Wastewater Servicing Strategies for Re-Zoning Submission to the Proposed Waikato District Plan

Sleepyhead Estate - Ohinewai

231 Tahuna Road & 88 Lumsden Road, Ohinewai
Ambury Properties Ltd

Final

Document Control

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Contents

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 wastewater servicing.

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

Five potential long-term wastewater servicing options have been considered for this report, including:

- Option 1 – Upgraded Te Kauwhata Treatment Plant, with vacuum reticulation in the network, a vacuum pump station with discharge pumps capable of transporting the wastewater 13km north via dual rising mains.
- Option 2 – Upgraded Huntly Treatment Plant, with vacuum reticulation in the network, a vacuum pump station with discharge pumps capable of transporting the wastewater 8km south via dual rising mains.
- Option 3 – New Centralised Treatment Plant, with low pressure sewer reticulation in the network, a 1.5km bulk main to the plant.
- Option 4 – On-Site Treatment utilising the Smith & Loveless system, vacuum reticulation in the network, a vacuum pump station with discharge pumps to the on-site plant.
- Option 5 – On-Site Treatment – Primary Treatment at Lot utilising the STEP system, low diameter low pressure sewer reticulation within the network and an Innoflow AX-Max treatment plant with post treatment requirements.

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

The interim options that have been considered include:

- Interim Option A – Containerised treatment plants staged to 250m^3/day to 1000m^3/day steps depending on development requirements.
- Interim Option B – Modular treatment plants staged to 250m^3/day to 1000m^3/day steps depending on development requirements.
- Interim Option C –Septic tanks and dripper fields for early factory stages where flows are low.

Three strategies for on-site discharge have been considered for the interim solutions:

- Land disposal – Locations to be investigated outside flood plain
- Lake Disposal – Waikato River
- River Disposal – Lake Rotokawau or Lake Waikare

This assessment and report confirms that the level of development proposed can be serviced for wastewater, 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 wastewater servicing for the proposed development. Other reports completed by Woods for the proposal include stormwater management, flooding assessment and water supply.

2.2. Proposed Development

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. The Structure Plan and Zoning Plan are included in this report as Appendix A.

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

In order to develop at this site, connections to the public wastewater infrastructure or interim on-site solutions are required.

2.3. Receiving Environment

The downstream catchment from the development is Lake Rotokawau located to the east of the site. This is situated within a Department of Conservation (DoC) reserve and flows to Lake Waikare. Due to this, any discharge from the site for wastewater should be minimised.

If on-site treatment is considered, then a high level of treatment will be required to ensure that the discharge improves upon the current discharge to the freshwater environment. Alternative discharge locations can be considered including land disposal in an area above the flood plain and Waikato river disposal. Discharges will require discharge consent and will need to consider environmental and cultural (Iwi) impacts.

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 wastewater flows.
- Sections 5, 6, 7 and 8 describe the potential components that could be utilised in the servicing solution for:
    - Section 5 – the potential wastewater servicing destinations
    - Section 6 – the transmission (bulk) reticulation to get the wastewater from the site to servicing destination
    - Section 7 – the wastewater treatment components and processes and discharge locations
    - Section 8 – the network reticulation within the site.
- Section 9 presents a combination of the components from Sections 5 to 8, as five options to service the development.
- Section 10 describes three 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 wastewater for the proposed development. WDC have existing reticulation and treatment facilities in the area surrounding the development which potentially could service the Sleepyhead Estate site.

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

WDC control two existing wastewater treatment plants (WWTP) locally at Te Kauwhata and Huntly. These both have abatement notices on them currently and are undersized for future development. These stations are explored in further detail in Section 5.

3.2. Watercare Services Ltd

Watercare Services Ltd (WSL) have taken over WDC's role as the local council 3 waters authority for the Waikato District surrounding the proposed development.

Woods have met with WSL and WDC who confirmed that:

- 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.
- Existing publicly owned infrastructure is not currently suitable to cater for the proposed development.
- These timeframes indicate that interim solutions will be required as development will proceed ahead of planned public infrastructure (still to be determined).

Minutes of this meeting have been provided in Appendix C – 3 Water Consultation

3.3. Waikato Regional Council

Waikato Regional Council's (WRC) responsibilities for 3 waters in the Waikato region is managing impacts on existing water bodies, ground water and water health.

Both public and private treatment systems that discharge into the receiving environment will need to meet WRC's requirements and obtain discharge consents.

A meeting was undertaken with WRC officers on 12 November 2019 to discuss the consenting implications of private wastewater options which it was confirmed that:

- WRC will be involved in the structure plan hearing as a submitter.
- Wastewater discharge needs to exceed current discharge quality levels and receiving environment quality levels
- Quality of the discharge will determine likely success and duration of a discharge consent.
- Land, River and Lake disposal for on-site treatment are all viable disposal options.
    - Lake disposal is a non-complying activity and consenting route will be more difficult
    - Waikato River disposal and land disposal are discretionary activities.

- Land disposal is WRC's preference and schemes quoted required tertiary treatment prior to disposal.

Minutes of this meeting have been provided in Appendix C – 3 Water Consultation

3.4. Iwi – Tangata Whenua Governance Group

The 3 waters strategy was presented to the Tangata Whenua Governance Group (TWGG) for the Ohinewai Development on 22 October 2019. Minutes of the meeting and presentation slides are included in Appendix C – 3 Water Consultation

This including discussions on the wastewater servicing options including:

- Local Authorities (WDC, WSL and WRC) and their servicing plans
- Supply Routes to Public Infrastructure
- Discharge Location & Quality
    - On site / land disposal – dripper fields not suitable for locations within the existing site, if utilised, then they need to be located outside 100-year flood plain
    - Lake disposal – discharge quality to exceed current farm runoff quality
    - River disposal least preferred

While the Iwi representatives did not formally indicate their position on the different solutions, they indicated that they were open to considering all options should they demonstrate a high level of treatment and no cause any adverse effect to the receiving environment.

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 wastewater and the following feedback was received on the day:

- Understanding on the required high water quality for wastewater discharge
- Local authority plans and WSL implementation plans
- Discharge to Lake Rotokawau via the drainage scheme through the DoC reserve – difficulty with consenting for that option.
- Regional water quality outcomes with Huntly & Te Kauwhata WWTP's potentially being shut down or upgraded
- Information on other local private treatment schemes, including a chicken farm to the east.

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.

Discussions need to be held to confirm possibility of discharge to Lake Rotokawau.

4. Wastewater Catchments & 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 wastewater flows as a result of the proposed land uses for the development. For modelling of the wastewater flows, each wastewater zone has been calculated separately based on anticipated land use. Figure 1 below outlines the expected wastewater zones that have been modelled across the site.

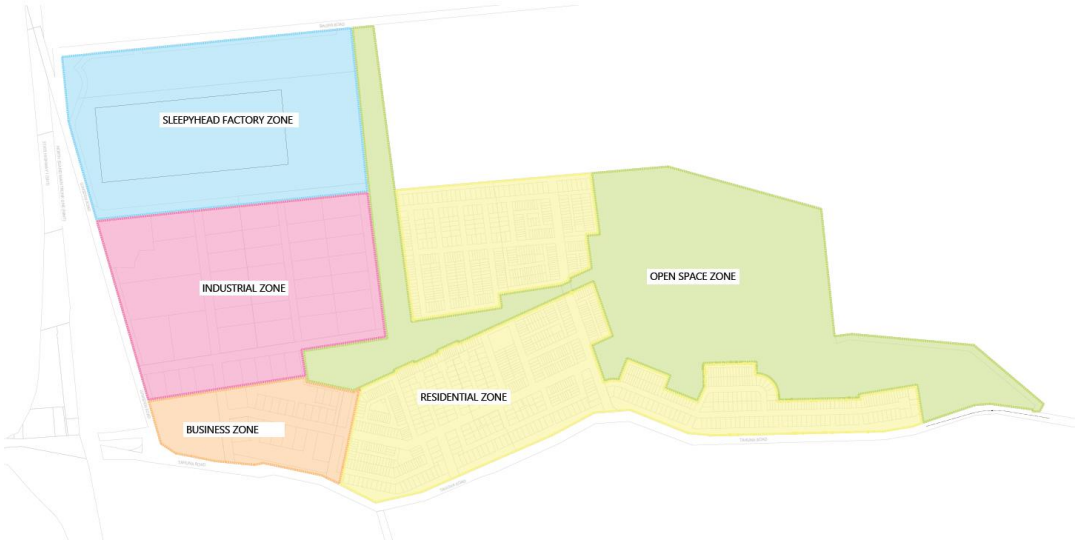


Figure 1: Sleepyhead Estate Land Uses / Wastewater Zones

4.2. Sleepyhead Estate Catchment 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 63 Ha industrial land use.

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

The factory contains chemicals and will have separate storage and removal facilities for these chemicals so that no trade waste enters the public wastewater system.

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 wastewater discharge. Trade waste generated from this location will not be suitable to discharge to the proposed public wastewater system.

4.2.3. Business Development Zone

Business (commercial) development is proposed for approximately 8.7 Ha including a service station, local convenience stores, factory outlet shops and other local amenities to service the proposed development.

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

4.2.4. Residential Development 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 wastewater 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. Wastewater flows are considered to be low in this part of the site, however there may be public facilities and other wastewater uses as part of this zone.

4.3. Hydraulic Design Assumptions

The flows have been developed using Watercare Services Ltd Code of Practice for Wastewater (C0P-02) version 2.2 dated 1/11/2019.

4.3.1. Factory Zone

The wastewater flows for the Sleepyhead factory zone have been developed utilising:

- The predicted factory worker population of 1500
- Average Dry Weather Flow (ADWF) of 65 litres per person per day
- Peak Wet Weather Flow (PWWF) peaking factor of 6.7

4.3.2. Industrial Zone

The wastewater flows for the industrial zone are based on:

- Light water users in the COP-02 table 5.1.4
- ADWF of 4.5 litres per square meter per day
- PWWF peaking factor of 6.7

4.3.3. Business Zone

The wastewater flows for the business zone are based on:

- Dry Retail users in the COP-02 table 5.1.3
- ADWF of 1 person per 50m2 at 65 litres per person per day
- PWWF peaking factor of 5.0

4.3.4. Residential Zone

The wastewater flows for the residential zone are based on:

- Up to three storey residential development in the COP-02 table 5.1.1
- 3 persons per dwelling per day
- ADWF based on 180 litres per person per day
- PWWF peaking factor of 6.7

4.3.5. Open Space Zone

The wastewater flows for the open space zone have been estimated on the likely fittings provided within that zone for public facilities.

4.4. Development Flows

Development flows have been estimated based on the current structure plan and wastewater zones as described above.

Table 1: Flow Summary

Zone	Number of DUEs	Gross Floor Area	ADWF (m^3/d)	PWWF (l/s)
Factory		100,000	98	7.6
Industrial		250,000	1125	87.2
Business		71,000	92	5.3
Residential	1250	4,000	681	52.6
Open Space			4	<0.1
Total	**1250**	**425,000**	**2,000**	**153**

For full calculations, refer to Appendix B – Development Flow Calculations.

4.5. Interim Flow Staging

It is anticipated that the development will be built-out over a number of years. The build-out may be initially constrained by the interim three waters services available and timing of the public network availability or on-site treatment options. 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 daily average and peak flow requirements is given in the table below:

Table 2: Daily Flow Staging Summary

Develop-ment Year	Residential DUEs	Business GFA (m2)	Industrial GFA (m2)	Average Daily Flow (m^3/d)	Peak Daily Flow (m^3/d)
1	150	57,300	71,900	482	965
2	175	3,000	76,700	965	1,930
3	300	1,000	0	1,128	2,256
4	75	13,700	101,400	1,672	3,344
5	225	0	0	1,794	3,587
6	175	0	0	1,914	3,828
7	150	0	0	1,995	3,990
Total	**1250**	**75,000**	**250,000**	**2,000**	**4,000**

4.5.1. Treatment Staging

For on-site treatment of interim flows, on-site plant options can be staged in 250 m3, 500 m3 and 1000m3 intervals. Based on the peak dry weather flows, this equates to:

Table 3: Interim Flow Staging

Zone	PDF (m^3/d)	Number of DUEs	Gross Floor Area
Industrial	500		55,550
Business	500		192,300
Residential	500	463	

Note: Combinations of this can be built up for each stage.

Peak daily flows should be used for design of treatment infrastructure, however peak wet weather flow should be utilised for pipeline design.

5. Servicing Destinations

For this development, several long term servicing destinations have been considered. For the public infrastructure (wastewater treatment plants), it is considered that these are likely to be long term solutions where, following upgrades, will be suitable to take development flows. On-site treatment options are likely to be interim solutions where they will allow the development to progress ahead of the planned creation or upgrade of public infrastructure as outlined in Section 3.3 above.

5.1. Te Kauwhata Treatment Plant

The Te Kauwhata Treatment Plant is located on Rata Street south of the Te Kauwhata township. The plant consists of two oxidation ponds which are adjacent to and discharge to the northern banks of Lake Waikare.

5.1.1. Capacity

It is understood that the treatment plant is currently under stress and requires an upgrade to accommodate the Lakeside Development which has commenced (There is more detail within the Consolidated Detailed Business case dated April 2018 which is available as a public document).

An abatement notice has currently been placed on this plant and a planned upgrade to this station has been put on hold while the WSL servicing strategy discussed above is completed.

Should this proposed development require connection to this facility, an upgrade will be required. There may be savings in a joint upgrade to accommodate this proposed development with the planned upgrade.

5.1.2. Required Delivery Infrastructure

To convey development flows to this WWTP, it is anticipated that a pump station at the Sleepyhead Estate development will be required and rising main from that pump station to the WWTP will be required. The rising main could be staged based on development flows.

5.1.3. Local Reticulation

It would be anticipated that the reticulation network would need to be vested in council, including:

- Vacuum
- Gravity

Private wastewater solutions may require metering of discharge for charges to the body corporate.

5.1.4. Advantages and Limitations

The advantages for this servicing strategy are:

- Publicly managed system
- Funding may be available for plant upgrade (HIF funding based on previous business case is pending further investigations)
- Existing discharge consent, albeit with compliance matters to be addressed

The limitations associated with this servicing strategy are:

- New infrastructure required to connect to the plant which is approximately 13km from the development site
- Plant requires upgrades or replacement before the development can connect into it
- Discharge consent is up for renewal in 2025 and any upgrade will require a variation or likely new consent

- Plant upgrades unlikely until next 5-10 years

5.2. Huntly Treatment Plant

The Huntly Wastewater Treatment Plant is located on McVie Road as part of the Huntly Recycle & Refuse Transfer Station. The site also has a frontage on East Mine Road.

5.2.1. Capabilities

It is understood there is some additional capacity in the treatment plant, but this has not been quantified and is unlikely sufficient for the entire Sleepyhead Estate development. The plant currently has an abatement noticed placed on it.

5.2.2. Required Delivery Infrastructure

To convey development flows to this WWTP, it is anticipated that a pump station at the Sleepyhead Estate development will be required and rising main from that pump station to the WWTP will be required. The rising main could be staged based on development flows.

5.2.3. Local Reticulation

It would be anticipated that the reticulation network would need to be vested in council, including:

- Vacuum
- Gravity

Private wastewater solutions may require metering of discharge for charges to the body corporate.

5.2.4. Advantages and Limitations

The advantages for this servicing strategy are:

- Publicly managed system
- Existing discharge consent, albeit with compliance matters to be addressed

The limitations associated with this servicing strategy are:

- New infrastructure required to connect to the plant which is approximately 8km from the development site
- Plant requires upgrades before the development can connect into it
- Plant upgrades unlikely until next 5-10 years and any upgrade will require a variation or likely new consent
- Existing discharge consent due to expire in the next few years

5.3. Centralised Treatment Plant

A Centralised Treatment Plant has been discussed for this part of the Waikato District in the past and may be constructed in lieu of upgrading each of the existing local plants individually.

WSL have indicated a range of locations have been considered for this plant, including:

- Ohinewai
- A new plant at Huntly or a major upgrade of the existing plant
- Hampton Downs
- adjacent to Spring Hill prison.

For this assessment, it has been assumed that this would be located centrally within the North Waikato region within 1.5km of the development site.

5.3.1. Capabilities

This plant would be constructed to full MBR capability and may include tertiary treatment depending on discharge location.

The plant will be designed to accommodate the existing and future catchments including that of this development. Due to the size and expenditure of this plant, it is likely to be staged based on flows generated per development stage.

5.3.2. Required Delivery Infrastructure

To convey development flows to this WWTP, it is anticipated that a pump station at the Sleepyhead Estate development will be required and rising main from that pump station to the WWTP will be required. The rising main could be staged based on development flows.

If the plan was located directly adjacent to the development, then low pressure sewer may be able to directly discharge into the head of the gravity network and negate the need for bulk reticulation.

5.3.3. Local Reticulation

It would be anticipated that the reticulation network would need to be vested in council, including:

- Vacuum
- Gravity

Private wastewater solutions may require metering of discharge for charges to the body corporate.

5.3.4. Advantages and Limitations

The advantages for this servicing strategy are:

- May be undertaken with funding available through a commercial agreement between the local authority (WDC/WSL) and developers
- Cost of plant will be spread across a large number of users
- Single centralised plant for the region will have lower maintenance costs than multiple plants
- Operational costs and risks are taken on by the local authority
- Consenting benefits due to economies of scale leading to improved wastewater treatment and consolidation of poorly performing existing plants.

The limitations associated with this servicing strategy are:

- Set up costs
- Infrastructure costs to connect the local systems to the Centralised Treatment Plant network
- Unknown factor of where it would be located relative to the development
- New discharge consent will be required
- Timeframe for availability likely 5-10 years

5.4. On-Site Treatment Plant

Due to the sensitive receiving environment and consenting process, a high level of treatment will be required for on-site treatment to be considered a viable servicing strategy. Stakeholder engagement is critical to inform the design and investigations for on-site options with discharges to either the Waikato River or adjacent lakes. Disposal to land may also be an option, however this is dependent on land availability near the proposed plant location.

There are several manufacturers locally for on-site treatment and generally all the systems will require the following stages of treatment:

- Primary Treatment - Solids Removal
    - Trash Removal
    - Clarifier
    - Secondary Clarifier or Membrane Bioreactor (MBR)
    - Sludge Digestion & Waste Removal
- Secondary Treatment – Liquid Treatment
    - Aerobic
- Tertiary Treatment – UV
    - Ultra-Violet Light Treatment
    - Discharge into receiving environment

5.4.1. Treatment Systems

For this report, three suppliers have been researched for the products and systems they provide:

- Innoflow Technologies Ltd
- MENA Water FZC
- Smith & Loveless NZ Ltd

All these suppliers utilised systems which provide for treatment of solids, water and tertiary disinfection. For this report, tertiary treatment has not been included as irrigation discharge does not require this.

Disposal to the receiving environment can either be to land or to waterway:

- To land – this involves dispersal fields which must be located above the 100-year flood level and sizing of the field depends on flow rates and infiltration rates of the soil. As the surrounding area to the site is within flood plains, if this option was to be implemented, then it would need to be pumped to a suitable location and utilised as irrigation for forest or similar use. Locations will need to be investigated further if this disposal option is developed.
- To waterway – the high level of treatment means that relatively clean water can be discharged to the receiving environment. Any treatment system would need to demonstrate that the treated effluent discharge will be to a higher quality than the existing condition of farm runoff. It is proposed that this will discharge into the site's wetland system prior to discharging to the receiving environment as a further polishing stage.

A full explanation of disposal options is provided in Section 7.7.

For the separate suppliers, all the systems researched treat waste in a similar way. For Innoflow, removal and treatment of solids occur at the individual property, whereas this is undertaken at the plants for the other suppliers.

An area will need to be set aside for any system to enable the treatment facilities to be installed. All the researched systems provide modular capabilities to enable installation to occur as the development flows increase.

Full details of the treatment systems have been included in Section 7.

5.4.2. Delivery Infrastructure

Due to the topography of the proposed site, the following delivery infrastructure methods should be utilised based on the different local reticulation utilised:

- Vacuum Pump Station for vacuum reticulation network
- Pump Station or Lift station for a gravity network
- No delivery infrastructure for an LPS or similar system with the design discharge location at the treatment plant.

Containerized pump stations could be utilised as an interim solution if a connection to the future public network was intended to be utilised or if the development was staged so that areas where unable to be connected into a single network.

5.4.3. Local Reticulation

On-site reticulation is likely to be private for this servicing strategy. This increases the options available for on-site reticulation, but also may require the roading network to also be private.

If there was consideration that this plant could be taken over by WSL (or others) in the future or connection is made into the local network at a point in time in the future, then the reticulation network should be designed for future vesting to council.

5.4.4. Advantages and Limitations

The advantages for this servicing strategy are:

- Does not require interface with council reticulation and therefore is not limited to delays in infrastructure upgrades to meet development requirements
- Delivery Infrastructure through Building Consent process
- Infrastructure sizes can be staged based on flows
- Bulk Infrastructure is cheaper as lower transport distances

The limitations associated with this servicing strategy are:

- Consenting requirements for discharge into receiving environment
- High level of reporting required to assess ecological and cultural affects to the receiving environment.
- High level of consultation required – lots of stakeholders including iwi, DoC, local groups
- Requires on-site wastewater treatment to a high standard, high cost of plant
- Requires land for treatment plant which removes developable land
- Negative perception from residents
- Discharge locations including through DoC land, WRC drainage scheme and other constraints
- Requires infrastructure and reticulation to be privately owned, maintained and managed by a body corporate structure, including costs and risks of this arrangement.

5.5. Other Options Considered

5.5.1. Composting Toilets & Reuse.

For this option, it is proposed that no wastewater discharge network is utilised. Instead, composting toilets provide on-site treatment of effluent and grey water is filtered before being reused for irrigation or discharged to the stormwater network.

The option would require significant infrastructure to be provided on every lot and while is very green, is unlikely to have much uptake as it has perceived high maintenance requirements (clearing composting toilet & filter maintenance for greywater system).

5.5.2. On-Site Treatment – Per Lot

This option has been considered and dismissed, as on-site treatment per lot typically requires large dripper fields and due to the medium to high density of the lots proposed in this development there is unlikely to be space available.

5.6. Interim Supply Strategies

5.6.1. Septic Tank & Dripper Field

For initial low flows from the Stage 1 Sleepyhead Factory, a septic tank could be provided with a dripper field to treat low flows and discharge treated effluent to land.

Due to the discharge of effluent to land, there will be a limitation on how much land can be provided and how much flow can be discharged before there is an adverse impact on receiving environments and therefore it is unlikely that this is a suitable interim strategy beyond the Stage 1 Sleepyhead Factory works.

5.6.2. Tanker Removed

During initial low flow scenarios, a tank could be provided to store wastewater and pumped out by a hydrovac truck for transport to a local treatment plant.

This solution would be suitable for a bridging solution between the development flows becoming live and the commissioning of the bulk reticulation.

5.6.3. Modular Treatment System

Some treatment plants can be constructed in a modular fashion and could provide treatment for initial flows and then be upgraded once flows increase. These would be constructed within a single structure with room for upgrades.

5.6.4. Containerized Treatment System

Some treatment plants can be suppled in a shipping container and could provide treatment for initial flows. Further containers could be provided for increased flows.

5.7. Wastewater Infrastructure Ownership

Ownership of the bulk delivery reticulation (transmission & trunk) and local reticulation infrastructure will depend on the treatment location and construction arrangement.

5.7.1. Publicly Owned

Publicly owned assets are normally constructed by the developer and its representatives and vested into Council. This model will be utilised if wastewater flows is discharged to a WDC or WSL asset as it will be an extension of their infrastructure. For the delivery reticulation (i.e. rising main), the developer usually installs

the works while acting as an agent of that authority to make works within the public roading corridor easier to gain approvals.

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

5.7.2. Privately Owned – Body Corporate

Where wastewater is serviced by an on-site treatment facility, the wastewater infrastructure is likely to be privately owned and run by a body corporate or similar entity.

There are complications with privately owned assets in public roads and therefore if a gravity or vacuum solution is used for reticulation, then these can be vested as public assets. Where low pressure sewer (LPS) networks are utilised, the wastewater reticulation is likely to be privately owned and run by a body corporate.

5.7.3. Interim Solutions

Where an interim solution is used ahead of a future connection is to be made to a public asset, it is likely that the reticulation and delivery network will be designed to public standards so it can be easily vested in the future when the connection is made.

6. Bulk Infrastructure Requirements

6.1. Summary

For the abovementioned servicing strategies, a range of bulk infrastructure will be required in order to transport the wastewater from the development to the treatment facility or public trunk network.

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

6.2. Pump Station & Rising Main

6.2.1. Summary

A pump station & rising main is used for conveying flows from the bottom of a catchment into the transmission network or to the treatment plant.

6.2.2. Location

The location of the pump station is generally at the lowest point of the catchment for a gravity network, the middle of the catchment for a vacuum network, or at a convenient discharge location for a low-pressure sewer catchment.

6.2.3. Arrangement

6.2.3.1. Gravity Pump Station

A gravity wastewater pumping station typically consists of:

- An Inlet Chamber, where all incoming flows discharge to
- A Wet Well to house submersible pumps, alarms, sensors, washing equipment and pump lifting equipment
- A Storage Tank, typically 4 to 24 hours ADWF storage
- Overflow System consisting of a scum baffle and scum screen to restrict floatables discharge
- Odour Treatment, typically an activated carbon filter and fan (or a biofiltration odour bed for larger systems)
- Electrical Control Cabinet & Aerial
- Water Supply Cabinet with RPZ and hose
- A building to house electrical equipment – typically for stations over 1000 lots
- Rising main to a discharge manhole with air valves and scour valves if required

6.2.3.2. Vacuum Pump Station

A vacuum wastewater pumping station typically consists of:

- A building to house vacuums systems and electrics – typically 3 rooms: Dry Well, Pump Room, Control Room
- Vacuum Equipment including; vacuum pumps, collection vessel, air/water separator, vacuum pipework & fittings
- Discharge Equipment including; wastewater discharge pumps, pressure pipework & fittings, magflow meter
- Odour Treatment, typically a biofiltration odour bed and fan

- Water supply systems
- Control systems and telemetry
- Rising main to a discharge manhole with air valves and scour valves if required

6.2.3.3. Rising Main

The rising main shall be designed so that:

- The pump flow is greater than the peak wet weather flow for the development (215 l/s)
- A flow velocity meets self-cleansing velocity (0.9 m/s) and does not exceed 2.0 m/s
- Discharges from the system within 8 hours to meet septicity requirements.

It is anticipated that the minimum flow shall be 215 l/s which corresponds to a pipe size for a single PE100 pipeline will be DN450 (367mm ID).

6.2.4. Staging

6.2.4.1. Pump Station

The pump station can be staged to allow for interim flows while providing the ability to be upgraded in the future for the ultimate flows.

6.2.4.2. Vacuum Pump Station

The vacuum pump station can be staged in the number of pumps installed during the initial stages, or a modular system can be installed where each smaller pumped system and vacuum vessel can service an individual stage.

6.2.4.3. Rising Main

Dual pipelines can be utilised to provide for initial lower flows and then be retained for maintenance purposes. This can be undertaken as two equally sized mains where flows are split, or one larger main and one smaller main.

6.3. Lift Station

6.3.1. Summary

A lift station is very similar to a pump station & rising main however does not have a rising main and usually can overflow into the downstream network.

6.3.2. Location

A lift station is located where wastewater needs to be raised up to a higher level within a network. For this development, a series of lift stations could be utilised, so that a gravity network is maintained.

6.3.3. Arrangement

The lift station typically includes:

- A wet well, with
    - pump operational range below the inlet level
    - dual pumps
    - pressure pipework connecting to downstream manhole
    - overflow pipe, typically connecting to downstream manhole

- float alarms
- ultrasonic sensors
- pump lifting equipment and accessories
- auto well washer

- control cabinet
- water supply cabinet with RPZ

6.3.4. Staging

The lift station will need to be installed when the upstream catchment needs to connect to the higher downstream catchment at this point.

The size of the pumps can be staged based on flows.

6.4. Interim Infrastructure Options

Several options have been considered for interim solutions to service bulk wastewater reticulation.

6.4.1. Container Pump Station

A containerised pump station can service a small first stage of the development

The containerised pump station can be retained and utilised to service sections of the development which are not connected to the main servicing reticulation as it is relocatable.

It can also be built into a main stage as a modular component; however, this may not be as efficient as building a complete station.

6.4.2. Modular Systems

Modular systems could be utilised to reduce the initial costs and size of plant for early stages of the development. The overall cost may be higher for these systems; however, they provide the ability to stage cost over the works, which may be more beneficial.

7. Treatment Requirements & Discharge Locations

7.1. Summary

The treatment of wastewater from the proposed site will be required to provide suitable effluent discharge to the receiving environment.

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

7.2. Public Treatment Plants

7.2.1. Summary

Flows from the development could be reticulated to upgraded public wastewater treatment plants (WWTP) when they have capacity to take development flows or a new centralised public treatment plant.

7.2.2. Location

There are two existing treatment plants in the areas:

- Te Kauwhata WWTP
- Huntly WWTP

It is understood that both of these WWTP have abatement notices lodged on them and their discharge consents will need to be renewed in the mid-2020s.

These WWTP are both owned and operated by WDC and will transfer to WSL for operation.

Should a new centralised public WWTP be constructed the location will be determined as part of that design.

7.2.3. Arrangement

It is understood that the two existing plants include for sludge removal and oxidation ponds for secondary treatment of the wastewater prior to discharging into the receiving environment

7.2.4. Capacity

Based on discussions with WDC and WSL, it is understood that currently both existing WWTP's do not have capacity to provide for the proposed development and would require upgrade to enable connections from the proposed development.

It is also understood that there has been discussion that these WWTP's may become redundant in favour of a new centralised WWTP, however no further information has been received on this option and is unlikely to be received until May 2020.

7.2.5. Discharge Locations

The Te Kauwhata WWTP discharges to Lake Waikare and the Huntly WWTP discharges into a drainage scheme watercourse which is connected to the Waikato River and Lake Kimihia.

It is understood that the Te Kauwhata WWTP will not gain approval for discharge into Lake Waikare when its discharge consent renews mid-2020s.

7.3. On-Site Treatment Plant - Innoflow

7.3.1. Summary

Innoflow Technologies Ltd are the exclusive NZ agent for Orenco Systems Incorporated who produce the plant used in this system. These systems are used all over the world for onsite wastewater disposal where conventional systems are not suitable. Innoflow's approach is to complete removal of 90% of solids at the lot, to reduce load on the treatment plant and pressure pipe reticulation network.

The Innoflow system utilises:

- Primary treatment at each property in the form of STEP tanks and pumps
- Pressurised network of low diameter pipelines
- Secondary & Tertiary treatment at a treatment plant

They key advantage of this solution is that solids stay on the lot and are reduced using microbes. This means that the tanks need to be cleaned out every 10 years. The discharge to the network is only liquids and the treatment plant is therefore smaller in size. Further details of these systems are included in Appendix G – Treatment Details.

7.3.2. Location

The STEP tanks and pumps are located at each lot and the treatment plant is located on site. A suitable area will need to be set aside of this plant.

7.3.3. Arrangement

The treatment plant can be installed as a modular system for the most part, however some items may need to be installed as the full size from the start.

Each Lot shall contain:

- STEP Tank for primary treatment & solids removal, including:
  - 4000 l tank
  - ProSTEP pump
  - Control Panel + accessories

Figure 2: STEP System within each lot

Figure 3: Advantex AX-Max Treatment Vault

The treatment plant shall contain:

- AdvanTex AX-Max Secondary Treatment Plant, including:
  - Anaerobic (MBR) treatment, to process waste particles
- De-nitrifying bed – to remove nitrogen based compounds
- Ultrafiltration System (Reverse Osmosis Membrane) – to remove fine particles and first stage disinfection
- Discharge Pond – a spilling pool before entering the receiving environment.

7.3.4. Staging

Some of this plant including the STEP Tank system, AdvanTex AX-Max, Ultrafiltration system, UV disinfection can be staged based on development flows.

7.3.5. Budget Estimate

Innoflow have provided preliminary figures for plant costing for their system. The full station costing has been estimated below:

Table 4: Preliminary Innoflow Plant Costing

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

Note: Other costs required at each lot and within network for this system.

7.3.6. Discharge Locations

For on-site treatment, there are three options for disposal locations: land, lake and Waikato River. An assessment will be undertaken should this plant be developed to determine the best disposal location.

7.4. On-Site Treatment Plant – MENA

7.4.1. Summary

MENA Water FZC are an international company based in the UAE that provide containerised systems for wastewater treatment. MENA's NZ agent is Stewart & Cavalier Ltd Engineers who have recently completed a system in NZ at Whitford.

The system proposed for this site is capable to turn wastewater into clean water suitable for irrigation.

7.4.2. Location

A suitable location will be selected on site for the plant, clear of the subdivision including a landscape buffer. While approximately 1000m2 is required for the plant, it is anticipated that 2500m2 will be required for the lot in order to provide suitable amenity items such as parking, facilities, etc.

7.4.3. Arrangement

Typically, the MENA plant requires above ground containerised systems, sludge storage and below ground tanks. Further details of the MENA systems are included in Appendix G – Treatment Details.

For this development, the MENA system requires several large tanks for:

- Sludge Tank
- Settling Tank
- Treated Effluent Tank
- Buffer Tank
- Aeration Tank

These can be located as shown in Figure 4 or as above ground tanks. The following plant is also required:

- Fine Screens
- Odour Control
- Machine Room
- Sludge Dewatering
- Package Plant:
    - MR300-U
    - MR600-U
    - 2x MR1000-U
- Pumps & mixers for tanks
- Operator Room

It is anticipated, that a full facility will also contain:

- Parking
- Fencing
- SW Treatment
- Water Supply Systems and RPZ
- Discharge Pond – a spilling pool before entering the receiving environment
- Landscaping

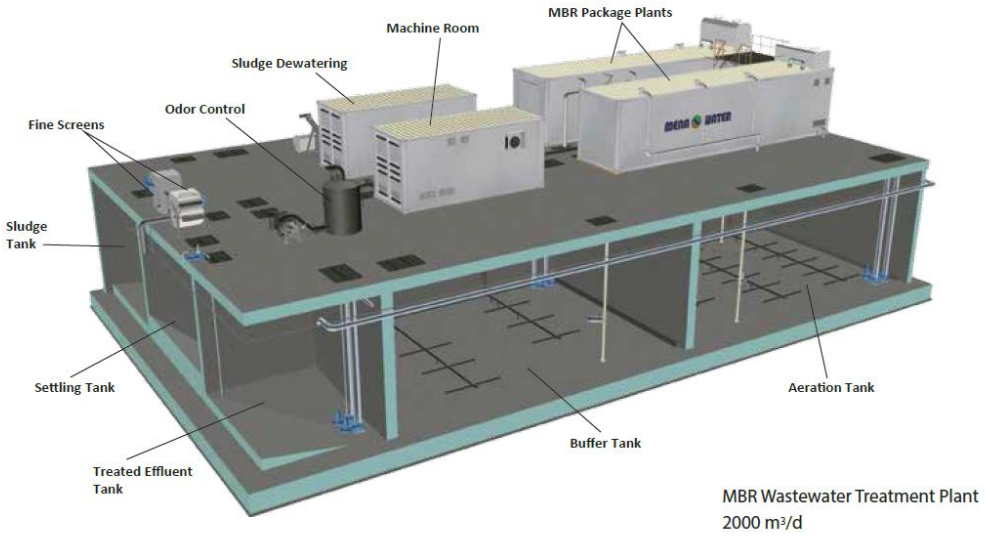


Figure 4: MENA Wastewater Treatment Plant Arrangement

7.4.4. Staging

For the fixed plant, the system can be staged so that the package plant can be installed in this order depending on inflow:

a) MR300-U

b) MR600-U

c) MR1000-U

d) MR1000-U

7.4.5. Budget Estimate

MENA have provided preliminary figures for plant costing for their system. The full station costing has been estimated below:

Table 5: Preliminary MENA Plant Costing

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

7.4.6. Discharge Locations

For on-site treatment, there are three options for disposal locations: land, lake and Waikato River. An assessment will be undertaken should this plant be developed to determine the best disposal location.

7.5. On-Site Treatment Plant – Smith & Loveless

7.5.1. Summary

Smith & Loveless NZ Ltd (S&L) provide components for the construction of water and wastewater treatment plants throughout NZ and Australia. Their two main package systems are Titan MBR and FAST Fixed-Film Treatment System.

For this development, S&L propose to utilise the Titan MBR system. Further details of these systems are included in Appendix G – Treatment Details.

7.5.2. Location

A suitable location will be selected on site for the plant, clear of the subdivision including a landscape buffer. While approximately 1000m2 is required for the plant, it is anticipated that 2500m2 will be required for the lot in order to provide suitable amenity items such as parking, facilities, etc.

7.5.3. Arrangement

For this development, the proposed treatment train required in the Titan MBR plant is:

- Fine Screen Filters
- Flow Equalisation Zone
- Sludge Holding Zone
- Anoxic Zone
- Aeration Zone
- Membrane Module

As shown from left to right in Figure 5.

7.5.4. Staging

The S&L system can be broken down into 250 to 500 m3/day modules for staging the construction of the plant to suit the growth rate of the development.

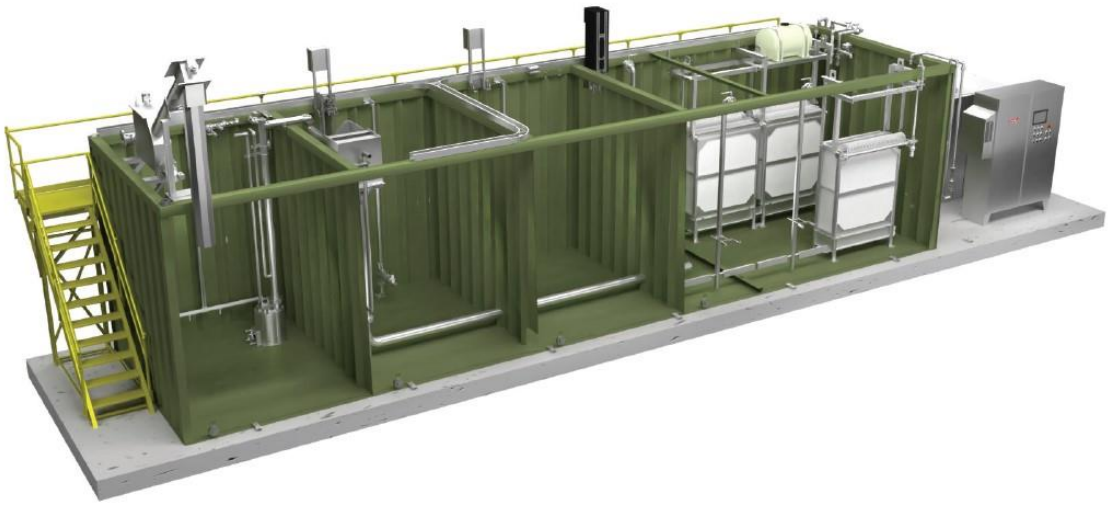


Figure 5: Titan MBR Wastewater Treatment Plant Arrangement

7.5.5. Budget Estimate

Smith & Loveless have provided preliminary figures for plant costing for their system. The full station costing has been estimated below:

Table 6: Preliminary S&L Plant Costing

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

7.5.6. Discharge Locations

For on-site treatment, there are three options for disposal locations: land, lake and Waikato River. An assessment will be undertaken should this plant be developed to determine the best disposal location.

7.6. Interim Treatment Solutions

7.6.1. Private Septic Tank & Dripper Fields

For initial low flows from the factory, it is proposed that an on-site treatment system consisting of a septic tank and dripper field is utilised for waste from the Stage 1 factory and construction site. This system may be suitable for small isolated development, however, will not provide a full solution for the site due to the large area required for dripper fields.

7.6.2. Container Treatment Plant

Several suppliers provide containerised solutions for wastewater treatment. This could be used for initial low flows or integrated into a larger plant.

7.6.3. Modular Systems

Most suppliers of wastewater treatment can provide modular systems. For early stages of the development a low flow modular system could be installed and utilised for treatment. This can be added to as the development progresses or removed if final servicing changes.

7.6.4. Chemical Treatment

Some chemical treatment solutions can be utilised as pre-treatment before being reticulated to a treatment plant. There are several microbe and chemical products available that reduce slime build up, gasses and blockages for low flow systems, which could be utilised to avoid septicity issues for initial stages.

7.7. Discharge Locations

For the on-site treatment options, several discharge locations can be considered for this site, including:

- Land Disposal – utilising dripper fields to disperse the treated effluent to land
- River Disposal – utilising a piped or swales/wetlands to the Waikato River
- Lake Disposal – utilising a piped or swales/wetlands to an adjacent lake.

7.7.1. Land Disposal

Land disposal consists of discharge of treated effluent to an effluent field where it soaks into the ground. Typically, these fields are located outside the 100 year flood extent and in good draining ground. Effluent fields are typically restricted access areas and require on-going maintenance.

For land disposal to be considered as an effluent disposal system, the site must consider:

- Nature of the subsoil - permeability and infiltration rates
- Stability of ground
- Site characteristics such as: slope, water table, flooding, vegetation
- Downstream effects such as: neighbouring properties, local water take from bores, local ecology, land use, local water bodies.

