorine causes skin and eye burns on contact.

1.7.2 **Sodium hypochlorite (NaOCl)** is generally a clear light-yellow/green aqueous solution, free from deposits or suspended matter, with a faint chlorinous odour. It is typically manufactured at between 13.0% and 16.5% (and can be up to 18%) free available chlorine by volume (i.e 14.8 to 16.5 kg FAC/100 L of product).

Light, heat, organic matter and certain heavy metal cations such as copper, nickel and cobalt accelerate the decomposition of sodium hypochlorite, with a loss in chlorine strength. Sodium hypochlorite undergoes a reaction which results in a decrease in the strength of the free available chlorine and the formation of chlorate ion (ClO_3^-). Sodium hypochlorite typically has a shelf life of 130 days, but the Free Available Chlorine (FAC) content will decrease during this time because of this reaction.

1.7.3 **Calcium hypochlorite $Ca(OCl)_2$** is a white or yellowish-white granular powder, generally produced in granular or tablet form. It has a chlorinous odour and approximately 60 to 70% free available chlorine by weight (i.e. 60 to 70 kg FAC/100 kg of product). When mixed to practical solubility levels (30g $Ca(OCl)_2$/L water) the expected level of FAC would be 1.8 to 2.1 kg FAC/100 L. The same factors for sodium hypochlorite decomposition apply. The presence of moisture appreciably decreases the life of metal containers due to its corrosive nature. Calcium hypochlorite has an expected shelf life in cool dry storage conditions of about 18 months to 2 years, but loses 2 to 3% FAC per year. Due to its oxidising properties, contact with flammable materials such as oil, grease, glycerine is highly reactive.

1.8 Methods of Dosing

Chlorine gas is normally fed directly into water, via an injector and automatic shutdown regulator, by means of a vacuum or positive pressure chlorinator. Pressure piping and connections should be minimised to decrease the possibility of leaks occurring.

Sodium Hypochlorite is dosed from a Polyethylene tank via PVC or polyethylene pipe and corrosion resistant dosing pump and polyethylene or PVC injector.

Polypropylene is not suitable. It is recommended that hypochlorite be diluted upon delivery to reduce the formation of chlorate and perchlorate. Further recommendations to minimise the formation of these impurities is included in section 2.3.2 and 2.3.3.

Calcium hypochlorite (in powder, granular or tablet form) must be dissolved in water and dosed as a settled, clear solution. When calcium hypochlorite is dissolved in water some insoluble sludge remains - this must not enter the feed line to the hypochlorinator. Solutions need to be prepared in advance, commonly by use of two tanks, to allow time for settlement. A float is attached to the feed line to ensure the solution is drawn from near the top of the tank and the last 100 mm cannot be drawn out.

1.9 Definitions

The following definitions shall apply in this Guide:

1.9.1	*Calcium Hypochlorite*	Calcium hypochlorite $Ca(OCl)_2$ is a white or yellowish-white granular powder, granule or tablet with a chlorinous odour containing from 60 to 70% free available chlorine by weight. A saturated solution will have up to 12.6 kg FAC/100L of $Ca(OCl)_2$ solution at 25°C. It is often sold under a trade name.
1.9.2	*Chlorine Products:*	A group of chemicals or compounds, consisting of liquefied chlorine gas, sodium hypochlorite and calcium hypochlorite, used for chlorination/disinfection of water.
1.9.3	*FAC:*	Free available chlorine.
1.9.4	*Guideline Value:*	Guideline values are the highest concentration of a determinand in the water that can be present without unduly impacting on the aesthetic properties of drinking water. Guideline values relate to determinands that do not pose a direct threat to public health, however may affect the appearance taste or smell of water. Guideline values are specified in the *Drinking Water Standards of New Zealand* (Ministry of Health, 2008).
1.9.5	*Liquefied Chlorine Gas:*	Chlorine Cl_2 in its elemental state (commonly known as liquid chlorine), is normally packaged as a liquid under pressure in specially fabricated containers.
1.9.6	*Manufacturer:*	The party that manufactures, fabricates, or produces materials or products.
1.9.7	*Maximum Acceptable Value:*	The highest concentration of a determinand in the water that, on the basis of present knowledge, is considered not to cause any significant risk to the health of the consumer over 70 years of consumption of that water. Maximum acceptable values are specified in the Drinking Water Standards of New Zealand (Ministry of Health, 2008).

1.9.8	*Purchaser:*	The person, company or organisation that purchases any products or work to be performed.
1.9.9	*Reception Point:*	The point of physical transfer of products from the supplier to the purchaser.
1.9.10	*Sodium Hypochlorite:*	Sodium hypochlorite solution NaOCl is a clear light-yellow liquid with a faint chlorinous odour containing up to 18 kg/100 L free available chlorine.
1.9.11	*Specific Impurity:*	Substances which have a maximum acceptable value (MAV) or guideline value assigned to them in the *Drinking Water Standards of New Zealand* (Ministry of Health, 2008).
1.9.12	*Specific Impurity Limit:*	Specific impurity limits are the maximum limit of an inorganic impurity given as weight of impurity by weight of product (mg of impurity/ kg of product) acceptable in a product.
1.9.13	*Supplier:*	The party that supplies product or services. A supplier may or may not be the manufacturer.

2 MATERIALS

2.1 Physical Properties

Table 1: Some Physical Properties of Chlorine Compounds

Property	Chlorine Compound		
	Liquefied Chlorine Gas	*Sodium Hypochlorite*	*Calcium Hypochlorite*
Physical Description	An amber coloured liquid about 1.5 times denser than water. At high concentrations in the gaseous state, it is a greenish-yellow gas about 2.5 times denser than air.	A clear light yellow/green aqueous solution, free from deposits or suspended matter, with a faint chlorinous odour.	A white or yellowish-white granular powder, granules or tablets with a chlorinous odour.
Molecular Formula	Cl_2	NaOCl	$Ca(OCl)_2$ (appox)*[1]
Molecular Weight	70.91	74.44	142.98
pH	N/A (but acidic when dissolved in water)	Timaru 9.6 On-site approx. 12-13	N/A (but alkaline when dissolved in water)
Density	1.408 kg/L @ 20°C *[2]	1.13-1.24 kg/L @ 20°C *[3]	Bulk density: loose granular – 0.8 kg/L tablets – 1.9 kg/L
Solubility in Water	7 g/L at 20°C and 100 kPa	Completely miscible	30 g/L *[4]
Particle Size	N/A	N/A	Granular powder – not more than 10% passing a 100 (147µm) mesh screen. Tablets – uniform in shape and weight variance no more than 5% from average; no more than 2% broken.

*[1] $Ca(OCl)_2$ is unstable and it is not possible to produce it in a pure form
*[2] at standard temperature and pressure
*[3] density varies with both FAC and excess NaOH content
*[4] 30g/L is practical solubility; theoretical is 180 g/L at 25°C

2.2 Product Purity

2.2.1 Liquefied chlorine gas shall be a minimum of 99.5% pure by volume as determined by the *AWWA B301010 Liquid Chlorine Standard* (American Water Works Association, 2010).

2.2.2 Sodium hypochlorite shall contain not less than 13.0 kg FAC/100L of product (unless specified otherwise by the purchaser) on delivery at the reception point. All deliveries shall be clearly labelled to show the FAC content.

2.2.3 Calcium hypochlorite shall contain not less than 60 kg FAC/100 kg of product (unless specified otherwise by the purchaser) on delivery at the reception point. All deliveries shall be clearly labelled to show the FAC content.

2.3 Impurities

2.3.1 Impurity Limits

2.3.1.1 The limits of impurities in chlorine products shall be as set out in Table 2 (unless set otherwise by the purchaser) to ensure that the product supplied is suitable for drinking-water treatment.

2.3.1.2 Impurity limits shall be given as weight of impurity by weight of chlorine product (mg impurity/kg chlorine product), except for sodium hypochlorite which shall be weight by volume (mg impurity/L sodium hypochlorite solution).

2.3.1.3 The levels of specific impurities in commercially available liquefied chlorine gas, sodium hypochlorite and calcium hypochlorite shall not exceed the specific impurity limits (SILs) shown in Table 2. For the purposes of this Guideline the term "specific impurities" refers to the determinands shown in Table 2, which have maximum acceptable values (MAVs) assigned to them in the *Drinking-water Standards for New Zealand 2005 (Revised 2008)* (Ministry of Health, 2008). The MAV and Guideline Value (GV) used for determining SILs are also shown in Table 2. The equations for determining SILs are shown in Appendix A and have been based on a maximum dose rate of 5mg/L.

2.3.1.4 SILs have been calculated for all inorganic impurities with MAVs in the *Drinking-water Standards for New Zealand 2005* (Revised 2008) (Ministry of Health, 2008), but some of these are not included in Table 2 because the levels are unrealistically high. Consequently, SILs constituting more than 1% of the product have been deleted.

2.3.1.5 In addition to the limits outlined in Table 2**,** calcium hypochlorite granular powder or granules shall be free from lumps and not contain any dirt or other foreign material.

2.3.2 Chlorate

The level of chlorate in sodium and calcium hypochlorite will increase over time. This limit is currently under review. In the interim purchasers of sodium hypochlorite should undertake samples of drinking water to ensure that chlorate levels are meeting Maximum Allowable Value specified by the Drinking Water Standards.

The formation of chlorate ion in a hypochlorite solution is influenced by storage conditions such as pH, temperature, length of time in storage, presence of ultraviolet light, concentration of solution and presence of transition metals. Purchasers should ensure hypochlorite solutions (Ministry of Health Canada, 2008);

- be used within a relatively short time frame after delivery (within 3 months); and
- be stored in a cool dry location where the temperature does not exceed 30°C, away from sunlight.

2.3.3 Perchlorate

There is currently no New Zealand limit for perchlorate impurities however it is well known that perchlorate is formed when sodium hypochlorite solutions breakdown.

Levels of perchlorate are most likely not a concern in water supplies where sodium hypochlorite is used within a few weeks of delivery. However, they may be a concern in water supplies that store sodium hypochlorite for longer than three months or have aged chemical in storage tanks that could contaminate new shipments.

Purchasers are recommended to take the following steps to reduce perchlorate formation in sodium hypochlorite (WRc, 2013);

- use sodium hypochlorite within a relatively short time after delivery (within 3 months)
- dilute hypochlorite solutions upon delivery (a four-fold dilution will decrease the rate of formation of perchlorate by a factor of 36, a ten-fold dilution by a factor of 270)
- store sodium hypochlorite in a cool location (a 5°C reduction in storage temperature will reduce the rate of perchlorate formation by a factor of approximately 2)

Hypochlorite solutions stored with pH 11-13 (even after dilution) will have a slower rate of perchlorate formation than solutions with lower pHs.

While this guide is not intended to be used for on-site generated hypochlorite, the following additional measures assist in reducing perchlorate in onsite generation;

- solutions should be as soon as possible after manufacture and should not be stored for more than 1-2 days (given the range of on-site-generated sodium hypochlorite is typically pH 9 – 10)
- use low-bromide salt to produce on-site-generated hypochlorite

2.3.4 General Impurities

Additional impurity limits may be specified by the purchaser to ensure the material supplied is suitable for water treatment. If additional impurity limits are specified, the purchaser must specify the methods to be used to show that these limits have been met.

Additional impurity limits may be warranted in situations where impurities are impacting treatment plant operations, or, where determinands listed in Table 2 occur in elevated levels in source water.

Table 2: Limits for product purity and impurities. Where these relate to parameters for metallic and metalloid determinands, boron, MAVs or guideline values (GV) in the *Drinking-water Standards for New Zealand 2005* (Revised 2008) they are shown.

Concentrations are rounded down to one significant figure for values less than or equal to 100 mg/kg (mg/L) and two significant figures

Determinand	MAV or GV (mg/L)	Impurity Limits expressed as mg of determinand per kg or L of product		
		99.5% pure Liquefied Chlorine Gas (mg/kg)	*13% Sodium Hypochlorite Solution (mg/L)*	*60%Calcium Hypochlorite (mg/kg)*
Moisture Content		150		
Total non-volatile residue		150		
Carbon tetrachloride		40		
Chloroform		300		
Total free alkali (expressed as NaOH)			3000<NaOH <18000	
Insoluble matter			1800	
Cobalt √			0.05	
Sodium chloride				180,000
Antimony	0.02	390	50	240
Arsenic	0.01	90	10	60
Barium	0.7	13000	1800	8400
Boron	1.4		3600	
Bromate			20	120
Cadmium	0.004	70	10	40
Chlorate	0.8		**WORK UNDERWAY TO DETERMINE VALUE**	
Chromium	0.05	990	130	600
Copper* √	1		0.05	
Iron* √	0.1		3	
Lead	0.01	90	10	60
Manganese*	0.04	790	100	480
Mercury	0.007	130	10	80
Molybdenum	0.07	1300	180	840
Nickel √	0.08	1500	0.05	960
Selenium	0.01	190	20	120
Uranium	0.02	390	50	240
Zinc	1.5		3900	

for values above 100 mg/kg (mg/L).

* These determinands are either aesthetic determinands having only a guideline value or are health significant determinands having both an MAV and a guideline value. In the latter case, the lower of the two is given in the table.

√These determinands catalyse hypochlorite decomposition so sodium hypochlorite limits have been assigned lower values than the SILs required for human health.