For land disposal, there are several options for how the treated effluent is disposed:

- Gravity soakage trenches/beds
    - This includes perforated pipes laid in trenches (or within a bed) filled with aggregate and soil which allows for the effluent to trickle into the surrounding soils.
    - This system is suitable for flat sites with good draining soils.
    - Due to the high water-table on site and in the surrounding area, and the poor soils, it is unlikely that this system will be suitable for this development
- Drip-line irrigation systems
    - There are several options for drip-line irrigation networks:
        - Sub-surface drip – lines buried in topsoil 100-150mm depth
        - Surface drip – lines laid on surface and covered with bark mulch
        - Spray system – where tertiary treated effluent is sprayed over the ground surface
    - This system needs at least secondary treated effluent which is pumped and distributed over the whole effluent field.
    - Typically, the effluent field is located in a planted or forest area where the area is fenced off from public access
    - System operates when discharge is available at the treatment plant and follows highs and lows of daily peaks
    - This system would be suitable for this development should an area be located above the flood plain and with suitable infiltration rates adjacent to site
- Low pressure effluent distribution (LPED) / dose loading
    - This system distributes treated effluent utilising similar systems as drip-line irrigation; however, the treated effluent is pumped at a regular interval (dosed) to avoid surges during daily peaks within the wastewater network.
    - This system would be suitable for this development should an area be located above the flood plain and with suitable infiltration rates adjacent to site

- Evapo-transpiration systems (ETS)
    - This system distributes treated effluent to shallow planted beds with selected shallow rooted plants. The plants absorb the effluent and release the water through the leaves back to the atmosphere in a natural process of transpiration. Effluent not taken up by the plants will absorb to the soil.
    - This system requires large flat beds above the flood plain level.
    - This system would be suitable for this development should an area be located above the flood plain adjacent to site
- Sand mound systems
    - Where ground conditions are not suitable for gravity soakage trenches, such as high ground water table, a sand mound system can be utilised
    - This system provides a soil or sand mound suitable for filtering and dispersing treated effluent to ground above the natural ground level.
    - This system would be suitable for this site if it is located outside the flood zone, however, will be impractical due to the size of bed required.

Land disposal can be used in conjunction with other systems where soil types, water table and ground conditions don't allow for winter discharge to land.

As there are not suitable locations on the proposed development site, alternative locations will need to be sourced. This will require a reservoir, pump station and rising main from the on-site treatment plant to the effluent discharge field. The size of this discharge infrastructure will be determined of the location of the effluent discharge field and land disposal option selected.

The typical arrangement for this system is:

- Reservoir and pump station located at treatment plant
- Rising main from treatment plant to effluent disposal field
- Effluent disposal field that is fenced off, planted and suitable infrastructure for maintenance activities.

Land disposal is typically a lower risk option for discharge consenting as there is a large buffer in place before the discharge reaches nearest watercourse. This buffer effect can be short-circuited if the system is not properly maintained and concentrated flows discharge from the effluent field.

7.7.2. River Disposal

River disposal consists of discharging treated effluent to the Waikato River via an open channel or piped network.

In order to discharge directly, a higher level of treatment will be required to ensure that the discharged effluent met a higher water quality than the receiving environment and the current discharge quality from site. A study of the current water qualities for the area should be undertaken should this option be considered as a solution.

The typical arrangement for this system would be:

- Discharge from treatment plant into piped network
- Pipe network to discharge into polishing wetland area
- Piped outlet to Waikato River through stop banks with outlet control during flooding events.

River disposal has higher consenting risk due to cultural implications and a shorter buffer zone between the discharge location and the receiving environment. This can be improved with monitoring systems.

7.7.3. Lake Disposal

Lake disposal consists of a similar process to river disposal, whereby a piped or swale/wetland delivery system conveys treated effluent to the lake. There are 3 nearby adjacent lakes which 2 could be considered:

- Lake Rotokawau – located to the east of the site and is the natural discharge location of the site currently. This is located within a DoC reserve which may add complications to approval to discharge to this lake.
- Lake Waikare – located to the north east of site and is the current discharge of adjacent drainage scheme channels. The water quality of the lake is considered low due to surrounding land uses and is located further from site. This option may require neighbour's approval for construction of pipelines and swales to access this.

It is understood from the consultation process that if lake disposal was utilised, then preference would be for discharge to Lake Waikare as the quality of the other two lakes is higher.

In order to discharge directly, a higher level of treatment will be required to ensure that the discharged effluent met a higher water quality than the receiving environment and the current discharge quality from site. A study of the current water qualities for the area should be undertaken should this option be considered as a solution.

The typical arrangement for this system would be:

- Discharge from treatment plant into piped network
- Pipe network to discharge into polishing wetland area
- Piped outlet to lake bank with outlet control during flooding events.

Lake disposal has higher consenting risk due to cultural implications and a shorter buffer zone between the discharge location and the receiving environment. This can be improved with monitoring systems.

7.7.4. Risk for Discharge Locations

The lowest risk discharge location is to land, which has the highest cost. The risk is lower as there is a longer path between the existing watercourses and the disposal location.

The highest risk is discharge to river as this requires infrastructure through the stop banks, the river is used for water supply, and has the shortest distance between the disposal location and the existing watercourse. To mitigate this, a wetland can be used as a buffering step with a shut off location available if monitoring indicates an issue.

8. Reticulation Options

Several options have been considered for the reticulation within the development between the properties and the bulk servicing solution. These are:

- Gravity Network
- Low Pressure Sewer Network
  - LPS System
  - STEP System
- Vacuum Network

8.1. Gravity Network

Gravity reticulation is the most widely used reticulation in New Zealand and utilises pipes to be graded from high to low in order to convey flows utilising gravity.

Due to the constraints of this development, including:

- Flatness of site – deep drains required to convey flows to single pump station
- Settlement issues on site – movement of pipe levels over time
- Weak Materials – making excavation difficult at depth
- High Water Table – difficulty with deep excavations and on-going issues with buoyancy

It is likely that gravity networks will only be able to be used sparingly or at a restricted maximum depth.

8.2. Low Pressure Sewer

Low Pressure Sewer (LPS) utilises pumped flow from properties in a pressurized network.

8.2.1. Arrangement

Normally gravity systems from the property is discharged into a tank with a pump, which then pumps into a pressurized network. If there are many connections on the system, then it is common to have a control system which regulates how often each pump can activate.

8.2.2. Types

There are two main types of LPS systems:

- Grinder Pumped system
- STEP System

8.2.2.1. Grinder Pumped System

The Grinder Pumped System grinds up solids with the effluent and discharges a slurry for treatment.

Some councils require that every lot owns and operates its own system, while others provide public pumps for 1 or more property and maintains it.

8.2.2.2. The STEP System

The STEP system separates out solids from the wastewater and only pumps liquid into the system.

For this system, the tank and pump are entirely private.

8.2.3. Ownership Model

Depending on the local authority, there are different ownership models employed. These could be:

- Individual pumps per lot, located within lot, owned and maintained by the lot owner.
- One pump per one to two lots, located within berm, owned and maintained by local authority.

If the network was a private system, the local authority would be a body corporate.

8.2.4. Advantages & Limitations

The Grinder Pump System compared to the STEP System has a lower on-site requirement, however, has a higher secondary treatment requirement. Pipe sizes are generally smaller for the STEP system.

The advantages for an LPS system include:

- Shallow pipework
- Pipework can follow grades up and down with contour
- Pipework can cope with some settlement
- Decentralises pumping, can mean no central pump station is required.
- Storage at the lot reduces overflows

The limitations include:

- Maintenance of pressure pipework within streets
- Maintenance of many pumps instead of few
- Traditionally problematic ownership model and maintenance issues
- Air valve, scour valve and isolation valves required in roads
- Many potential overflow points

8.3. Vacuum Network

Vacuum Wastewater reticulation utilised air flow and negative pressure to pull the wastewater through the network to a centralised pumping station.

8.3.1. Arrangement

The typical arrangement for a vacuum system is:

- Collection Chamber between 4-6 properties (less for commercial or industrial use), including:
  - 400 l chamber
  - Gravity pipework
  - Vacuum valve
  - Vent
  - Telemetry
- Vacuum network consisting of PE100 pipework in saw tooth configuration
- Vacuum Pump Station, including:
  - Collection Vessel
  - Vacuum Pumps
  - Wastewater Discharge Pumps

- Odour Treatment
- Controls & Telemetry

8.3.2. Advantages & Limitations

The advantages for a vacuum system include:

- Shallow pipework
- Pipework can follow grades up and down with contour
- Pipework can cope with some settlement
- Damaged pipe doesn't leak to external environment
- Monitoring system allows easy location of faults
- No overflow component, system can fully flood and be pumped out using a hydrovac truck

The limitations include:

- The vertical lift range is limited to plus or minus 6m
- Large centralised station – higher cost
- Stringent set out of network pipes
- High testing regime during construction

9. Proposed Servicing Options

9.1. Summary

Five strategies have been explored as part of this assessment, with the single likeliest infrastructure option considered for each strategy. Preliminary costings have been undertaken for the main components of the works.

9.2. Option 1 - Te Kauwhata Treatment Plant

9.2.1. Summary

For this option, it is proposed that a centralised pump station is installed within the Ohinewai development with a dual DN200/DN500 rising main installed to the existing WDC treatment plant at Te Kauwhata. The proposed route generally follows public and paper roads:

- Exit the development and follow Lumsden Road to end, then continue along paper road
- Cross the Te Onetea Stream utilising a directional drill methodology adjacent to the KiwiRail bridge
- Continue along the paper road to Austen Street in Rangiriri
- Follow Austen Street, Rangiriri Road and Te Kauwhata Road
- Turn off at Mahi Road, including a crossing of the KiwiRail corridor
- Turn down Rata Street until the treatment plant is reached.

Refer to Section 16 – Appendix D for the route layout. Alternatively, this could be constructed within the KiwiRail corridor to Mahi Road if permission was received.

9.2.2. Reticulation Options

For this assessment, Vacuum Reticulation has been selected.

9.2.3. Bulk Servicing Requirements

For this option, a vacuum wastewater pump station and rising main has been selected.

9.2.4. Treatment Requirements

During initial stages of the development, chemical treatment of the rising main may be required to reduce the risk of septicity.

9.2.5. Capacity Implications

This plant has been noted as currently undersized and has funding for an MBR upgrade. If flows from this development were to be directed to this location, then upgrade plans would incorporate the development size into the upgrade works.

Commercial arrangements would need to be entered into between the network operator and the developer. Consenting would also need to be addressed.

9.2.6. Preliminary Costings

It is anticipated that development will be levied against this infrastructure upgrade in the form of development growth charges.

9.2.6.1. Capital Costs

Table 7: Strategy 1 Costing

Item	Total
Infrastructure (pump station)	Medium
Treatment (public)	Low
Bulk Reticulation (rising main)	High
Network Reticulation	Medium
Agreements or growth charges	
Residential	High
Business/Industrial	High
Total	**High**

Note: Development growth charges have been estimated. Actual figures are to be confirmed by the local authority at the time of the development and would be subject to any commercial agreements entered into.

9.2.6.2. 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.

9.2.7. Staging

The vacuum pump station can be staged to allow for progressive growth.

9.3. Option 2 – Huntly Treatment Plant

9.3.1. Summary

For this option, it is proposed that a centralised pump station is installed within the Ohinewai development with a dual DN200/DN500 rising main installed to the existing WDC treatment plant at Huntly. The proposed route generally follows public and paper roads:

- Exit the development and follow Tahuna Road west
- 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.
- Turn off Tahuna Road and head south on Ohinewai South Road
- Turn on to State Highway 1 and follow the western side of the road
- Cross under State Highway 1 at East Mine Road
- Follow East Mine Road until the treatment plant lot is reached

Refer to Section 16 – Appendix D for the route layout. Alternatively, this could be constructed within the KiwiRail corridor to East Mine Road if permission was received.

9.3.2. Reticulation

For this assessment, Vacuum Reticulation has been utilised.

9.3.3. Bulk Servicing Requirements

For this option, a vacuum wastewater pump station and rising main has been utilised.

9.3.4. Treatment Requirements

During initial stages of the development, chemical treatment of the rising main may be required to reduce the risk of septicity.

9.3.5. Capacity Implications

This plant has been noted as currently undersized for this development and any upgrade would require an MBR to be installed for the full plant. If flows from this development were to be directed to this location, then the development will likely have to fund the entire upgrade.

Commercial arrangements would need to be entered into between the network operator and the developer. Consenting would also need to be addressed.

9.3.6. Preliminary Costings

It is anticipated that development will be levied against this infrastructure upgrade in the form of development growth charges.

9.3.6.1. Capital Costs

Table 8: Strategy 2 Costing

Item	Total
Infrastructure	Medium
Treatment (public)	Low
Bulk Reticulation	Medium
Network Reticulation	Medium
Agreements or growth charges	
Residential	High
Business/Industrial	High
Total	**High**

Note: Development growth charges have been estimated. Actual figures are to be confirmed by the local authority at the time of the development and would be subject to any commercial agreements entered into.

9.3.6.2. 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.

9.3.7. Staging

The vacuum pump station can be staged to allow for progressive growth.

9.4. Option 3 – Centralised Treatment Plant

9.4.1. Summary

There have been discussions that WDC or WSL may provide a Centralised Treatment Plant in the area near Ohinewai to replace existing plants at Te Kauwhata and Huntly to service the North Waikato region.

9.4.2. Reticulation Options

For this assessment, LPS has been utilised.

9.4.3. Bulk Servicing Requirements

For this assessment, it has been assumed that the Centralised Treatment Plant is located nearby the development and an LPS system can discharge to the gravity network above the plant without requiring an additional bulk pumping station.

9.4.4. Treatment Requirements

If the Centralised Treatment Plant was provided by WDC or WSL, then no on-site treatment would be required as part of the development.

It is presumed that the Centralised Treatment Plant will be constructed so that primary, secondary and tertiary treatment is provided for liquids and solids.

9.4.5. Capacity Implications

A new plant will be sized to cater for the development.

9.4.6. Preliminary Costings

9.4.6.1. Capital Costs

It is anticipated that development will be levied against this infrastructure in the form of development growth charges and an allowance for a bulk main to extend from the site to the public treatment facility will be required within 1.5km of the site.

Table 9: Strategy 3 Costing

Item	Total
Infrastructure	Low
Treatment (public)	Low
Bulk Reticulation	Low
Network Reticulation	Medium
Agreements or growth charges Residential Business/Industrial	 High High
Total	**High**

Note: Development growth charges have been estimated. Actual figures are to be confirmed by the local authority at the time of the development and would be subject to any commercial agreements entered into.

9.4.6.2. 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.

9.4.7. Staging

It is likely that this will not be operational for the first stages of the development and interim solutions would be required.

9.5. Option 4 – On-Site Treatment

9.5.1. Summary

On-site treatment could utilise one of the systems investigated (Innoflow, MENA and Smith & Loveless) or another arrangement. This is likely to be located adjacent to the development area where a site can be screened off from the rest of the development.

It is anticipated that this will be a private asset and run as a private system managed by a body corporate and therefore IGC's will not be required for the development for wastewater.

9.5.2. Reticulation Options

For this assessment, Vacuum Reticulation has been utilised.

9.5.3. Bulk Servicing Requirements

For this assessment, it is assumed that the vacuum pump station will discharge to the on-site treatment plant located nearby the vacuum pump station and no further bulk reticulation is required.

9.5.4. Treatment Requirements

For this assessment, S&L's Titan MBR plant has been utilised as described in Section 7.4.6.

9.5.5. Capacity Implications

A new plant will be sized to cater for the development.

9.5.6. Preliminary Costings

9.5.6.1. Capital Costs

Table 10: Strategy 4 Costing

Item	Total
Infrastructure	Medium
Treatment	Medium
Bulk Reticulation	Low
Network Reticulation	Medium
Agreements or growth charges	Low
Total	**Medium**

9.5.6.2. 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.

9.5.7. Staging

The S&L system can be staged to allow for progressive installation of plant as the development grows.

The vacuum pump station can also be staged to allow for progressive growth.

9.6. Option 5 – On-Site Treatment – Primary Treatment at Lot

9.6.1. Summary

This option will utilise Innoflow's system which includes for every lot to have an on-site STEP tank which includes removal of solids and a pump.

9.6.2. Reticulation Options

The network reticulation will be a private low pressure sewer with small diameter pipes as the flows from the STEP systems at each lot will be lower than a conventional system,

9.6.3. Bulk Servicing Requirements

For this option, it is anticipated that no additional bulk servicing will be required.

9.6.4. Treatment Requirements

For this assessment, the Innoflow plant will be utilised as described in Section 0.

9.6.5. Capacity Implications

A new plant will be sized to cater for the development.

9.6.6. Preliminary Costings

9.6.6.1. Capital Costs

Table 11: Strategy 5 Costing

Item	Total
Infrastructure	Low
Treatment	High
Bulk Reticulation	Low
Network Reticulation	Low
Agreements or growth charges	Low
Total	**Medium**

9.6.6.2. 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. It is anticipated that this plant will have lower operation costs as solid removal is undertaken by the lot owners.

9.6.7. Staging

The Innoflow system can be staged to allow for progressive installation of plant as the development grows.

9.7. Other Options Considered

9.7.1. Composting Toilets & Reuse.

As an alternative to a wastewater network, each lot could provide composting toilets and undertake filtration of greywater for discharge into a stormwater network. This would ensure solids remain on site, and wastewater is not generated.

As an alternative to composting toilets, combustion toilets are available were the by-products are just distilled water and ash.

This system would be suitable for a third world use, however, is not common practice where reticulation networks are normal.

9.7.2. On-Site Treatment – Per Lot

On-site treatment in the form of septic tanks and dripper fields are not suitable for this development due to the small lot size. Other forms of on-site treatment are too costly to be implemented on a per lot basis.

10. Interim Options for Early Stages

The following interim strategies have been considered for the initial stages of the development ahead of public infrastructure being completed or available as outlined in Sections 3 and 7.

10.1. Early Stage Servicing

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 with on-site septic tank system and dripper field already installed.
- 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 depends on the Stage 1 subdivision catchment build up and can be developed in steps based on Table 2.
    - Discharge Consent
    - 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 discharge 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 wastewater to the development and decommission and remove defunct infrastructure.

10.2. Interim Option A – Containerised Systems

10.2.1. Summary

A containerised pump station and treatment plant could be installed for the initial stages. It is anticipated that any of the three suppliers considered would be able to provide suitable temporary plant, however MENA and S&L have better suited plant to be integrated with public reticulation network at a later date.

10.2.2. Network Reticulation

The network reticulation for this system would need to be suitable to be vested as public infrastructure when the connection is made to the public network. Therefore, Vacuum and Gravity systems could be considered.

10.2.3. Bulk Infrastructure

It is likely that a pump station will be required to pump to the public infrastructure and therefore a system which can be replaced or upgraded should be considered.

Either a containerized pump station or a pump station designed to be easily upgraded to public standards should be utilised.

Rising mains could be staged for interim and final flows.

Depending on the discharge location, further delivery infrastructure may be required.

10.2.4. Treatment Options

MENA and S&L have indicated that the plant can be stepped in 250m3, 500m3 and 1000m3 intervals depending on development requirements, planned build out and costs.

This should be selected based on anticipated staging and build out rates, as oversizing plant can cause microbe systems not to function correctly.

10.2.5. Discharge Locations

Any discharge locations outlined in Section 7.7 would be suitable for these systems. The discharge location should be selected based on likely usage duration and risk on achieving a discharge consent.

10.3. Interim Option B – Modular Systems

10.3.1. Summary

A modular pump station and treatment plant systems could be installed for the initial stages. It is anticipated that any of the three suppliers considered would be able to provide suitable temporary plant, however MENA and S&L have better suited plant to be integrated with public reticulation network at a later date.

10.3.2. Network Reticulation

The network reticulation for this system would need to be suitable to be vested as public infrastructure when the connection is made to the public network. Therefore, Vacuum and Gravity systems could be considered.

10.3.3. Bulk Infrastructure

It is likely that a pump station will be required to pump to the public infrastructure and therefore a system which can be replaced or upgraded should be considered.

Either a containerized pump station or a pump station designed to be easily upgraded to public standards should be utilised.

Rising mains could be staged for interim and final flows.

Depending on the discharge location, further delivery infrastructure may be required.

10.3.4. Treatment Options

MENA and S&L have indicated that the components within their treatment plant systems can be stepped in 250m3, 500m3 and 1000m3 intervals depending on development requirements, planned build out and costs.

This should be selected based on anticipated staging and build out rates, as oversizing plant can cause microbe systems not to function correctly.

A single structure could be constructed with room for planned upgrades which will help distribute the cost of the on-site treatment plant over the subdivision build out.

10.3.5. Discharge Locations

Any discharge locations outlined in Section 7.7 would be suitable for these systems. The discharge location should be selected based on likely usage duration and risk on achieving a discharge consent.

10.4. Interim Option C – Septic Tanks and Dripper Fields

10.4.1. Summary

Small stages such as Stage 1 of the Sleepyhead Factory zone could utilise a temporary septic tank and effluent discharge field arrangement for initial flows.

As this option would require use of existing high areas on site, which later will be developed, this option is not suitable for development stages outside of the factory zone.

10.4.2. Network Reticulation

Low-pressure sewer systems are proposed for the factory site (private system) and therefore these can temporarily discharge to a septic tank. A bypass arrangement can be set up so these later discharge to a single point for subdivision network reticulation.

10.4.3. Bulk Infrastructure

No bulk infrastructure is required for this option.

10.4.4. Treatment Options

A typical commercial/rural septic tank system should be selected for the anticipated flows and should seek approval through WRC.

10.4.5. Discharge Locations

The dripper field should be located in high points on the site (above RL 8) and should be fenced off to prevent access. This should be maintained during the life of this interim solution.

11. Options Assessment

11.1. Strategies Assessed

The five long term strategies considered as part of this assessment are:

- Strategy 1 - Te Kauwhata Treatment Plant
- Strategy 2 – Huntly Treatment Plant
- Strategy 3 – Centralised Treatment Plant
- Strategy 4 – On-Site Treatment
- Strategy 5 – On-Site Treatment – Primary Treatment at Lot

11.2. Options Summary

Table 12 shows the assessed areas.

Table 12: Options Summary Matrix

Option	Complexity	Safety Risk	Consenting Risk	Environment Risk	Capital Cost	Operation Cost
1	Medium	High	High	Medium	High	Medium
2	Medium	High	Medium	Medium	High	Medium
3	High	Medium	Medium	Medium	High	Medium
4	High	Medium	High	Medium	Medium	Medium
5	Medium	Medium	High	Medium	Medium	Low

The 5 Options have been assessed utilising the following criteria:

11.2.1. Complexity

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

- For Options 1, 2 & 4, there is complexity in design for vacuum reticulation and pump station.
- For Options 1 & 2 there is complexity in construction for the long rising main routes through existing roads
- For Options 3 & 4 there is complexity in design and construction for supply a new treatment plant, however Option 5 is less complex in its treatment plant design as primary treatment is undertaken at the lots.

11.2.2. Safety Risk

Safety risk is considered for construction and operation activities.

- For Options 1 & 2 there is higher safety risks for constructing within existing road and rail corridors and maintenance activities will also require higher safety protocols in these areas
- For all options, a medium safety level has been applied for construction and operation of bulk infrastructure.

11.2.3. Consenting Risk

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

- Options 1 & 2 will require corridor access approvals for working in public roads (local authority and NZTA) and KiwiRail corridors
- All options will require variations to or new discharge consents and the difficulty in receiving that discharge consent depends on the disposal option implemented.
- All options will require resource consent for elements of the works,

11.2.4. Environment Risk

Environmental risk has been assessed for impact during construction, discharge requirements for treatment, and overflow risks.

- Options 1, 2 & 4 have low overflow risks as vacuum wastewater reticulation has been utilised
- All options have some environmental risks as they eventually discharge to lakes or rivers.
- Interim solution discharge options have varying risk, with the lowest risk being land disposal.
- Option 1 (Te Kauwhata WWTP) has a compromised receiving environment.

11.2.5. Capital Cost

Capital cost has been assessed in 5 areas:

- Network Reticulation Costs
- Infrastructure Costs – i.e. pump stations
- Bulk Reticulation Costs – i.e. rising mains
- Treatment Costs – i.e. treatment plants
- Infrastructure Growth Charges – these have been assessed based on the Watercare Services Ltd website based on wastewater only systems. Actual figures are to be confirmed by the local authority.
- Options 4 & 5 will have higher costs if on site disposal is utilised depending on the distance the disposal location is from site.

11.2.6. Operational Costs

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

- Options 1, 2 & 3 have medium operation costs as these include treatment plants operated by local authorities. Options 1 & 2 also have pump stations.
- Option 4 has medium operational costs as this includes a treatment plant operated by a body corporate.
- Option 5 has low operational costs as the treatment plant operated by a body corporate doesn't include for large solid removal. There are additional operational costs borne by the individual lot owners.
- Options 4 & 5 will have higher costs if on-site disposal is utilised depending on the distance the disposal location is from site.

11.3. Interim Options Assessed

The three interim strategies considered as part of this assessment are:

- Interim Option A – Containerized Systems
- Interim Option B – Modular Systems
- Interim Option C – Septic Tank & Dripper Field

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

- Interim Option C has the lowest lifespan as the higher areas within site as the current staging plan develops these areas first.
- Interim Option A may have a shorter lifespan than Interim Option B as the shipping containers are known to have lifespan issues due to rusting in exposed environments.

12. Summary, Conclusions & Recommendations

12.1. Summary

APL is submitting as part of the re-zoning provisions for the Sleepyhead Estate a mix of zonings including factory, industrial development, business development, residential and open space zones.

Woods have been engaged by APL to prepare an infrastructure assessment report for wastewater servicing in support of the Structure Plan submission.

Five main servicing strategies have been investigated as well as interim solutions for the initial stages of this development ahead of the final reticulation network and downstream treatment facilities being available. For each of the 5 potential servicing strategies a single option has been considered for this report. They are:

- Option 1 – Upgraded Te Kauwhata Treatment Plant, with vacuum reticulation in the network, a vacuum pump station with discharge pumps capable of transporting the wastewater 13km north via dual rising mains.
- Option 2 – Upgraded Huntly Treatment Plant, with vacuum reticulation in the network, a vacuum pump station with discharge pumps capable of transporting the wastewater 8km south via dual rising mains.
- Option 3 – New Centralised Treatment Plant, with low pressure sewer reticulation in the network, a 1.5km bulk main to the plant.
- Option 4 – On-Site Treatment utilising the Smith & Loveless system, vacuum reticulation in the network, a vacuum pump station with discharge pumps to the on-site plant.
- Option 5 – On-Site Treatment – Primary Treatment at Lot utilising the STEP system, low diameter low pressure sewer reticulation within the network and an Innoflow AX-Max treatment plant with post treatment requirements.

Three interim options have also been considered including:

- Interim Option A – Containerised treatment plants staged to 250m3/day to 1000m3/day steps depending on development requirements
- Interim Option B – Modular treatment plants staged to 250m3/day to 1000m3/day steps depending on development requirements
- Interim Option C – Septic tanks and dripper fields for early factory stages where flows are low and on site land above the flood plain can be used.

Three strategies for on-site discharge have been considered for the interim solutions:

- Land disposal – Locations to be investigated outside flood plain
- Lake Disposal – Waikato River
- River Disposal – Lake Rotokawau or Lake Waikare

12.2. Conclusions

This assessment and report confirms that the level of development proposed in the Sleepyhead Estate Development can be serviced for wastewater.

The selection of the preferred supply strategy requires further engagement with key stakeholders to determine a short list of preferred options, preliminary design of these options and then selection based on the best practicable option.

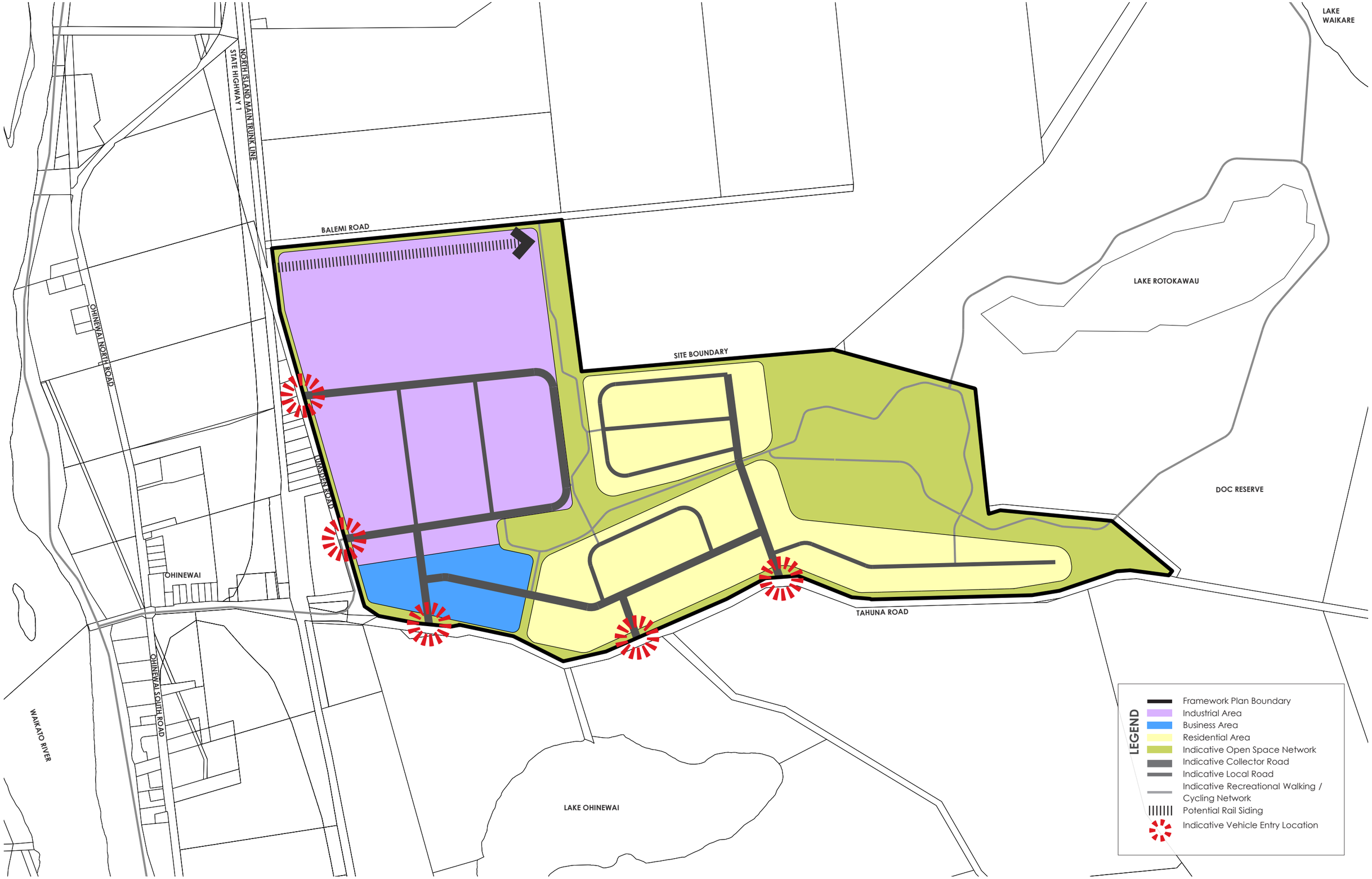
12.3. Recommendations

Three options for the interim wastewater servicing and five options for the final wastewater servicing for the Sleepyhead Estate development have been established. These options demonstrate the viability for wastewater 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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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

N

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OHINEWAI STRUCTURE PLAN

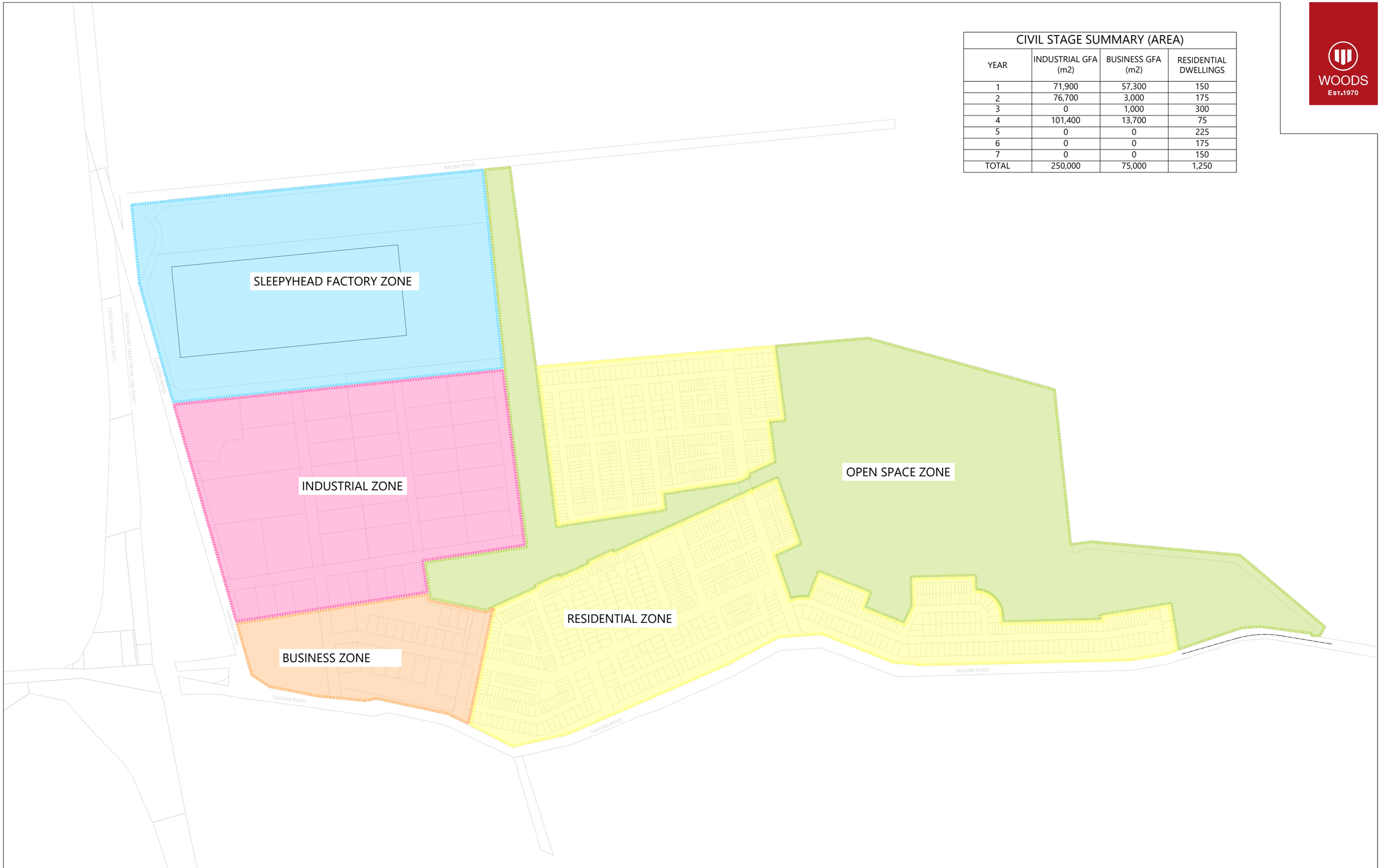
Illustrative Masterplan

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

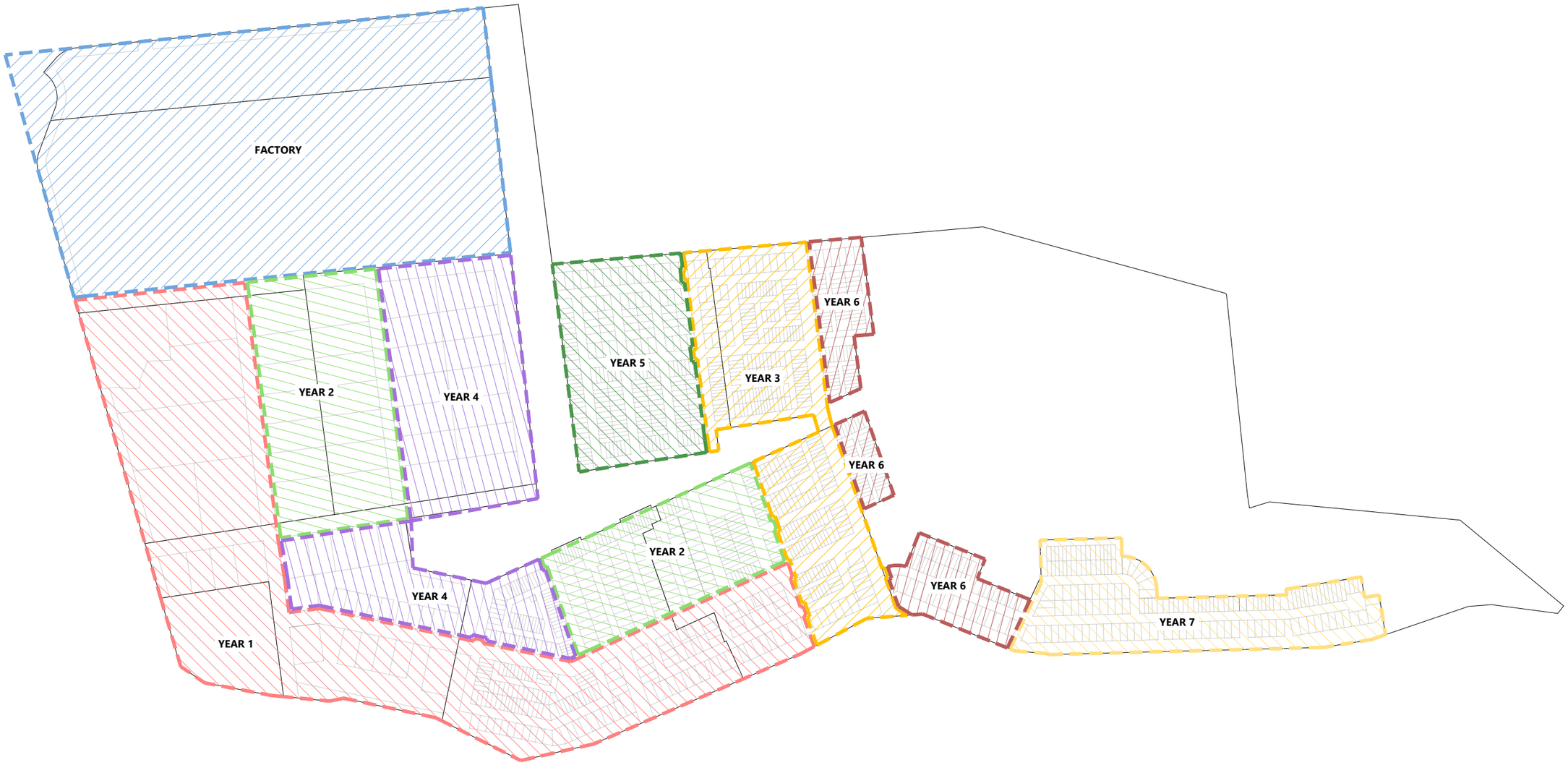
SLEEPYHEAD ESTATE, OHINEWAI - 3 WATERS

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 Flow Calculations

Ohinewai Development - Flows Staging

Wastewater

Sheet #: **1 of 1**
Project #: **P19-140**
By: **BP**
Date: **25-11-19**

Staging		Residential									Business - Assuming Dry Retail						Industrial - Assuming Light Industry						Factory - Assuming Light Industry						Total Flows		Total Volumes	
Year	Date	DUE per Stage	Cumulative DUE	Persons Per DUE	Usage l/p/day	Volume per Day (m3)	ADWF l/s	ADWF m3/day	Peaking Factor	PWWF l/s	Area (m2)	Cumulative Area	ADWF l/s	ADWF m³/day	Peaking Factor	PWWF l/s	Area (m2)	Cumulative Area	ADWF l/s	ADWF m3/day	Peaking Factor	PWWF l/s	Stage	Staff	ADWF l/s	ADWF m3/day	Peaking Factor	PWWF l/s	ADWF l/s	PWWF l/s	Average m3/day	Peak m3/day
	2020		0	3	180	0	0.00	0	6.7	0.0																			0.00	0.0	0	0
	2021		0	3	180	0	0.00	0	6.7	0.0		0	0.00	0	5.00	0.0							1	50	0.04	3	6.7	0.3	0.04	0.3	3	7
1	2022	150	150	3	180	81	0.94	81	6.7	6.3	57300	57300	0.86	74	5.00	4.3	71900	71900	3.74	324	6.7	25.1		50	0.04	3	6.7	0.3	5.58	35.9	482	965
2	2023	175	325	3	180	176	2.03	176	6.7	13.6	3000	60300	0.91	78	5.00	4.5	76700	148600	7.74	669	6.7	51.9	2	650	0.49	42	6.7	3.3	11.17	73.3	965	1930
3	2024	300	625	3	180	338	3.91	338	6.7	26.2	1000	61300	0.92	80	5.00	4.6		148600	7.74	669	6.7	51.9		650	0.49	42	6.7	3.3	13.06	85.9	1128	2256
4	2025	75	700	3	180	378	4.38	378	6.7	29.3	13700	75000	1.13	98	5.00	5.6	101400	250000	13.02	1125	6.7	87.2	3	1100	0.83	72	6.7	5.5	19.35	127.7	1672	3344
5	2026	225	925	3	180	500	5.78	500	6.7	38.7		75000	1.13	98	5.00	5.6		250000	13.02	1125	6.7	87.2		1100	0.83	72	6.7	5.5	20.76	137.2	1794	3587
6	2027	175	1100	3	180	594	6.88	594	6.7	46.1		75000	1.13	98	5.00	5.6		250000	13.02	1125	6.7	87.2	4	1500	1.13	98	6.7	7.6	22.15	146.5	1914	3828
7	2028	150	1250	3	180	675	7.81	675	6.7	52.3		75000	1.13	98	5.00	5.6		250000	13.02	1125	6.7	87.2		1500	1.13	98	6.7	7.6	23.09	152.8	1995	3990
10	2029		1250	3	180	675	7.81	675	6.7	52.3		75000	1.13	98	5.00	5.6		250000	13.02	1125	6.7	87.2		1500	1.13	98	6.7	7.6	23.09	152.8	1995	3990
11	2030		1250	3	180	675	7.81	675	6.7	52.3		75000	1.13	98	5.00	5.6		250000	13.02	1125	6.7	87.2		1500	1.13	98	6.7	7.6	23.09	152.8	1995	3990
12	2031		1250	3	180	675	7.81	675	6.7	52.3		75000	1.13	98	5.00	5.6		250000	13.02	1125	6.7	87.2		1500	1.13	98	6.7	7.6	23.09	152.8	1995	3990