3 TEST METHODS

3.1 Sampling

3.1.1 The sampling procedure set out in Appendix B of this Guide shall be followed.

3.2 Testing

3.2.1 The product shall be sampled and tested at the manufacturer's or supplier's own cost in order to provide a Certificate of Compliance as required in Section 4.1. Records of sampling and testing of representative samples, process monitoring results, and any other relevant records shall be made available to the purchaser on request.

3.2.2 The purchaser may randomly take samples of the product and have these samples analysed for conformance with this Guide. The cost of the analysis shall be paid by the supplier if the product does not meet the requirements of this Guide, and shall be paid by the purchaser if the product does meet the requirements of this Guide. These samples shall be taken at the place of manufacture and/or at the delivery point, as may be agreed upon by the manufacturer or supplier and the purchaser.

3.2.3 When inspection and sampling are to be conducted at the point of manufacture, the manufacturer shall afford the inspector representing the purchaser all reasonable facilities for inspection and sampling of finished product, which shall be so conducted as not to interfere unnecessarily with the operation of the plant.

3.2.4 Analytical testing methods shall be as specified in this Guide in Section 3.3.

3.2.5 If the analysis of a sample taken at the place of manufacture shows the product does not comply with the requirements of this Guide, the purchaser may require that the manufacturer provide a certified analysis from an IANZ accredited laboratory (or equivalent) for successive deliveries. The cost of analysis shall be met by the manufacturer.

3.2.6 If the analysis of a sample taken at the point of delivery shows the product does not comply with the requirements of this Guide, a notice of non-conformance shall be provided by the purchaser to the supplier.

3.3 Standard Tests

3.3.1 Refer to Table 3 for the standard tests for chlorine products.

Table 3: Standard tests for chlorine products

Liquefied Chlorine Gas	
Assay	ASTM E 1746 (ASTM International, 2008)
Moisture and residues	ASTM E E410 (or for moisture, a method validated against ASTM E 410) (ASTM International, 2008)
Arsenic	AWWA B301 (American Water Works Association, 2010) & Food Chemicals Codex (The United States

	Pharmacopeial Convention, 2012)
Carbon tetrachloride and chloroform	ASTM E 806 (ASTM International, 2008) or ICI in-house procedure7
Lead	AWWA B301 (American Water Works Association, 2010) & Food Chemicals Codex (The United States Pharmacopeial Convention, 2012)
Mercury	AWWA B301 (American Water Works Association, 2010) & ASTM E506 (ASTM International, 2008)
Heavy metals	AWWA B301 (American Water Works Association, 2010) & Food Chemicals Codex (The United States Pharmacopeial Convention, 2012)
Sodium Hypochlorite	
Free available chlorine	AWWA B300 (American Water Works Association, 2010)
Insoluble matter	AWWA B300 (American Water Works Association, 2010)
Free alkali	AWWA B300 (American Water Works Association, 2010)
Calcium Hypochlorite	
Free available chlorine	AWWA B300 (American Water Works Association, 2010)
Sodium chloride	BS EN 900: 2014 (British Standards Institution, 2014)

3.3.2 In all chlorine products, the concentrations of the specific impurities listed in Table 2, shall be determined by test methods found in *Standard Methods for the Examination of Water and Wastewater*, *22nd Edition* (E.W. Rice, 2012) unless methods have been otherwise stated in Table 3. The purchaser must state which of the testing methods is to be used to determine compliance with the specific impurity limits.

3.4 Frequency

3.4.1 Base frequency of testing

The sampling and certified analysis on which the Certificate of Compliance of a product is based (section 4.1) must occur at least annually for all of the properties listed in Table 2. Sampling and analysis must also be carried out:

i. whenever the process and/or raw materials changes, in which case all impurities in Table 2 must be tested, and
ii. at the frequency listed in Table 4 if any test shows the concentration of an impurity in the product exceeds 50% of its SIL, in which case only the impurities exceeding 50% of their SIL need be tested.

3.4.2 P2a determinands

Compliance with the chemical requirements of the *Drinking-water Standards for New Zealand* (Ministry of Health, 2008) for P2a determinands can be demonstrated using the alternative approach given in section 8.2.1.2 of the Standards. This requires a certified analysis stating the concentration of the P2a determinand in the product as provided for in section 4.

Table 4: Test frequency of product purity (specified in section 2.2) and impurity limits (specified in section 2.3)

	Liquefied Chlorine			Sodium Hypochlorite			Calcium Hypochlorite	
	Supplied from the Kinleith plant	*Other ISO19001 certified process*	*Other uncertified process*	*Continuous process*	*Continuous process ISO19901 certified*	*Other processes*	*Manufacturer testing**	*Other*
Purity	Annually	Three Monthly	Monthly	Monthly	Three monthly	Per batch	Annually	2% of containers in each shipment
Moisture Content	Annually	Annually	Annually	-	-	-	-	-
Total non-volatile residue	Annually	Annually	Annually	-	-	-	-	-
Carbon tetrachloride	Annually	Annually	Annually	-	-	-	-	-
Chloroform	Annually	Annually	Annually	-	-	-	-	-
Total free alkali (expressed as NaOH)	-	-	-	Monthly	Three monthly	Per batch	-	-
Insoluble matter	-	-	-	Monthly	Three Monthly	Per batch	-	-
Cobalt	-	-	-	Annually	Annually	-	-	-
Chlorate	-	-	-	Annually	Annually	-	-	-
Sodium chlorate content	-	-	-	-	-	-	Exempt	2% of containers in each shipment
Fluoride	Per batch, or weekly if multiple batches are received in a week			Per batch, or weekly if multiple batches are received in a week			Per batch, or weekly if multiple batches are received in a week	
Specific Impurity Limits	Per batch, or monthly if multiple batches are received in a month			Per batch, or monthly if multiple batches are received in a month			Per batch, or monthly if multiple batches are received in a month	

* Calcium hypochlorite manufactured:

(i) by a process which is certified to ISO 9002, and

(ii) for which sampling and testing has been carried out on every batch to meet product purity and impurity requirements outlined in 2.2 and 2.3

(iv) for which the certification links every container to a unique batch number

4 QUALITY ASSURANCE

4.1 Certificate of Compliance

4.1.1 The manufacturer or supplier shall provide the purchaser with a certificate of compliance with each delivery that states that the material furnished in accordance with the purchaser's order complies with all applicable requirements of this Guide. This is to include the concentrations of properties listed in section 2.3 and 2.2 using tests undertaken at frequencies outlined in section 3.4.

4.1.2 The purchaser shall not use a delivered product until a certificate of compliance for that delivery is received from the chemical supplier, and the supplier has demonstrated that there is a satisfactory system in place to ensure the quality of the product between the point of manufacture and point of delivery.

4.1.3 The chemical supplier shall provide a certified analysis of the material from a mutually agreed upon IANZ or ISO 17025 accredited laboratory showing that the requirements of Sections 2.3 and 2.3 have been met at test frequencies outlined in 3.4.

4.1.4 If the method of manufacture, source and/or quality of raw material used is changed during the contract period, additional samples shall be tested by the supplier to demonstrate that the changes have not affected conformance with this Guide. A copy of the certificate of compliance shall be provided to the purchaser.

4.2 Weight Certificate

The weight of bulk product delivered shall be determined by certified instrumentation, and a record from the instrumentation of the weight delivered provided to the purchaser.

4.3 Rejection

4.3.1 **Notice of Non-conformance**

If the chlorine product delivered does not meet the requirements of this Guide or the additional impurity limits notified by the purchaser, a notice of non-conformance must be provided by the purchaser to the supplier within 30 working days after receipt of the shipment at the point of destination. The results of the purchaser's tests shall prevail unless the supplier notifies the purchaser within five working days after receipt of the notice of complaint that a retest or inspection is desired. On receipt of the request for a retest, the purchaser shall forward to the supplier one of the sealed samples taken in accordance with Section 3. In the event that the results obtained by the supplier upon retesting do not agree with the results obtained by the purchaser, the other sealed sample shall be forwarded, unopened, for analysis to a referee laboratory agreed upon by both parties. The results of the referee analysis or inspection shall be accepted as final.

The cost of the referee analysis shall be paid by the supplier if the material does not meet the requirements of this Guide, and shall be paid by the purchaser if the material does meet the requirements of this Guide.

4.3.2 **Material Removal**

4.3.2.1 If the material does not meet the impurity limit requirements of this Guide, the supplier shall remove the material from the premises of the purchaser when requested by the purchaser. Removal of material shall be at no cost to the purchaser.

4.3.2.2 If the material meets the impurity limits but not the chlorine content requirements of this Guide, a price adjustment may be agreed between the supplier and the purchaser. In the event that a price adjustment cannot be agreed, the supplier shall remove the material from the premises of the purchaser if required by, and at no cost to, the purchaser.

4.3.2.3 The material that shall be removed shall include the rejected material and any other material the rejected material may have contaminated, for example, contents of a tank into which a bulk delivery has been unloaded, if required by the purchaser.

4.3.2.4 All material removed shall be concurrently replaced with material conforming to this Guide with an appropriate compliance certificate at no cost to the purchaser.

Appendix A: Specific Impurity Limits

A 1 Equation for determining Specific Impurity Limits

Equations are based on a maximum dose of 5.0 mg of chlorine per litre of water, and a safety factor of 10.

Where SILs in Table 2 have stated MAV's and health related impacts, these are calculated using the following equation:

$$SIL\ (mg/kg) = \frac{MAV\ (mg/litre) \times 10^6\ (mg/kg) \times P}{MD\ (mg/litre) \times SF \times 100}$$

Where	SIL	=	Specific Impurity Limit
	MAV	=	Maximum Acceptable Value of the impurity determinand set in the *Drinking-water Standards for New Zealand 2005* (Revised 2008),
	MD	=	Maximum Dose of chlorine
	SF	=	Safety Factor
	P	=	Purity - minimum percentage of chlorine in the product

The SILs are calculated based on:

1. the MAV, or guideline value (GV), for each determinand taken from the *Drinking-water Standards for New Zealand 2005 (Revised 2008)* (Ministry of Health, 2008).
2. a maximum dose (MD) of 5 mg/L of chlorine as FAC – the MAV for chlorine.
3. a safety factor (SF) of 10, which reflects the view that no more than 10 percent of a MAV should be contributed by a given impurity in a water supply chemical. Arsenic and lead have been assigned a safety factor of 20, reflecting recent concern amongst some public health practitioners of the impact on these impurities on public health.

Note inclusion of a determinand in Table 2 is not an indication that the products are expected to contain the impurity, or, if present, that the impurity will occur near its calculated SIL.

A 2 Example Specific Impurity Limit Calculations

Specific Impurity Limits (SILs) are calculated based on a maximum dose (MD) of 5 mg of chlorine as Cl_2 /litre of water and the maximum acceptable value (MAV) for each determinand taken from the *Drinking-water Standards for New Zealand 2005 (Revised 2008)*. The safety factor (SF) used in these calculations is 10, which reflects the view that no more than 10% of a MAV should be contributed by a given impurity in a water supply chemical.

An example calculation is as follows:

Antimony[1]: MAV = 0.02 mg/litre

[1] Note that antimony is not a known impurity in liquefied chlorine gas, but is used in this Standard as an indicator of

MD = 5 mg/litre as Cl_2
SF = 10

For 99.5% pure liquefied chlorine gas, this SIL equates as follows:

$$SIL = \frac{0.02\ (mg/litre) \times 10^6\ (mg/kg) \times 99.5}{5\ (mg/litre) \times 10 \times 100}$$

$$SIL = \frac{398\ mg}{kg} \quad of\ liquefied\ chlorine\ gas$$

Rounding down to two significant figures, yields

$$SIL = \frac{390\ mg}{kg} \quad of\ liquefied\ chlorine\ gas$$

For a 13% NaOCl solution (13 kg Cl_2 per 100 L, or 130,000 mg/L) this SIL equates as follows:

$$SIL = \frac{0.02\ (mg/litre) \times 10^6\ (mg/L) \times 13}{5\ (mg/litre) \times 10 \times 100}$$

$$SIL = \frac{52\ mg}{kg} \quad of\ sodium\ hypochlorite\ product$$

Rounding down to one significant figure, yields

$$SIL = \frac{50\ mg}{kg} \quad of\ sodium\ hypochlorite\ product$$

For a 60% $Ca(OCl)_2$ product (60 kg Cl_2 per 100kg of product) this SIL equates as follows:

$$SIL = \frac{0.02\ (mg/litre) \times 10^6\ (mg/L) \times 60}{5\ (mg/litre) \times 10 \times 100}$$

$$SIL = \frac{240\ mg}{kg} \quad of\ calcium\ hypochlorite\ product$$

Rounding down to two significant figures, yields

$$SIL = \frac{240\ mg}{kg} \quad of\ calcium\ hypochlorite\ product$$

possible heavy metal contamination of hypochlorite

Appendix B: Sampling Procedure

B 1 Sampling Method

B 1.1 General

B 1.1.1 Sampling and preparation shall be conducted as expeditiously as possible in order to avoid undue exposure of the material to the air, thus avoiding contamination and evaporation.

B 1.1.2 The sampling method must give a gross sample that is representative of the material and which may be divided to provide representative samples for analysis. The quantity of sample required by the testing laboratory to carry out the desired tests must be known prior to the sample being taken.