Notes

1. Factors from Watercare (Auckland) COP for Land Development and Subdivision - July 2018 Chapter 5

2000 4000

2. Residential Occupancy Factors

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

2. Residential Flows based on 180 l/p/d

3. Residential Peaking Factors

Dry Weather Peak	3	
Wet Weather Peak	6.7	Up to 3 Stories
Wet Weather Peak	5	High Rise (>4 stories)
Vacuum Peak	5.025	25% reduction

4. Commerical Factors

Type	L/GFA/day	Peak Dry	Peak Wet	
Dry retail (no toliet)	1.30	2	5	1 person per 50m2 net floor area at 65 L/p/D
Dry retail + toliet	4.33	2	5	1 person per 15m2 net floor area at 65 L/p/D
Office Building	4.33	2	5	1 person per 15m2 net floor area at 65 L/p/D
Wet retail, food retail	15	2	6.7	15 L/GFA/day of floor area (including dining area)

5. Industrial Factors

Type	L/GFA/day	Peak Dry	Peak Wet
Light	4.50	5	6.7
Medium	6.00	5	6.7
Heavy	11.00	5	6.7

6. Sleephead Factory

Type	L/Person/D	Peak Dry	Peak Wet
Office	65.00	5	6.7
Factory	65.00	5	6.7
Visitor Centre	65.00	5	6.7

7. Peak daily flow based on 2.0 x ADF
8. Year 1 based on first subdivision stage
9. Volumes based on ADWF for average and twice ADWF for peak, to match water supply peak day supply volume

15. Appendix C – 3 Water Consultation

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

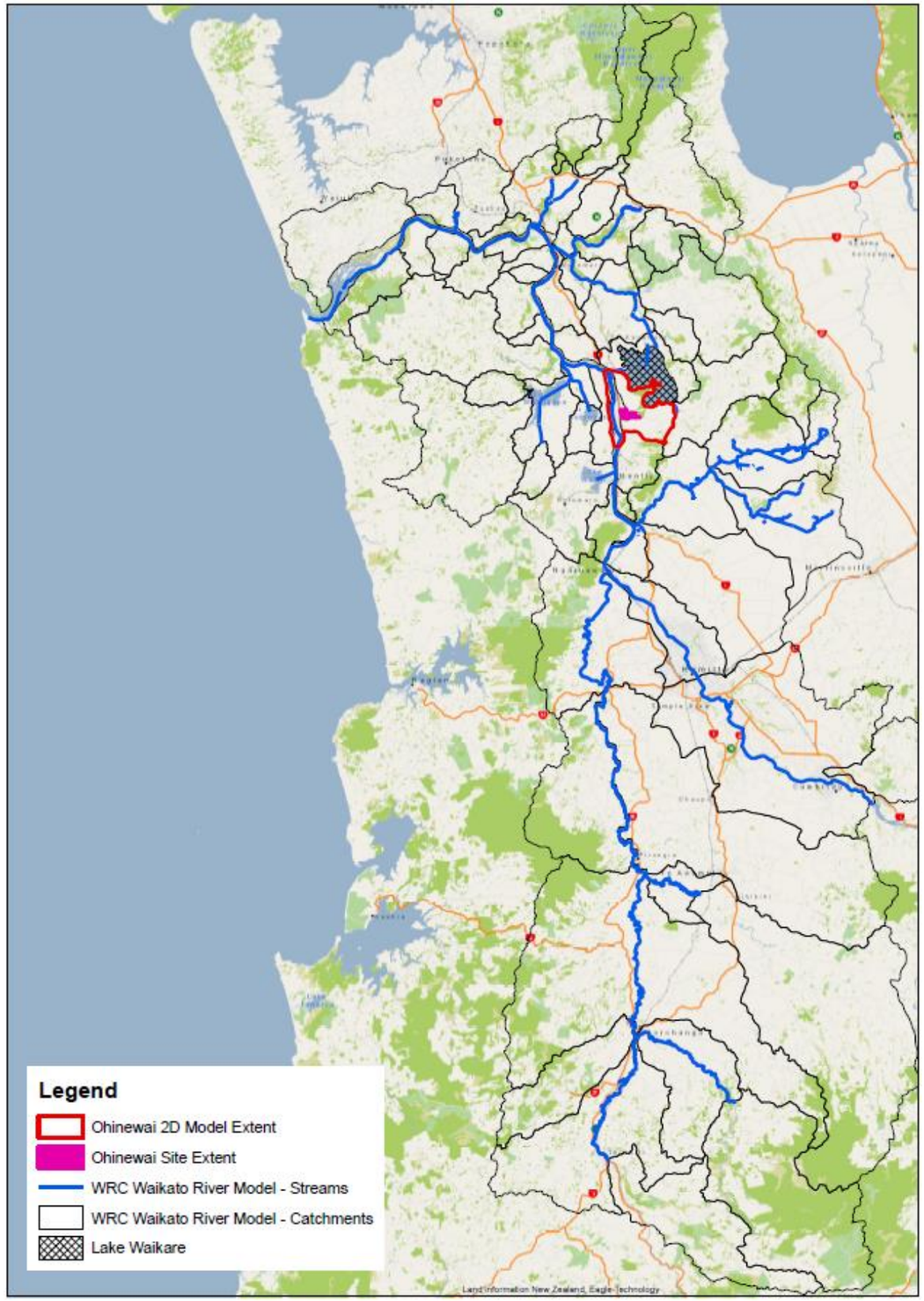
1. STORMWATER
2. WATER SUPPLY
3. WASTEWATER

SLEEPYHEAD ESTATE

STORMWATER

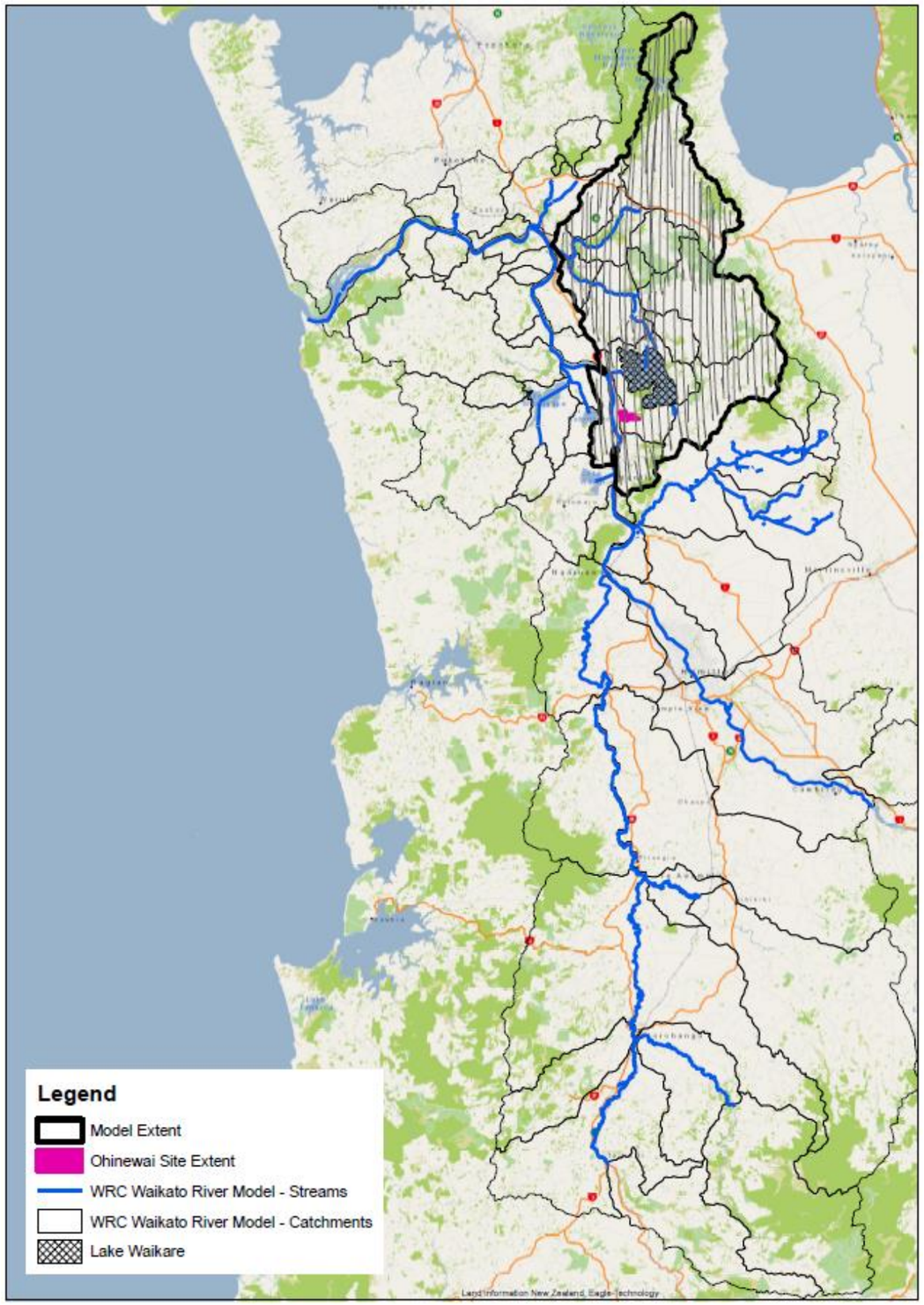
CONTENTS:

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
- 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>
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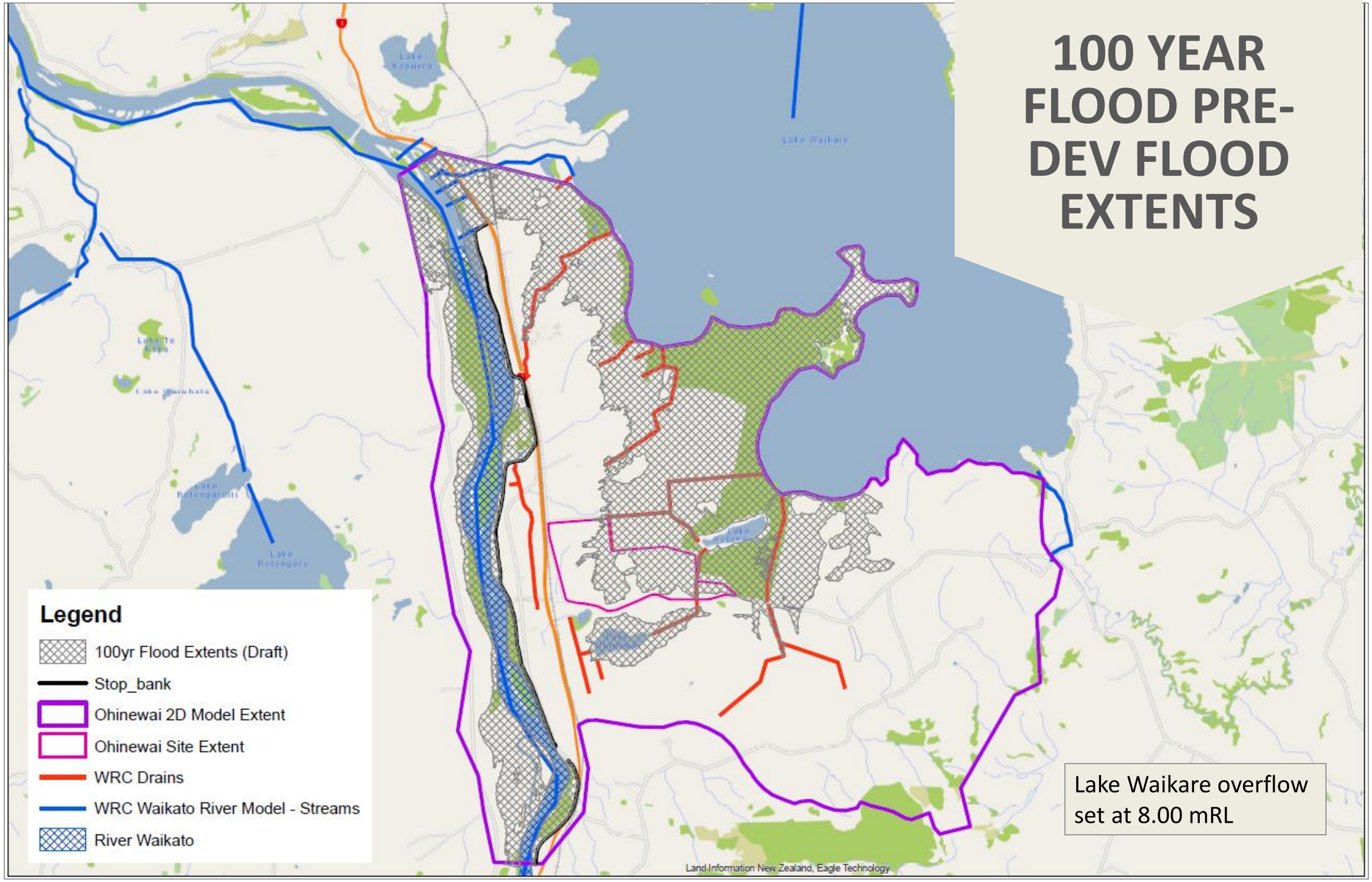
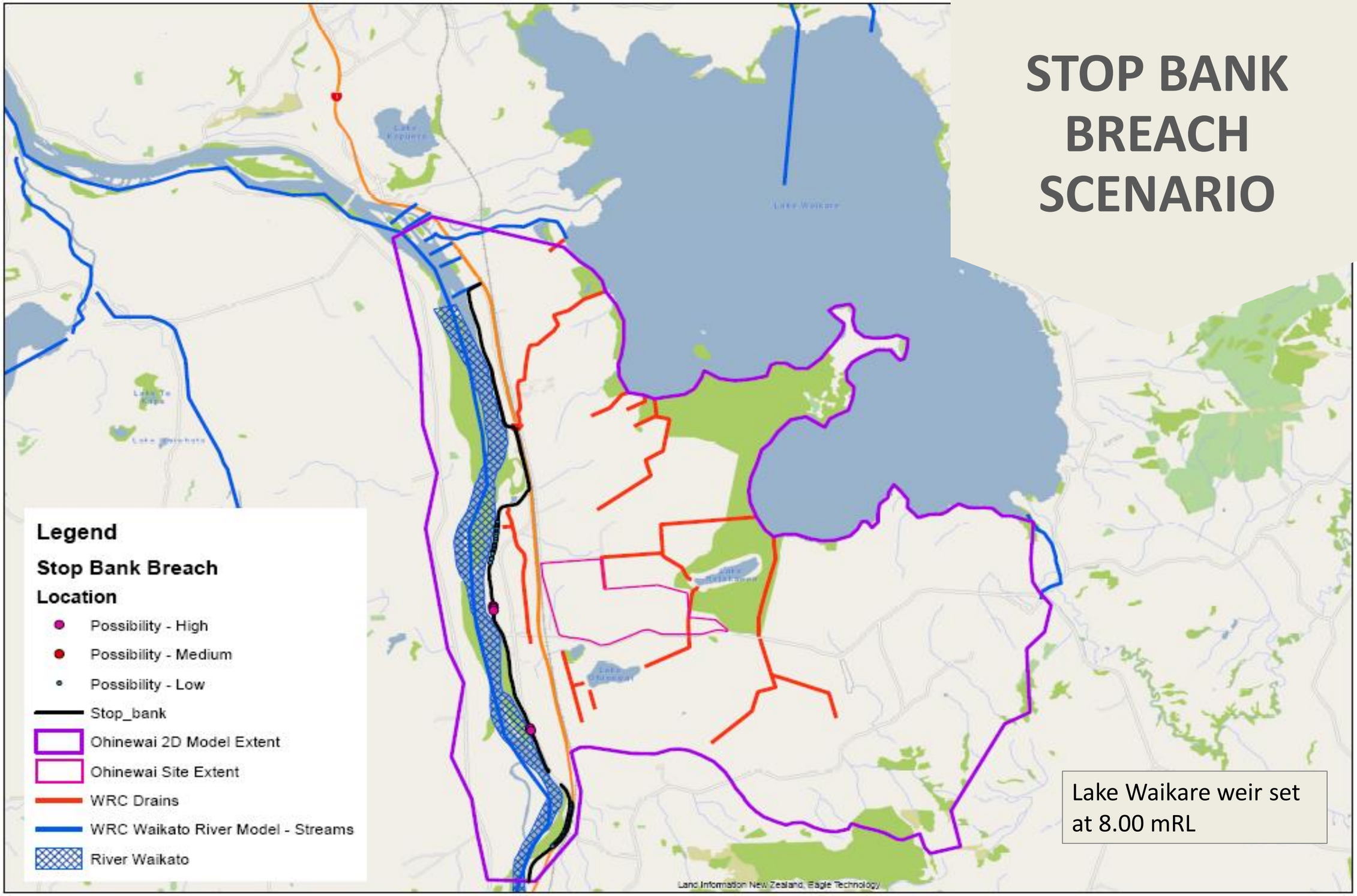
    - Water level boundary at the Whangamarino Control Gate
- The purpose of the flood model is to get a detailed understanding of the flood risk within the site, to identify these risks and assess the effects of development on adjoining landowners, Lake Waikare and the Whangamarino Wetland

100 YEAR FLOOD PRE-DEV FLOOD EXTENTS

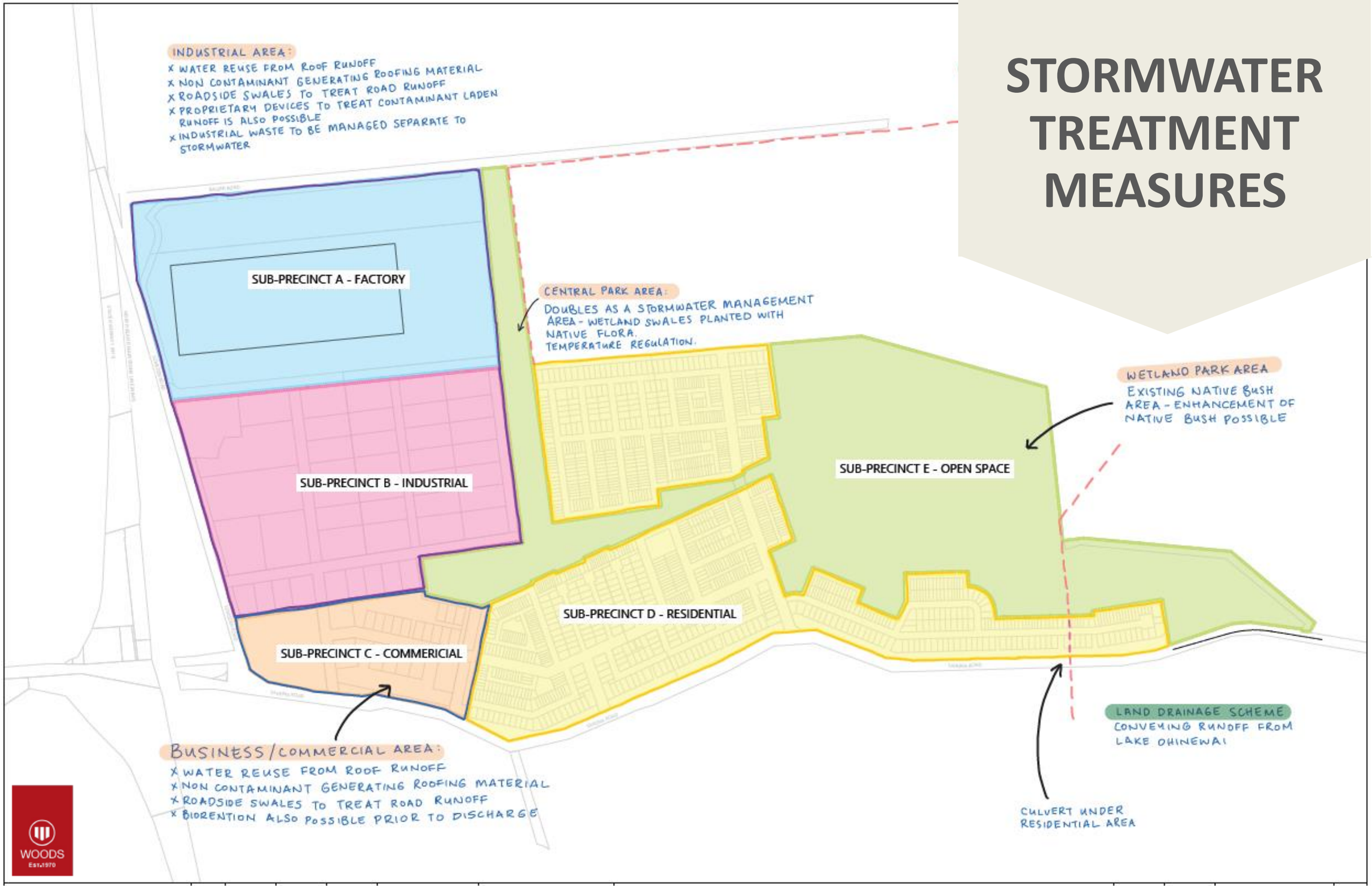


STOP BANK BREACH SCENARIO

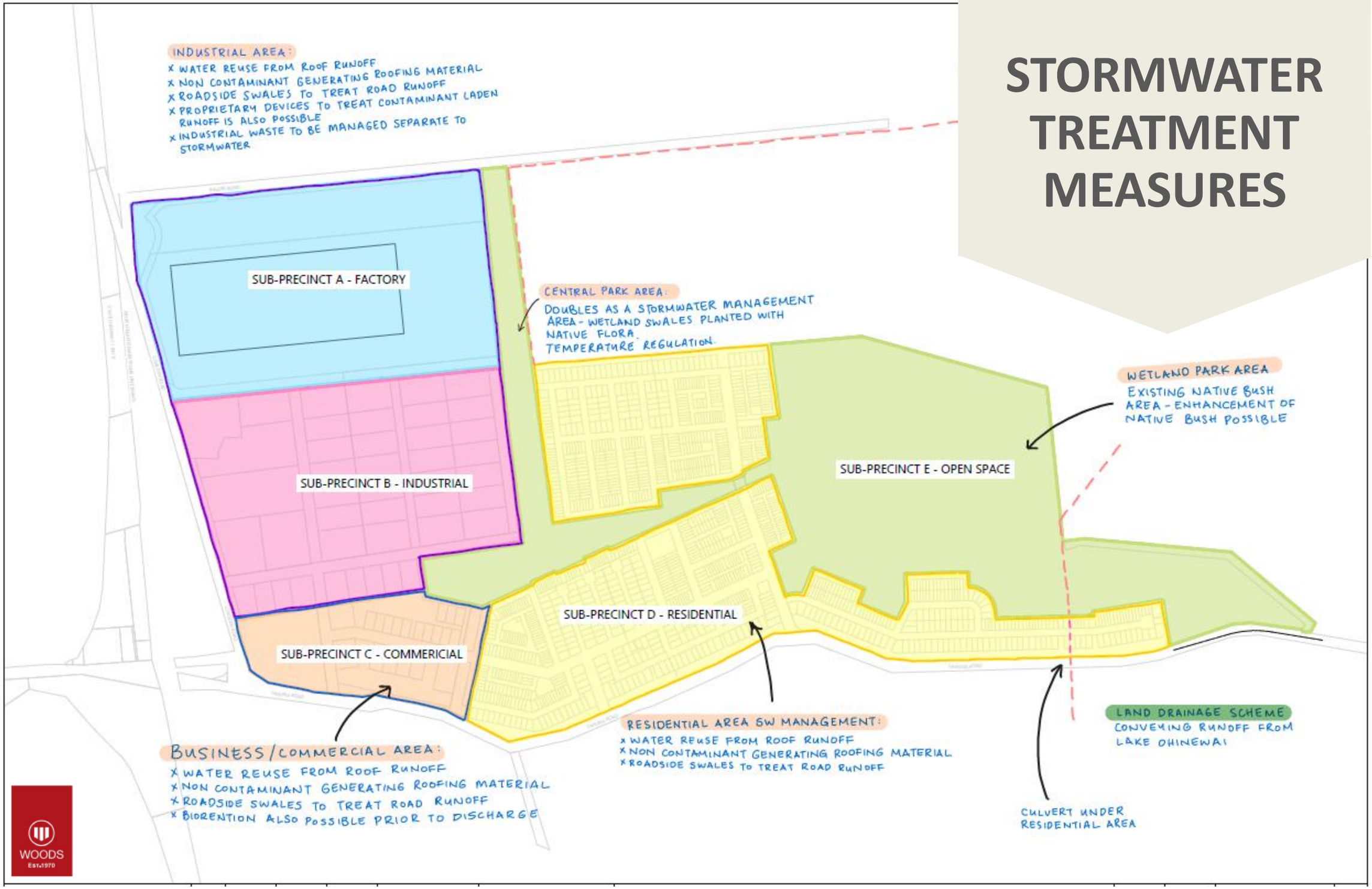


STORMWATER MANAGEMENT ZONES

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

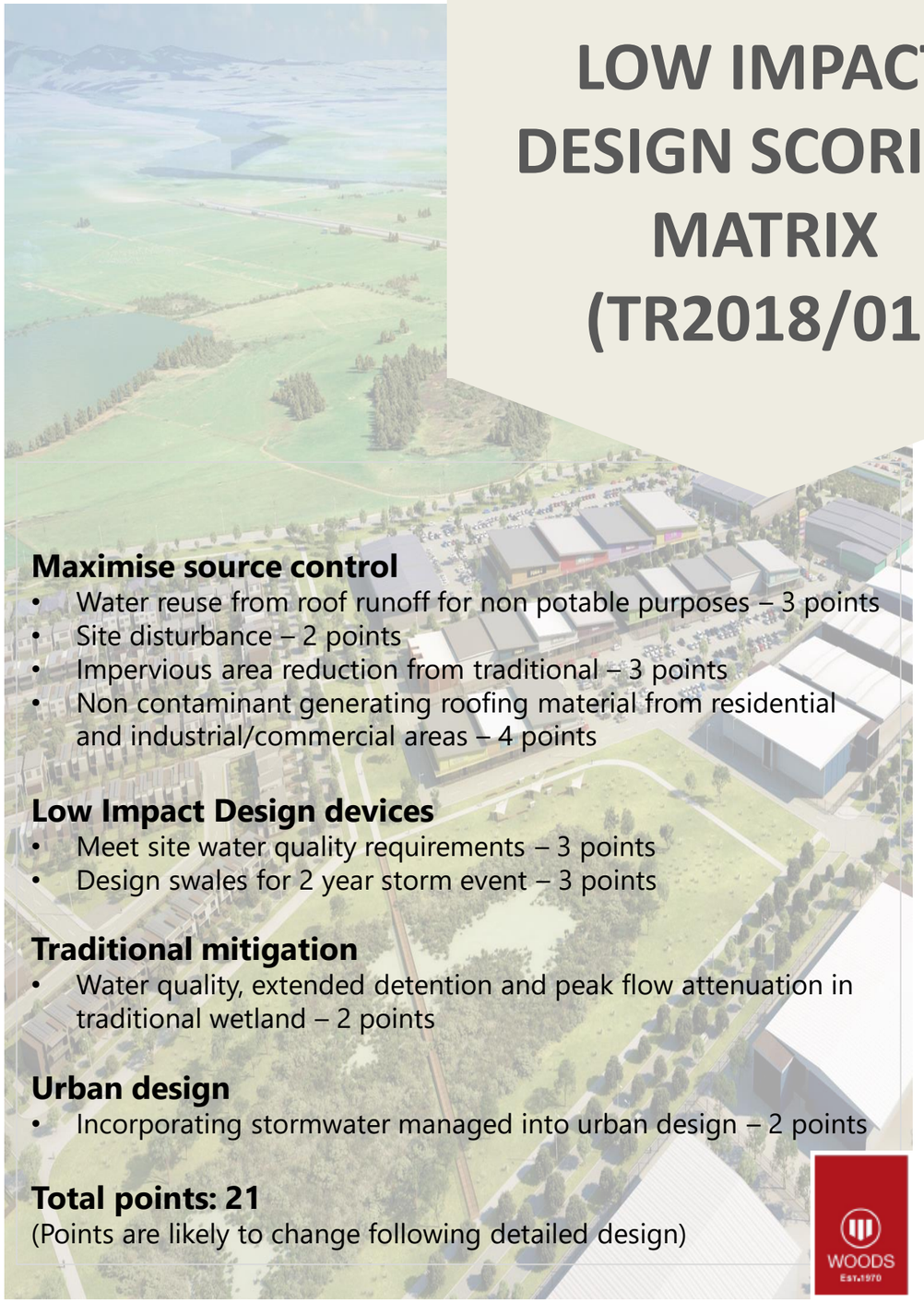
Information contained in the report shall also include a low impact design scoring matrix for which the summation provides an overall score of the design. The scoring is based on Table 6-1 below.

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:

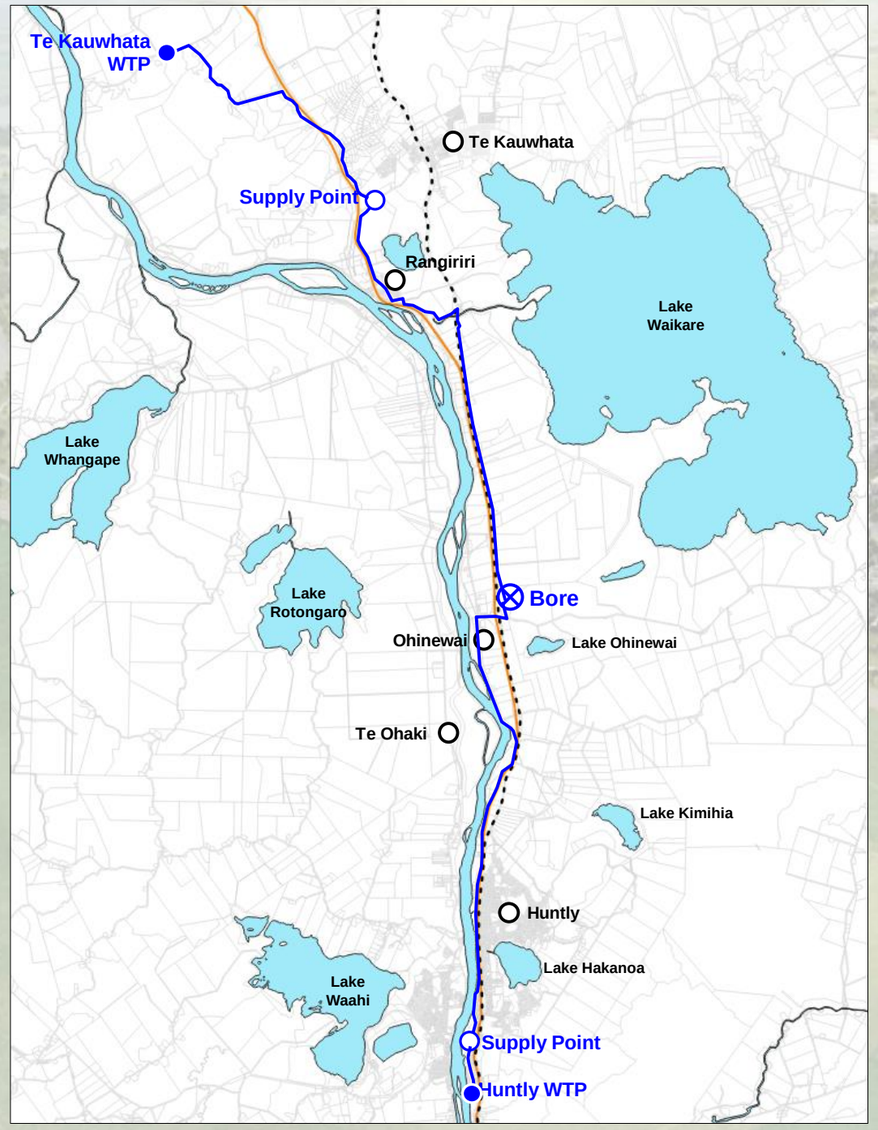
- On-Site or
- Public Infrastructure (WDC)

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

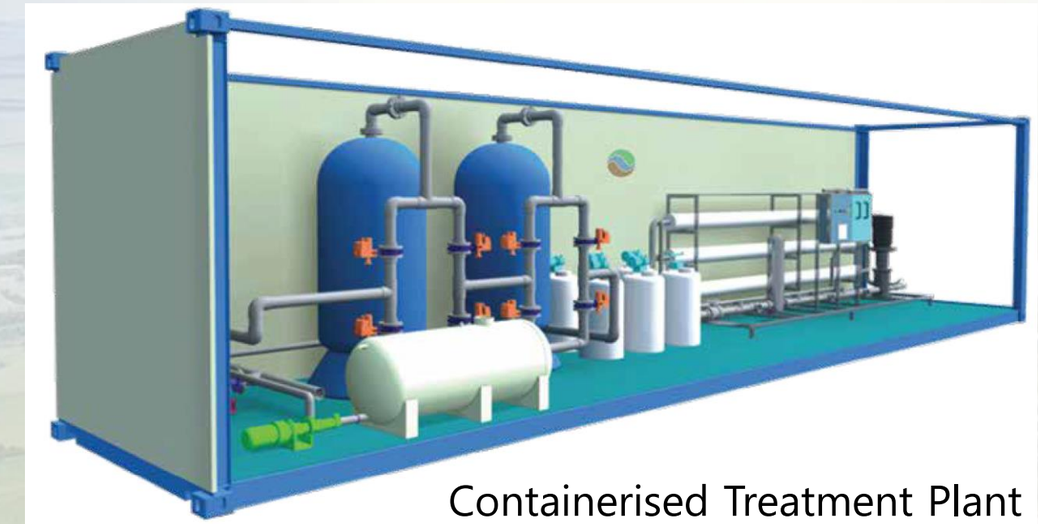
WOODS
Est.1970

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:

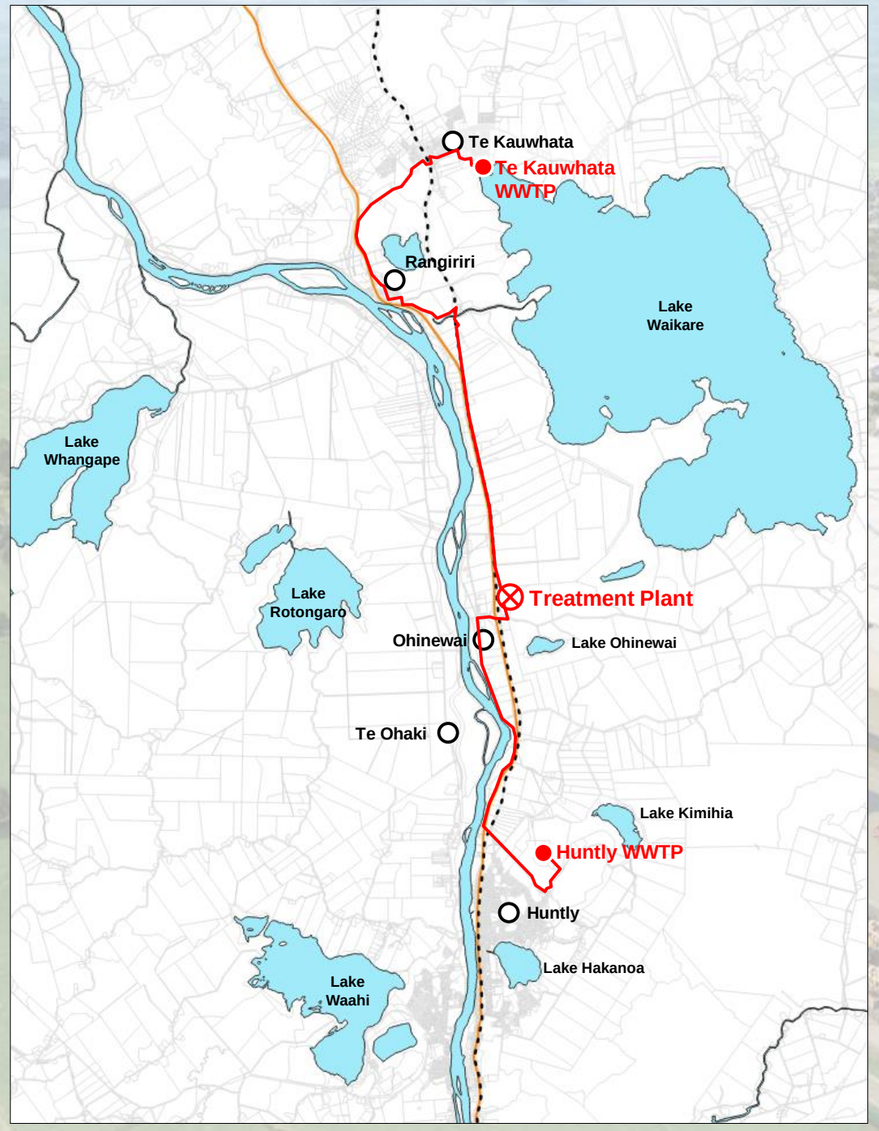
- On-Site or
- Public Infrastructure (WDC)

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

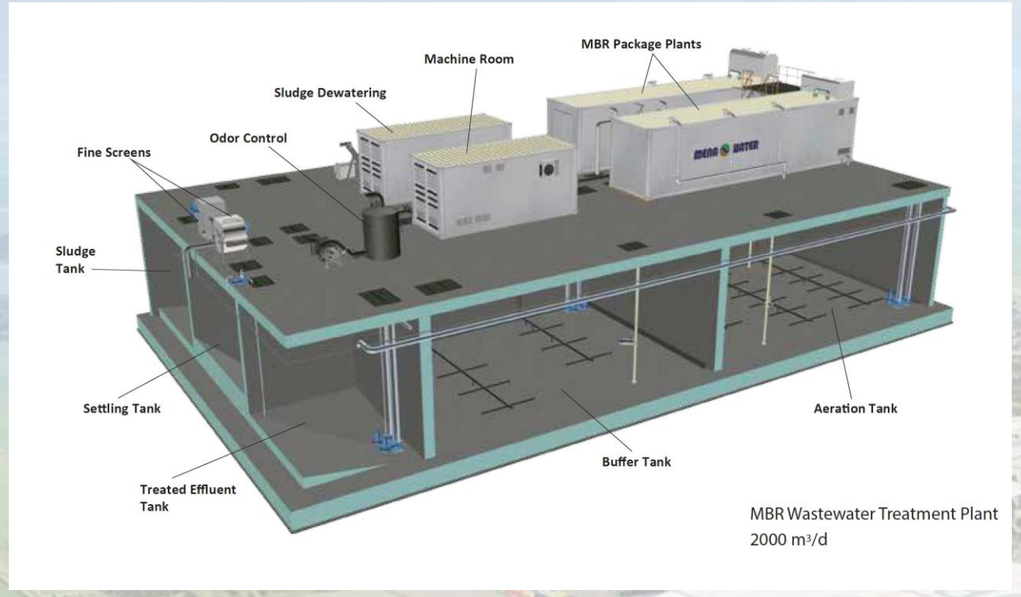
WOODS
Est.1970

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 Strategy Layout Plans

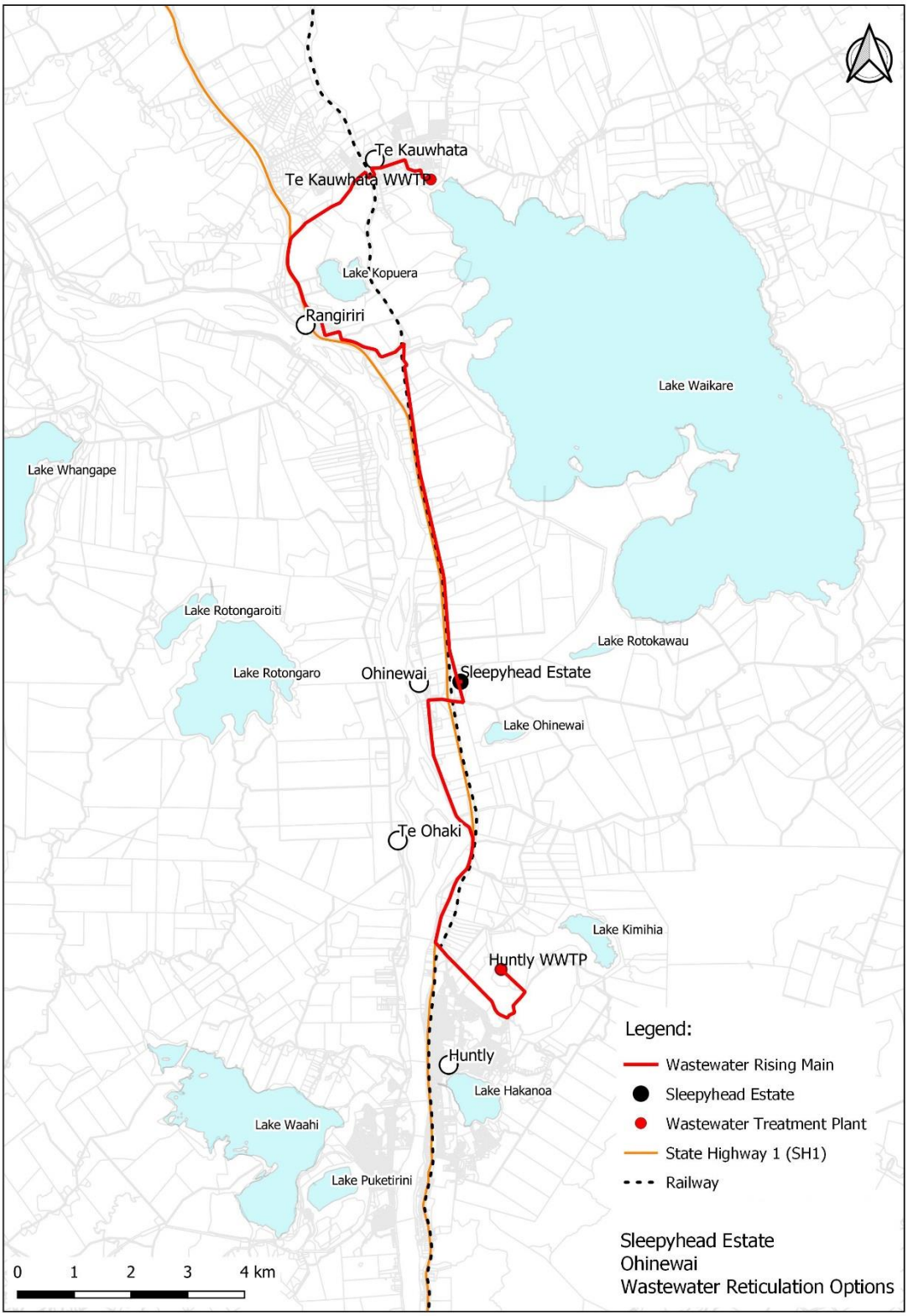


Figure 6: Overall Wastewater Bulk Reticulation Route Options

Figure 7: Strategy 1 - Te Kauwhata Treatment Plant Bulk Reticulation Proposed Route

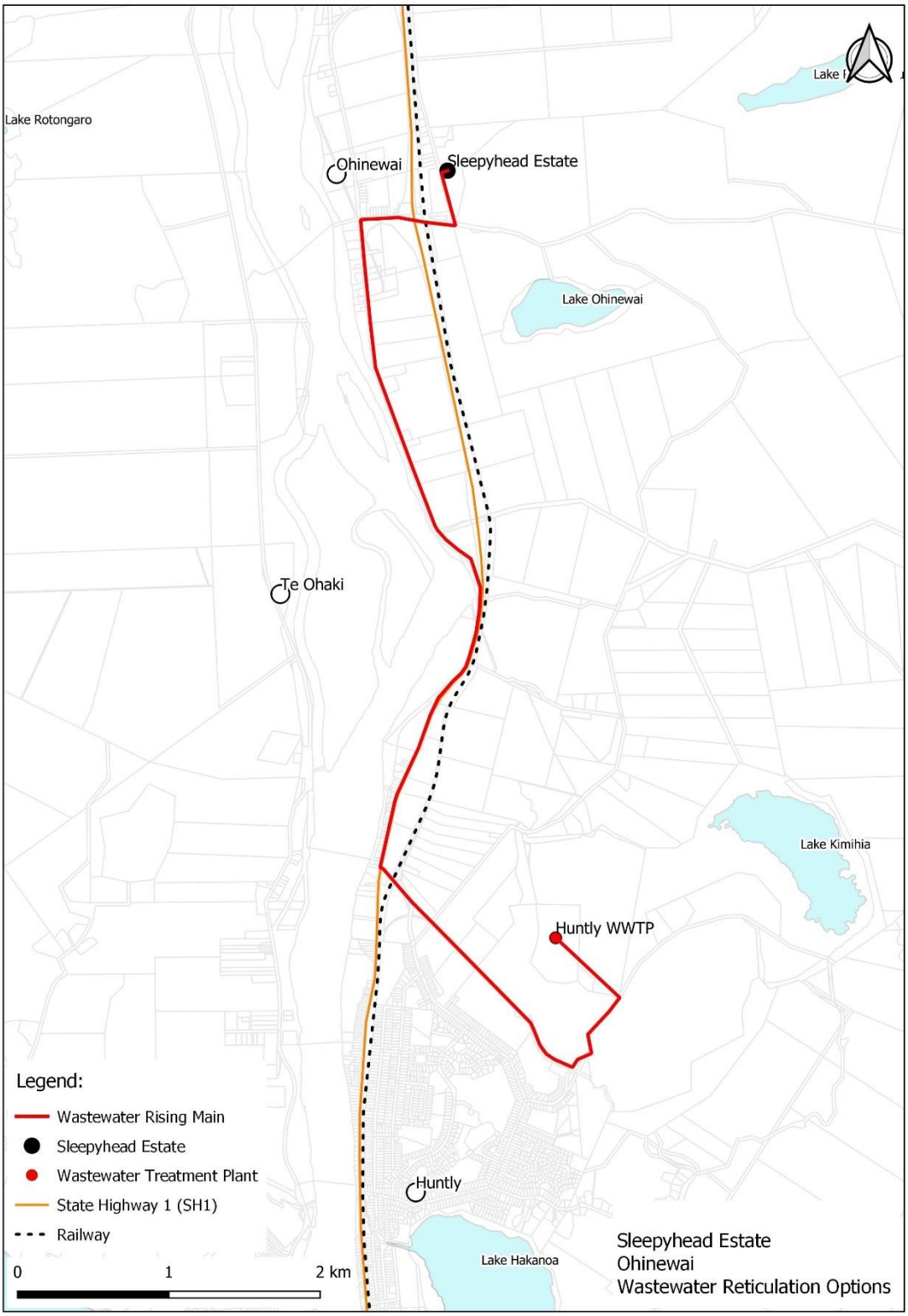


Figure 8: Huntly Treatment Plant Bulk Reticulation Proposed Route

17. Appendix E – Discharge Details

Smith & Loveless NZ Ltd.
Above All Others.