B 1.1.3 Samples for analysis shall be provided in triplicate. One sample is for the immediate use of the purchaser for testing of the shipment. The other two samples shall be retained until it is known from the results of the laboratory examination that the shipment meets the requirements of this Guide. The second sample shall be delivered to the supplier if requested within five days of notification of the examination results of the first sample. The third sample is for the use of a referee laboratory if there is a controversy over the analyses.

B 1.1.4 Samples shall be sealed in airtight, moisture-proof containers supplied by the analysing laboratory.

B 1.1.5 Each sample shall be labelled with at least the following information: the material name, the name of the purchaser, the name of the sampler, package number, date sampled, and date received.

B 1.2 Risk Assessment and Management

B 1.2.1 Before collecting samples, the sampler shall assess the risks to their own safety, and to others in the vicinity, of taking the sample (e.g. the release of dust from powdered or crystalline material, splashing or spillage of liquid product), identify what measures can be taken to minimise these risks (e.g. different approach for taking the sample, dust masks, protective clothing), and take those steps.

B 1.2.2 Where possible, samples should be taken by an experienced laboratory technician.

B1.2 Liquefied Chlorine Gas

B 1.2.1 Samples shall be taken in 4.5 kg cylinders as set out in the appropriate test method given in Section 3.3.

B 1.3 Sodium Hypochlorite

B1.3.1 For safety reasons, samples shall be taken from the tanker after it has been filled. A gross sample shall be taken, the total volume of which shall be no less than three times the volume required for Section B1.4.3.

B1.3.2 The gross sample shall be thoroughly mixed, and split into three subsamples as provided for in Section B1.1.3. The containers for the subsamples shall be supplied by the laboratory for the tests listed in Section 3.3, that is, more than one container may be required for each subsample.

B 1.3.3 Each sample container shall be labelled to identify it and shall be signed by the sampler.

B.1.3.4 The concentration of chlorate in the product will change over time. Samples for chlorate should therefore be taken on delivery at the reception point.

B1.4 **Calcium Hypochlorite**

B1.4.1 For powdered or granule forms, the product shall be sampled using a sampling tube that measures at least 20 mm in diameter.

B1.4.2 For tablet form, the tablets shall be selected at random from each container sampled.

B1.4.3 The gross sample, of at least 1.0 kg, or as agreed, shall be mixed thoroughly and divided to provide three 0.3 kg samples. These samples shall be sealed in air tight, moisture-proof, plastic or glass containers.

B1.4.4. No sample shall be taken from a broken container.

B2 Sample Preparation

B2.1 The preparation of subsamples for testing may affect the results obtained from identical samples so appropriate and consistent preparation procedures are most important.

B2.2 Sample handling and test procedures for sodium and calcium hypochlorite are detailed in *AWWA B300-10 Standard for Hypochlorites* (American Water Works Association, 2010).

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20. Appendix H – Reticulation Details

Rain tanks

On this page

Where are rainwater tanks required?

All new urban premises in the Waikato District are now no longer required to have a rainwater tank under the Water Supply Bylaw.

Rural properties are still required to have a rainwater tank with a minimum size of 22,000L or equivalent of at least 48 hours storage, whichever is greater.

Rainwater tanks are encouraged as they help create a more sustainable water supply and provide storage for non-drinking use.

However, you may need a building consent for your rainwater tank - see below for more details.

If you instead need to connect to a council water supply, see treated drinking water for more information.

Note: that the Waikato District Council Bylaw 2014 came into force on 1 October 2014. The Waikato District Council Water Supply Bylaw 2009 and the Franklin District Council Water Supply Bylaw 2008 were revoked at the time the new bylaw came into force.

Maintaining tank water quality

Poorly-maintained tanks and roof catchment systems increase the risk to public health as they can significantly lower water quality. Preventative measures and corrective actions for safe rainwater harvesting include:

1. Keeping roof catchments clean of moss, lichen, debris and leaves.
2. Keeping roof catchments clear of overhanging vegetation, to avoid providing roosting posts for birds; and access for animals, such as rodents and possums.
3. If appropriate, install gutter guards or screens.
4. Install screened rain-heads or other debris protection devices on each downpipe. The recommended screen mesh size is 4-6 mm and these should be self-cleaning devices.
5. Install a first foul flush diverter to prevent contaminated water entering the water tank. These should have automated diversion and drainage systems.
6. In the event of any weed/chemical spraying in a nearby location, advise the contractor that the roof is used for collecting drinking water. There should not be any overspray reaching the roof. Organ-ochlorine pesticides should not be used.
7. Prevent access by small animals to the rainwater tanks by screening all inlets and overflows; make sure access hatches are left closed.
8. Inspect tanks annually and have a professional clean the tanks regularly.
9. If tank contamination is apparent, the water should be chemically disinfected and boiled before it's used for consumption. Seek advice from a professional.
10. For more information on maintaining the quality of your drinking water, visit www.drinkingwater.org.nz.

Tanks and building consents

A rain tank will require a building consent if:

- the tank will supply roof water to the house
- the Council mains will be plumbed to the tank (eg, backup supply)
- the tank exceeds 35,000L
- the tank exceeds 2,000L and is more than two metres above ground or
- the tank exceeds 500L and is more than four metres above ground.

Unless the tank exceeds the size limits above, installing a rain tank for garden irrigation does not require a building consent.

These criteria apply to both new premises and when retrofitting a tank to an existing property. If a consent is required, it can be included as part of the overall building consent.

Find out more about building consents.

Stormwater attenuation tanks

If you need one of these, it is possible to combine the rainwater tank and stormwater attenuation tank, but the volume of the tank needed should be the sum of the two levels for each function being handled by the combined tank. The top part of the tank drains quickly to buffer storm flows and the bottom saves water for recycling.

Related documents

Water Supply Bylaw 2014

PDF, 2950 KB Download

Forms

Application for connection to water supply

PDF, 104 KB Download

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RECYCLED WATER – THE FOURTH WATER UTILITY

Louise Jones
MWH New Zealand Ltd

ABSTRACT

Around the world the use of recycled water, either from stormwater or from treated wastewater, is gaining in popularity. Many water utilities are utilising recycled water for non-potable uses, such as open space irrigation and industrial use, or for augmentation of drinking water supplies though aquifer and reservoir recharge. Recycled water is also being used to enhance the environment with schemes such as reduction of salt water intrusion and boosting river flows.

Water recycling is a relatively new process, for both the water utility provider and for the communities they serve, so in recent years there has been much written on the public perception of recycling schemes and, to a lesser extent, the technical aspects of building and commissioning such projects. But little consideration has been given to the day to day management of water recycling schemes which can be complex at both an operational and management level.

Drawing on experience gained from a water recycling scheme in Western Australia this paper looks at some of the challenges of establishing and managing a water recycling asset, and asks whether these assets, which can simultaneously be both a wastewater and drinking water asset, should be fitted into the existing asset management structures or should in fact be considered as a separate, fourth, water utility.

KEYWORDS

Recycled water, water re-use, asset management, water utility.

1. INTRODUCTION

Around the world the use of recycled water, either from stormwater or from treated wastewater, is gaining in popularity. Many water utilities are utilising recycled water for non-potable uses, such as open space irrigation and industrial use, or for augmentation of drinking water supplies though aquifer and reservoir recharge. Recycled water is also being used to enhance the environment with schemes such as reduction of salt water intrusion and boosting river flows.

Water recycling is a relatively new process, for both the water utility provider and for the communities they serve, so in recent years there has been much written on the public perception of recycling schemes and, to a lesser extent, the technical aspects of building and commissioning such projects. But little consideration has been given to the day to day management of water recycling schemes which can be complex at both an operational and management level.

Drawing on experience gained from a water recycling scheme in Western Australia this paper looks at some of the challenges of establishing and managing a water recycling asset, and asks whether these assets, which can

simultaneously be both a wastewater and drinking water asset, should be fitted into the existing asset management structures or should in fact be considered as a separate, fourth, water utility.

Particular examples have been taken from the Groundwater Replenishment Trial project carried out by Water Corporation in Perth, Western Australia for which the Author was project manager. This project comprised a 5Ml/day ultra-filtration, reverse osmosis and UV plant designed to purify treated wastewater from the nearby Beenyup wastewater treatment plant. The aim of this project was to trail the injection of recycled water into the ground at 60m depth to recharge the local drinking water aquifer. If the trial is successful and there are no detrimental effects on the groundwater quality the aim is to build a full scale plant by 2015.

2. WHAT IS RECYCLED WATER?

A water recycling scheme will generally entail collecting water that has been 'used' in some way, treating it to improve quality and then re-using again for a different purpose. A recycling scheme can be as simple as the redirection of stormwater back into the groundwater system or as complex as full purification of wastewater for potable use. Other terms used for recycled water are reclaimed water or water re-use.

In nearly all water recycling schemes the source water requires some form of treatment to remove contaminants. Stormwater often requires treatment to remove pollutants from road and drainage systems. Wastewater requires treatment to at least remove pathogens, BOD and most nutrients before it can be re-used. Considerably more treatment is required if the end use is for drinking water supply.

In most cases the use of recycled water leads to rigorous testing that may not be applied to a more traditional source. This is to ensure that there are no man-made contaminants present, such as pesticides, hydrocarbons, chemicals and hormones, which are potentially harmful to users, and would not be expected to be present in a more traditional source.

For the purpose of this paper, the discussions use the example of treated wastewater as the source water and presume an end use that requires water of drinking water quality, for example aquifer recharge or market garden irrigation. This presents one of the more common uses of recycled water and perhaps one of the more complex in terms of establishment and management.

3. THE CHALLENGES OF ESTABLISHING A NEW RECYCLED WATER SCHEME

The difficulties of managing a water recycling utility commence even before the project is built. For traditional stormwater, wastewater and drinking water utilities there are existing protocols for obtaining approvals to build the scheme, and established standards by which the scheme will be monitored. For a water recycling scheme this may not be the case.

On an international level there are now many water recycling schemes in operation but this experience and expertise may not filter down to the regional or local level. Often there is no specific regulatory framework for a water recycling scheme meaning that either existing regulations must be adapted to suit or new regulation put in place. Either way this can mean lengthy delays for asset managers in obtaining consents or permits. In addition, the absence of a regulatory framework will often mean an absence of quality standards by which the scheme will

be monitored. This can create difficulties in completing the design of the new asset as the required treatment processes cannot be fully defined.

3.1. OBTAINING CONSENTS AND PERMITS

In nearly every developed nation there is some sort of consent or permit system in place to protect the environment and natural resources. These can be in the form of a permit to abstract from the environment or a permit to discharge back to the environment. For wastewater and drinking water schemes there are clear criteria for obtaining a discharge or abstraction consent. But existing criteria do not apply to water recycling schemes. Where recycled water is used for irrigation, for boosting river flows or for aquifer recharge is a consent required if the discharge to the environment is of a higher quality than that of the receiving environment? Similarly, is an abstraction permit required if the water utility is drawing water that was previously added to the aquifer by a recycling scheme? If recycled water is taken from a wastewater treatment plant and added direct to a drinking water system is a consent required at all? Of course there will need to be some sort of regulation, but what is clear is that the existing consent systems are not necessarily applicable to a recycled water scheme.

In Western Australia there are three regulators concerned with water recycling schemes. The Department of Environment and Conservation (DEC) control discharges to the environment, the Department of Water (DoW) control abstraction of water and the Department of Health (DoH) control the quality of Drinking water. For the Groundwater Replenishment Trial the initial concern was to obtain a permit from the DEC as the injection in the aquifer was considered a discharge. However, it was agreed by all parties (via an interagency agreement) that the recycled water would be of drinking water quality prior to injection. Therefore, the DoH set the recycled water quality standards and this was by far the most complex part of the consenting process. The DoW also contributed with additional measures to ensure that the integrity of the aquifer was maintained in the long term.

Obtaining the consents and permits was a long process as agreements and standards had to be written and agreed as the process progressed. Overall it took well over two years to get the consents in place and the conditions of the consents were still being developed and agreed as the recycling plant was being commissioned.

3.2. ESTABLISHING AND MEETING WATER QUALITY REQUIREMENTS

For any recycled water scheme the quality of the final treated water may end up being considerably higher than those of a more traditional water source. This is because there will be pollutants and pathogens from the urban environment present in the source water, both stormwater or wastewater, that would not normally be present if the water were coming direct from the ‘natural’ environment and so treatment is generally more rigorous.

This means that for a water recycling scheme there is a very strong focus on ensuring that these ‘unnatural’ pollutants are removed before the water can be reused. The degree to which these pollutants will need to be removed will of course depend on the actual end use of the recycled water but the specific use of ‘recycled’ water has, to date, lead to regulators to enforce quality standards that are far more onerous than schemes using a more traditional water source.

In Western Australia, the DoH set water quality standards that required the regular testing of over 100 different chemicals which included hormones, phenols, pharmaceuticals, metals, VOCs and metals. These were in addition to the usual drinking water quality tests and had to be carried out for the duration of the trial as the composition of the treated wastewater could alter at any time.