SYSTEM APPLICATION - FAST® WWTP

PROJECT: OAKURA WWTP - NORTHLAND
CLIENT: WHANGAREI DISTRICT COUNCIL
ENGINEER: MWH NZ LTD
EQUIPMENT: **FAST®** WASTEWATER TREATMENT SYSTEM
DATE: JUNE, 2008




System Features

- 1200 EP Peak Summer Design
- 654m^3 Peak Daily Flow
- SFC Automatic Fine Screen
- Submerged Media Reactor with Clarifier
- Tertiary Filter & UV Disinfection
- PLC Control System
- Treated Effluent disposed via surface irrigation

Reference No. 1

Facility Location	Rochester, WA
Start-up Date	September 2008
System Capacity (mgd)	0.1
Number of Membrane Elements	600 plates
Number of Membrane Elements per Unit (Cassette)	200 plates per 200W module 100 plates per 100S module
Number of Membrane Units (Cassettes)	4 modules (2 x 200W, 2 x 100S)
Design Flow Rate (mgd)	0.1
Design Peak Hour Flow Rate (mgd)	0.15
Current Avg. Flow Rate (mgd)	0.033
Design MLSS (mg/L)	10,000
Current Avg. MLSS (mg/L)	10,000
Net Flux at Design Flow (gfd)	11.1
Net Flux at Design Peak Hour Flow (gfd)	16.6

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	5	<3
TSS (mg/L)	5	<3
Total Nitrogen (mg/L)	5	<3
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	350	270
TSS (mg/L)	350	Not measured
TKN (mg/L)	70	Not measured


35
30
25
20

Reference No. 2

Facility Location	Centerville, MA
Start-up Date	April 2009
System Capacity (mgd)	0.022
Number of Membrane Elements	100 plates
Number of Membrane Elements per Unit (Cassette)	100 plates per 100S module
Number of Membrane Units (Cassettes)	1
Design Flow Rate (mgd)	0.022
Design Peak Hour Flow Rate (mgd)	0.033
Current Avg. Flow Rate (mgd)	0.01
Design MLSS (mg/L)	9200
Current Avg. MLSS (mg/L)	9000
Net Flux at Design Flow (gfd)	14.8
Net Flux at Design Peak Hour Flow (gfd)	22

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	30	2
TSS (mg/L)	30	0.5
Total Nitrogen (mg/L)	10	<5
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	350	305
TSS (mg/L)	100	100
TKN (mg/L)	45	38


DANGER
HARD HAT
AREA

Reference No. 3

Facility Location	Calistoga, CA
Start-up Date	May 2009
System Capacity (mgd)	0.01
Number of Membrane Elements	50 plates
Number of Membrane Elements per Unit (Cassette)	50 plates per 50S Module
Number of Membrane Units (Cassettes)	1
Design Flow Rate (mgd)	0.01
Design Peak Hour Flow Rate (mgd)	0.012
Current Avg. Flow Rate (mgd)	0.01
Design MLSS (mg/L)	10,000
Current Avg. MLSS (mg/L)	10,000
Net Flux at Design Flow (gfd)	13.3
Net Flux at Design Peak Hour Flow (gfd)	22

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	5	0.5
TSS (mg/L)	5	3
Total Nitrogen (mg/L)	N/A	N/A
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	7,700	7,700
TSS (mg/L)	1,200	1,200
TKN (mg/L)	Not measured	Not measured

Reference No. 4

Facility Location	Napa, CA
Start-up Date	October 2006
System Capacity (mgd)	0.015
Number of Membrane Elements	100 plates
Number of Membrane Elements per Unit (Cassette)	50 plates per 50S module
Number of Membrane Units (Cassettes)	2 x 50S modules
Design Flow Rate (mgd)	0.015
Design Peak Hour Flow Rate (mgd)	0.022
Current Avg. Flow Rate (mgd)	0.015
Design MLSS (mg/L)	10,435
Current Avg. MLSS (mg/L)	15,000
Net Flux at Design Flow (gfd)	10
Net Flux at Design Peak Hour Flow (gfd)	22

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	4	<4
TSS (mg/L)	3	<3
Total Nitrogen (mg/L)	N/A	N/A
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	7,700	7,700 (low 900, high 12,000)
TSS (mg/L)	1,000	1,000
TKN (mg/L)	Not measured	Not measured

Reference No. 5

Facility Name	Summerwinds/Nautical Club Condos
Facility Location	Indian Beach, NC
Contact Name & Title	Doug Haggett, President (Haggett Engineering)
Telephone Number	910-397-0909
Email Address	Haggettengineeri@bellsouth.net
Start-up Date	Expected November 2010
MBR Model No.	44-01012
System Capacity (mgd)	0.06
Number of Membrane Elements	400 plates
Number of Membrane Elements per Unit (Cassette)	200 plates per 200W module
Number of Membrane Units (Cassettes)	2
Design Flow Rate (mgd)	0.08
Design Peak Hour Flow Rate (mgd)	0.1
Current Avg. Flow Rate (mgd)	Plant not started up
Design MLSS (mg/L)	10,345
Current Avg. MLSS (mg/L)	Plant not started up
Net Flux at Design Flow (gfd)	16.6
Net Flux at Design Peak Hour Flow (gfd)	22

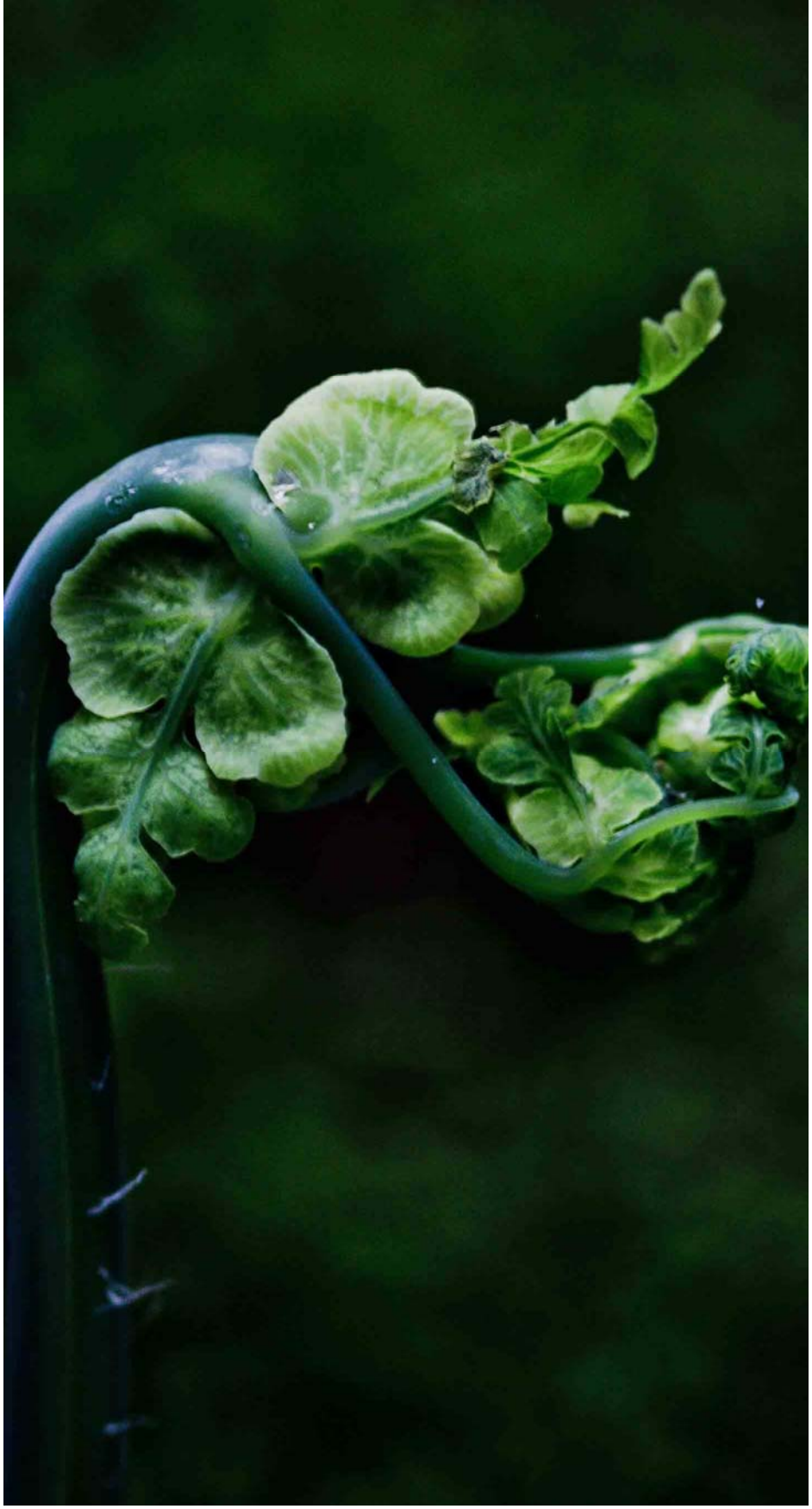
Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	5	Plant not started up
TSS (mg/L)	5	Plant not started up
Total Nitrogen (mg/L)	10	Plant not started up
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	250	Plant not started up
TSS (mg/L)	250	Plant not started up
TKN (mg/L)	45	Plant not started up



Protecting our Natural Environment

MEMBRANE BIOLOGICAL REACTOR PILOT TRIAL AT KANDOS

PILOT TRIAL AT KANDOS

22 MARCH 2017

MID-WESTERN REGIONAL COUNCIL

SELECT YOUR DEPARTMENT.

TOWARDS 2030

Mid-Western Regional Council

THIS DOCUMENT HAS BEEN PREPARED BY VINCE RIDLEY, ENGINEERING OFFICER FOR WATER AND WASTEWATER FOR MID-WESTERN REGIONAL COUNCIL.

ANY QUESTIONS IN RELATION TO THE CONTENT OF THIS DOCUMENT SHOULD BE DIRECTED TO:
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DATE OF PUBLICATION: 22 MARCH 2017

Table of Contents

1. INTRODUCTION

The present sewerage treatment process at Kandos is a traditional Trickling Filter. This involves

- Primary and secondary sedimentation to remove settleable solids
- Trickling Filter media bed for conversion of ammonia to nitrites and nitrates
- Anaerobic digester for the processing of volatile gross solids from the sedimentation phase

Whilst this form of treatment operated effectively as designed, it was unable to meet the changing expectations of society and governing bodies. The Pollution Reduction Program (PRP) gave direction to utilities with respect to the desired levels of pollutants to be achieved. This has led to the development of other forms of treatment such as Activated Sludge and more recently Membrane Bio Reactor (MBR) technology. Pollutant levels achievable for the different processes are outlined in Table 1.

TABLE 1

	RAW SEWER	TRICKLING FILTER	ACTIVATED SLUDGE	TARGET	MBR
BOD – mg/l	350	30	<5	< 10	<5
Amonia – NH4 mg/l	>30		<5	< 2	
Nitrates			<5		
Nitrogen Total – N mg/l	70	35	<10	< 10	< 10*
Total Phosphorus – P mg/l	10	10	<0.5	< 0.5	< 1*
pH - Units	6 - 8	6.5 -8.5	6.5 -8.5	6.5 -8.5	6.7 - 7.3
Suspended Solids – mg/l	350	50	<10	< 10	<1
Oil and Grease – mg/l	<50	10	<2	< 2	<1
Faecal Coliforms – CFU/100ml	Extreme	V.High	Lagoon Disinfection	>2	<0.01*

Note: MBR data supplied by manufacturer

- * TN concentration in effluent can be less than 5 mg/L with proper design of nitrification/denitrification process which is done during detail design of the treatment process. It is also dependent on the acceptable pollutant levels and planned application of treated water.
- * TP concentration in effluent can be reduced to a lower value with addition of chemical phosphorus removal stage which results in precipitation of phosphorus compounds.
- * 99.9999% bacteria and virus rejection by UF membrane (manufacturer's claim)
- Current target levels based on active EPA license's for effluent discharge to sensitive waters.

The Current Situation

The Kandos STP is approaching 50 years of service. Whilst it met the environmental standards at the time it was built it is difficult to consistently achieve the current licence standards. Factors that have contributed to this are:

- Population demographics. The plant was designed for a much larger population. The impact of this is a reduced flow of nutrients which does not adequately feed the nutrient beds. This results in a higher level of nitrogenous based nutrients in the treated effluent.
- The higher levels of nutrients discharged from the plant results in algal growth in the maturation ponds causing pH levels to rise above the license limits of 8.5. This is a significant problem in the summer months.
- To chemically control the growth of algae is problematic and costly.

The summary of water quality discharged from the plant during the period 1/7/2015 and 30/6/2016 is outlined in Table 2.

TABLE 2.

PARAMETER	MEAN RESULT	COMMENT
pH (Units)	9.13	Outside limit of 6.5 - 8.5
Electrical Conductivity uS/cm	1110.83	High
Total Dissolved Solids mg/L	716.42	
Total Suspended Solids @ 105C mg/L	37.83	High <5 preferable
Biochemical Oxygen Demand BOD (mg/02/L)	5.75	<5 preferable
Oil & Grease mg/L	<1	Acceptable
Total Phosphorus – P (mg/L)	2.19	High < 0.5 preferable
Total Nitrogen mg/L N (mg/l)	13.66	High <10 preferable
Faecal Coliforms cols/100ml	3844.92	High <2 preferable
Chlorine – Total Residual mg/L	<0.2	Acceptable

- With the age of the infrastructure approaching 50 years the mechanical and electrical components are nearing the end of their serviceable life with repair and retrofitting costs high.
- Pollution levels. In addition to the high levels of discharge pollutants, the anaerobic processes used in this type of plant produces noticeable levels of air pollution in the form of methane and sulphides gases. These are not pleasant for neighbours such as the adjoining Kandos Golf Course.

The current Trickling Filter plant at Kandos is depicted in Figure 1(a) and 1(b) below.

1(A)

1(B)

2. DISCUSSION

2.1 Looking to the Future

Planning for the future needs in sewerage treatment in Kandos, it became clear we needed to look to technology that will produce an effluent that will meet the environmental standards into the future. The difficulty here is there is no way of knowing what the standards will be. Using historical trends as a guide supports the view that acceptable pollutant levels will continue to be lowered. Therefore in planning the future treatment processes we need to look towards those processes that currently produce effluent quality as far above the current standards as possible while remaining economically viable.

There are two options that need to be considered in planning for the future. These are:

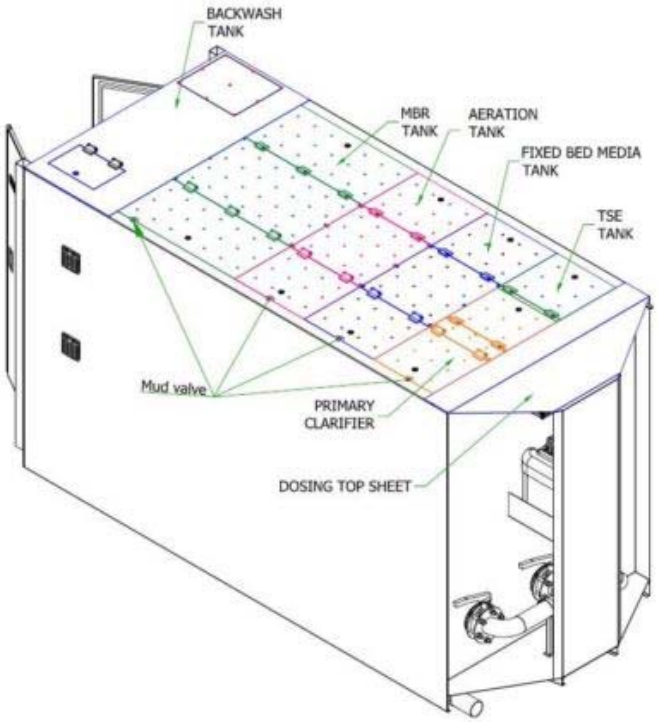
1. Current Activated Sludge Extended Aeration technology in its various forms. This is a proven process that produces effluent that meets the current water quality standards. Higher standards can be achieved by

    - The application of chemical dosing for the removal of certain pollutants.
    - The traditional reliance on maturation ponds for bacterial disinfection and final polishing is problematic given the management issues associated with the algal growth and high pH in the discharge effluent. These are increasingly been replaced with UV treatment or chemical treatment with chlorine.

As the acceptable pollutant levels become lower these processes will require further advanced treatment such as filtration to achieve the required results.

2. Membrane Bio-Reactor

A membrane bio-reactor (MBR) is a wastewater treatment process combining membrane filtration with biological activated sludge treatment. Whilst this technology is not used extensively in Australia for sewerage treatment it has been used worldwide for the past ten years. Membrane Technology has been used in potable water production in Australia since 2000. The basic components are displayed in the Isometric View below.

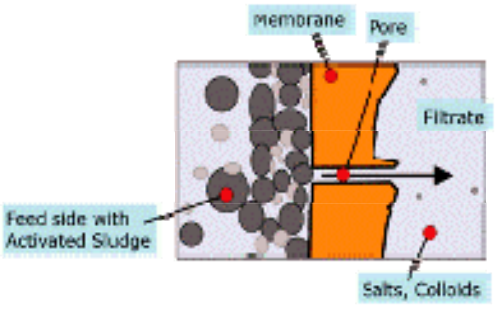


Plant Isometric View

This innovative technology offers several advantages over the conventionally activated sludge process. Among these advantages are higher biomass concentration, eliminating the need for secondary clarifiers and improved effluent quality.

The MBR process transforms sewage to clear and high quality water. The small footprint of the treatment technology enables the systems to be integrated in existing surroundings and to treat wastewater for other uses.

FIGURE 2



The Membrane system has the core technology inside the MBR which consists of polypropylene plates with a polymeric membrane on each side. The membrane is welded on rigid frame. The module reduces virus and bacteria by 99.9999% (manufacturer's claim). Filter plates are continuously aerated through bubble diffusers to keep them clean. The membranes don't require regular chemical cleaning except one or two maintenance cleanings per year. **Figure 2** above shows a diagramatic representation of the filtration process.

2.2 The Trial

The trial commenced on late November 2016. To prepare the unit for operation the following works were carried out after positioning the unit on site at Kandos STP.

- Temporary power connected to the unit.
- A small submersible pump was installed in the primary sedimentation tank of the STP to transfer raw sewerage to the MBR plant
- An effluent pipe connection returned the treated water back to the head of works at the STP
- Lay flat hoses were fitted to the sludge discharge valves of the MBR plant. These transferred Waste Activated Sludge (WAS) to the sludge drying beds of the STP.

FIG 2 THE MBR PLANT

Early Problems: The MBR Plant being a prototype was not without its commissioning problems. These, whilst only minor, required some time and thought to rectify. The treatment of sewerage commenced early December 2016. The early results, although encouraging, were hampered by the fact we could not maintain a satisfactory level of activated sludge in the bio-reactor. It in turn led to fouling of the membranes and the subsequent shut down of the unit from high trans membrane pressure. By the 20th December 2016 it was decided to shut down the plant and resume in the new year. The data for this period is seen in Table 3.

TABLE 3

DATE	TEMP DEG C	PH	FLOW RATE (L/MIN	TOTAL DAILY KL	MEMBRANE PRESSURE (MBAR)	AMMONIA (NH4) MG/L	NITRATES (NO3) MG/L	PHOS (P) MG/L	SETTLE ABILITY (MM)
					TESTED RAW SEWERAGE LEVELS	26.3	0.07	5.78	
1/12/2016	22.5	7.25	18.1	19	-1	0.034	20.6	0.35	800
2/12/2016	21.2	7.15	18.2	8	-2	0.035	21.1	0.35	860
6/12/2016	26.5	7.3	18.4	8	-10				275
7/12/2016	21.5	7.1	18.1	11	-4	0.073	19.7	0.8	800
8/12/2016	24.2	7.1	18.5	13	-5	0.027	23.4	1.42	860
9/12/2016	20.5	7	18.1	21	-9	0.007	19.1	1.64	850
12/12/2016	23.1	7.1	16.6	19	-14	0.294	20.6	1.9	500
13/12/2016	21	7.3	16.7	19	-24	0.051	20.5	2.08	300
14/12/2016	19.9		16.6	19	-16				270
15/12/2016	22.5	7.6	17.1	15	-18	0.042		2.5	250
17/12/2016			16.7	14	-47				280
19/12/2016	20	7.5	16.7	18	-59	0.102	20.9	2.02	280
20/12/2016		7.6	16.9	16	-74				200
21/12/2016	21.1	7.7	16.7	19	-97	0.04	22.6	2.03	170
22/12/2016	21.3	7.5	16.8	19	-80	0.058	23	2.03	160

Observations and Notes

- We achieved excellent conversion of ammonia to nitrates.
- A 69% reduction in phosphorus without chemical dosing.
- The settled levels of activated sludge (MLSS) indicated a loss of activated sludge.
- As we lost the sludge the trans-membrane pressure increased to unacceptable levels. This was due to fouling of the membranes
- Trial was put on hold over Christmas to investigate problems with loss of MLSS

NOTE: The trial unit was not equipped with an anoxic tank in which denitrification occurs in a permanent plant. Hence the high readings for nitrates. The addition of a de-nitrification chamber and Dissolved Oxygen (DO) control would achieve de-nitrification.

2.3 Resumption of Trial

The trial was resumed on January 19th 2017. We discovered the loss of MLSS was due to it being carried over the overflow weir by foam that accumulated in the membrane tank. The overflow in this tank was sealed off to prevent any further loss. Once done the MBR plant then operated in a more consistent pattern. The data below in Table 4 demonstrates this.

TABLE 4:

Kandos STP MBR Trial																					
Nov-16			Temp	Flow Rate	Total Treated Effluent	Cycle Intervals	Pressure during filtration	Pressure during filtration pause	Ammonia	Nitrites	Nitrates	Total Nitrogen	Total Phosphorus	pH	BOD	SS	MLSS	Conduct	E.coli	Total Coliforms	Oil & Grease	Settleabiity mm in 30 mins
			Deg C	l/min	kL	mins	mBar	mBar	mg/l	mg/l	mg/l	mg/l	mg/l	units	mg/l	mg/l	mg/l				mg/l	
Date	Operator	Time	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily								
30/11/2016	ALS Lab	Raw Sewer							26.3	0.07	0.07	35	5.78	7.6	96	141		1780	15000000	15000000	13	
01/12/2016	ALS Lab	12.00				10/2			0.08	0.24	21.6	23.7	0.38	7.7	<2	<1		1550		17?	<2	
14/12/2016	ALS Lab					10/2			<0.01	<0.01	22.4	25.6	3.45	7.6	<2	2		1390	<1	<1	<2	
18/01/2017	ALS Lab									0.06	22.4	23.8	1.72	7.5	COD 20				<1	<1	<2	
19/01/2017	JJ	1.00	24.6	18.2	23	10/2	-2	45	-0.023		20.1		1.91	7.5								670
20/01/2017	JJ	10.00	24.2	18.1	20	10/2	-2		-0.008		20.06		2.03	7.5								
21/01/2017	JJ	9.30	23.1	18.1	21	10/2	-4		0.072		20		2.24	7.4								
22/01/2017	JJ	9.30	22.8	18.2	21	10/2	-5		0.111		23.1		2.09	7.6								
23/01/2017	JJ	9.45	21.7	18.6	21	10/2	-4	43	0.014		21.7		2.12	7.6			3630					800
24/01/2017	JJ	1.00pm		18		10/2	-1	45	-0.012		22.7		2.66				3860					
24/01/2017	ALS								0.05	0.04	29.2	29.6	3.24	7.4	COD 18	3		1200	<1	<1	<2	795
25/01/2017	JJ	11.00		18.1	21	10/2	-4	44	-0.034		24.1		2.17				4500					
30/01/2017	KM	8.00	23.1	18.1	21	10/2	-5	45	0.01		29.1		2.58	7.1								860
31/01/2017	km	11.00	24.3	18	21	10/2	-5	45	0.019		25.2		2.49	7.1								890
01/02/2017	KM	7.45	24.1	18	21	10/2	-6	45	0.073				2.59	7.1								900
04/02/2017						10/2			0.027		24.4		2.51	7.2								940
05/02/2017						10/2			0.03		24.6		2.47	7.1								940
06/02/2017	kev	9.00	24.2	18.1	21	10/2	-7	44	-0.031		24.2		2.44	7.1			6060					940
07/02/2017	VR	1.00	23.1	18	21	10/2	-6	44	0.021		high		2.15	7.3								940
08/02/2017			23.8	18.1	21	10/2	-9		0.039				2.8	7.2								940
09/02/2017			23.9	18	21	10/2	-12		0.039		26.8		2.8	7.3								930
10/02/2017			23.9	18.1	21	10/2	-12		0.028		26.9		2.78	7.2								930
11/02/2017	KM	8.00	23.1	18.1	21	10/2	-15	45	0.01				2.58									860
12/02/2017	km	11.00	24.3	18	21	10/2	-16	45					2.49									940
13/02/2017	KM	7.45	24.6	18	21	10/2	-19	45	0.019		26.1		2.59	7.1			5890					920
14/02/2017	KM	9.30		18.1	21	10/2	-21	45	0.025		25.2			7.1								920
15/02/2017	ALS Lab								0.03	0.02	24.6	25.4	3.49	7.3	<2	<1		1020	<2	<2	<2	
17/02/2017	KM	9	25.1	18	21	10/2	-28	44	-0.34		23.2		3	7.1			7050					960
21/02/2017	KM	7.45		21.5	17.6	10/2	-40	44	0.022		23.8		2.62	7.1			7550					980
22/02/2017	KM	9.30		22.5	18.7	10/2	-40	44	0.003		24.6		2.56	7.1								980
23/02/2017	KM	9.30		23.4	18.7	10/2	-42	44	0.028		22			7.2								980
24/02/2017	KM	9.00			18.7	10/2	-45	45	0.026		27.4											980
27/02/2017	KM	2pm		24.4	18.7	10/2	-54	43	0.021		25.6			6.9								980
28/02/2017	KM	10.30		23	18.7	10/2	-53	44	0.015		24.4			7								980
01/03/2017	KM	9.30		23.2	18.8	10/2	-60	45	0.09		24.6			7								960
02/03/2017	KM	10.00		23.6	18	10/2	-68	45	0.004		20.2		2.55	7.5			7130					960
03/03/2017				17.4	16	10/2	-57	45						7.54			4760					940
06/03/2017				17.4		10/2	-53	45	0.093		22.2			7.5			4170					900
07/03/2017	KM	9.00	22.6	17.4	10	10/2	-52	46	0.022		20.9			7.5								910
08/03/2017	KM	9.30	21.5	17.4	10	10/2	-56	45	0.28		23.8			7.4								910
Average			23.51	19	19		-25	45	0.02	0.09	23.85	25.62	2.47	7.29	<2	<2	5460	1290	<2	<2	<2	918

Observations and Notes

- Membrane pressure is following a normal trend.
- Settleability and sludge build up indicated the process is healthy and operating as expected. The average Mixed Liquor Suspended Solids (MLSS) was 5460 mg/l
- Flow rate and total daily production are constant.
- The trial plant achieved excellent conversion of ammonia with an average residual NH4 of 0.02 mg/l
- The plant achieved a reduction in phosphorus without the use of chemicals from 5.78 mg/l to 2.49 mg/l. This equates to a 57% reduction

Note: Chemical dosing for phosphorus (P) removal would lower the P levels further to very low levels

2.4 Independent Testing

Periodically samples were sent to Analytical Laboratory Services (ALS) for independent analysis. The results for the key parameters as shown in Table 5.

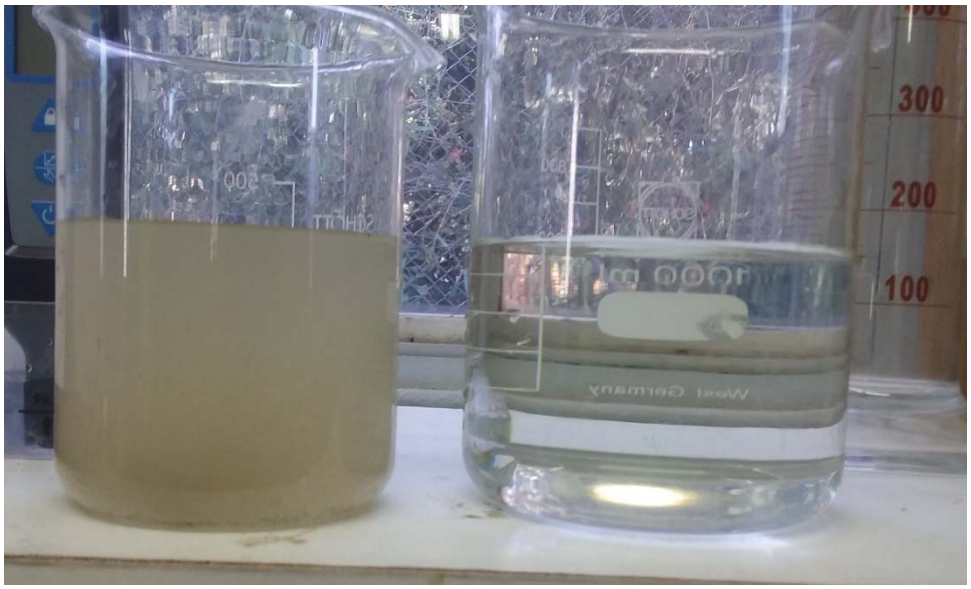
TABLE 5:

Date	Ammonia mg/l N	Nitrites mg/l N	Nitrates mg/l N	Total Nitrogen	Total Phosphorus mg/l P	pH	BOD mg/l	Suspended Solids mg/l	E.coli	Total Coliforms	Oil & Grease mg/l
Raw	26.3	0.07	0.07	35	5.78	7.6	96	141	15000000	15000000	13
Treated											
30/11/2016	0.08	0.24	21.6	23.7	0.38	7.7	<2	<1	17?	17?	<2
05/12/2016	<0.01	<0.01	22.4	25.6	3.45	7.6	<2	2	<1	<1	<2
14/12/2016	<0.01	<0.01	22.4	25.6	3.45	7.6	<2	2	<1	<1	<2
18/12/2016	0.24	0.06	22.4	23.8	1.72	7.5	COD 20	<1	<1	<1	<2
24/01/2017	0.05	0.04	29.2	29.6	3.24	7.4	COD 18	3	<1	<1	<2
15/02/2017	0.03	0.02	24.5	25.4	3.49	7.3	<2	<1	<2	<2	<2

Observations and Notes

- The laboratory results validated the onsite data with respect to the conversion of ammonia and the reduction in phosphorus.
- The results demonstrate the MBR process achieves high effluent quality with respect to BOD, total and faecal coliforms and removal of oil and grease.
- The suspended solids would normally be <1mg/l. The readings of 2 were the result of membrane fouling as explained above. The reading of 3 was in the sample collected the second day after the three week shutdown over Christmas. It is believed film build up in the treated water tank and the discharge pipe caused this reading.
- The effluent quality achieved is perhaps best demonstrated in the photograph taken of the raw sewerage and treated effluent – see Fig 3 below.

FIGURE 3. RAW SEWERAGE AND TREATED WATER QUALITY



2.5 Costing

Table 6 summarises the budget estimates for a 1 mega-litre plant that would accommodate the needs of Kandos. A smaller plant with a 0.5ML capacity could be utilised however wet weather flows would need to be managed more closely.

Note: A comprehensive proposal would need to be prepared for the specific sites if the application of this technology is to be considered further.

TABLE 6: COSTING

ITEM	Notes	
MBR Plant		1 x MR 1000
Plant Capacity (average daily flow m3/day		1000
Filter Model		siClaro FM6163
Number of Filter Modules		1 x 6
Filtration Area (m2)		2025
Daily energy consumption kWh/day	1	1400
Electricity cost per day @ $0.20 c/kWh	6	$280.00
Electricity cost per Year	6	$102,200
Chemical consumption for CIP (l/year)	2 & 4	4,200
Chemical consumption for disinfection (l/year)	1, 3 &4	7690
Plant Area Length x Width (m)		26 x 8
Estimated Cost (M&E)		$3,000,000
Estimated Cost (Civil)	7	$2,500,000
Installation, Commissioning & Project Management		$450,000
Total Cost (Ex GST)		$5,950,000
Cost of Membrane Replacement (Ex GST)	5 & 8	$243,000

NOTES	
Plant Operating at full capacity	1
Teo CIP cleans per year	2
3 mg/l dosage	3
NaOCl @ 12.5% solution	4
After 5 years and replacing the entire module.	5
Average cost of power at 20c/kWh (A$)	6
This can be reduced significantly if current infrastructure modified to accommodate new plant components	7
Membranes have a typical Life of 10 years. Not all modules have to be replaced at the same time. 5 Years stated in **Point 5** is the guaranteed life of the menbranes.	8

3. CONCLUSION

Membrane Biological Reactor (MBR) technology is at the cutting edge in sewerage treatment technology. The trial at Kandos Sewer Treatment Plant has demonstrated the MBR process produces effluent quality that can meet current EPA standards for release to sensitive waters. The demonstrated ability to reduce microbial pathogens indicate the treated effluent is also suitable for recycled water schemes. Further investigation could be carried out to validate this.

At Kandos the demonstrated water quality outcomes would negate the need for the old tertiary ponds which have proved difficult to manage. These could be closed off to the environment and utilised as a detention basin in the event of excessive wet weather or equipment failure.

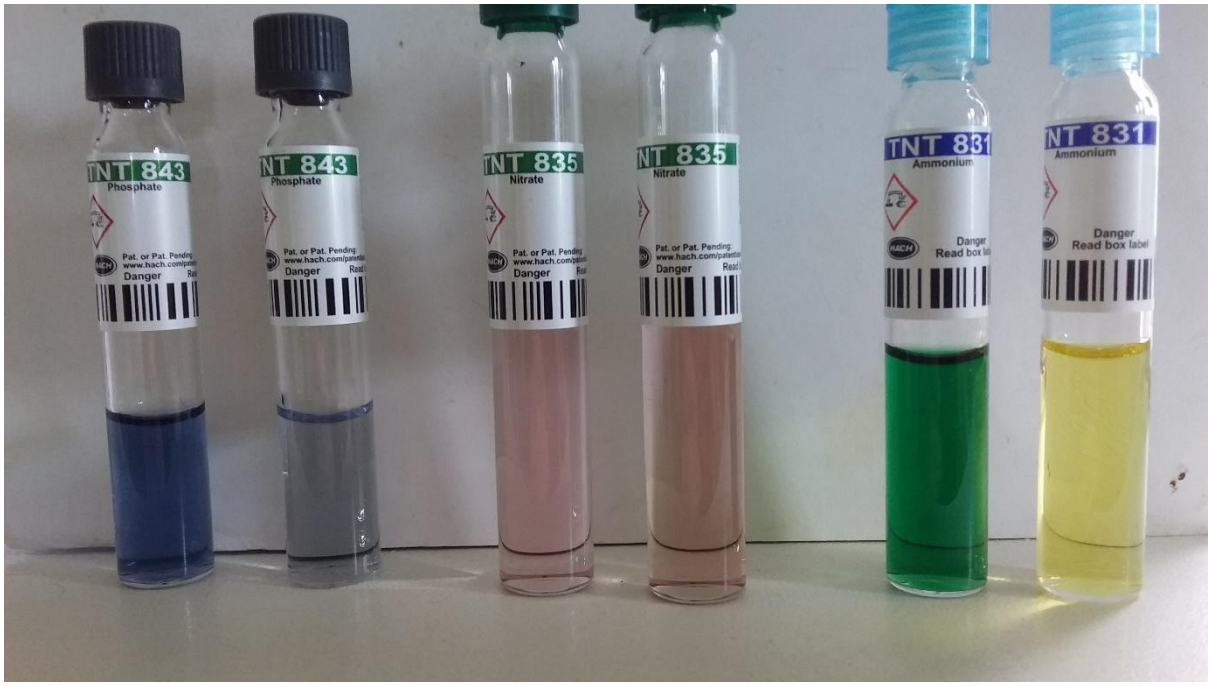
Waste Water Treatment Technology

Stewart & Cavalier Ltd are excited about the opportunity to offer new treatment process technology into the New Zealand market.

Late last year, representatives from Stewart & Cavalier were invited to view a Mena Water pilot plant treatment package in Kandos, in the Mid Western Regional Council area, in Australia.