There are two issues for consideration when establishing a new water recycling scheme. Firstly, what quality standards will be need to achieved, and secondly, how can compliance with these standards be demonstrated. Assuming that regulatory authorities will determine the quality standards required, the asset managers job is to demonstrate that their new water recycling asset complies with this standard. For a traditional wastewater or drinking water plant the means of compliance has been established for many years with set sampling protocols, monitoring and reporting requirements. For a recycled water asset this may not the case. There are several issues that may need to be addressed before a recycled water asset can be brought in to service. The frequency of sampling and level of continuous monitoring required will likely be far greater than a more traditional asset. This can add significant operational costs to the scheme and may require the installation of automated systems and data logging in order to achieve compliance.

For the Groundwater Replenishment Trial the treatment plant processes were continually monitored for parameters such as pH, dissolved oxygen, conductivity and turbidity. The aim of this monitoring was to demonstrate that the treatment units were operating correctly at all times. This monitoring was verified by weekly testing of over 20 chemicals. On a quarterly basis over 100 parameters were tested. Samples were also taken from the groundwater adjacent to the injection areas to monitor the effects on the aquifer.

Another issue to consider is the ability of local laboratories to test for the parameters specified in the standards, for example the ability to test for low levels of hormones or particular pesticides. If local laboratories can not perform these tests provision will need to be made for testing for these parameters at other locations and again may add significant costs to a project.

In Western Australia the main testing laboratory, Chem Centre, had to employ additional staff and purchase new equipment to be able to carry out the level of analysis required for the groundwater Replenishment Trial. In some cases they had to establish completely new techniques for analysing for some of the chemicals required by the DoH. Fortunately, the size of the contract (testing was to cost A$4M over 3 years) meant that the Laboratory were happy to oblige but it was some time before all parties were happy that water quality analysis would comply with the required standards.

3.3. TRAINING OPERATORS

With any new asset there will be always be a need to train operational staff in the operation of the plant and equipment and establish new working procedures. It is usual to draw on the existing skilled operators to form the basis of the team and add new staff as required. With a water recycling asset it is likely that the treatment processes used will differ from those used elsewhere and monitoring and reporting requirements will differ. This can lead to a scenario where all the staff must be trained from scratch and there will be limited hands on experience and no established work routines. This can cause difficulties during the first few months of operation.

Another factor to consider is there may not be an established training syllabus for water recycling plant operators and therefore no local training schemes available. Provision may be required for training by plant and equipment manufacturers and customised or one off training packages will be required. For many regulatory authorities demonstrating that the staff operating the recycled water asset are fully trained and competent is an important factor in demonstrating compliance with standards. Therefore, establishing training requirements and training the operators is an important element in managing the recycled water asset.

Water Corporation, being a large organisation, had an in house training team and established training packages for drinking water, wastewater and stormwater operation staff which combined elements of nationally recognised qualifications and local knowledge. For the Groundwater Replenishment Trial it was initially thought that the

drinking water training packages would be suitable but as the plant was put in to operation there were several gaps in knowledge that needed to be addressed, for example, understanding the differing composition of the source water from the wastewater treatment plant. These shortfalls were easy to overcome, the hardest part was demonstrating to the regulators that the operational staff were competent and fully trained when there were no training standards to benchmark against.

4. THE CHALLENGES OF MANAGING A RECYCLED WATER ASSET

Once an asset is built the challenges of day to day management of the asset begin. Managing water utility assets is never easy but there are some complexities in managing a water recycling asset that need to be addressed if the asset is to operate successfully. There are several subtle differences in managing a water recycling asset and a clear understanding of the operational drivers and monitoring requirements is important if the scheme is to succeed. Another issue to consider is building a knowledge base around the operational and maintenance of the recycled water asset as in the early stages it is likely that few people will have experience and expertise in this area. In the longer term there are also issues around duplication of knowledge across the asset groups as recycled water assets span across traditional asset groups.

4.1. SETTING OPERATIONAL TARGETS

A water recycling asset may require very different operational targets to a wastewater or drinking water asset. Water Recycling schemes are often 'non critical' assets in that they are not directly serving the public but instead are supplying water for irrigation or for industry. These assets may be turned off from time to time without reductions to levels of service and therefore do not require an immediate response to shutdowns or failures. Full emergency response plans are not required with problems being dealt with the next working day.

Operation of a non-critical asset can also result in some very different maintenance strategies. Maintenance can be reactive rather than preventive as shutdowns are acceptable. There can be cost savings from adopting a reactive maintenance strategy as equipment does not need to be replaced before failure.

Overall these factors can lead to a different operational philosophy from a traditional wastewater or drinking water asset and this should be reflected in any operational targets. There may be a tendency to rollover existing operational targets from similar wastewater or drinking water schemes which may not suit a water recycling scheme. The significance of this should not be underestimated as operators and managers who have worked on more traditional schemes will need to understand the different operational drivers and have appropriate targets if they are to operate the scheme successfully.

On the Groundwater Replenishment Trial this was not appreciated until after the scheme had commenced operation. The biggest issue came from setting the wrong key performance indicators (KPIs). The KPIs did not take in to account the non-criticality of the plant forcing call-outs and repairs out of standard hours to meet volume targets that were not critical whilst not capturing lapses in recycled water quality that were critical to regulatory compliance.

4.2. ESTABLISHING REPORTING SYSTEMS

The reporting systems used in an organisation are a key aspect in managing a recycled water asset as some of the day to day operational tasks will revolve around ensuring that the correct data is collected and recorded. The

reporting system will also demonstrate that the asset is achieving regulatory compliance and so it is vital that this is done effectively.

In most cases the reporting system is shaped by external reporting requirements and will differ for wastewater and drinking water assets. Wastewater requires periodic sampling of the treated effluent to check for pathogens, BOD and nutrient levels, drinking water requires ongoing, sometimes continuous monitoring for a range of chemicals and pathogens. In addition, these monitoring results will be reported to a different regulatory authority: usually an environment agency for wastewater and a health agency for drinking water.

For a water recycling asset the reporting requirements will invariably be far more onerous than those from a more traditional source and will ultimately be determined by the the end use of the recycled water. Where treated wastewater is used as the source water is it likely that there will be requirements to sample and monitor the wastewater quality as it enters the recycled water plant. Water will require monitoring as it passes though the recycled water plant to demonstrate that the treatment process is operating correctly at all times and the final treated water will require frequent sampling to test for a wide range of parameters as set by the regulatory authority. All of this data will need to be collected, collated and presented and, given both the number of samples and the increased frequency of samples, there will need to be a resource made available to do this work.

Many organisations rely on automated and computerised collection of data and population of databases to enable fast and efficient reporting. Whilst these systems can save on time and resources the cost of setting up such a system can be prohibitive. Propriety systems for data collection will likely be tailored to wastewater or drinking water schemes and modification may be required to meet the reporting requirements of a recycled water scheme.