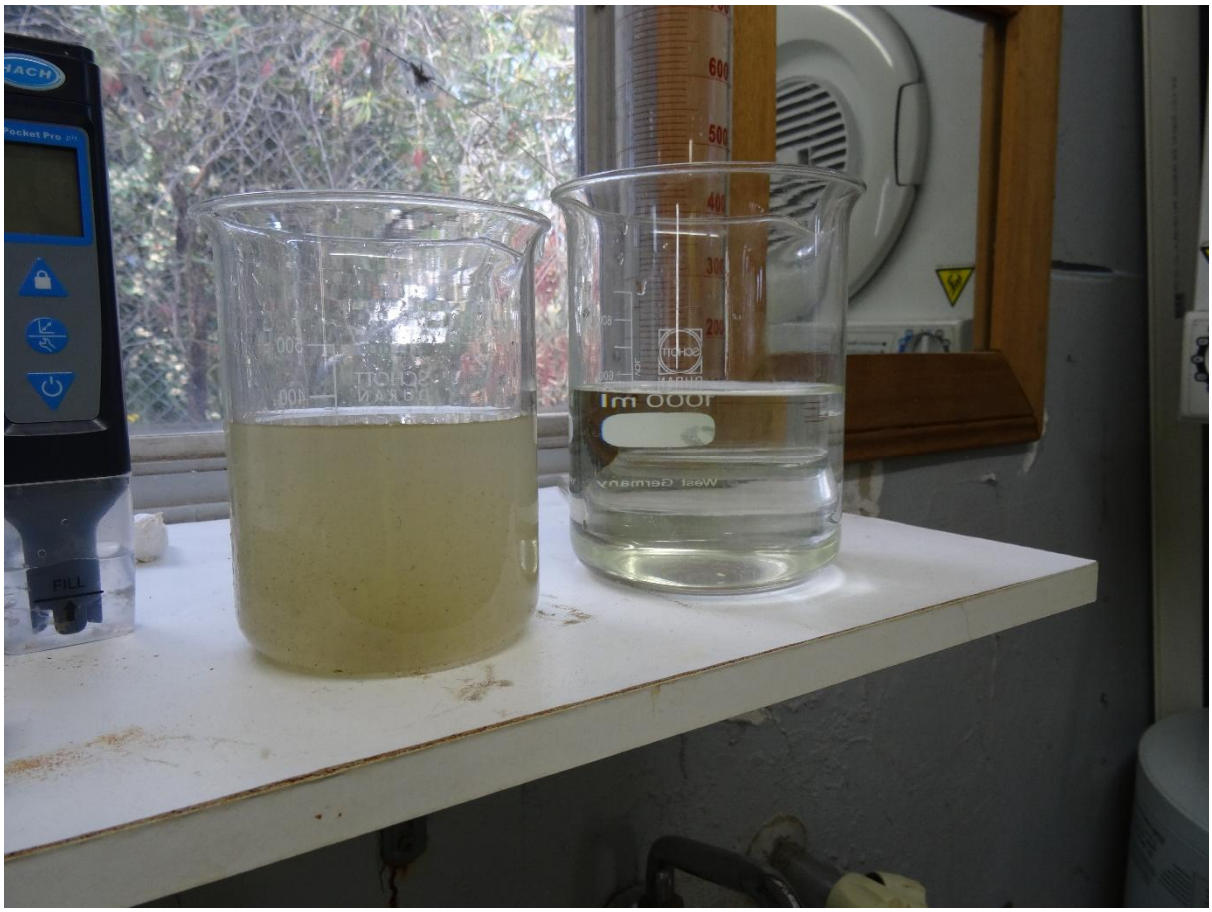
We met with Senior Plant Operator Vincent Ridley who is conducting plant trials to complete a case study on the Membrane Bio-Reactor (MBR) treatment process for local council. We were fortunate enough to spend the good part of the day with someone who clearly has a passion and vast amounts of experience with WWTP's. It takes a special breed to work at the smelly end of town!

With only a few days of operation, testing produced very encouraging results. A significant increase in reduction of Phosphate and Ammonia were apparent immediately, when compared with the outflow of a conventional trickling filter process arrangement that Kandos WWTP currently adopts, the same process that is traditionally used in the majority of cities and towns throughout New Zealand. The initial tests also showed similar reductions in Nitrate, while this may be seen as a dissimilar result, it needs to be remembered that there is no denitrification consideration engineered into the trial plant that would normally be a part of a full MBR treatment package.



While it needs to be remembered where it came from, you could be excused for thinking you could drink the sample on the right. In reality, because of the nature of the location, cross contamination is feasible, but in actual fact the clear sample outflow from the MBR membrane system is microbiologically safe to drink!

Additionally, many plants these days use ultraviolet light to further disinfect the outflow, you can imagine the difficulty of trying to shine light through the sample on the left compared to the sample on the right, a terminology known as effluent UV transmissivity.



For simplicity, the pilot plant is mounted on a trailer, allowing ease of transport and is fully self-contained. A larger plant would be fully automated, and have the option of subterranean process tanks, further reducing the occupation of above ground space.

The Mena Water systems are modular by design, making the installation of pre-engineered packages contained in ISO shipping containers simple and cost effective, remote, fully automated, self-contained systems are very much a reality, ranging from small settlements to cities with large populations.

With an expanding population, real estate is and will become more and more precious. Traditionally, large land areas go hand in hand with conventional Waste Water Treatment Plants. Not anymore, we even have a client who is considering a completely underground installation!

Wherever there is a population base, a waste stream needs to be considered, and treated. Traditionally with these conventional facilities comes unpleasant odour, it goes with the territory. With an MBR system continual aeration is part of the process, one of the first things you will notice from an MBR plant is the distinct lack of smell! Additionally, where systems are required to be completely odour free, because the process is contained, odour control packages can be used, you could literally live next to one of these plants and never smell a thing!

It is really exciting to appreciate that 10 of these...

Could treat the average daily flow for one of these…

Many of the treatment plants in NZ, and Australia alike, are significant in age, when they were constructed they were built to meet the demands of the environment. Nowadays effluent discharge quality is very topical, and these conventional plants struggle to meet the ever increasing demands of effluent discharge quality.

Maybe on the lighter side…

There were constant reminders we were out of territory, we were subject to the odd sheep joke, but we have come to expect that! Further reminders we were away from NZ were the temperature and fly population, oh and you won't find one of these at a WWTP in New Zealand any time soon (hopefully).

18. Appendix F – Delivery Infrastructure Details

Smith & Loveless, Inc.

14040 Santa Fe Trail Dr.
Lenexa, KS 66215-1284
Phone: (913) 888-5201
Fax: (913) 888-2173

EVERLAST™

EVERLAST™ Budget Proposal:

EVERLAST™ Series 3000
Wet Well Mounted Pump Station
Ohinewai Sewage Pump Station
S&L Proposal #29322
27 August 2019

Prepared For:

Woods

Represented by:

Smith & Loveless NZ

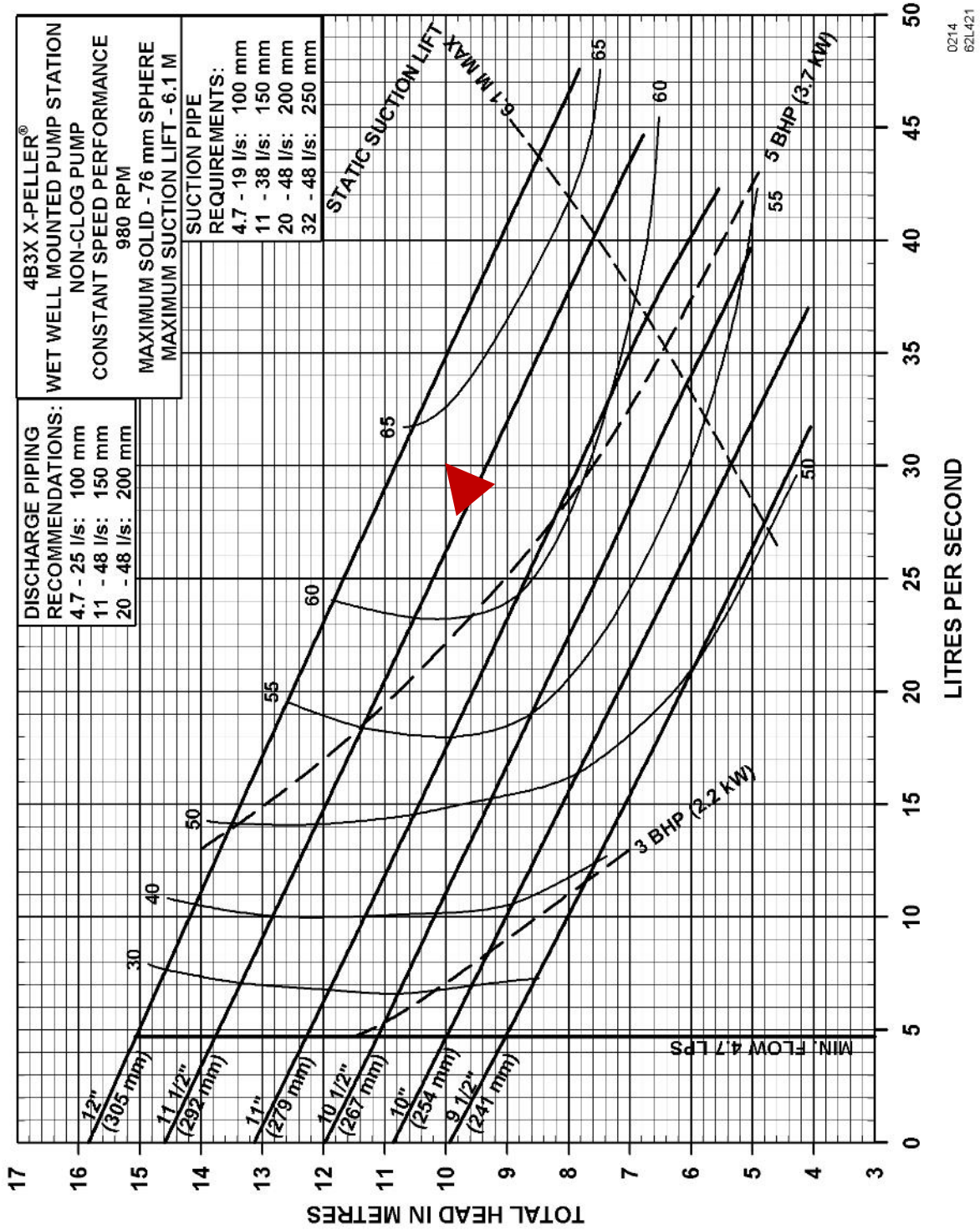
Proposal Table of Contents

Proposal Introduction

Smith & Loveless, Inc., having an office at 14040 Santa Fe Trail Drive, Lenexa, Kansas 66215 (hereinafter referred to as “Seller”), hereby agrees to sell to the buyer designated below (hereinafter referred to as “Buyer”), the following equipment subject to all of the provisions set forth in this Sales Agreement. The Sales Representative is not an agent or employee of Seller and is not authorized to enter into any agreement on Seller’s behalf or bind Seller in any way.

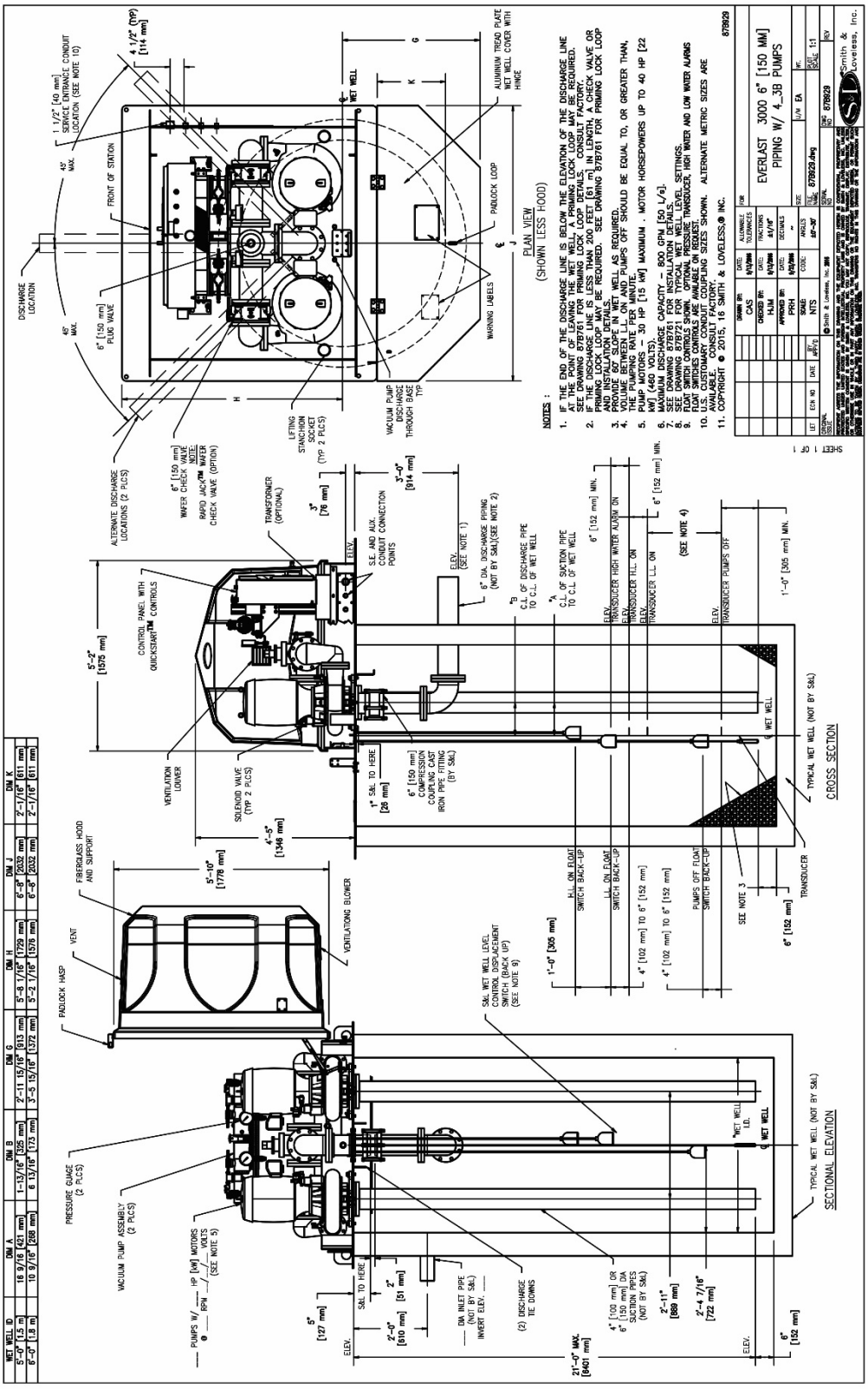
The information contained herein is considered proprietary and confidential. It is not to be released without prior written permission from Smith & Loveless, Inc.

Pump Curve

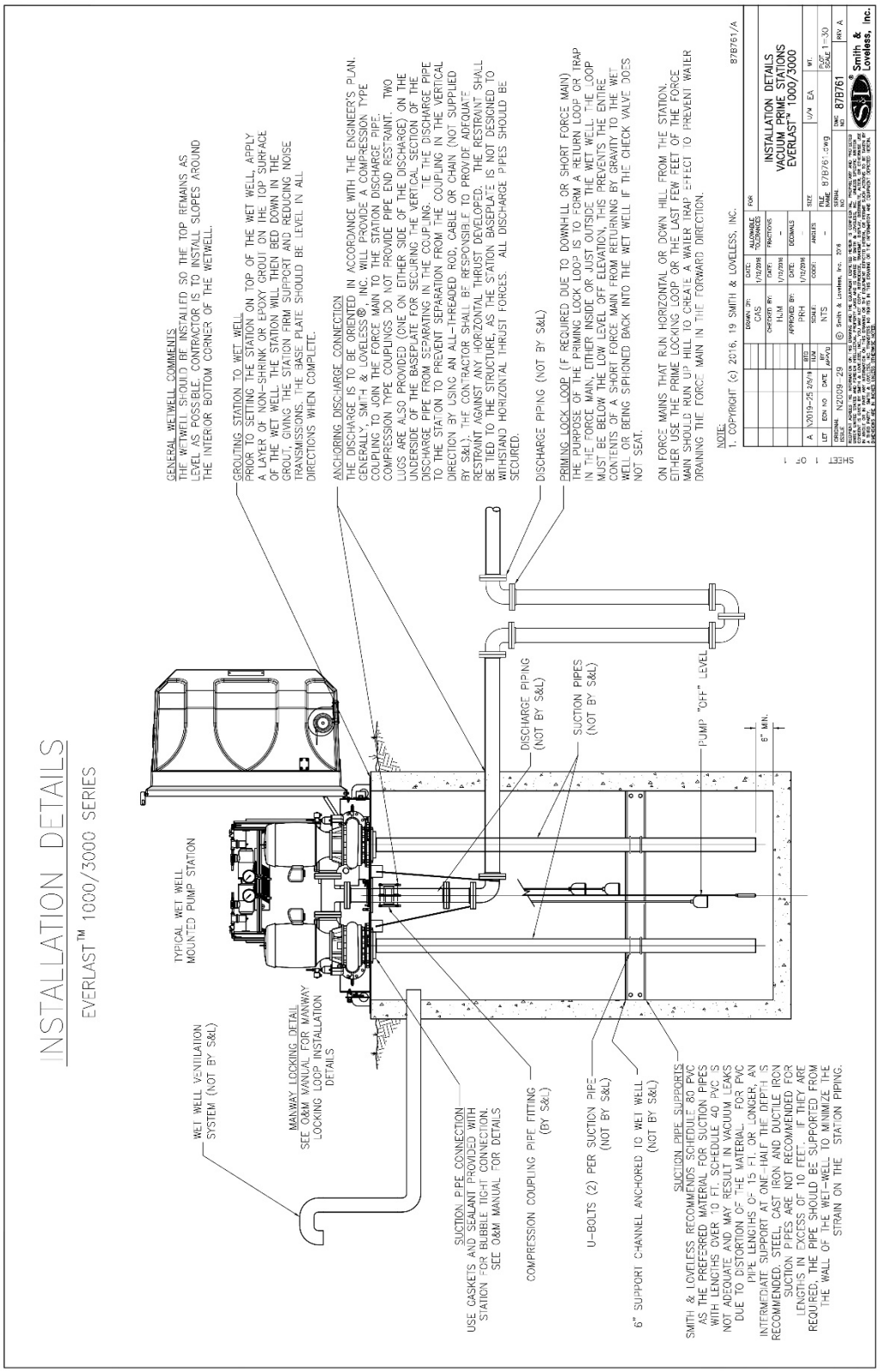


Design Conditions: 30 lps @ 10 m TDH

Station Outline Drawing



Installation Details Drawing



Online: smithandloveless.com • Phone: 913.888.5201 • FAX: 913.888.2173

EVERLAST™ Series 3000 Overview:

EVERLAST™ **SERIES 3000**

Tip-Up Enclosure

12.7 mm Baseplate

QUICKSMART™ Controls

System Model:	**EVERLAST™** Series 3000
Wet Well Diameter:	1.83 m
Discharge / Suction Piping:	150 mm with compression coupling
Static Suction Lift:	6.1 m
No. of Pumps:	2
Pump Size:	100 mm
Pump Model:	4B3X*1
Design Conditions:	30 lps @ 10 m TDH
Pump Power:	5.6 kW
Pump Speed:	980 RPM
Electrical Info:	3 Phase, 50 Cycle, 415 Volt motor

Price and Timeline Details:

Budget Price:	
Submittal Timeline:	2-4 Weeks (after receipt of complete details)
Mfg. Timeline:	12-14 Weeks (after receipt in Seller's office of approved Submittal Data)

Additional Price Details:

The estimated cost of this budget proposal constitutes a non-binding estimate for certain goods and/or services and is exclusive of applicable taxes.

F.O.B. factory plus any taxes, which may apply. Truck/Rail freight allowed to the job site, rail siding or nearest unloading area-unloading to be by Buyer. Due to the spike in gas prices, which is beyond the control of Smith & Loveless at the time of our quotation/bid, a fuel surcharge may need to be assessed at time of shipment.

One day supervision of initial operation over one trip is included. If additional days are required, Seller will furnish a factory-trained supervisor for $925 per day including travel time plus actual travel expenses.

Smith & Loveless, Inc. will provide one electronic copy of the O&M on CD in PDF format and four hard copies of the O&M. Additional copies can be provided for $50 per copy.

Standard EVERLAST™ Series 3000 Features:

✓ **STAR ONE™** Non-Clog Pumps

Vertical, close-coupled design featuring oversized, stainless steel shafts and bearings, delivering leading efficiencies and a 20+ year service life.

Learn More:
https://smithandloveless.com/energy-efficiency-reuse-sl-systems

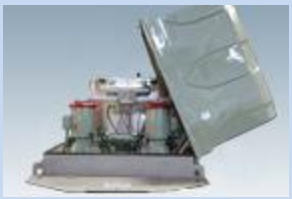
✓ **SONIC START® STREAMLINE™** Vacuum Priming System

Employing frequency modulation and minimal connections, primes in under 60 seconds, maintains it indefinitely and eliminates routine O&M.

Learn More:
https://smithandloveless.com/sl-pumping-advantage

✓ **Tip-Up Enclosure**

Easy-lift 1-piece tip-up enclosure with newly redesigned S&L style



✓ **12.7 mm Baseplate**

Carbon steel baseplate comes standard

✓ **QUICKSMART™** System Controls

PLC Touchscreen Station Controls (1.8 m 65K-Color TFT LCD HMI), IP55 when Installed in Enclosure.

Learn More:
http://files.smithandloveless.com/documents/QuickSmart_Pumping_interactive_e.pdf

✓ **10 Year Warranty Protection**

The industry's longest service life and warranty protection, including 10-year protection for various pump, baseplate and enclosure equipment.

Standard EVERLAST™ Series 3000 Features (continued):

- ✓ Submersible Level Transducer
- ✓ 24v Control Circuits
- ✓ Back-up Float Control System - 3 Floats
- ✓ Prime Mode Selector - Constant or On-Demand Prime
- ✓ Selectable Alternation - Timed or Sequential
- ✓ High Water Alarm
- ✓ Pump Fail / Prime Fail Sensors
- ✓ Compound Pressure Gauges
- ✓ Running Time Indication - Individual & Totalizing
- ✓ Aluminum Manway Cover
- ✓ Spare Mechanical Seal
- ✓ Spare 24V Power Supply
- ✓ Surge Protection Device

Optional EVERLAST™ Series 3000 Features (included if checked):

✓	**DURO-LAST®** Stainless Steel Baseplate 316 and/or lean duplex series 2100 stainless steel baseplate for superior pump station protection, backed by 25-year warranty protection.	
✓	**X-PELLER®** Clog-Fighting Impeller Features a mono-port design, which allows it to pass 75 mm solids, including consumer flushable wipes, rags or other trashy items. *Learn More:* https://www.youtube.com/watch?v=mW3bLAxVX7E	
Available	**RAPIDJACK™** Quick Clean Check Valve Wafer check valve design simplifies access for clearing blockages or obstructions, requiring removal of only 4 bolts and approx. 15 min. *Learn More:* https://www.youtube.com/watch?v=xK6d8l0Xh58	
	3KVA Transformer	
	Transducer Signal Splitter	
	Dialer Interface / Dialer Not Included	
	Generator Interlock	
	Panel Mounted Automatic Silence Switch	
	Non-Mercury Float Switches	

Built for the Lowest Total Cost of Ownership.

Compare vs. Submersibles & Self-Primers

Highest Efficiency
The S&L Non-Clog Pump with custom-trimmed impellers and premium efficient motors deliver the highest wire-to-wire efficiencies. Vacuum-priming uses much less energy than self-primers.

Safest O&M
All mechanical equipment is instantly accessible with no confined space entry, eliminating extra gear and personnel for O&M. No oil-filled mechanical seals, adjustable parts, or spillage.

Most Reliable
S&L Non-Clog Pumps are always designed for 76 mm (3") solids handling per industry standards.

Lowest Total Costs
EVERLAST™ pump stations offer the longest service life (25+ years) and proven 50% savings vs. submersibles. Our seals offer longer average service life than typical submersible pumps.

Smith & Loveless
www.SmithandLoveless.com

Offices in
United States • United Kingdom • New Zealand • India

Smith & Loveless

EVERLAST™

Surface Mounted Pump Stations

Smith & Loveless Inc.'s above-ground wastewater pumping stations pave the way for end-users to reap the benefits of robust construction, operator-safe maintenance and single-source solutions. The result is efficient pump station performance, long service life and realised savings—verified by decades of successful installations.

S&L's next generation **EVERLAST**™ Surface Mounted Pump Stations perfectly embody this philosophy. Featuring the top S&L innovations, new looks and enclosures, convenient package options, and leading warranty protection, **EVERLAST**™ is designed to provide you a long, successful pumping life.

HIGHEST EFFICIENCY.
New STAR ONE™ S&L Non-Clog Pumps Add 3-5%

SAFEST O&M.
No Confined Space Entry; Operator Ease

MOST RELIABLE.
Anti-Clog Solutions; Easy to Maintain

LONGEST LIFE.
Durable Equipment; Decades of Service

Smith & Loveless

Visit SmithandLoveless.com

EVERLAST™ Surface Mounted Pump Station Specifications

Individual Pumps:	100-300 mm / 4"-12"
Piping:	100-750 mm / 4"-30"
Power (Hp / KW):	1.1-225 kW / 1.5-300 Hp
Max. Ind. Pump Capacity:	350 lps / 5,000 gpm
Max. TDH Capacity:	78 m / 255 ft.
Wet Well Diameters:	1.2-3.6 m / 4-12 ft.

- 2, 3 or 4-Pump Designs Parallel or Series Operation
- Multiple Control Options PLCs to Relay Logic
- Multiple Alarms
- Concrete or Steel Wet Wells
- Cold Climate Packages
- Multiple Enclosure Types Above-Ground/ Partial-Bury

Specialised Pumping System Models

EVERLAST™

Series 5000
Higher Capacity Duplex

5000: Packaged Station Two-Piece Hinged Enclosure; Higher Capacity Duplex Pumping Accomodates Larger S&L Pumps

Series Hi-Head
Pumps in Series Operation

SHH: Packaged Station Multiple Enclosure Options; Higher Head Pumping with 4 S&L Pumps in Series Arrangement

Triplex
Higher Capacity & Flex

TRIPLEX: Packaged Station Two-Piece Hinged Enclosure; Higher Capacity Pumping Provides Design Flex with 3 S&L Pumps

CAPSULAR®
Highest Capacity WWMPS

CAP: Packaged Large-Capacity WWMPS; Pre-Fabricated Building 2-6 S&L Pumps (in Parallel or Series)

	5000	Hi-Head	Triplex	CAPSULAR®
Flows	Up to 189 lps (3,000 GPM)	Up to 82 lps (1,300 GPM)	Up to 164 lps (2,600 GPM)	Up to 788 lps (12,500 GPM)
TDH	Up to 78 m (255')	Up to 96 m (316')	Up to 48 m (158')	Up to 107 m (350')
Power	1.1 - 149 kW (1.5 - 200 Hp)	1.1 - 37 kW (1.5 - 50 Hp)	1.1 - 37 kW (1.5 - 50 Hp)	1.1 - 223 kW (1.5 - 300 Hp)
Piping	100 - 250 mm piping (4" - 10")	100 - 150 mm piping (4" - 6")	100 - 150 mm piping (4" - 6")	100 - 750 mm piping (4" - 30")

ADD Premium S&L Feature Options For Any Station Model

XPELLER®

Exclusive S&L single-port impeller design proven to prevent pump clogging; effectively expels high volumes of consumer flushables

RapidJack™

NEW! S&L check valve design that simplifies valve access and any unclogging in just minutes

LAST

Popular station baseplate upgrade made of 316 and/or lean duplex series 2100 stainless steel. Backed by 25-year warranty protection

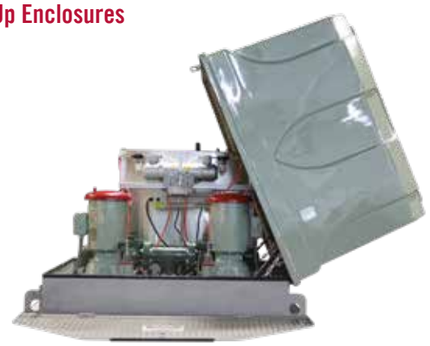
STATION COMM™

Remotely receive updates, monitor and control pump station functions via cell phone text messaging direct with your station

Featured Duplex Pumping System Models

Series 1000 & 3000

Tip-Up Enclosures



1000: Packaged Station
Hinged One-Piece Enclosure
9.5 mm (3/8") Baseplate
Relay Logic controls

3000: Packaged Station
Hinged One-Piece Enclosure
12.7 mm (1/2") Baseplate
QUICKSMART™ PLC controls

Series 2000 & 4000

2-Piece Sliding Enclosures

2000: Packaged Station
Two-Piece Sliding Enclosure
9.5 mm (3/8") Baseplate
Relay Logic controls

4000: Packaged Station
Two-Piece Sliding Enclosure
12.7 mm (1/2") Baseplate
QUICKSMART™ PLC controls

Rectangular Recessed

Earth-Insulated with Dual Hatch Entry

RR: Packaged Station
Ground-Level, Dual Hatch
Allows for Deeper Wet Well
Maintains Low Profile
Relay Logic or **QUICKSMART**™

Flows	Up to 82 lps (1,300 GPM)
TDH	Up to 48 m (158')
Power	1.1 - 37 kW (1.5 - 50 Hp)
Piping	100 - 150 mm piping (4" - 6")

+ ADD EVERLAST™ Series 1000 - 5000 Supplemental Packages

Station Monitoring Package

Advanced pump station status monitoring features including digital flow rate
*Avail. only with **QUICKSMART**™*

Enhanced Alarm Package

Enhanced alarm notifications including intrusion, operator assist, low water alarm, and other water level alarms

Building Enclosure Package

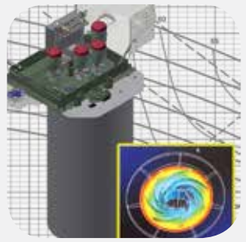
Skid-mounted pumping system configurations inside one of many climate controlled pre-fab or site-built buildings

Cold Weather Package

Insulated versions of standard S&L enclosures combined with additional heating and vacuum release systems

S&L Total Life-Cycle Support

Engineering and Design



S&L provides total support with 3-D Modelling and CAD drawings, computational fluid dynamics (CFD) analysis, finite analysis, specification support, product demonstrations, and other value-added technical services.

Manufacturing and Testing

S&L pump stations are factory-built and assembled, and tested to Hydraulic Institute standards in state-of-the art facilities that replicate actual field conditions. Our customers are invited to witness testing at our factory.

Delivery, Installation and Startup

Upon delivery, simply connect suction and discharge piping and electrical connections, and secure the baseplate to the wet well. The process is typically completed within a few hours. S&L Start-up assistance is available.

Aftermarket Parts and Services

S&L's After Market & Field Service groups completely support you through the life of your system with factory-certified parts and retrofits, service inspections and contracts, technical phone assistance, O&M training, and continuing education.

Industry-Leading Pump Station Warranty Protection

EVERLAST™ Series 1000-5000 pump stations offer the industry's longest service life and warranty protection, including 10-year protection for various pump, baseplate and enclosure equipment. The **DURO-LAST**® stainless steel baseplate option comes with 25-year protection. Rest easy knowing your station is designed to offer service life for a generation or longer.

The Wet Well Mounted Advantage

Above-Ground Access from Simple Vacuum-Priming

Robust, yet simple S&L Vacuum-Priming delivers the benefits of above ground, operator safe pumping. When wet well levels rise, the proven **SONIC START® STREAMLINE™** priming system achieves prime in 60 seconds under standard conditions, maintaining it indefinitely. Employing frequency modulation and minimal connections, the system virtually eliminates O&M tasks associated with older priming systems, and utilises far less energy than self-priming pumps.

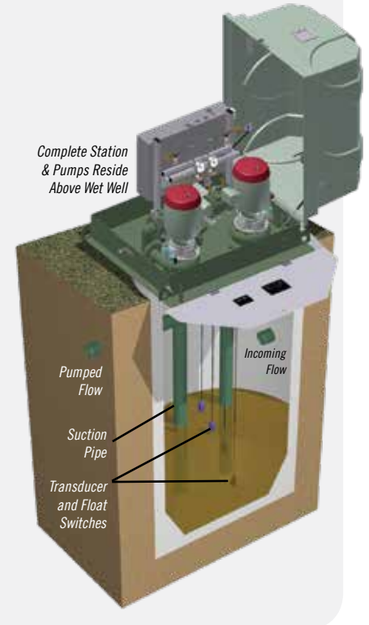
Priming System

No Confined Space Entry for Routine O&M

Offering the safest pump station access on the market, S&L **EVERLAST**™ Wet Well Mounted Pump Stations are inspected and maintained without the requirements typically associated with confined space entry, like harnesses, gas monitoring equipment, and multiple personnel.

Paves the Way for the Lowest Life-Cycle Costs

One operator is able to inspect S&L stations. Maintenance tasks like pulling an entire pump or changing out a pump seal or impeller can be completed without costly outside contractors or pump maintenance centres. This results in significant savings in parts and labor costs over the life of the system.



S&L Pumps & Impellers

1 STAR ONE™

S&L Non-Clog Pumps

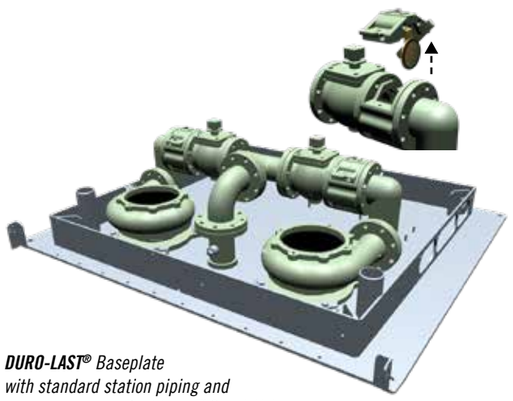
Our vertical, close-coupled **STAR ONE**™ S&L Non-Clog Pump design meets the highest of standards that promote superior efficiency, durability and ease of maintenance, including industry standards for 76 mm (3") solids. Its rugged design, featuring exclusive oversized, stainless steel pump shafts and bearings, will typically deliver service for more than 20 years with basic care. The **STAR ONE**™ construction streamlines access to the volute, impeller and seal merely by removing four to eight cap screws from the connecting motor adapter on the station base in just a few minutes without any spillage.

STAR ONE *™ S&L Non-Clog Pumps offer industry-leading wire-to-water pump efficiencies and service-life while effectively handling problem flushables.*

2 X-PELLER®

Impeller

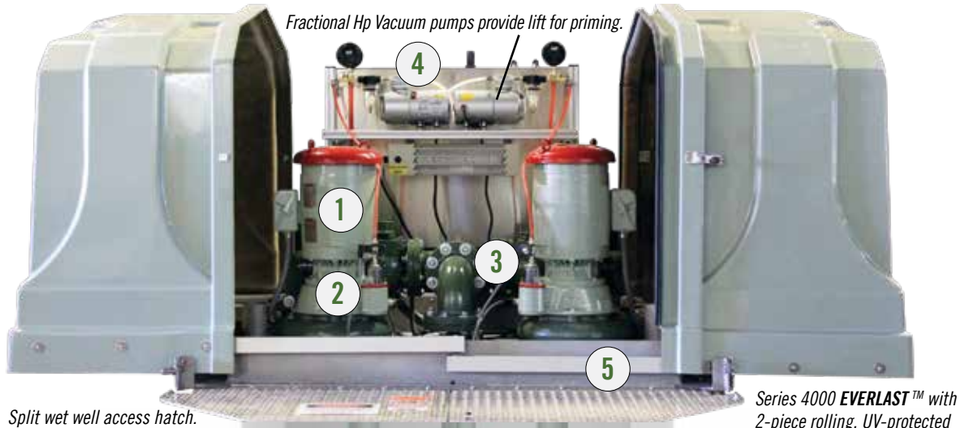
Specifically designed for applications with high volumes of consumer flushables, the **X-PELLER®** Impeller has been proven to effectively expel high volumes of consumer stringy materials, including flushable wipes, rags and other unusual trashy items, because of its mono-port design. Designed to pass 76 mm (3") solids, the **X-PELLER®** eliminates clogging and the need to pull pumps to unbind the impeller. Fully trimmable to the user's specific pumping conditions, it even works well in low flow conditions. Optional. *For more see Bulletin 612.*



DURO-LAST® *Baseplate with standard station piping and new easy-access* ***RapidJack™*** Check Valve. *(Inset above shows clapper removal for rapid access).*

3 RapidJack™ Quick-Clean Check Valve

Revolutionising wafer check valve maintenance, the optional **RapidJack**™ Quick-Clean Check Valve is easily removed and replaced using 4 bolts in less than 15 minutes. Its unique design allows the clapper system to be removed while the valve body remains in the piping. Simply remove the obstruction, reinsert the **RapidJack**™ clapper system and the four bolts! *See Bulletin 635.*



Split wet well access hatch.

Level controls not all shown.

Series 4000 ***EVERLAST*** *™ with 2-piece rolling, UV-protected enclosure.*

Station Assembly

Controls & Accessories

4 QUICK SMART™

System Controls

Delivering simplified operation yet powerful pump station control, **QUICKSMART**™ PLC Station Controls provide unparalleled ability to monitor and adjust all of your pump station functions. The user-friendly, graphical touchscreen makes control modifications, screen navigation and viewing of pump station status easier and smarter than ever. Features include a push-notification maintenance log and I/O Status (digital and analog) screen. *Available in all models except Series 1000 & 2000. See Bulletin 660.*

STATION COMM™

Remote Communication

Remotely monitor critical alarms and control a variety of pump station functions via simple cell phone text messaging commands with **STATIONCOMM**™. Send simultaneous service messages to as many as ten different users. *See Bulletin 685.*

Force Main Sync

By combining **QUICKSMART**™ PLC controls with Variable Frequency Drives (VFDs) and smart sensors, the **Force Main Sync** system option ensures that multiple pump stations in a single force main achieve optimal energy efficiency and cost-saving pump performance. *Contact S&L for application.*

5 DURO-LAST®

Stainless Steel Baseplate

The rugged **DURO-LAST®** 9.5 or 12.7 mm (3/8" or 1/2") baseplate option, backed by full 25-year warranty, is available in 316 and/or lean duplex series 2100 stainless steel. It features a Pitting Resistance Equivalent Number of 24.0 or greater. **DURO-LAST®** is glass bead blasted to remove surface contamination and passivated to provide a uniform finish. *See Bulletin 641.*

+ Additional Station Features

- **Multiple Enclosure Options** (incl. pre-fab buildings)
- **Station Advanced Warning System** (standard S3000 / 4000)
- **Submersible Transducer & Back-up Floats** (std.)
- **NEMA 4X Stainless Steel Panels** (optional)
- **ShadeAide™ HMI Protector** (optional)
- **Wet Well Mounted Fall Protection** (optional)

PUMP&VALVE
SPECIALTIES LTD

Providing Pumping Solutions

Water, Waste and Reticulation

Water, Waste and Reticulation

Pump & Valve Specialties are proud to be actively involved in the Water, Waste & Reticulation industry in New Zealand.

As a supplier of quality pumps and valving products we are fully acquainted with what's important to you in ensuring efficient, trouble-free, reliability in your Water and Waste water operation.

Our vast range of innovative products and long service history to your industry will give you peace of mind when looking to upgrade or expand the equipment in your facility, from our extensive commitment to spares stock to our team of in-house engineers, we are totally committed to your industry and the contribution it makes to this country.

We are able to offer full technical support for all products with our fully equipped in-house engineering facility, giving us the ability to provide quick turn-around service for both new equipment and refurbishment and maintenance on existing plant.

Our engineers have considerable experience and understanding that proves invaluable when those challenging applications come along, whether it be partnering with you on plant design or to bring greater efficiency and reliability to your existing operation – we are here to provide the technical support you deserve.

With four branches nationwide we offer full on-site application assistance and commissioning to ensure your process is at its full potential.

MAG Drive Pumps are designed for chemical transfer.

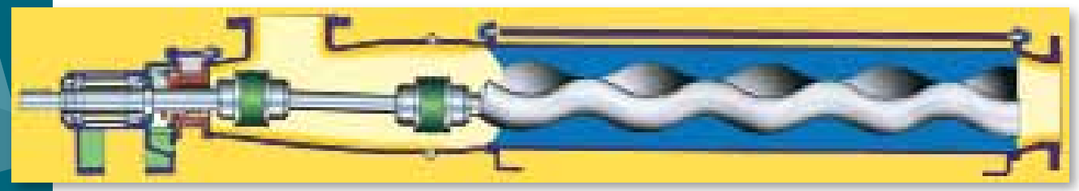
Progressive Cavity Pumps

APPLICATIONS:

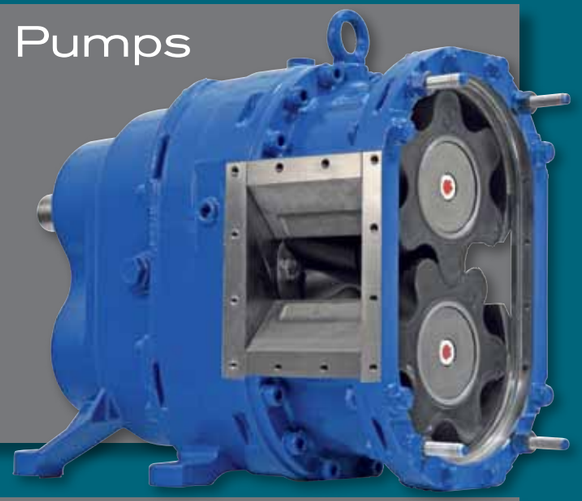
Sewage treatment plants for sludge transfer and polymer dosing.

FEATURES/SPECS:

- **Self priming capability**
- **Cost effective**
- **Non-clogging**
- **Low internal velocity**
- **Reversible**
- **Able to handle solids laden liquids**
- **Flows to 345 m3/hr**
- **Pressures to 48Bar**
- **kW range 0.18kW – 75kW**



Rotary Rubber Lobe Pumps



APPLICATIONS:

Sludge transfer

FEATURES/SPECS:

- Run dry capability
- Rapid self priming,
- Easy maintenance
- Large solids handling capability
- Can handle high and low viscosities
- Flows to 1000m3/Hr.
- Pressures to 16Bar

Rota-Cut

APPLICATIONS:

Maceration of sewage, abattoir waste and by-products.