Water Corporation used an automated system to schedule the time and location of the sampling, print sample bottle labels and then collate and present that data once analysis was complete. The system was initially set up for wastewater treatment plants and when the decision was made to use this system for the Groundwater Replenishment Trail the sheer volume of samples and number of parameters that had to be tested for was not known. The existing system had to undergo a major upgrade in order to meet the needs of the Trail increasing the number of different parameters that could be stored in the system, the number of samples that could be processed and the requirements for identifying reporting of discrepancies and violations. This was time consuming and expensive and, with hindsight, not the best system for the task.

4.3. BUILDING A KNOWLEDGE BASE

An issue arising from the operation of a water recycling plant is building a knowledge base around the recycled water asset and then the possible duplication of the knowledge base within the organisation. When a recycled water plant is first commissioned it is likely there will be limited operational knowledge. It is also likely that due to the nature of a recycling plant there will be some crossover in the processes and procedures used. For example, stormwater operators need pressurised distribution system knowledge to enable distribution for irrigation and wastewater operators need drinking water sampling knowledge. This crossover does not just occur at the operational level but also at a management and strategic level.

Once the knowledge base it established there is a dilemma as to whether to keep the expertise in one area and share experience as needed, or to allow the expertise to sit in each asset group. Sharing expertise and experience will require a very high level of co-operation between assets groups, which although is possible, is not something that is likely to have been required previously. However, duplication of knowledge by having expertise in each group would seem to be least efficient long term.

In Water Corporation there was already an existing knowledge base for water recycling schemes gained from the operation of a recycling scheme for the supply of industrial water. This plant was operated by the wastewater asset group as the asset sat at a wastewater plant and the water was not intended for drinking water supply. Whilst the wastewater group had knowledge of the recycling plant and equipment used they did not have knowledge of the requirements for drinking water supply such as sampling procedures. In addition, the knowledge regarding the large reverse osmosis plants used for the new desalination plants in Perth, sat with the Drinking Water asset group. In order to overcome this Water Corporation chose to second expertise in to the wastewater group in the short term and made the decision to hold the expertise in both groups longer term.

5. RECYCLING WITHIN WATER UTILITY ASSET MANAGEMENT STRUCTURES

In all but the smallest organisations the management of the three water utility assets; stormwater, wastewater and drinking water, is carried out separately.

Wastewater and drinking water assets are managed separately for several reasons:

1. At an operational level the management of wastewater and drinking water assets are separated to minimize cross contamination during day to day operation and maintenance. The treatment processes are generally different and operational staff are often only trained in one asset type.

2. At a management level the quality monitoring and reporting requirements for wastewater or drinking water are very different. In addition, the size of the asset base may require that more than one manager is required. More often than not the split occurs on an asset basis rather than a geographic one.

3. At a strategic level the planning of new infrastructure is generally carried out on an asset by asset basis and the technical expertise tends to specialise in one asset type.

Stormwater management has a different set of issues again. Stormwater is not collected or distributed to individual households and is not monitored in the same way as wastewater and drinking water. The extent to which stormwater assets are required is dependent upon the geography of the area and the magnitude of rainfall events.

So where does a recycled water asset fit in to the structure?

For some recycled water schemes there is an obvious choice of asset group. For example, where stormwater is collected, stored, and then recycled for public space irrigation, stormwater may be the obvious asset group. However, if a pressurised distribution system is required this may lie outside the expertise of the stormwater asset team and so expertise from the drinking water asset team may be required.

Where wastewater is the source water the choice becomes even more complex. It may be logical to locate the additional treatment processes required for water recycling at the existing wastewater treatment plant to minimize transfer costs and make use of the operational staff all ready on site. On this basis the asset could be considered a wastewater asset?

However, the treatment processes used to further treat the wastewater will be different to traditional wastewater treatment processes meaning that staff may not be correctly trained. In addition, the monitoring standards required are more likely to be similar to those used for drinking water. On this basis the asset could be considered a drinking water asset?

The answer will, of course, be different for each organisation depending on the internal management and operational structure. In some organisations the size and split of the existing asset base may be a major factor in deciding which asset group to manage a recycled water asset. Where there is an imbalance in the size of the asset base between the three water utilities, the recycled water asset may be allocated to the smallest asset base to distribute work load evenly across resources. Geography and asset location may also influence the decision. These are the simplest solutions but may create issues and higher operational costs in the longer term as personnel may need to be up-skilled and management systems upgraded to cater for the different operational requirements of a recycled water asset.

Other factors that may affect the decision are the internal and external monitoring and reporting requirements, the operational philosophy and the levels of operator skill and knowledge, all of which have been discussed earlier in the paper. Whatever the decision it should be made based on consideration of all the issues discussed in this paper as a poor choice at an early stage may mean extensive up-skilling of personnel and upgrades of existing management and reporting systems adding to project costs and creating delays.

For Water Corporation whether to make the Groundwater Replenishment Trial assets drinking water or wastewater assets was a complex problem. Similar plants set up for recycling wastewater for industrial use all sat in the wastewater asset group and the new Groundwater Replenishment Trial assets sat adjacent to the existing Beenyup Wastewater Treatment Plant. On that basis the decision was made early in the project that it was to be a wastewater asset. However, as the project developed it became apparent that this may have not been the correct decision.

The first problems arose in the design stages of the project as the wastewater asset group did not have the correct expertise to review the design and advise designers on Water Corporation standard requirements for drinking water standards compliance. In addition, the critical regulator was the DoH, a group with which the wastewater asset group had no established links.

During commissioning and early operation there were some minor issues with the operational staff who had all come from a wastewater background. These staff continued with the same operational philosophy as a wastewater treatment plant and some failed to understand the importance of reporting deviations from quality standards.

Other issues encountered were an inadequacy of the automated reporting system which had to undergo a major upgrade and the difficulty in establishing KPIs that were outside of those normally reported in the wastewater asset group. With an organisation the size of Water Corporation the need to alter the established reporting routines was a time consuming and surprisingly complex process.

6. CONCLUSIONS

This paper has highlighted the many subtle, and not so subtle, differences in managing a recycled water asset compared to a stormwater, wastewater or drinking water asset. It has discussed the issues that may be encountered when establishing a new recycled water asset and also the issues that may be encountered in the day to day operation of such an asset. It is hoped that this paper, whilst not providing solutions to these many issues, will at least alert asset managers to the challenges they may face so that they may give them better consideration during the conception and planning of a water recycling project.

Although it may seem like the most efficient solution to try and fit a recycled water asset in to one of the existing asset groups the efficiencies will be short lived as adapting existing systems to fit the differing requirements of a

water recycling scheme and meeting targets which are governed by a different operational philosophy will make the day to day management of the asset difficult and time consuming.

Just as stormwater has become a separate asset group to wastewater, it is likely that in the future recycled water will become a separate, fourth, water utility.

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