FEATURES/SPECS:

- Run dry capability
- Rapid self priming
- Easy maintenance
- Flows to 750m3/Hr.
- Reliable maceration of fibrous and coarse materials
- Protection from foreign objects for all downstream components
- Fluids and suspensions are homogeneous and less viscous, requiring less power consumption by mixing and pumping equipment.
- Auto reverse in case of jamming
- Self-sharpening blades

Dosing Pumps

SMART DIGITAL DOSING PUMPS

FEATURES/SPECS:

- Powerful variable-speed stepper motor
- Internal stroke speed control
- Flow control with selective fault diagnosis
- Integrated flow measurement
- Auto flow adapt
- Auto de-aeration also during pump standby
- Batch modes (timer- or pulse-based)
- Always full stroke length – even at small flow rates
- Smooth, continuous dosing
- SlowMode function for high-viscosity liquids
- Flow to 30 l/h
- Pressure to 16 bar
- Turn-down ratio 1:3000 (7.5-16) or 1:1000

Grit Pumps

APPLICATIONS:

Grit Pumping, Sand & Gravel

FEATURES/SPECS:

- Non clogging system
- Double shaft seal
- Increased efficiency
- Extended service life by generously dimensioned shafts and bearings
- Impeller options include open, single and twin vane, closed multi vane and vortex.
- Close coupled design
- Can be dry-mounted horizontally or vertically

Peristaltic Hose Pumps

APPLICATIONS:

Lime Slurry and Chemical dosing

FEATURES/SPECS:

- Seal-less
- Can run-dry without damage
- High suction capability
- Choice of hose materials
- Suitable for very high viscosities
- Ideal for abrasive slurries
- Temperature range 0-80'C
- Up to 15Bar discharge pressure

Magnetic (MAG) Drive Pumps

APPLICATIONS:

Chemical transfer

FEATURES/SPECS:

- Easy set outer drive
- Multiple impeller diameters
- Multiple connections
- Run dry system
- Close-coupled design
- Flows to 60m3/hr
- Pressure to 90psi
- Viscosity to 150 cP
- Max temperature 90°C

Packaged Booster Sets

APPLICATIONS:

Water Boosting, Irrigation Supply, Water Reticulation

FEATURES/SPECS:

- Vertical multistage centrifugal pumps.
- Inline design
- A complete turn-key package, tailored to suit your requirements
- Economical, reliable and trouble-free
- Easy to install and connect
- Numerous control options within two main types (fixed and variable speed)
- A single inlet and outlet connection for multiple pumps means no manifolding of pipe work is required on site.
- Flows to over 270 m^3/hr
- Pressure to over 20 Bar
- Temp to over 140°C

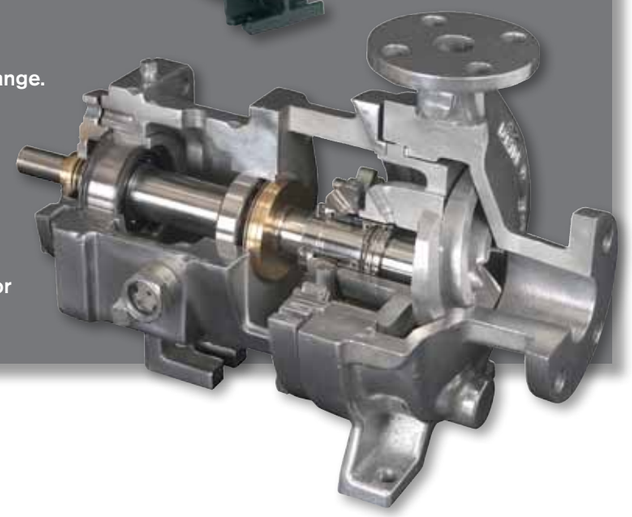
End Suction Pumps

APPLICATIONS:

Wash down areas.

FEATURES/SPECS:

- Pumps available according to ISO, DIN, or ANSI.
- Flows from 2 to 1000 m^3/h
- Head from 2 to 160 m.
- Motor sizes fall in the 0.55 to 355 kW range.
- Impellers are hydraulic balanced to reduce axial thrust.
- The pumps are of the back pull-out design enabling removal of the motor, coupling, bearing bracket and impeller without disturbing the pump housing or pipework.



Sewage Pond Mixers

APPLICATIONS:

Sewage settlement pond stirring

FEATURES/SPECS:

- Ideally suited to effluent pond stirring to aid in the prevention of solids settling and surface crusting
- Mounting options via threaded bracked or box section slide guide
- Inbuilt motor protection via Klixon thermal cut out. Water in oil sensor, 10m cable
- Stainless steel and cast iron construction
- Stainless Steel propellers
- Triple seal system (with DI sensor
- Highest efficiency on the market (IE3 motors)
- Solids deflection ring protects mechanical seal
- Available up to 25kW

CONTROL PANEL HAS THE FOLLOWING FEATURES

- Motor overload protection
- On/off/auto control switch with time clock for optimized energy savings
- 24 hour time clock for optimised energy savings
- Visual alarm

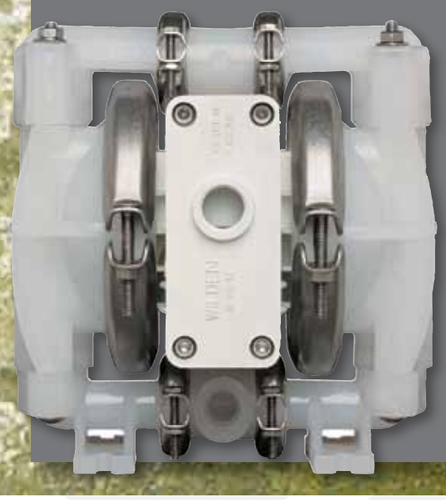
Odour Filters

APPLICATIONS:

Vent stacks, pump stations, air valves, receiving manholes, sewer lines, holding tanks and overflow tanks

FEATURES/SPECS

- Low operating costs
- Long media life compared to standard carbon filters
- Reduces customer complaints
- Replacement media cartridges
- Economical & effective
- Can be adapted to any pipe size
- Low maintenance costs
- Adsorbs & treats gases fast
- Quick, safe & easy to install
- Size range to suit all sites
- Easy & safe servicing
- Wind assisted fans available



AODD Plastic Pumps

APPLICATIONS:

Chemical transfer

FEATURES/SPECS:

- Positive displacement
- Can be run dry
- Various elastomers
- Anti-freeze/anti-stall and lube free air distribution systems
- Range of designs
- Self priming
- High suction lift capability

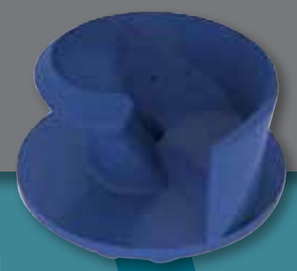
Submersible Pumps

APPLICATIONS:

For the pumping of wastewater and sewage from buildings and sites in private, commercial, industrial and municipal areas.

FEATURES/SPECS:

- NEMA Class A temperature rise.
- Premium Efficiency motors in accordance with IEC 60034-30 level IE3 with testing in accordance with IEC60034-2-1.
- Continuously rated motor suitable for submerged and non-submerged applications.
- Double mechanical seals; SiC-SiC at the medium side, SiC-C at the motor.
- All seals are independent of rotation direction and resistant to temperature shock.
- Anti-wicking cable plug solution (80C - 150E), or water-pressure-sealed connection chamber (100G - 201G).
- Hydraulic options of Contrablock and Contrablock Plus impellers for high efficiency, or vortex impellers for maximum solids handling.
- Lubricated-for-life bearings with a calculated lifetime of minimum 50,000 hrs. (80C - 150E), and 100,000 hrs. (100G - 201G).
- Stainless steel shaft. Designed with high safety factor to prevent fatigue fracture.
- Temperature monitoring by thermal sensors (140 °C) in the stator windings.
- Seal monitoring by a moisture probe (DI) in the seal chamber (80C - 150E), or dry chamber (100G - 201G), which signals an inspection alert if there is leakage at the shaft seals.
- DN 80, DN 100, DN 150 and DN 200 radial slot DIN flange discharge.
- Maximum allowable temperature of the medium for continuous operation is 40 °C.
- Maximum submergence depth of 20 m.
- Explosion-proof as standard, in accordance with international standards Ex d IIB T4 and ATEX.
- Max Flow 1800l/sec
- Max Pressure 78m



Pulsation Dampeners

APPLICATIONS:

Water treatment

FEATURES/SPECS:

- Dampeners reduce pulsation, water hammer,
- Extend life of pumps, valves and pipe work
- Creates steady flow for dosing and blending.
- Range of sizes available.
- Simple installation.
- Wide range of metals, polymers and rubbers available to suit most applications.

Waste Water Blowers

APPLICATIONS:

Aeration for treatment of municipal and industrial wastewater

FEATURES/SPECS:

- High efficiency, guaranteeing optimal life cycle costs
- Low noise: no need for additional soundproofing
- Magnetic Bearings
- Permanent magnet motor
- Very quiet
- Vibration free
- Does not need to be installed in a purpose built building.
- Air flow range 1,000–16,000 Nm^3/h
- Pressure range 30–120 kPa

Environmental Solutions

- Pump stations
- Oil retention and containment

Oil retention and containment

Domestic Pump Station

Municipal/Industrial Pump Station

Service

We have a dedicated service facility with trained engineers and test facility.

Your pump is in professional, trained hands from the time it comes through our doors until it is returned to you.

Every pump – where possible – is water tested on our test rig after service has been completed – providing total confidence in our workmanship.

Spare Parts

Full range of spare parts stocked to support our product line.

Spares stocked for all common industrial pumps and valves.

Parts sourced for all products.

PUMP&VALVE SPECIALTIES LTD

Auckland:
100 Montgomerie Rd, Airport Oaks.
Ph: 09 276 9045, Email: salesakl@pumpandvalve.com

Wanganui:
43 Heads Road, Wanganui.
Ph: 06 349-0088, Email: info@pumpandvalve.com

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Ph: 04 239 6006, Email: info@pumpandvalve.com

Christchurch:
Ph: 03 329 3037, Email: info@pumpandvalve.com

www.pumpandvalve.com

Airvac

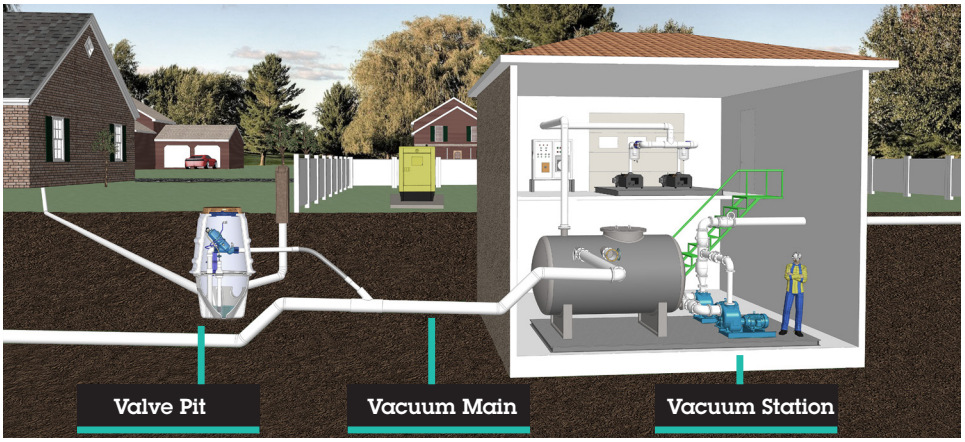
A brand of
Aqseptence Group

Developers Profit From Airvac Vacuum Sewer Systems

- **Low Construction Cost**
  Shallow trenches and small pipe diameter
- **Eliminate Multiple Lift Stations**
  One vacuum station can replace multiple lift stations
- **More Lots Available for Sale**
  Fewer lots needed for lift stations leaves more available for sale
- **Deferred Cost/Low Capital Expense**
  New container station
- **Environmentally Friendly**
  Protects environmentally sensitive areas
- **Minimum Surface Disruption**
  Minimal disruption to existing community and ecosystem
- **Expandability**
  May be easily extended for future construction phases
- **Closed System**
  Eliminates inflow, infiltration and exposure to raw sewage
- **Energy Savings**
  Only 1 source of power needed at the station

About Airvac

- World leader in vacuum sewer technology
- 1000 installations worldwide with 330+ located in the U.S.
- In business for nearly 50 years; manufactured in the USA
- Free estimate and layout
- Best-in-class technical support and services



Typical Vacuum System Components

Reduced Initial Capital Expenses

- New inexpensive station models developed
- Leasing of low cost containerized vacuum station available for phased projects
- Vacuum valves and/or valve pits can easily be added later as lots are sold
- Cost of certain components can be deferred or added to the price of the lot

Containerized Vacuum Station – option for initial phases

Reduced Installation and O&M Cost

- Lower installation costs than gravity due to shallow main lines
- Eliminate multiple lift stations
- Narrow trenches reduce excavation, dewatering and surface restoration
- Increased level of automation and monitoring
- Easier operation

Flexibility

- Ease of making horizontal and vertical piping changes allows for flexibility in site configuration and lot layout
- Overcome site difficulties such as: sandy soils, high groundwater, rocks, etc.
- Easy to expand with new phases

Environmentally Friendly

- Completely sealed system protects environmentally sensitive areas
- Less surface disruption initially and when future phases are added
- Operating personnel are not exposed to raw sewage
- Power required only at the vacuum station; valves operate pneumatically

Aqseptence Group, Inc.
Vacuum Technology Systems

4217 N Old US Highway 31
Rochester, IN 46975
Phone +1 574 223 3980
Fax +1 574 231 7424
info.airvac@aqseptence.com

www.aqseptence.com

19. Appendix G – Treatment Details

19.1. Innoflow Technologies Ltd

Orenco® Sewers

Cost-Effective, Environmentally Sound Wastewater Collection System

IDEAL FOR COMMUNITIES OF ALL SIZES

- New subdivisions
- Neighborhood clusters
- Commercial properties
- Sewer expansions
- Septic tank abatement
- Ecologically sensitive areas
- Challenging site conditions

Orenco® SYSTEMS

814 Airway Avenue, Sutherlin, Oregon, USA 97479
Toll-Free: 800-348-9843 • +1-541-459-4449 • www.orenco.com

Orenco® Sewers

Choose the Superior Wastewater Solution:

Orenco Effluent Only Sewers

Communities and developers throughout the world are struggling with wastewater collection and treatment issues. For many areas, conventional gravity sewer systems are too costly. Moreover, conventional sewers are not watertight, so their overflows contaminate our rivers, bays, and oceans.

"Given the diversity of the new technology that is now being developed, it is reasonable to speculate that, in the future, the continued use of conventional gravity flow systems will be a thing of the past."

Dr. George Tchobanoglous, UC Davis, Author of *Wastewater Engineering: Treatment, Disposal, Reuse* and *Small and Decentralized Wastewater Management Systems*

"Managed decentralized wastewater systems ... merit serious consideration in any evaluation of wastewater management options for small and mid-sized communities and new development."

EPA, *Response to Congress on Use of Decentralized Wastewater Systems,* April 1997

Watertight effluent sewer systems are becoming recognized as one of the best solutions for collecting waste and transporting it to a treatment facility.

Orenco has helped hundreds of communities throughout the world to design, build, and maintain low-cost, watertight, reliable effluent sewers. Depending on terrain, effluent sewers are often half the cost of conventional sewers, or less.[1]

Orenco (effluent only) sewers are compatible with existing wastewater infrastructure. They take the burden off maxed-out municipal systems and allow sustainable service area expansion. For monitoring and control, Orenco offers telemetry panels that provide the power of SCADA at an affordable price.

There are other alternative sewer technologies – grinder systems, for example. However, because the effluent from an Orenco Sewer is relatively free of grease, oil, and solids, the pumps and collection lines require less maintenance than grinder systems And the high-quality filtered effluent from an Orenco Sewer requires less costly treatment.

For all these reasons, communities that purchase our effluent sewers enjoy system-wide, long-term savings.

system-wide
long-term savings

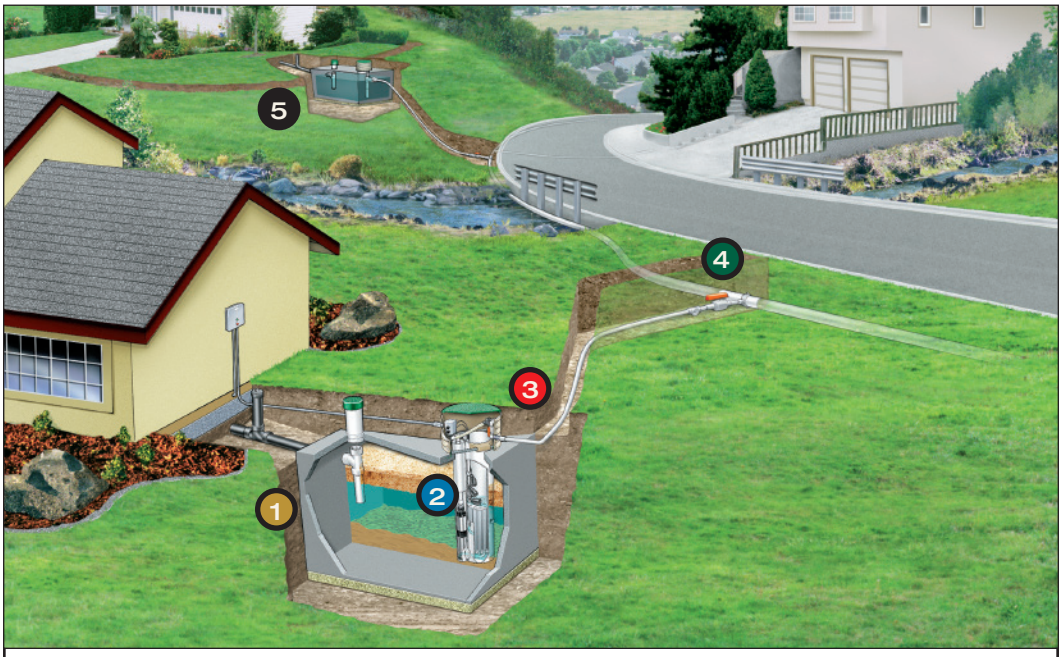
1. *Water Environment Research Foundation Fact Sheet C1 (Gravity Sewer Systems) and Fact Sheet C3 (Effluent Sewer Systems), 2010.*

Orenco® Sewers

How an Orenco Sewer Works

With an Orenco Sewer, raw sewage flows from the house or business to an underground tank, where it is pretreated. Only the filtered liquid is discharged (by either pump or gravity) through the service lines to shallow, small-diameter collection lines that follow the contour of the land. Solids remain in the underground tank for passive, natural treatment. Tanks typically need pumping only once every 10-12 years, depending on the number of users.[2]

Orenco Sewers are designed as a totally integrated package, and system components are compatible and preassembled. Each item is covered by a limited warranty and components are corrosion-resistant, durable, and lightweight.



1. *Underground tanks provide primary treatment, so only liquids are conveyed to the treatment plant.*
2. *Our patented Biotube® Pump Vault filters out solids and our lightweight, non-corroding pumps last more than 25 years.[3]*
3. *One-inch (25-mm) diameter service lines can be easily installed with a trencher.*
4. *Small-diameter main lines follow the contour of the ground, saving on excavation costs. No expensive manholes or lift stations are required.*
5. *Filtered effluent is conveyed by gravity from homes at higher elevations, so no pump is typically required.*

From Sewer to Treatment

The high-quality, filtered effluent from an effluent sewer is ideal for use with a low-cost, low-maintenance treatment system, such as Orenco's AdvanTex® AX100 textile filter. From there, it can be used for irrigation, toilet flushing, or other kinds of beneficial reuse (subject to local regulations). Without infiltration or solids to contend with, the size of the treatment plant can be substantially reduced. This saves money on equipment, installation, and operation costs.

This photo shows Phase 1 and 2 of Orenco's modular AdvanTex AX100 Wastewater Treatment System, located in Bethel Heights, Arkansas. Bethel Heights now has 45 AX100 filter modules that are designed to handle 225,000 gpd (850 m^3/day) of wastewater. Multiple Orenco telemetry panels control the small, low-energy pumps that move wastewater through the filters and out to drip irrigation fields.

2. *Terry R. Bounds, PE. 1995. "Septic Tank Septage Pumping Intervals." Sutherlin, Oregon: Orenco Systems, Inc., 13.*
3. *Elkton, Oregon.*

Orenco® Sewers

A Fraction of the Cost of Conventional Sewers

Orenco Sewers dramatically reduce short-term and long-term wastewater treatment costs for communities and developers. In fact, effluent sewers are often one-half the cost of conventional gravity sewers or less. Here are the many ways you save:

Save On Equipment And Labor

- Collection lines are shallowly buried, just below the frost line, reducing excavation costs.
- Inexpensive, small-diameter collection lines are used.
- Expensive manholes and lift stations are eliminated.
- Installation time is reduced by one-half or more, compared to conventional sewers.[4]
- Ease of installation causes less disruption to communities, allowing businesses to operate normally during construction.
- Ease of installation makes the system well-suited for community "self-help" programs.
- Most equipment isn't purchased until lots are developed, deferring costs.

Save On Operation And Maintenance

- Low maintenance requirements have been documented with Orenco Sewers.[5]
- 24-hour back-up storage in on-lot tanks reduces emergency calls and overtime costs.
- Homeowners pay about $1.50/month in energy costs for pumps.[6]
- Residential tanks typically need pumping just once every 10-12 years, depending on the number of residents.[7]

Save On Treatment Costs

- Because of high effluent quality, low-cost treatment systems – such as packed-bed filters and sub-surface disposal – are ideal.
- Less costly permitting and testing are required when not discharging into waterways.
- Treatment facilities can be sized economically, since the whole system is designed to be watertight. There's no need to allow for the infiltration and inflow from high stormwater flows or groundwater.

Orenco Sewer Systems are ideal for new subdivisions, whether on flat ground or on the most difficult terrain.

"In general, alternative collection systems should be considered for smaller rural communities with low population density and site specific environmental conditions . . . Shallow bedrock, high groundwater conditions, extremely flat or very hilly terrain and limited room for construction make alternative collection systems more cost-effective than conventional systems."

Illinois Community Action Association
Alternative Wastewater Systems in Illinois

4. *Vero Beach, Florida.*
5. *Bill Cagle, Terry Cargil, and Roger Dickinson. 2013. "20-Year Life Cycle Analysis of an Effluent Sewer (STEP) System." Proceedings of the Water Environment Federation Technical Exhibition and Conference; Chicago, Illinois, October 5-9. Alexandria: Water Environment Federation, 14.*
6. *Run Time = 20 min/day, VAC = 115, A = 12.7, National Average Power Cost = $0.1/kWh.*
7. *Terry R. Bounds, PE. 1995. "Septic Tank Septage Pumping Intervals." Sutherlin, Oregon: Orenco Systems, Inc., 13.*

Community Case Studies

Hundreds of communities throughout North America are successfully collecting and treating their wastewater with Orenco Sewer Systems. For more detailed case studies, go to www.orenco.com/systems and click on "Markets."

Diamond Lake, Washington

In 1986–87, an Orenco Sewer system serving 500 homes was installed in this Washington lakeside community. Half the properties are seasonally occupied, with sudden start-ups and prolonged shut-downs. And the winters are very cold. Even so, operator Larry Garwood said, "The systems are simple, dependable, and easy to maintain."

Lacey, Washington

Lacey, Washington, was an early adopter of Orenco Sewer. The community's first effluent sewer mains were installed in 1986. Orenco staff worked closely with the city to design an effective maintenance schedule that would provide residents with a sustainable and affordable level of service. "We truly appreciate the effort that Orenco has made in doing what they can to reduce our costs and effort, " said Terry Cargil, City of Lacey Water and Wastewater Supervisor. The city now has over 3,200 Orenco Sewer connections and almost 50 miles of small-diameter effluent sewer mains.

Elkton, Oregon

In 1989, an Orenco Sewer system was installed to serve more than 100 homes and businesses in Elkton, Oregon, at an average cost of less than $7,000 per home for both collection and treatment. Ten years after installation, maintenance on the entire collection system averaged less than one hour per month, and not a single residential septic tank needed pumping.

Steamboat, Oregon

In 1999, an Orenco Sewer, followed by an innovative textile filter treatment system, was installed in Steamboat, Oregon, to replace a leaking gravity system along a wild and scenic river. Annual operating costs have been reduced by 72%![8]

Mobile, Alabama

In the 1990's, South Alabama Utilities realized they needed to provide wastewater services to new subdivisions or risk losing customer share. Since then, SAU has installed Orenco Sewer systems serving 47 subdivisions. When all the developments are built out, SAU's collection systems will handle more than 2,000 homes.

SW Barry County, Michigan

To preserve water quality, this Michigan lake county has had an effluent sewer system since 1993. The system includes more than 1200 Orenco units. Orenco's units have worked so dependably that hundreds more have since been ordered.

"Progressive AE has been designing and observing the installation of STEP systems for small Michigan communities for over 15 years. And we've used the Orenco Systems STEP unit exclusively for more than 10 years."

William J. Parker, P.E.
Progressive AE

8. *Interview with Jim Van Loan, owner of the Steamboat Inn, April 20, 2000.*

Orenco® Sewers

Frequently Asked Questions

Effluent Sewer Systems have been in use for several decades. During that time, the technology has improved so dramatically that effluent sewers are highly recommended by the U.S. Environmental Protection Agency, as well as by engineers, academics, and public agencies.

Who takes care of the system?

The community or a utility will own the system and provide centralized maintenance. Orenco's VeriComm® Monitoring System can provide automated, round-the-clock, computerized supervision. Orenco provides training for system operators and engineers.

Will there be lots of service personnel on people's property?

Service time per home is minimal. Utility meter readers come by far more frequently.

Do pumps have to be repaired or replaced frequently?

No. With normal maintenance and cleaning, our pumps last more than 25 years.[9] Plus, the electricity to run them averages about $1.50 per month.[10]

Will the system smell bad?

No. Not if properly designed and installed. Any wastewater collection system will smell if not properly designed and installed.

I've heard stories about these systems failing. Are they true?

Orenco Effluent Sewers work well. Solid engineering, proper equipment, and attention to detail ensure that. With any type of sewer system, poor engineering, substandard equipment, or sloppy installation can cause problems. Orenco Effluent Sewers have a well-documented track record of success.

Is the underground tank hard to take care of?

No. We require watertight tanks, and most need pumping only once every 10–12 years.[11] Otherwise, they're underground, out of sight and out of mind.

What happens to the solids that accumulate in the tank?

Accumulation of solids occurs slowly because of the digestion process that takes place in a watertight tank. In fact, the tank digests more than 80% of the biosolids.[12] Remaining solids are easily managed through planned pumping schedules

What if something goes wrong with my tank?

Each property has a control panel with an alarm function. Your system's operator will be automatically notified of any alarms. And the 24-hour reserve space in your tank gives the operator time to have a problem checked.

If I have more questions, whom can I call?

Call Orenco at ...
541-459-4449 or toll-free at 800-348-9843.

9. *Elkton, Oregon.*
10. *Run Time = 20 min/day, VAC = 115, A = 12.7, National Average Power Cost = $0.1/kWh.*
11. *Terry R. Bounds, PE. 1995. "Septic Tank Septage Pumping Intervals." Sutherlin, Oregon: Orenco Systems, Inc., 13.*
12. *H. Philip, S. Maunoir, A. Rambaud, and L. S. Philippi. 1993. "Septic Tank Sludges: Accumulation Rate and Biochemical Characteristics." Proceedings of the Second International Specialized Conference on Design and Operation of Small Wastewater Treatment Plants; Trondheim, Norway.*

Orenco® Sewers

Rely on Orenco for System Support

Orenco's innovative solutions to wastewater problems have become state-of-the-art. Our designs appear regularly in engineering textbooks and professional journals, and our engineers are invited to speak around the world. We routinely offer our expertise in the following ways:

Project Delivery

On the front end, Orenco offers design reviews for community systems. On the back end, we provide a variety of asset management services, including O&M protocols and recommendations to optimize financial performance.

Engineering and Technical Support

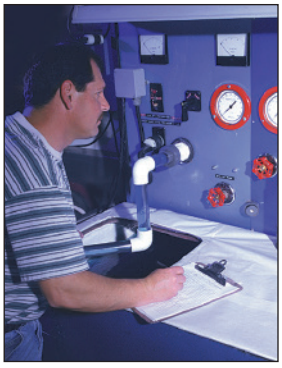
We can provide referrals to engineers who have successfully designed effluent sewers. And we offer a wide range of engineering and technical support services, from permitting assistance, plan reviews, hydraulic analyses, and electronic drawings of products and systems. We also provide plan reviews, bid documents, material specifications, O&M support, and tech support for advanced controls, including telemetry and SCADA.

Training

We offer installation and operation trainings at our headquarters in Oregon, U.S.A., at off-site locations, and via webinars.

Because our team of civil, environmental, mechanical, and electrical engineers work exclusively in the onsite and effluent sewer industries, we're able to offer unmatched technical assistance. When you choose an Orenco system, you'll have the industry leader behind you.

We provide training at our Oregon headquarters and around the country.



Orenco maintains an environmental lab and invests heavily in research.

Our engineers offer unmatched technical assistance. Orenco's engineers and scientists have more than 500 years' experience in the water/wastewater industry.

Orenco® Sewers

Orenco Systems is owned and managed by engineers who develop wastewater systems that work — systems based on sound science. From left to right: Eric Ball, P.E., Jeff Ball, P.E., Hal Ball, P.E., (front) Terry Bounds, P.E.

Defining Sustainable Solutions Since 1981

Orenco Systems has been researching, designing, manufacturing, and selling leading-edge products for wastewater treatment systems since 1981. The company has grown to become an industry leader, with about 300 employees and 300 points of distribution in North America, Australasia, Europe, Africa, and Southwest Asia. Our products and technologies have been installed in more than 70 countries around the world.

Orenco is headquartered at a 26-acre (10.5 ha) site in Oregon, a state that's known for its environmentally sustainable practices.

Orenco maintains an environmental lab and employs dozens of engineers, scientists, and wastewater treatment operators. Orenco's systems are based on sound scientific principles of chemistry, biology, mechanical structure, and hydraulics. As a result, our research appears in numerous publications and our engineers are regularly asked to give workshops and offer trainings.

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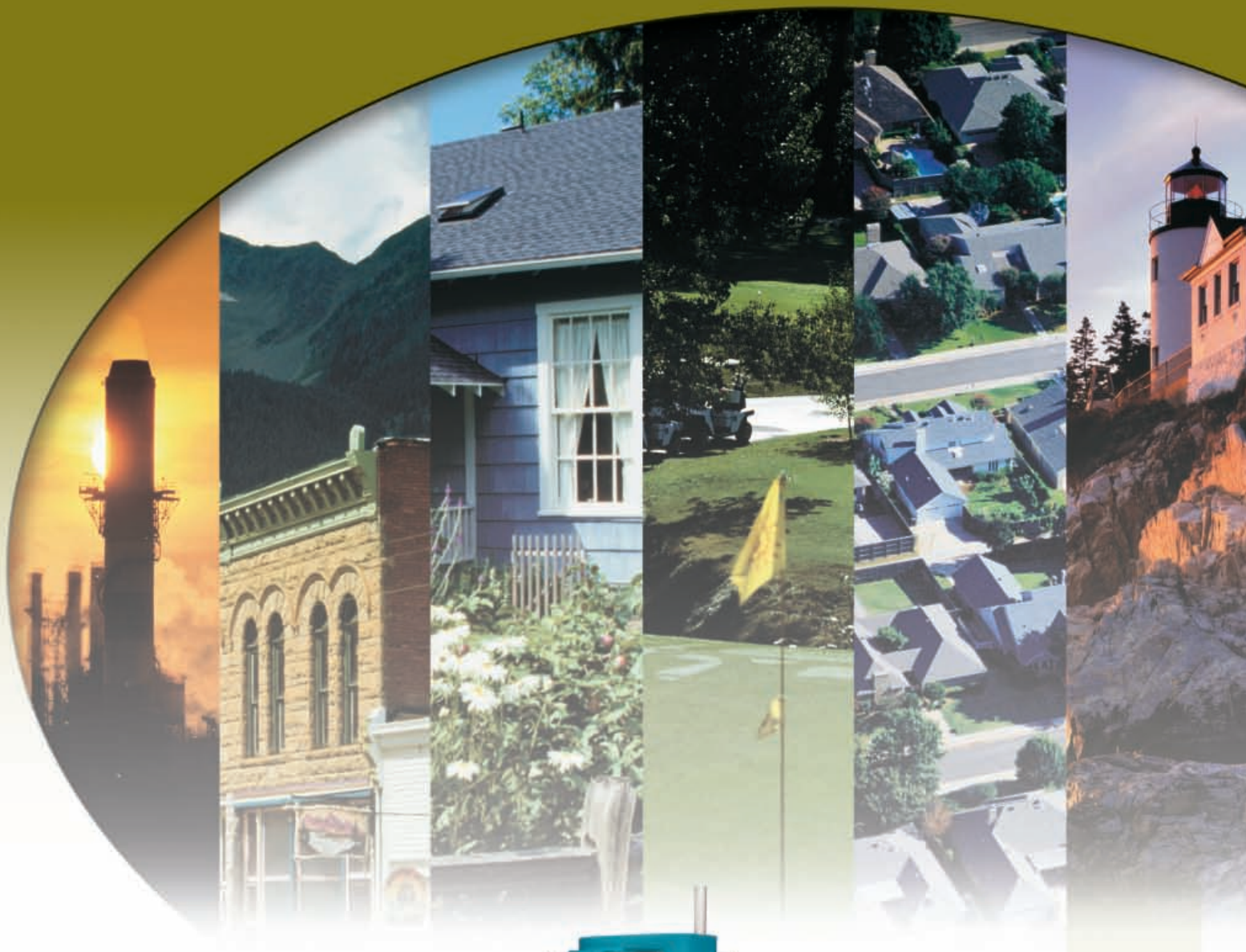
ABR-EFS-1
Rev. 3.1, 03/17

ProSTEP™

Effluent Pumping Systems



for Onsite Wastewater Collection and Treatment

Ideal for:

- Effluent sewers
- Drainfields
- Textile filters
- Sand filters
- Peat filters
- Mounds
- Trickling filters
- Aerobic units
- Wetlands
- Lagoons
- Effluent irrigation
- Other applications

Orenco Systems®
Incorporated

Changing the Way the World Does Wastewater®

1-800-348-9843
orenco.com
vericomm.net

ProSTEP™
Protects, Transports, Filters

More than twenty years ago, Orenco Systems®, Inc. pioneered and packaged the modern filtering pump vault for onsite wastewater collection and treatment. Today, about 150,000 ProSTEP Effluent Pumping Systems are in service all over the world. They transport and filter wastewater from watertight septic tanks and dosing tanks, protecting "downstream" lines, drainfields, and other treatment systems. The pump vault's patented* Biotube® filter has several times the capacity of other filters and removes about two-thirds of suspended solids, on average.

"Easy Access" Design Aids Maintenance

The pump vault's "easy access" design allows service providers to remove the Biotube® filter cartridge without pulling the pump or vault. And the float assembly's quick-release float stem and adjustable float collars make it easy to remove and adjust.

Easy access design

Quality Components Outlast Others

ProSTEP™ Effluent Pumping Systems are superior in quality and outlast other brands. Constructed of stainless steel, thermoplastic, and fiberglass, they're corrosion-resistant and durable, reducing lifetime system costs.

Advanced Controls Available

For a modest incremental cost, advanced control panels are available . . . control panels that give peace of mind to property owners, system designers, contractors, service providers, and regulators. MVP digital programmable panels allow easy, accurate setting of multiple parameters and the use of one type of float for all functions. VeriComm® remote telemetry panels are coupled with the Web-based VeriComm® Monitoring System, which verifies, monitors, records, and communicates system operation round-the-clock, while remaining invisible to the homeowner.

* Covered by U.S. patents 4,439,323 and 5,492,635. Foreign patents pending.

"We've had more than 500 Orenco ProSTEP Effluent Pumping Systems in operation since 1987. They're simple, dependable, and easy to maintain."

Larry Garwood
Diamond Lake Water & Sewer District
Newport, Washington

Unmatched Technical Support

When you specify, purchase, install, or service Orenco products, you tap into a wide range of technical support services.

Distributor Network

Orenco's products are available from about 200 different Distributor locations. Distributors stock products, provide customer service, and help with system design, product takeoffs, ordering, shipping, and more. For a list of stocking Distributors, go to www.orenco.com and click on "Distributor Locator."

Orenco Technical Sales and Engineering

If there isn't a Distributor in your region, Orenco's Tech Sales and Engineering staff provide professional customer service, including plan reviews. When you call our toll-free number for information and assistance, you'll talk to a wastewater specialist with practical experience in effluent pumping system design, construction, and maintenance.

Design Aid CD-ROM

Our Design Aid CD-ROM saves layout and drafting time. The CD-ROM includes more than 200 scaled AutoCAD® and PDF drawings and our exclusive Pump Select™ software that provides fast, error-free hydraulic calculations for pump sizing. It also includes our General Specifications document, as well as media gradation charts for use when designing sand and gravel filters.

Supportive Literature

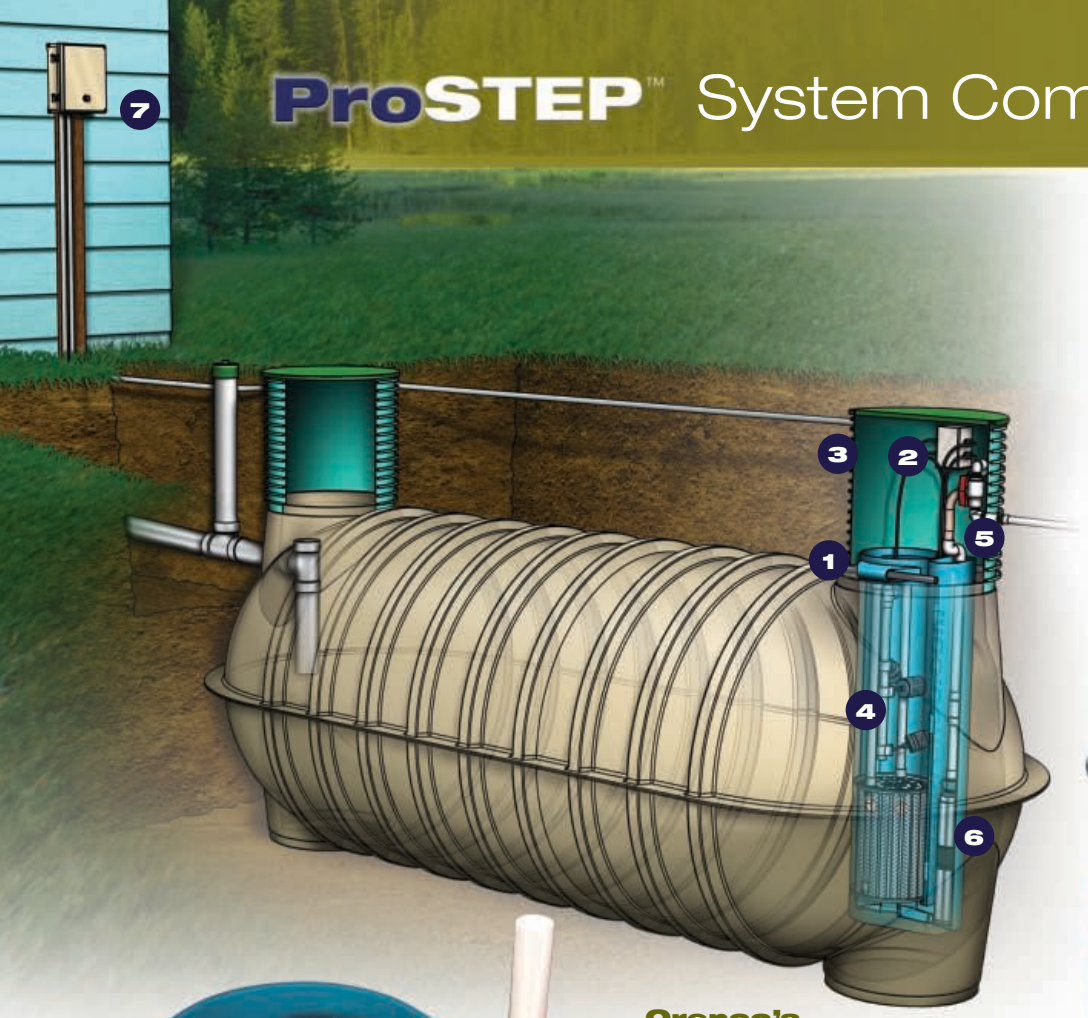
Each ProSTEP™ Effluent Pumping System comes with installation and maintenance instructions. There's also a Homeowner's Manual for the property owner (available in English and Spanish), with Do's and Don'ts for preventive maintenance. Spec sheets, product sheets, and additional color brochures are also available, by request.

Web Sites

Orenco maintains two Web sites

- www.orenco.com includes an extensive document library and lets you e-mail questions and view/print product and system information round-the-clock.
- www.vericomm.net (coupled with our VeriComm® telemetry control panels), allows password-holders to manage alarms and monitor/control their systems remotely. (See our online demo on the home page; no password required.)

ProSTEP™ System Components



Complete, Lightweight Package

ProSTEP Effluent Pumping Systems are a fully integrated package with seven compatible components. No need to shop for parts and pieces. In-tank equipment is lightweight, comes preassembled, and installs neatly into our tanks and most others, saving time and money.

Orenco's Injection-Molded Fiberglass Tanks are 100% watertight and water-tested, and they're strong enough to resist 4-foot (1.2-meter) burial, empty, with groundwater to grade. Available in 1000-gal and 1500-gal sizes (3785 L and 5678 L).

1 Biotube® Pump Vault

- Pump vault comes in standard and custom heights
- Handle assembly aids removal of filter cartridge
- Biotube filter goes longer between cleanings than other brands
- External flow inducer accommodates one or two pumps
- Removable float stem keeps floats in proper positions

2 Splice Box

- Two kinds available:
  - ~ Internal (see drawing at top of page)
  - ~ External (see photo below)
- Advantages of the External Splice Box:
  - ~ Mounts outside riser, flush-to-ground
  - ~ Protects external wiring
  - ~ Easy to access, install, maintain
  - ~ Completely watertight; UL listed, NEMA 6p rated

ProSTEP™ System Components

6 Effluent Pump

- Life of 25+ years with routine cleaning
- Lasts 3–4 times longer than conventional effluent pumps
- Minimum 24-hour run-dry capability
- Lightweight — about 25 lb (11 kg)
- Easy to service in the field
- Noncorroding stainless steel construction
- UL and CSA listing for wastewater applications
- A variety of pump power/sizes available; low power costs
- Five-year warranty available

4 Float Switch Assembly

- Provides level control
- Quick-release stem
- Adjustable float collars
- Variety of floats, float arrangements

3 Risers, Lids, and Accessories

- Allow easy access to tank
- Attractive, nonskid lids
- Strong and lightweight
- Tamper-resistant
- Custom lid imprinting available for 24 in. (600 mm) and 30 in. (760 mm) sizes

7 Control Panel

- Engineered specifically for wastewater applications
- Highest quality “touch safe” components, NEMA 4X-rated enclosures
- “Smart” digital programmable panels and telemetry panels available
- UL and UL-C listed; standard configurations available to meet requirements of NEC Class I, Division 1 or 2
- Three-year warranty

5 Discharge Assembly

- Flexible design eliminates “hard plumbing”
- Typically includes quick disconnect (union or cam-style), ball valve, check valve
- Available for special situations (cold weather, deep bury, etc.)
- Provides easy access

Orenco Systems is owned and managed by engineers who develop wastewater systems that work — systems based on sound science.

Clockwise from left:
Eric Ball, P.E., Jeff Ball, P.E., Hal Ball, P.E., (front) Terry Bounds, P.E.

Carefully Engineered by Orenco

Your health is our priority. At Orenco Systems, we are committed to "Changing the Way the World Does Wastewater®."

Orenco Systems has been researching, designing, manufacturing, and selling leading-edge products for small-scale wastewater treatment systems since 1981. The company has become an industry leader, with nearly 300 employees and with more than 100 distributors and dealers representing most of the United States, Canada, New Zealand, Australia, and parts of Europe. Our products and technologies have been installed in 50 countries, all over the world.

Orenco has a maintenance division and an environmental lab and employs dozens of scientists and civil, structural, agricultural, electrical, mechanical, and manufacturing engineers. Orenco's systems are based on sound scientific principles of chemistry, biology, mechanical structure, and hydraulics. As a result, our research appears in numerous publications, and our engineers are regularly asked to give workshops and offer trainings.

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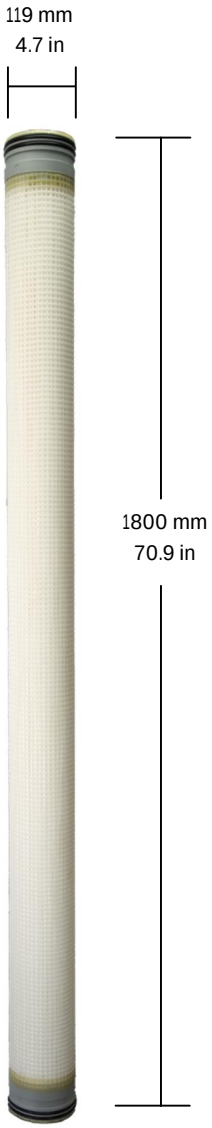
MEMCOR® L20N MEMBRANE FILTRATION MODULE SPECIFICATION

L20N MODULE SPECIFICATIONS

Parameter	Details
Module Operating Process	Pressurized Ultrafiltration
Typical Applications	General Applications
Membrane Type	Hollow Fiber
Filtration Flow Direction	Outside to Inside
Backwash Type	Air Scour with Liquid Backwash
Membrane Material	PVDF (Polyvinylidene Fluoride)
Other Wetted Module Components	Polyurethane, Polyethylene, Polyamide, EPDM
Nominal Membrane Pore Size	0.04 µm
Nominal Membrane Area	34.8 m^2 / 375 ft^2
Nominal Module Length (Overall)	1800 mm / 70.9 in
Nominal Module Diameter (Overall)	119 mm / 4.7 in
Approximate Module Mass	12.0 kg / 26 lb



L20N MODULE OPERATING SPECIFICATIONS

Parameter	Details
Operating Temperature Range	> 0 to 35 ^{O}C / > 32 to 95 ^{O}F (Must not be exposed to freezing conditions)
Temperature Range for Transportation and Storage	Preferred range 5 to 25 ^{O}C / 41 to 77 ^{O}F Allowable range > 0 to 35 ^{O}C / > 32 to 95 ^{O}F (shipment/storage in a temperature controlled container (or reefer) at 20 ^{O}C / 68 ^{O}F recommended). Modules must not be exposed to freezing conditions and must remain moist at all times.
Typical Feed pH Range	6.0 – 9.0 pH Note i
Allowable pH Range for Cleaning	2.0 – 10.0 pH typical Note ii
Typical Maximum Recommended Trans-Membrane Pressure (TMP) in Filtration	140 kPa / 20 psi Note iii
Maximum Allowable TMP at any time	± 150 kPa / ± 22 psi @ ≤ 30 ^{O}C / 86 ^{O}F ± 120 kPa / ± 17 psi @ > 30 ^{O}C / 86 ^{O}F
Maximum Module Housing Operating Pressure	500 kPa / 75 psi
Typical chlorine concentration during cleaning (MW or CIP)	50 – 200 mg/L @ 25 ^{O}C / 50 – 200 ppm @ 77 ^{O}F Note iv
Maximum chlorine concentration during cleaning	1000 mg/L @ 25 ^{O}C / 1000 ppm @ 77 ^{O}F Note iv
Maximum total exposure to chlorine during cleaning	500,000 mg.h/L @ 25 ^{O}C / 500,000 ppm.h @ 77 ^{O}F Note iv
Maximum separate exposure to chlorine in feed or during storage	< 1 mg/L average, < 5 mg/L maximum, pH > 6.5 @ 25 ^{O}C < 1 ppm average, < 5 ppm maximum, pH > 6.5 @ 77 ^{O}F 100,000 mg.h/L @ 25 ^{O}C / 100,000 ppm.h @ 77 ^{O}F Note iv
Maximum separate exposure to chloramines in feed or during storage	< 2.5 mg/L average, < 5 mg/L maximum, pH > 6.5 @ 25 ^{O}C < 2.5 ppm average, < 5 ppm maximum, pH > 6.5 @ 77 ^{O}F 150,000 mg.h/L @ 25 ^{O}C / 150,000 ppm.h @ 77 ^{O}F Note iv

Notes:

i. Exposure to chlorine or chloramines is not recommended in feeds below 6.5 pH.

ii. Occasional brief exposure during chlorine cleans to pH 10.5 is acceptable.

iii. Maximum recommended filtration TMP for a particular application is usually feed dependent. The actual recommended value may vary from the value shown.

iv. Please consult Evoqua Water Technologies for additional guidance on exposure limits and for operation at different temperatures.

Evoqua Water Technologies Membrane Systems Pty Ltd

15 Blackman Crescent

South Windsor NSW 2756

Australia

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Fax: +61 (0)2 4577-0078

Email: memcorasia.au@evoqua.com

Internet: http://www.evoqua.com

AdvanTex® Treatment Systems

AX-Max™

Manufactured by Orenco Systems®, Inc.

This full-sized AdvanTex® AX-Max™ wastewater system was installed at a 50-site campground in the LaPine State Park, LaPine, Oregon, to handle design flows of 7,500 gpd (28.4 m³/day).

Decentralized Wastewater Treatment for Commercial Properties and Communities

Applications:

- Municipal systems
- Subdivisions, apartments
- Golf course developments, resorts
- Manufactured home parks
- Parks, RV parks, campgrounds
- Schools, churches, businesses
- Rest areas, truck stops

Orenco® SYSTEMS

814 Airway Avenue, Sutherlin, Oregon, USA 97479
Toll-Free: 800-348-9843 • +1-541-459-4449 • www.orenco.com

AdvanTex® AX-Max™ Treatment System

Reliable, Energy-Efficient Wastewater Treatment Everywhere!

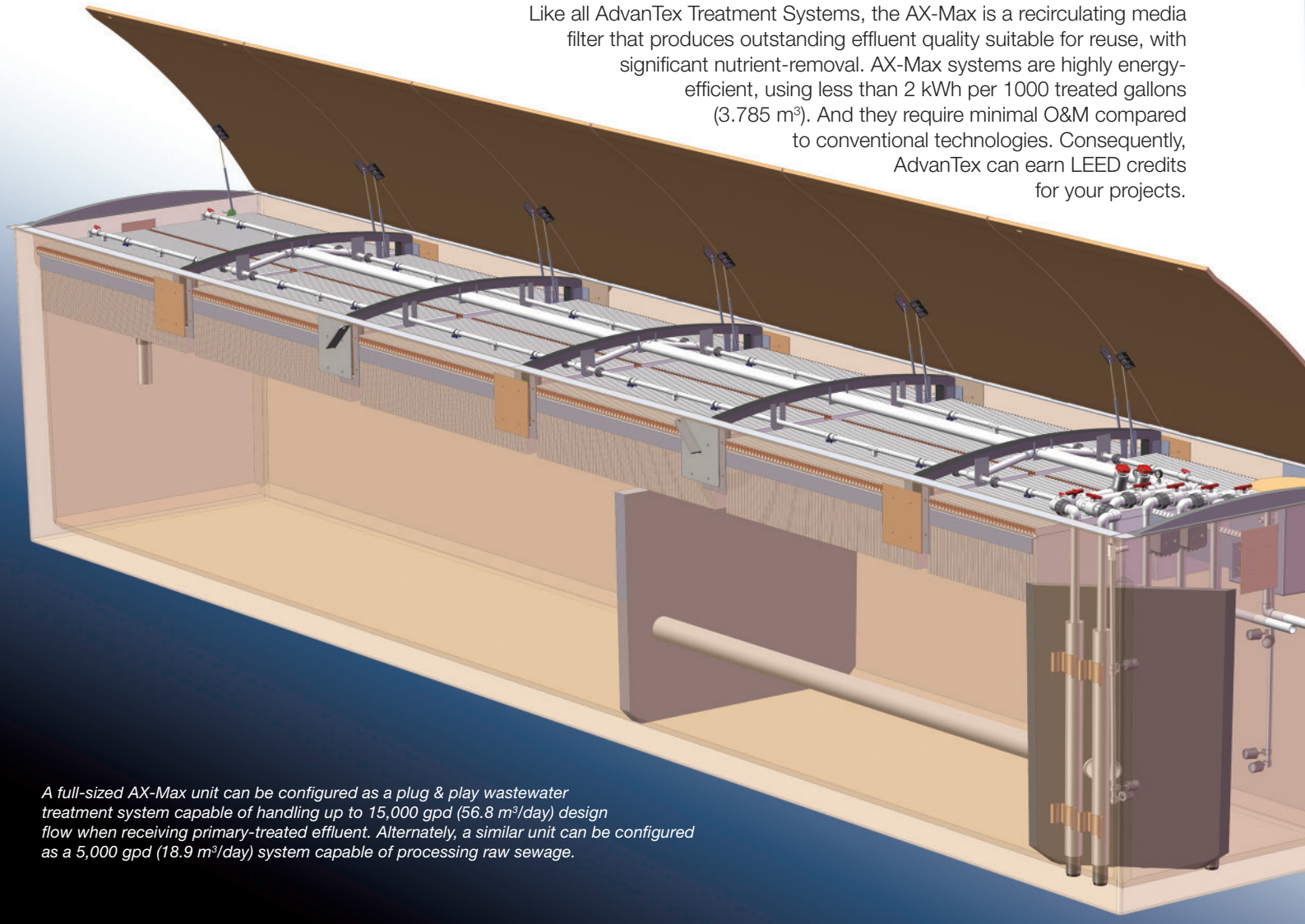
The Yakama Nations Housing Authority in Washington state added five AdvanTex® AX-Max units (background) to its ten AdvanTex AX-100 units, increasing the capacity of its wastewater system by 50%. Photo courtesy of Fextex Systems, Inc.

For more than 15 years, Orenco's AdvanTex® Treatment Systems have been providing reliable, energy-efficient wastewater treatment inside and outside the urban core. AdvanTex textile filter technology has been winning awards and coming out on top in field trials and demo projects, all over the world.

Orenco's newest product in the AdvanTex line is the AX-Max™: a completely-integrated, fully-plumbed, and compact wastewater treatment plant that's ideal for commercial properties and communities. It's also ideal for projects with strict discharge limits, limited budgets, and part-time operators.

A Sustainable Solution for Wastewater Treatment

Like all AdvanTex Treatment Systems, the AX-Max is a recirculating media filter that produces outstanding effluent quality suitable for reuse, with significant nutrient-removal. AX-Max systems are highly energy-efficient, using less than 2 kWh per 1000 treated gallons (3.785 m^3). And they require minimal O&M compared to conventional technologies. Consequently, AdvanTex can earn LEED credits for your projects.



A full-sized AX-Max unit can be configured as a plug & play wastewater treatment system capable of handling up to 15,000 gpd (56.8 m^3/day) design flow when receiving primary-treated effluent. Alternately, a similar unit can be configured as a 5,000 gpd (18.9 m^3/day) system capable of processing raw sewage.

AdvanTex® AX-Max™ Treatment System

Units range from 14'-42' in length. This 21' unit is ideal for lower flows.

Set, Plumb, Wire, and Go

The AX-Max is pre-plumbed and easy to install, so AX-Max projects can meet the tightest deadlines. The entire system — including treatment, recirculation, and discharge — is built inside an insulated fiberglass tank that ranges from 14-42 feet (4.3-12.8 m) in length. AX-Max units can be installed above-ground — for maximum versatility in temporary or variable-flow situations — or in-ground. They can also be installed individually or in multi-tank arrays, treating up to 1 MGD (3,800 m^3/day).

For Every Climate and Condition

AX-Max systems provide excellent treatment anywhere, and they have been installed all over the world. For example, AX-Max systems have been installed at Malibu's famous beach parks and New Zealand's Glendhu Bay campground. Several more were installed in Soyo, Africa, to serve a new hospital and school. Other AX-Max systems have been installed on top of Alaska's frozen tundra and St. Lucia's volcanic rock. Still more have been installed in mining camps from Alberta to Texas and, in the Midwest, at a U.S. Department of Defense demo site.

Benefits

- Containerized, fully-plumbed
- Capable of meeting stringent permit limits
  - ~ Reuse-quality effluent
  - ~ Significant reductions in ammonia, total nitrogen
- Compact and versatile
- Above-ground or in-ground installation
- Easy to set
- Simple to operate
- Low energy usage: <2 kWh per 1000 treated gal. (<2 kWh per 3.785 m^3)*

  ** When treating domestic waste*

Textile Treatment Media

The treatment medium is a uniform, engineered textile. AdvanTex textile is easy to clean and allows loading rates as high as 50 gpd/ft^2 (2000 L/day/m^2) with primary-treated influent.

Effluent Distribution

High-quality, low-horsepower pumps micro-dose the treatment media at regular intervals, and proprietary spin nozzles efficiently distribute the effluent, optimizing treatment.

Telemetry Controls

Orenco's telemetry-enabled control panels use a dedicated phone line or ethernet connection, ensuring 24/7 monitoring and real-time remote control.

AdvanTex® AX-Max™ Treatment System

Carefully Engineered by Orenco

Orenco Systems has been researching, designing, manufacturing, and selling leading-edge products for small-scale wastewater treatment systems since 1981. The company has grown to become an industry leader, with about 300 employees and 300 points of distribution in North America, Australasia, Europe, Africa, and Southwest Asia. Our systems have been installed in more than 70 countries around the world.

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ABR-ATX-MAX-1
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Orenco Systems®, Inc.

Project Summary

Installation photos courtesy of BioSolutions, Inc.

Point Dume State Beach and Preserve, Southern California

In spring, 2011, Los Angeles County needed to quickly upgrade restrooms at Malibu's Point Dume State Beach in time for the long — and busy — Memorial Day weekend. The county's engineer specified three AX-Max units, one for each restroom, and all three were installed in a matter of days. The small footprint of this configuration saved the county valuable space for visitor parking. After disinfection, the treated effluent is dispersed right into the sand. Point Dume is part of a large-scale upgrade of L.A. County beach parks, virtually all of which include AdvanTex Treatment Systems of various sizes and configurations.

Fully Supported by Orenco

AdvanTex Treatment Systems are part of a comprehensive program that includes ...

- Designer, installer, and operator training
- Design assistance, technical specifications, and plan reviews
- Installation and operation manuals
- Lifetime technical support

Distributed by:

MEMCOR® XP "ECONOMY" LOW PRESSURE MEMBRANE FILTRATION SYSTEMS (Including Models E4L10,E6L10,E8L10, E12L10, and E18L20, E24L20, E32L20, E40L20, E48L20)

Typical MEMCOR® XP "Economy" Unit (Model XP-E24L20 shown).

MEMCOR® XP "Economy" PROCESS DESCRIPTION

Evoqua Water Technologies

Document MAS00trp04_04e_XPEcon.docx
Issue 4
Issue Date 22 October 2015

INTRODUCTION

The unrivalled experience of Evoqua Water Technologies in the research and development of membrane filtration and membrane manufacturing processes continues to produce leading edge technology membrane filtration systems that are used around the world.

MEMCOR® XP "Economy" Low Pressure Membrane Filtration Units are pre-packaged and factory tested, ready for site installation. These low cost Units provide high quality, highly efficient and reliable water filtration with a small plant footprint and economic operation.

A MEMCOR® XP "Economy" MF Unit typically includes:

- Memcor Membrane Filtration Modules (either L10 or L20 type) with PVDF homogeneous asymmetric ultrafiltration hollow fibre membranes with a nominal pore size of 0.04 µm;
- Module Housings, made from proprietary moulded Nylon components which assemble to form the pressure casing for each Membrane Filtration Module (see Figure 1 below);
- A Module Array, formed by assembling Module Housings into one or more interconnected rows, with process connections for feed, filtrate and air;
- Pipe, valves and fittings, instrumentation and controls;
- A frame or skid on which the core equipment is mounted.

The MF Unit also requires a Feed Pump. The Feed Pump draws water from the feed supply and pumps it to the Membrane Module Array. On smaller sized Units the Feed Pump is supplied fitted to the MF Unit skid. Larger sized Units require an external Feed Pump. External Feed Pumps are typically supplied and controlled by others.

Each Membrane Filtration Module contains thousands of hollow fibres surrounded by a protective plastic mesh screen and sealed with polyurethane "pots" at the top and bottom. The pots allow filtered water to pass from the hollow inner core, or lumen, of all the membrane fibres to the upper and lower filtrate manifolds of the Module Array. An air manifold is fitted in the bottom of each row of Module Housings. This allows low pressure process air to enter the bottom of each Membrane Filtration Module to scour the outside surface of the membrane fibre bundle during the aeration step of each backwash. Each Membrane Filtration Module is a serviceable filter element that is easily removed from the MF Unit for repair or replacement.

Figure 1

A photograph of a cut away display model showing details of a MEMCOR® Low Pressure Hollow Fibre Membrane Filtration Module, Module Housing, Filtrate Isolation Valve (lower)and other components.

TYPICAL SYSTEM COMPONENTS

The MEMCOR® XP "Economy" Low Pressure Membrane Filtration Unit forms the core equipment necessary for an operational membrane filtration plant. When the MF Unit is installed on site, external equipment, typically supplied by others, is connected to it by means of appropriate termination points. Please refer to the Typical System Process and Instrumentation Diagram and the MF Unit Termination Point Schedule for further details.

Figure 2 below shows the equipment in a typical "Economy" Low Pressure Membrane Filtration process. The main parts of the system are described in the following section.

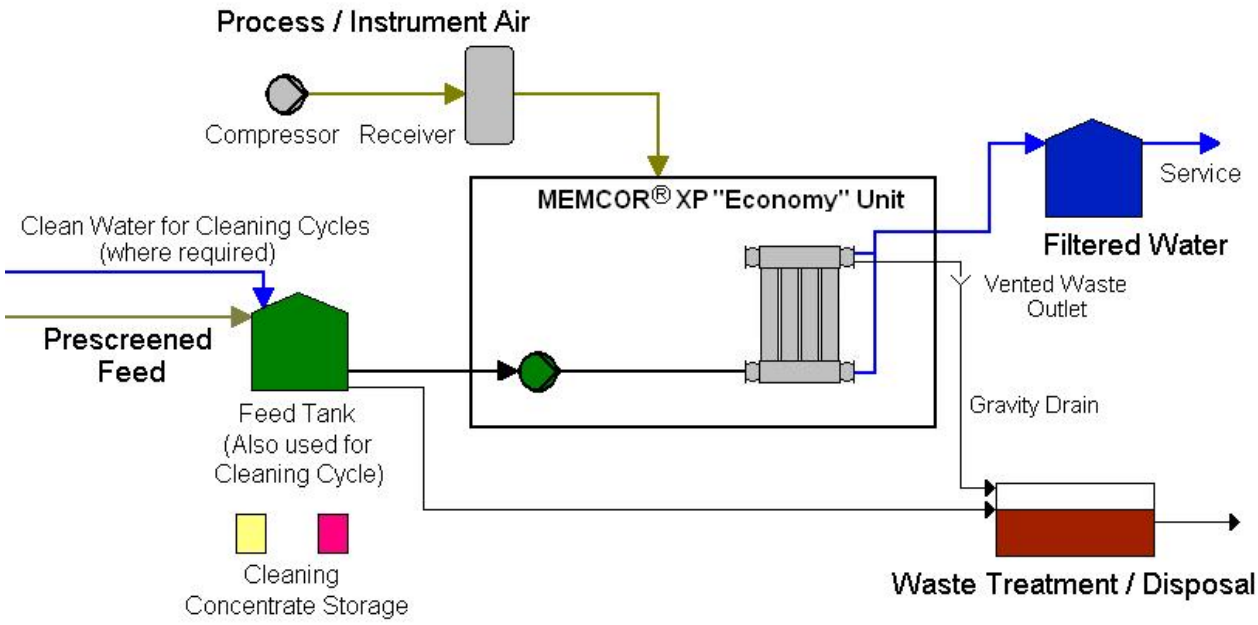


Figure 2

Typical MEMCOR® XP "Economy" Low Pressure Membrane Filtration System
(where Feed Pump is supplied fitted to the MF Unit and Feed Tank is used for CIP)

Feed System

Raw water to be filtered is typically pumped or gravity fed into a feed storage tank. This water must be screened to remove large solids before it enters the MF Unit. Evoqua Water Technologies recommends that an over-capacity screen that is easy to clean is provided for this purpose. A self-backwashing screen should be considered where regular cleaning of the pre-screen will be necessary. Some systems may include other raw water pre-treatment, such as coagulant dosing or pH correction.

Some limitations on feed quality apply, typically including the allowable feed temperature and pH ranges, maximum allowable feed turbidity and maximum allowable exposure to oxidants, such as chlorine. Other membrane or application specific limitations may also apply. Please refer to the relevant membrane filtration Unit and membrane module specification sheets for further details.

Typically, the feed storage tank holds screened raw water that is pumped into the Membrane Modules by the MF Unit Feed Pump. Feed Pumps may be mounted outside the MF Unit frame in larger installations. A level switch or level transmitter in the feed storage tank is generally used to ensure that it is above the minimum level for the Feed Pump to operate. This level instrument is typically used to place the Unit into Standby until the available feed level rises again to return the Unit to service.

For high TDS (Total Dissolved Solids) applications such as sea water, brackish water or waste water, a separate clean water supply must be provided for use during cleaning cycles. This fresh water may be from a town water supply or RO (Reverse Osmosis) permeate, if available, or similar good quality water for cleaning solution make-up.

In a typical system the feed storage tank:

- …should be translucent (allow some light to pass through it) or have a sight gauge fitted, so that the operator can easily observe the liquid level in the tank. For larger systems a Feed Tank level transmitter typically provides tank level indication.
- …should have a screened raw water inlet flow rate at least 15 % higher than the Unit design filtration flow rate.
- …must provide flooded suction to the MF Unit Feed Pump in normal operation.
- …should have a working volume that provides enough water for at least five (5) minutes of filtration with no raw water feeding into this tank.
- …should have a top (tank full) level that is not above the vent that must be provided on the Waste Outlet (TP3). This applies only if the Waste Outlet Valve (AV2) is configured as "Normally Open". If the Feed Storage Tank full level is above the vent and the valve is "Normally Open", then raw water will drain/siphon from this tank to the Waste Outlet when the XP "Economy" Unit is not in service.

Note: *Please refer to your MF Unit Process and Instrumentation Diagram to check the AV2 valve actuator configuration. This level limitation applies to some older systems only. It* ***does not apply*** *on systems in which AV2 has a "Normally Closed" pneumatic actuator.*

- …may have Drop Test "Start Level" and "End Level" Markers so that operating flow rates may be determined by timing the transfer of a known volume of water from this tank. This is not required for systems with a Feed Tank level transmitter.

Please refer to notes in the Cleaning System section below for further design considerations for the feed storage tank.

Filtrate System

In basic MEMCOR® XP "Economy" Unit systems, filtrate flow rate through the MF Unit is controlled by a flexible flow control orifice in the filtrate discharge pipework. In some more advanced systems, filtrate flow control may be performed by an external controller using a flowmeter and, either a variable speed drive on the Feed Pump or a positioning valve in the feed or filtrate line.

Filtrate from the MF Unit usually flows to a local filtrate storage tank or direct to a service outlet pipe. Available filtrate discharge pressure from the MF Unit is usually limited, typically to around 50 kPa (5 metres head) maximum. A level switch or level transmitter in the filtrate storage tank is generally used to monitor for a high level in this tank and place the Unit into standby until the stored filtrate level drops again to return the Unit to service.

Unlike some other membrane filtration systems, the MEMCOR® XP "Economy" Unit backwash process uses filtrate that is stored within the Unit Modules and pipework, so no provision is required for the use of externally stored or pumped filtrate for backwashing.

In typical systems, the MEMCOR® XP "Economy" Unit filtrate discharge line must be built so that the filtrate coming from the Unit can be directed to one of three locations:

- In normal filtration service, the filtrate discharge is connected to the service outlet, usually the filtrate storage tank.
- During cleaning cycle recirculation, the filtrate discharge line is directed back to the feed storage tank (where no separate CIP Tank has been installed).
- In cleaning cycle rinsing, the filtrate discharge line is directed to the cleaning cycle waste disposal point.

Unless additional equipment has been added to automate this function, an operator is required to redirect the MF Unit filtrate discharge to the appropriate point at various times during a cleaning cycle. For smaller systems, these piping connection changes may be made by means of flexible hosing with quick connectors. Typically for larger systems, these connections are made with fixed piping fitted with manual or automated valves, typically butterfly or ball valves. This equipment is site specific and is not included with the MF Unit.

Compressed Air System

Clean, dry compressed air is required for the operation of pneumatically actuated valves and for draining, pressurising and aerating the Module Array at various times in the process. Process air that enters the membrane filtration modules must be oil free.

In the backwash process, low pressure air is blown through connections in the bottom of the Module Array and distributed into all the Module Housings, flowing up into the fibre bundle of each Membrane Filtration Module. This is the Aeration step of the backwash sequence. The air used in this Aeration process must vent freely to atmosphere at a point as close as possible to the Waste Outlet termination point on the MF Unit. An open discharge into a large diameter pipe or drain, or alternatively, a vertical tee vent with the top open to atmosphere, is recommended. Please refer to the Typical System Process and Instrumentation Diagram and the MF Unit Termination Point Schedule for further information on the design of this critical outlet.

The compressed air system must be sized to provide all the compressed air needs of the system, in particular, for the air used in the aeration steps of backwash. Process air that enters the Membrane Filtration Modules must be oil free. Evoqua recommends the use of quality compressed air filters, typically cartridge type filter/coalescer units. On larger systems, refrigerated air dryers are recommended. Air lubricators are not necessary. Air receivers should be fitted with automatic drains to remove condensate.

Backwash Waste Disposal System

When the filtrate backwash and aeration steps of the backwash sequence have been performed, the solids that have been loosened from the membrane filtration modules need to be removed from the shell side (feed side) of the MF Unit. The feed pump flushes this "high solids" backwash waste out of the modules using raw water from the feed storage tank. This liquid is discharged via the Waste Outlet termination point on the MF Unit, and should flow freely by gravity, usually to a low tank or sump near the Unit.

Note that the MF Unit waste outlet must also provide venting for the aeration step of the backwash sequence as detailed in the Compressed Air System description above.

Depending on local requirements, backwash waste may need further treatment before disposal or re-processing.

Cleaning System

Before using cleaning system equipment, operators should be provided with safety equipment and trained in its use. This includes Personal Protective Equipment (PPE) such as overalls, aprons, gloves and face-shields and should include an eye bath and safety shower near chemical handling areas. Material Safety Data Sheets for all chemicals used should be readily accessible.

Containers of cleaning solution concentrates should be stored securely, out of direct sunlight and protected from the weather and extremes of temperature. Where cleaning concentrate must be added manually, suitable measuring containers should be provided so that the operator can safely prepare and handle the correct quantity of cleaning concentrate for each cleaning cycle.

Many MEMCOR® XP "Economy" Low Pressure Membrane Filtration Unit systems use the feed storage tank to store the cleaning solution while it is recirculated through the Unit during a cleaning cycle. Other systems are fitted with a separate CIP Tank that is used for this purpose.

In a typical system, the tank used to hold cleaning solution during cleaning cycles:

- …must have a separate clean water inlet connection, where the raw water supply is not suitable for use in making up cleaning solutions (for example, in seawater or wastewater applications).
- …must have a "Clean Level" Marker (or a "Clean Level" setpoint, where a level transmitter is fitted) that sets the cleaning solution storage tank level required for a cleaning cycle. This level should be clearly identified during commissioning. On completion of the backwash at the start of a cleaning cycle, the tank must be drained to this level. This level setpoint should be slightly above the minimum required to allow the MF Unit Feed Pump to operate. This minimises the amount of concentrate to be added.

- …must have a means of returning the filtrate from the Unit to the cleaning solution storage tank. During a cleaning cycle, filtrate is redirected from the filtrate storage tank to the cleaning solution storage tank. This is required to allow recirculation of cleaning solution to take place. This may be done by means of flexible hosing, or may be in the form of fixed site pipework fitted with manual or actuated valves.
- …must have a drain valve fitted as low as possible, so that most of the tank contents can be drained by gravity. This is necessary, in particular, to remove cleaning solution waste from the cleaning solution storage tank after cleaning solution recirculation. This drain valve should be sized to drain the tank in a reasonable amount of time – less than 15 minutes is recommended.

For systems where a higher level of automation is appropriate, typically those using larger MF Unit sizes or multiple MF Units, a separate CIP Tank may be used. Additional equipment may include actuated valves, concentrate storage tanks and concentrate transfer pumps to automate the MF Unit cleaning process. Control and monitoring of these larger systems is the responsibility of others and should be done in consultation with Evoqua Water Technologies to ensure that system design conforms with all MF Unit process requirements.

MEMCOR® XP "Economy" systems use PVDF Membrane Modules. For these systems the cleaning solution is usually made up from Sodium Hypochlorite liquid (swimming pool chlorine), which is normally obtained at about 10 – 15 % active chlorine concentration. In some cases, acid cleaning may be required, typically using citric acid in powder form. Please consult the MF Unit specification sheet or operating manual for further cleaning solution details and recommendations.

Typically in smaller MEMCOR® XP "Economy" systems, cleaning solution concentrates are measured out and added to the cleaning solution storage tank manually by the operator during cleaning cycles. In larger systems, this process is often automated using concentrate dosing pumps. The quantity of each cleaning solution concentrate should be calculated for every system during commissioning. The volume of each concentrate is based on the raw concentrate and the target cleaning solution concentrations, and on the total recirculated cleaning solution volume. In most systems, the recirculated volume is the cleaning solution storage tank volume at the "Clean Level Marker" (or setpoint) plus the MF Unit Module Array and pipework volume plus the volume of interconnecting hoses and pipework.

During commissioning, the actual concentration of each cleaning solution should be measured during solution recirculation after the concentrate has been added (say by pH or chlorine concentration tests) to confirm correct dose. If concentrations are too low, cleaning will be less effective. If concentrations are too high, concentrate is wasted and equipment may be damaged.

MEMCOR® XP "Economy" Low Pressure Membrane Filtration Units use a cleaning regime that uses cleaning solution once only and is then discarded. This prevents the build-up of contaminants that can occur in cleaning solutions if they are used more than once.

Cleaning Solution Waste Disposal System

On completion of the MF Unit cleaning cycle, the used cleaning solution is typically drained from the Unit and the cleaning solution storage tank, to a waste disposal system. In many cases, this is the same disposal system that collects backwash waste. In some systems, a separate cleaning solution waste disposal system is required.

At the end of a cleaning cycle the MF Unit filtrate discharge is redirected from the cleaning solution storage tank to the Cleaning Cycle Waste Disposal Point to drain all cleaning solution prior to rinsing. This may be done by means of a flexible hose or hoses, or may be in the form of fixed site pipework fitted with manual or actuated isolation valves.

The cleaning solution waste disposal system typically provides a means to neutralise or dilute the cleaning solution waste prior to further treatment or disposal.

Instrumentation and Control System

In some MEMCOR® XP "Economy" Membrane Filtration Units, a small Programmable Logic Controller (PLC) is provided as standard. This controls the main functions of the Unit and provides limited monitoring of typical external system components. These include a feed storage level low switch and a filtrate storage level high switch for monitoring the level in these tanks. Some alarms are provided, including Air Pressure Low and Feed Pump Fault. The simple controller used has only limited expansion capacity for connection and programming of additional inputs or outputs or for network communications for specific site requirements. The control panel on these systems provides a small operator interface that shows Unit status and provides controls for selection of operating modes. This control system also provides a means of configuring the MF Unit controller so it behaves like a remote input/output device. This requires hard wired inputs and outputs from an external programmable controller and allows the external controller to operate the skid mounted devices.

All MEMCOR® XP "Economy" Low Pressure Membrane Filtration Units are supplied with basic feed and filtrate pressure indicators (gauges) which are used to monitor operation of the Unit. Feed and filtrate pressure transmitters may be supplied as optional equipment and can be used for more accurate process monitoring.

A Marshalling Panel version is standard for some MF Units and is available as an option for MF Units in which the small PLC is supplied as standard. Please refer to the relevant MF Unit specification sheet to determine which control arrangements are standard and which are optional. The Marshalling Panel version is typically used where additional system automation is required and an external programmable controller is to be used for plant control.

Regular operator monitoring and recording of operating data, at least once per day, is crucial to the successful operation of these Units. The operator should regularly monitor and record the value of the Trans-Membrane Pressure (or TMP) to determine when a cleaning cycle is necessary.

Module Maintenance Equipment

MEMCOR® XP "Economy" Low Pressure Membrane Filtration Units have an integrity testing function that can be used to detect and identify areas of integrity loss.

If system integrity loss is detected in this test, individual module housings can be disassembled one at a time from the module array allowing the hollow fibre membrane filtration module inside it to be removed for inspection and further testing.

Evoqua can supply standard tools necessary for module array maintenance, including special spanners and other equipment that facilitate removal and installation of membrane filtration modules.

Membrane filtration modules that have been removed from the module array may then be integrity tested one at a time in a module test vessel that Evoqua can also supply. The test vessel allows membrane filtration modules to be tested and "pin-repaired" if necessary to restore integrity prior to return to service.

Please consult Evoqua Water Technologies for details of module maintenance equipment (such as standard tools, test vessels and pin repair kits) if required.

MEMCOR® XP "ECONOMY" UNIT OPERATION

A MEMCOR® XP "Economy" Low Pressure Membrane Filtration Unit generally operates automatically to produce high quality treated water and at the same time, concentrates removed solids for further processing or disposal. Please consult the operator manual for detailed operating instructions.

The main operating states or sequences of the Unit are described below. For systems using an external controller, such as those using MF Units fitted with Marshalling Panels, the operating states and operator monitoring and controls, may vary slightly from these descriptions.

"FILTER" MODE

"Filter Mode" may be selected through the operator interface provided another mode (such as a cleaning cycle or a Pressure Decay Test) has not been selected, the air pressure switch is on and feed is available.

Filtration

When "Filter Mode" is selected the Feed Pump starts to fill the Unit with water from the Feed Storage Tank. Once the feed side of the Module Array has been filled, the Waste Outlet valve at the top of the Module Array is closed. This pressurises the Module Array, causing the filtrate side of the Filtration Modules and the filtrate pipework to be filled with filtered water. Usually the Feed Pump then continues to operate, forcing water through the Hollow Fibre Membranes and discharging filtrate to service at the flow rate controlled by the flow control device.

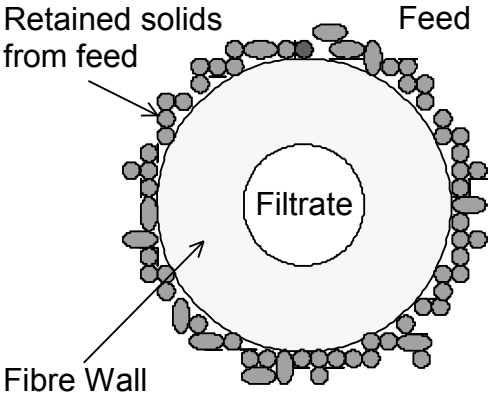
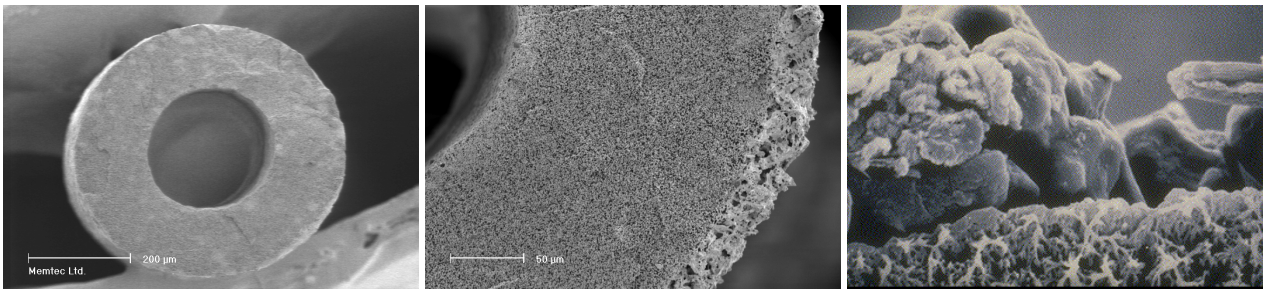


Figure 3 (Right)

A sectional view through a typical hollow fibre membrane during filtration.



(a) *(b)* *(c)*

Figure 4

Electron micrographs of typical MEMCOR® hollow fibre membranes: (a) sectional view enlarged about 200 times, (b) close-up of membrane cross-section with outer fouling layer visible, (c) enlargement of interface between fouling layer and membrane.

Backwashing is performed at preset time intervals in "Filter Mode". A Backwash will be automatically initiated based on the preset time value (typically after 20 minutes of filtration) and the total filtration time that has elapsed since the last Backwash. The total elapsed filtration time since the last Backwash is retained by the controller even through a power cycle.

Backwash

As feed passes through the membrane barrier, a filter cake builds up on the membrane surface, increasing the resistance to flow. The key to the efficient operation of low pressure membrane filtration is the patented Memcor backwash process.

This process uses low pressure aeration to scour and agitate the hollow fibre membranes and, when combined with a short, compressed air driven reverse flow of filtrate, removes the retained solids from the membrane fibre surfaces. Raw feed water is then used to flush the concentrated backwash waste from the Unit to the waste outlet for disposal. The filtrate side of the Modules and pipework is then refilled and the Unit then returns to filtration service. Some air usually flows into the filtrate discharge line during this filtrate fill step.

The control system initiates an automatic Backwash at fixed intervals, typically every 20 to 30 minutes of filtration (depending on feed quality). The Backwash cycle usually takes about two minutes to complete.

Standby

While operating in "Filter Mode" the feed storage tank level and the filtrate storage tank level are usually monitored by means of level switches or level transmitters. If the feed storage tank level goes low, or if the filtrate storage tank level goes high, the level inputs from these tanks to the Unit controller will automatically place the Unit into Standby. In Standby, the Unit waits for the feed storage tank to go above low level, and for the filtrate storage tank level to drop below high level. When this happens, the Unit returns to service, performing a flush sequence and then resuming filtration.

"CLEAN" MODE

The MEMCOR® XP "Economy" Unit Backwash process is very efficient at keeping the Membrane Modules clean. However, depending on raw water quality, a small residual of organic and inorganic foulants tends to build up on the membrane, increasing the resistance to flow over time. When the build-up of foulants on the Membrane Modules reaches an unacceptable level a cleaning cycle should be performed. In most systems a cleaning cycle will typically be required at intervals of around one to four weeks of normal operation.

Filtration performance, in particular the trans-membrane pressure or TMP in filtration, should be monitored by the operator to determine when a cleaning cycle is necessary. TMP is usually calculated simply by subtracting the filtrate pressure from the feed pressure while the Unit is producing filtrate. Typically a TMP of around 80 kPa to 100 kPa will indicate that a cleaning cycle is necessary.

> *Note: If the feed and filtrate pressure sensors are mounted at different heights on the MF Unit, the static head difference should also be taken into account in the TMP calculation.*

As the cleaning cycle also helps to reduce and minimise organic growth and helps to disinfect the system, cleaning may also be initiated simply on an elapsed time basis, such as once per month or every six weeks, even before the filtration TMP reaches a high level. This is a particularly useful strategy to maintain cleanliness in potable water systems.

MEMCOR® XP "Economy" Units often use a manual cleaning cycle. An operator must be present during the manual cleaning process to disconnect and reconnect hoses or to operate valves and to add cleaning solution concentrate at the appropriate time. Other systems have additional control and monitoring equipment fitted so that an external PLC can automate the whole cleaning process. In these fully automated systems, operator presence may not be required during the cleaning cycle.

MEMCOR® XP "Economy" Units fitted with standard PVDF (polyvinylidene fluoride) Membrane Modules (either L10 or L20 type) are cleaned using Sodium Hypochlorite solution as the primary cleaning regime and acid as the secondary regime. Depending on the type of acid used in the application, an additive such as EDTA (ethylenediaminetetraacetic acid, a chelating agent) or Citric Acid may also need to be added during an acid clean.

Cleaning cycles using the primary cleaning regime are most commonly performed. Depending on the application, a cleaning cycle using the secondary regime may occasionally be necessary if the cleaning efficiency of the primary cleaning regime has diminished.

Please refer to the operating manual for further cleaning cycle details.

For MEMCOR® XP "Economy" Units with a manually operated cleaning cycle, the following sequence of steps is typically followed:

1. **The Operator stops the Unit and prepares the Feed Storage Tank**

   With the XP "Economy" Unit stopped, the cleaning solution storage tank is filled with fresh water suitable for cleaning solution make-up. If necessary, the water inlet to this tank is turned off to prevent the tank from refilling during the cleaning cycle. The MF Unit filtrate discharge line is changed so that filtrate is returned to the cleaning solution storage tank.

2. **The Operator confirms Cleaning Cycle start**

   The operator then starts the cleaning sequence through the operator interface. The cleaning solution storage tank contents are then filtered by the MF Unit for a preset time. The Unit then performs a backwash to remove excess solids and is then filled with clean, membrane filtered water to maximise cleaning efficiency.

   The Unit then usually waits for operator confirmation to proceed.

3. **The Operator drains the cleaning solution storage tank to the "Clean Level" Marker or setpoint**

   The operator then opens the cleaning solution storage tank drain valve until the level in this tank drops to the "Clean Level" Marker or setpoint. This minimises the amount of concentrate that must be added to achieve the target cleaning solution concentration.

4. **The Operator resumes the Cleaning Cycle then slowly adds concentrate**

   The operator then resumes the cleaning sequence at the control panel. The MF Unit then starts to recirculate the liquid in the cleaning solution storage tank through the Unit and back to the tank. The operator carefully adds the required amount of cleaning solution concentrate to the cleaning solution storage tank while recirculation takes place.

5. **Cleaning Solution Recirculation**

   Recirculation of the cleaning solution continues for the preset time (typically 60 minutes) to ensure that it makes contact with all parts of the MF Unit, particularly the Membrane Modules and the filtrate pipework.

6. **Cleaning Solution Soak**

   Recirculation then stops and the Unit is left to soak in the cleaning solution for the preset time (typically 60 minutes).

7. **The Operator drains the cleaning solution storage tank**

   The operator opens the cleaning solution storage tank drain valve. This allows the used cleaning solution to drain to the cleaning solution waste outlet for further processing and disposal.

8. **The Operator redirects the Filtrate Discharge to waste**

   The MF Unit filtrate discharge line is changed so that filtrate is now directed to the cleaning solution waste outlet for further processing and disposal.

9. **The Operator refills the cleaning solution storage tank or switches to feed from the Feed Storage Tank**

   When all the used cleaning solution has been drained from the cleaning solution storage tank, the drain valve is closed and the operator prepares the system for rinsing of the MF Unit.

   Where a separate CIP Tank is fitted this may be filled again with clean water for rinsing. Alternatively, where raw feed is suitable, this may be used for the rinsing steps by changing the system to use water from the Feed Storage Tank.

10. **The Operator resumes the Cleaning Cycle sequence**

    The operator then resumes the cleaning sequence at the control panel. The Feed Pump then starts, drawing water from the appropriate tank and filling then rinsing the MF Unit in filtration mode for the preset time. The rinse waste exits the Unit from the filtrate discharge line, which is still directed to the waste disposal point.

11. **The Operator ends the Cleaning Cycle and Returns the MF Unit To Service**

    On completion of the cleaning cycle, the Unit can be returned to normal service. The filtrate discharge connection is redirected to the normal service discharge point, typically, the Filtrate Storage Tank.

A cleaning cycle will typically take about two and a half hours to perform.

Cleaning Cycle Halted

If a Shutdown Alarm occurs, or if the XP "Economy" Unit is stopped for any reason during a cleaning cycle, the cleaning cycle will be aborted, unless the sequence has reached or has passed the Recirculation step. This is intended to prevent the Unit from being returned to service with cleaning solution in it. The cleaning cycle step and the elapsed time in that step are retained by the controller, even through a power cycle.

If the cleaning cycle is aborted, it will have to be restarted. If the cleaning cycle had already entered Recirculation or a later step of the cleaning cycle when stopped, the cleaning cycle must be resumed. The operator interface can be used to identify progress through the steps of a cleaning cycle.

"PD TEST" MODE

Integrity testing may be used to validate the membrane filtration barrier to ensure consistent treated water quality and maximum availability for the MF Unit. The MEMCOR® XP "Economy" Unit has a built-in integrity testing function called "PD Test" or Pressure Decay Test mode.

Typically, this function is initiated manually. In a Pressure Decay Test, air is used to drain filtrate from the Membrane Filtration Modules and the filtrate side of the system is pressurised with low pressure air, typically to around 100 kPa. The low pressure air supply is then turned off and the rate of decay of filtrate side air pressure can be monitored. System integrity can be related to the rate of pressure decay measured during this test.

If a higher than normal pressure decay rate is measured, the MF Unit integrity test function can also be used to perform a Sonic Test to determine the location of any integrity loss.

A MEMCOR® Sonic Analyser is required to perform a Sonic Test. This device helps to localise a problem Membrane Module, or leaking seal, valve, pipe or fitting by amplifying and filtering the sound of air bubbles within the Unit. A Module or other component in the area likely to be leaking or damaged can then be removed, if necessary, for further inspection and testing.

The Unit is typically off-line for about five minutes while the Pressure Decay Test function is being used. The time taken for a Sonic Test is usually longer and depends on the number of Membrane Modules fitted to the Unit as the Sonic Analyser is normally used to test several locations on each Module Housing.

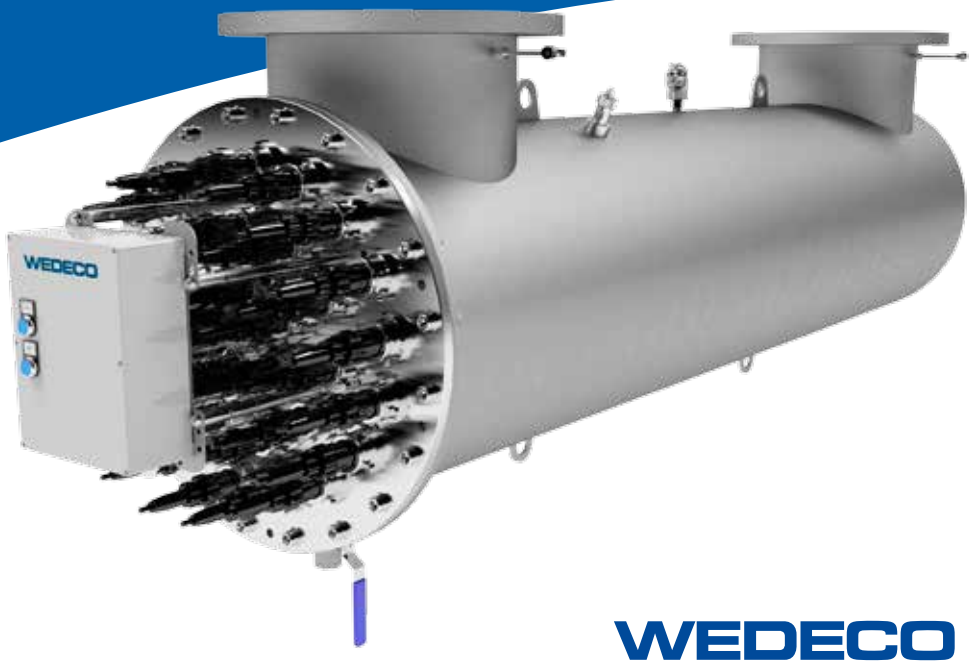
"EXTERNAL CONTROL" MODE

For MEMCOR® XP "Economy" Units fitted with a LOGO! controller, this device is programmed with an "External Control" mode. In this mode the Unit controller behaves like a remote I/O device so that an external PLC may be used to set "External Control" Mode then indirectly control MF Unit devices including its valves and the Feed Pump (where this is fitted as part to the MF Unit skid).

This function may be used to automate functions, such as cleaning cycles, that require operator attendance on standard Units.

WEDECO LBX Series

THE IDEAL UV SOLUTION WHEN WASTEWATER IS UNDER PRESSURE



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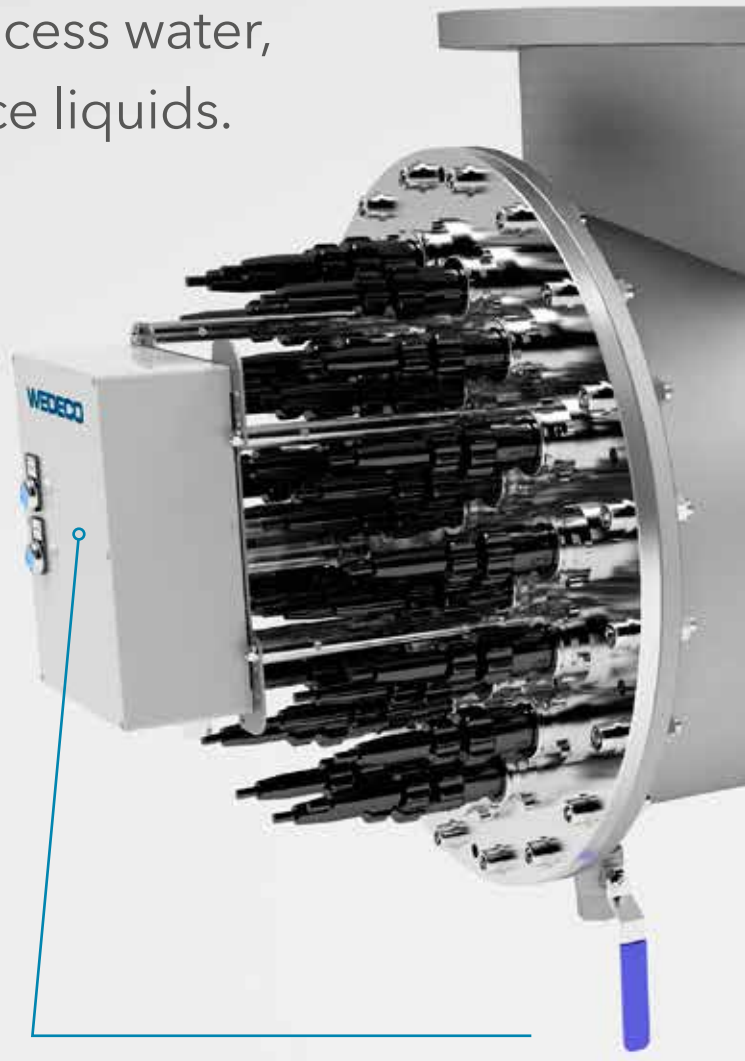
The WEDECO LBX Series is a thousand times proven, energy efficient solution for the disinfection of pressurized wastewater, surface water, process water, and other low UV transmittance liquids.

Validated performance for applications from water to water reuse

LBX systems have been extensively tested to meet the U.S. Environmental Protection Agency's UV Disinfection Guidance Manual (USEPA's UVDGM 2006) and the National Water Research Institute (NWRI) guidelines, including the most stringent California Title-22 Water Reuse standards. The extensive validation envelope allows for proven disinfection performance over a wide range of UV transmittance (UVT) and a variety of target organisms including Adenovirus.

Highest efficiency and adaptability for various municipal and industrial treatment schemes

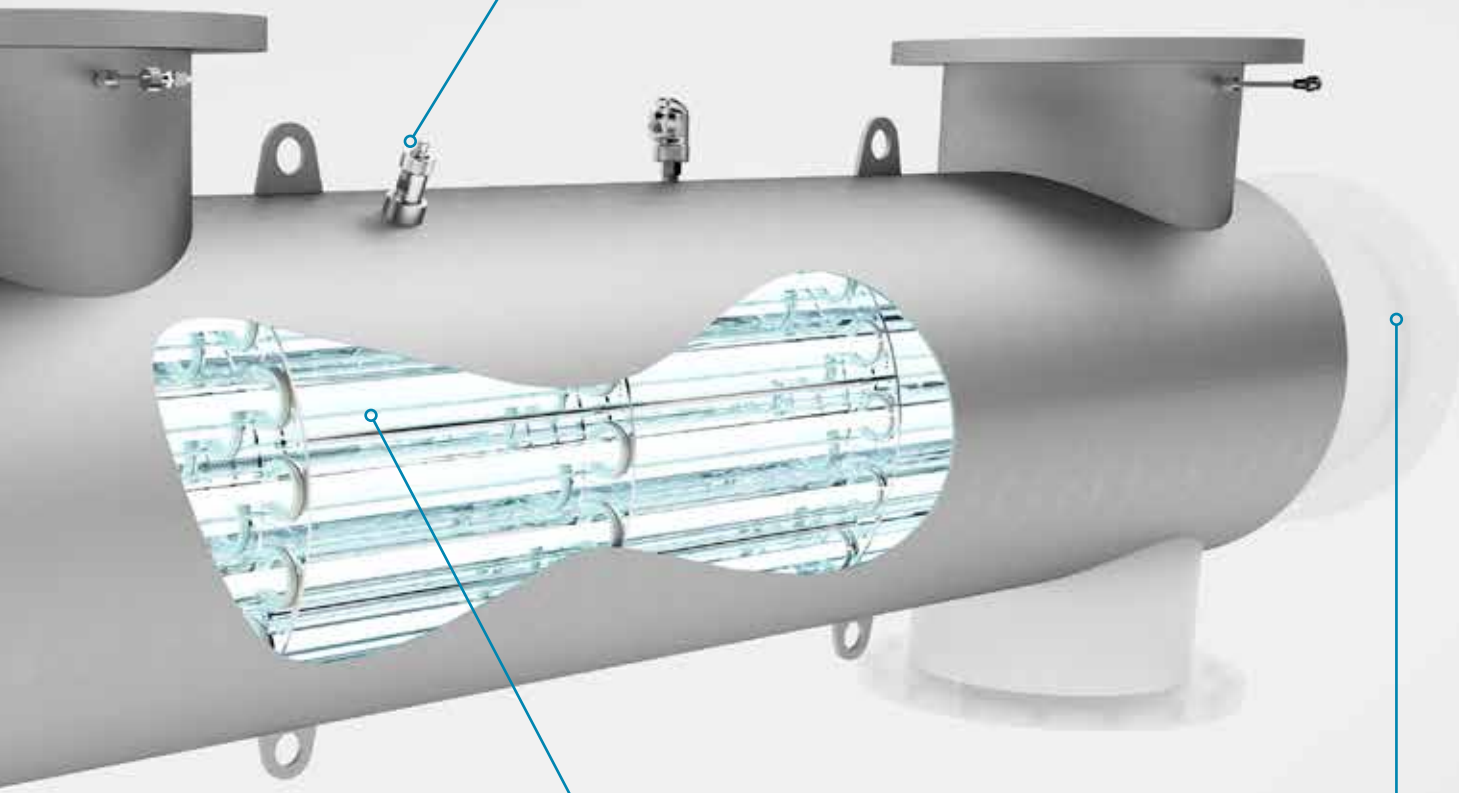
For improved economy and maximum sustainability LBX units employ WEDECO's low-pressure, high-output (LoHi) amalgam ECORAY® UV lamps. With numerous sizes for a wide range of flow rates and extensive options including alternative flange connectors and reactor shapes, cabinet types, various control modes, chemical free wiping system, and SCADA communications, the LBX Series is easily customizable to match specific site requirements.



Reduce Costs
The automatic wiping system maintains maximum sleeve transmittance resulting in peak efficiency. By keeping the sleeves clean, the system uses less energy and lowers operational costs.

Save Energy
UV sensor-based OptiDose™ closed-loop UV control allows energy savings up to 20% by adjusting the output to match water quality and flow in real-time. This avoids over dosage and reduces overall operating cost without compromising disinfection performance.

Simplify Operation
The unique EcoTouch controller unifies all sensor signals, alarms, SCADA connectivity, and OptiDose closed loop control to maximize operator usability.



Improve Performance
Exclusive ECORAY Technology perfectly matches UV lamps and ballasts to deliver the highest efficiency, longer lamp life, shorter warm-up time and excellent dimming mode properties to do the job. More stable and sustainable by reduced mercury content, ECORAY lamps are an environmentally friendly choice that can help reduce your carbon footprint.

Maximize Flexibility
Alternative shapes and flanges maximize the flexibility to fit in site-specific arrangements. L shape units also feature the patented OptiCone flow diverter that optimizes hydraulics no matter of inlet piping conditions.

WEDECO LBX Series FLEXIBLE SOLUTIONS TO FIT YOUR SPECIFIC NEEDS

LBX Series - System Specification													
Model #	**3**	**10**	**20**	**33**	**50**	**90**	**120**	**200**	**400**	**550**	**850**	**1000**	**1500**
Standards	CE					CE, UL, cUL							
UV Transmittance	20 - 98												
Flow Rate (m³/h / GPM)**	2.6 / 11	10.2 / 45	21.7 / 96	29.3 / 129	45.1 / 199	83 / 365	127 / 559	216 / 951	347 / 1528	536 / 2360	717 / 3157	911 / 4011	1346 / 5926
Bioassay Tested	N/A					Yes *	N/A		Yes *	N/A	Yes *		
UV Lamps and Monitoring System													
Power Per Lamp (W) Approx.	80					315							
Number of UV Lamps	1	3	6	8	12	4	6	10	16	24	32	40	60
Lamp Certification	N/A					3rd Party on Aging and UV-C Output							
UV Intensity Monitoring	Germicidal, ÖNORM Compliant												
Dose Pacing (Variable Power)	N/A					Optional							
Individual Lamp Monitoring	Yes					Yes							
UV Reactor													
Protection Class	IP 65					IP 65 / NEMA 4X							
Automatic Wiping System	N/A	Optional											
Reactor Material	Stainless Steel 1.4404 / 1.4435 (ASTM 316L)												
Flange Sizes	R 1 ½"	DN 50	DN 80		DN 100	DN 150 / ANSI 6"		DN 200 / ANSI 8"	DN 250 / ANSI 10"	DN 300 / ANSI 12"	DN 400 / ANSI 16"		DN 500/ ANSI 20"
Reactor Shape	U or Z										L	U or Z	L
Reactor Length (MM / Inch) Approx.	930 / 37					1530 / 60		1540 / 61			2400 / 95		
Operating Pressure (Bar/PSI), Max.	10 / 145	16 / 232				16 / 232	10 / 145						
UV System Contol Cabinet													
Controller	Microprocessor					EcoTouch or PLC							
Common Outputs	System Status, Lamp Status, Alarm Messages, Process Values												
Bus Communication	N/A					Yes							
Protection Class	IP 54					IP 54 / cUL Type 12 (4X Optional)							
Supply Voltage (V / V / Hz)	230 V / 50 - 60 Hz (TN-S-net, TN-C-net)					CE: 400/230 +/- 10%, 50 Hz (TN-S Net) cUL: 480/277 +/- 10%, 60 Hz (5 Wire WYE; L1,L2,L3,N,GND)							
Power Consumption (kW) Approx.	0.1	0.34	0.6	0.76	1.1	1.72	2.38	3.7	5.69	8.33	11.19	13.84	20.57

* Compliant with NWRI and UVDGM protocol

** UV Dose according to the "point source summation" method: 40 mJ/cm²; UVT = 65% per 1 cm at the end of the lamp lifetime.

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Figure 9: Denitrifying Bed Images

19.2. MENA Water FZC

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Ref. RB6875-19

1st October 2019

Woods
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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

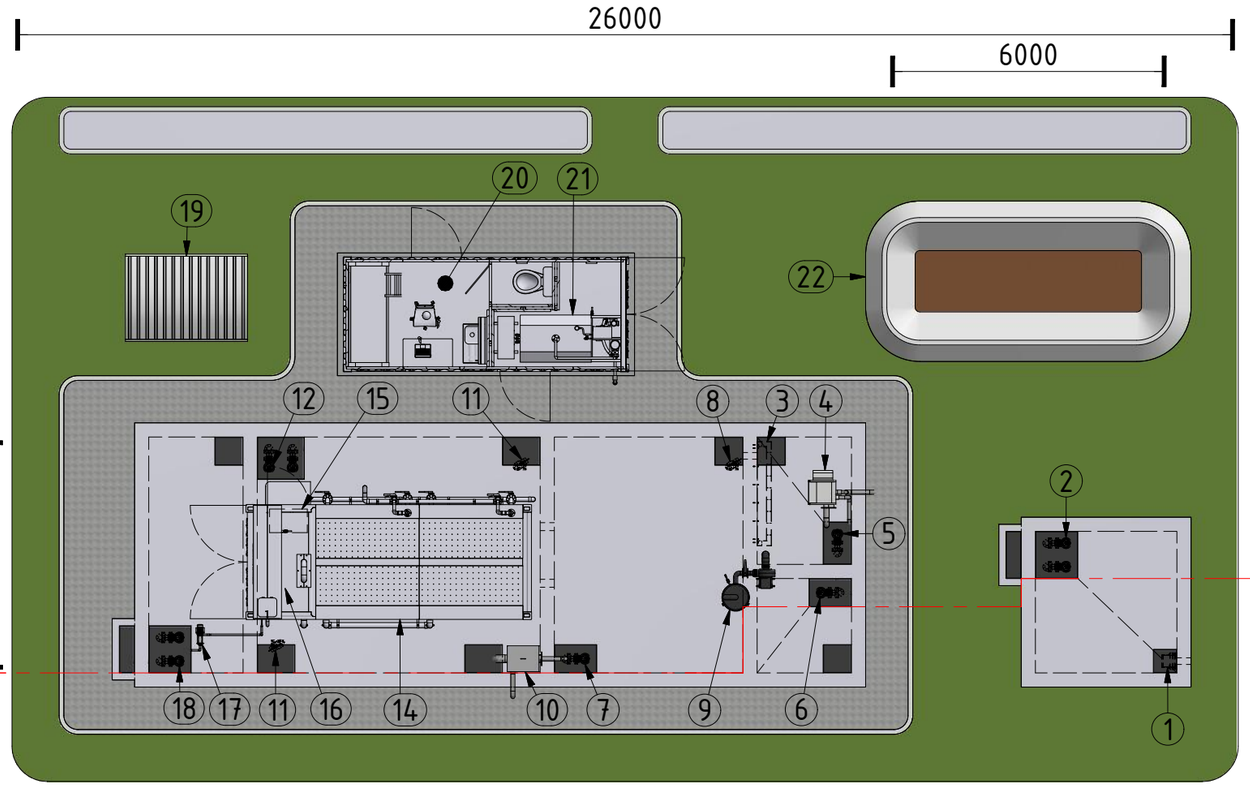
The following items are excluded from our scope of supply at this stage:

- Raw sewage transfer pumps (if required)
- Treated effluent transfer pumps (if required)
- External Process Tanks
- Any civil works

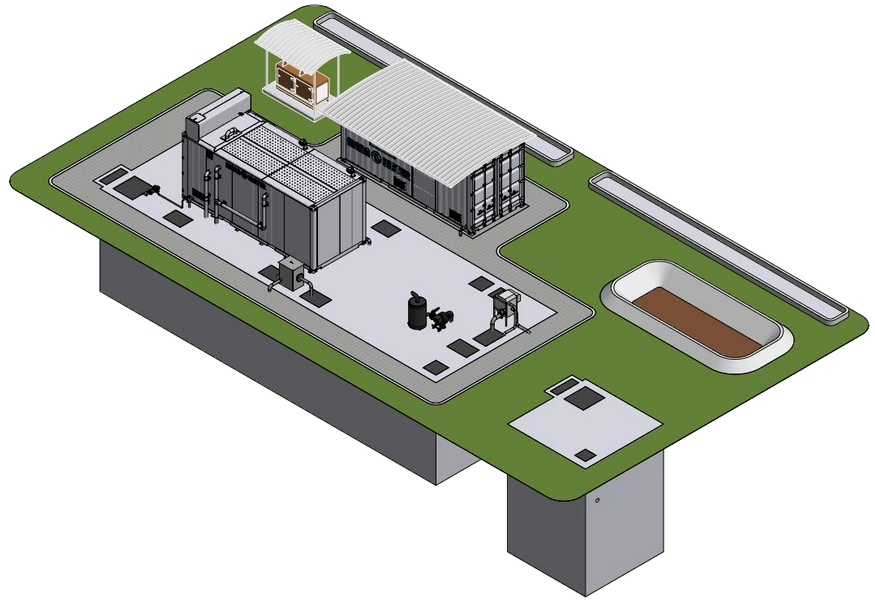
Each container usually comes completely self-contained, including any chemical dosing and control system. It is worth considering a common point for some of these items, to allow a more cost effective and simple approach. The modular system offered for both processes will benefit the staged growth of 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

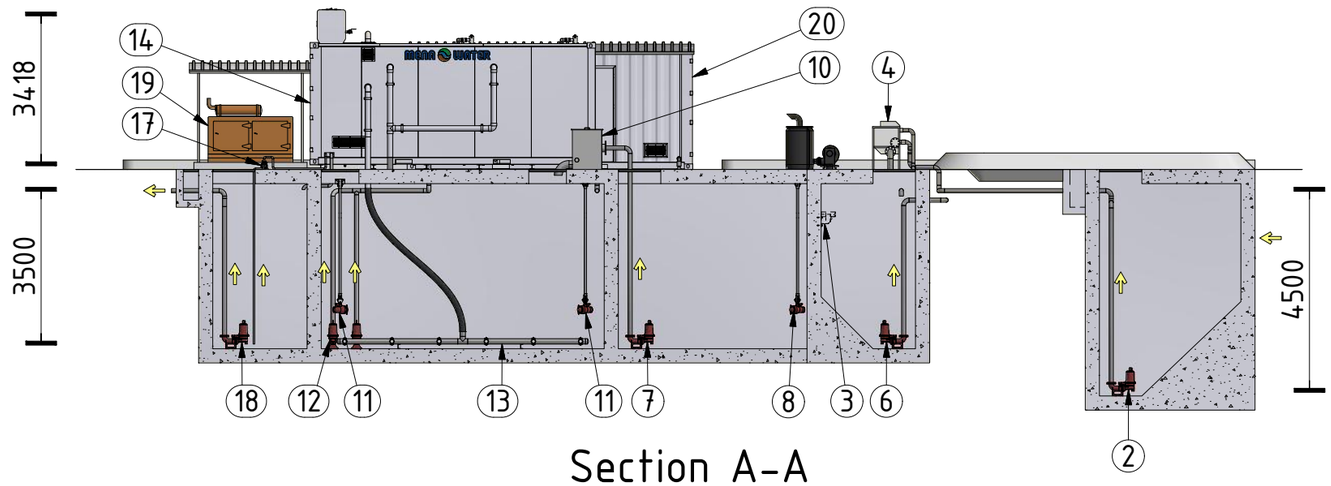
Ross Burrell
Sales Engineer



Plant Layout



Isometric View



Section A-A

Itemref	Quantity	Title / Name, designation, material, dimension etc.	Article no./ Reference
22	1	Sludge Storage Area	
21	1	Sludge Dewatering Unit	
20	1	Operator Room	Optional
19	1	Standby Power Generator (DG)	Optional
18	2	Treated Water Discharge Pumps (TWP)	Optional
17	1	Service Water Pump (SP)	Optional
16	1	Machine Room	Optional
15	1	Control Panel	
14	1	Package Plant MW-MR300-U	
13	1	Aeration Diffusers (DP)	
12	2	Recirculation Pumps (RCP)	
11	2	Aeration Mixers (MX)	
10	1	Secondary Screen (Static)	
9	1	Odor Control Filter (OD)	Optional
8	1	Buffer Tank Mixer (MX)	
7	1	Balancing Pump (BP)	
6	1	Sludge Pump (SP)	Optional
5	1	Grit Pump (GP)	
4	1	Automatic Fine Screen (SC)	
3	1	Grease Baffle (GOB)	
2	2	Lifting Station Pumps (LSP)	
1	1	Basket Screen (BKL)	Optional

Equipment List

Designed by:	Drawn by:	Approved by:	Paper Size:	Date:	Scale:
A.G	J.T.	A.G.	A3	15-12-2016	N.T.S.

MENA WATER

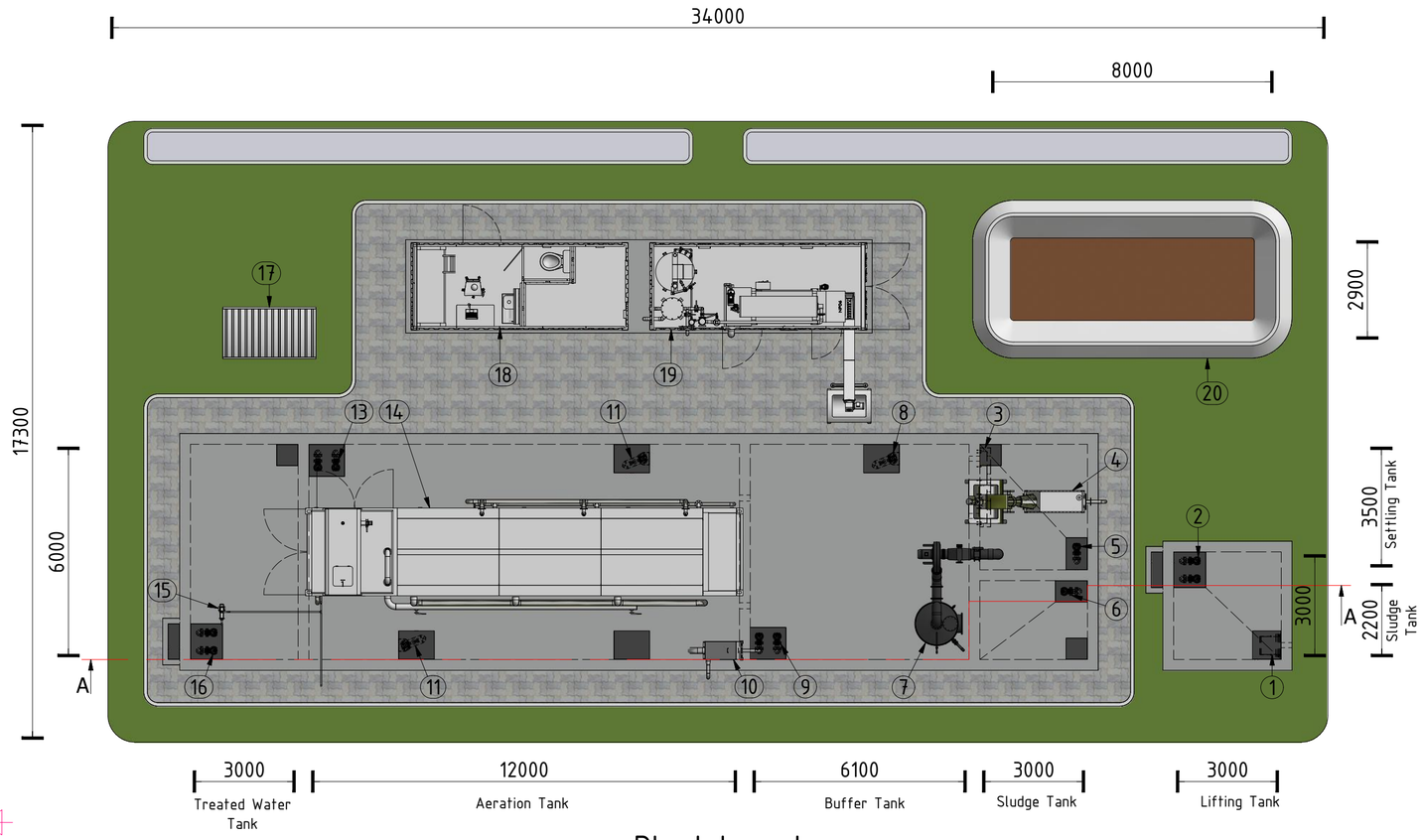
E-mail: info@mena-water.com - Web: www.mena-water.com

Title: MW-MR300-U
Plant Layout

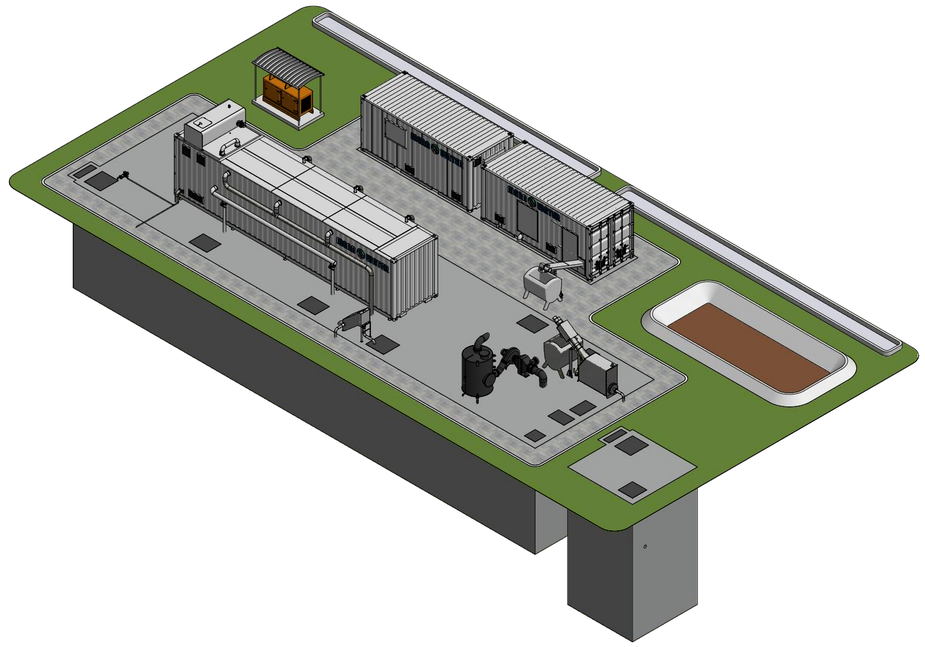
Drawing number: PL-MR300-U-GD-(1)

Edition: V0

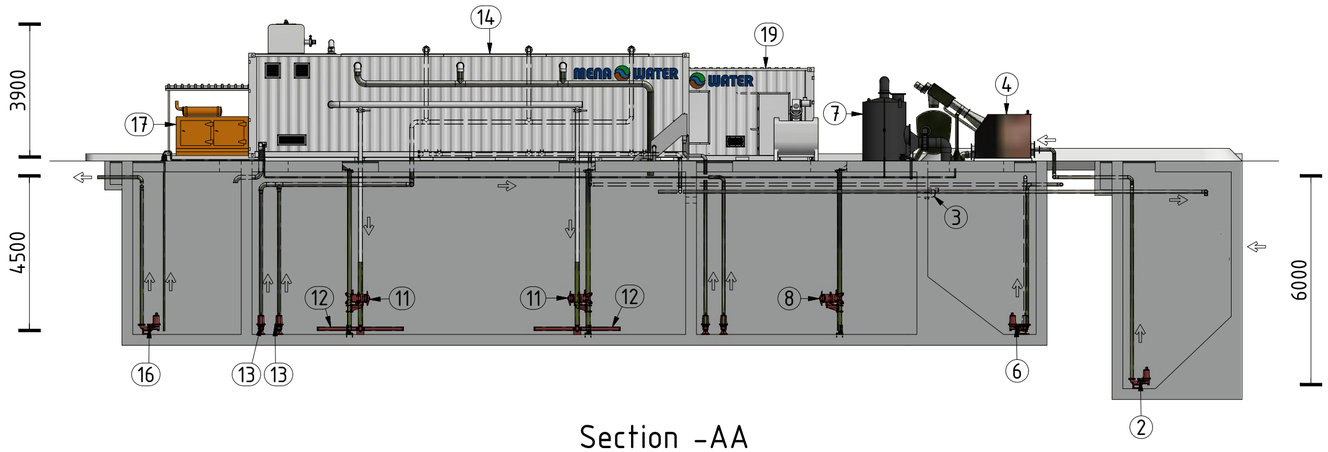
Sheet: 1 / 1



Plant layout



Isometric View



Section -AA

Itemref	Quantity	Title / Name, designation, material, dimension etc.	Article no./ Reference
20	1	Sludge Storage Area	Optional
19	1	Sludge Dewatering Unit (SDU)	Optional
18	1	Office Container	Optional
17	1	Standby Power Generator (DG)	Optional
16	2	Treated Water Discharge Pumps (TWP)	Optional
15	1	Service Waterl Pump (SP)	Optional
14	1	Package Plant MW-MR1000-U	
13	2	Recirculation Pumps (RCP)	
12	1	Aeration Diffusers (AD)	
11	2	Aeration Tank Mixers (MX)	
10	1	Secondary Screen (Static) (ST-SC-1000-1)	
9	2	Balancing Pumps (BP)	
8	1	Buffer Tank Mixer (MX)	
7	1	Odor Control Filter (OD)	
6	1	Sludge Pump (SP)	Optional
5	1	Grit Pump (GP)	
4	1	Screw Screen (SC)	
3	1	Grease Baffle (GOB)	
2	2	Lifting Station Pumps (LSP)	Optional
1	1	Basket Screen (BKL)	Optional

Equipment List

Designed by:	Drawn by:	Approved by:	Paper Size:	Date:	Scale:
A.G	J.T.	A.G.	A2	26-09-2016	N.T.S.

MENA WATER

E-mail: info@mena-water.com - Web: www.mena-water.com

Title: MW-MR1000-U Plant Layout

Drawing number: PL-MR1000-U-GD-(1)

Version: V0

Sheet: 1/1

STEWART & CAVALIER LTD

ENGINEERS

Te Awamutu

Company Brief

PO Box 22
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.

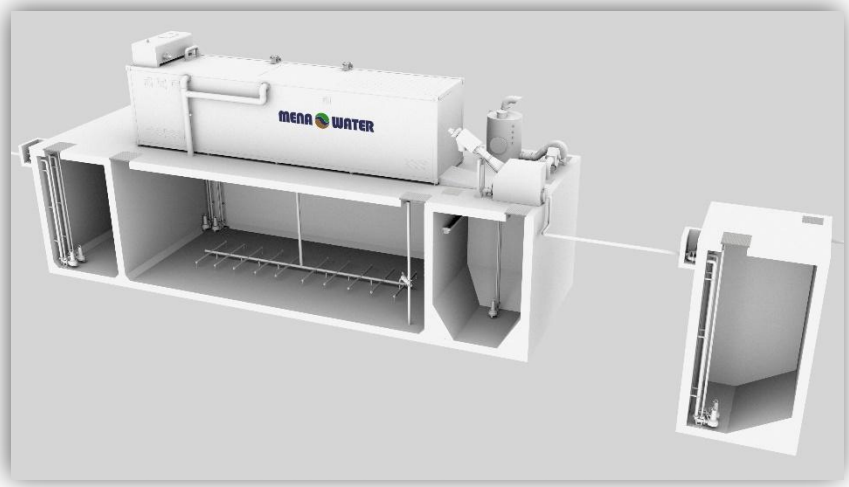
Conventional wastewater treatment plants are very expensive to build and have a lengthy construction time and often are not economical when they only serve a limited number of dwellings and with ever tightening environmental standards, they are sometimes unable to cope and require expensive upgrades.

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.

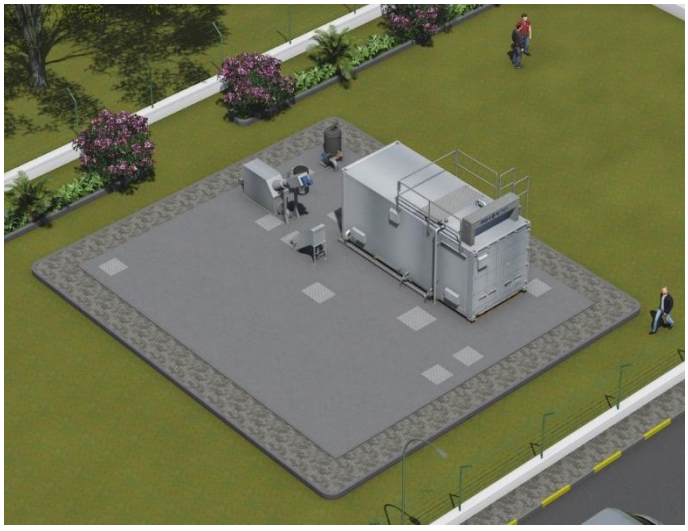
'Whitford Manor Estate' is an exclusive development project with about 150 stand-alone sections, terraced houses and 'Manor House' apartments.

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

MBR Package Plants

for Sewage Treatment

From Sewage to Pure Irrigation Water

Convenient Operation

Clean Effluent Water

Modular System

Wastewater Treatment with MBR Technology

Our system ensures reliable reduction or elimination of polluting load such as suspended solids, organic matter, nutrients and microorganisms within an efficient process combination of biological treatment and membrane filtration. The result is clean and high quality effluent water, which can be re-used as service water or discharged to (even sensitive) receiving waters.

Scope of Supply for Complete Package Plants

MENA-Water offers complete MBR package plants, pre-assembled as containerized system (ISO sizes). This facilitates easy transportation, fast availability and straight start-up of the MBR plant. Included inside the package housing are all main components such as:

- Stainless steel membrane tank with modules and aeration system
- Blowers for aeration tank and membrane scouring
- Permeate pump, backwash and disinfection system
- Process instrumentation, electrical control cabinet with PLC

For optimized performance of the entire plant, all necessary equipment for installation in the external structures is included in our scope of supply:

- Equipment for lifting station and mechanical pre-treatment
- Diffusors, pumps, mixers for biological treatment section
- Equipment for sludge, grit and clean water pumping

If desired, MENA-Water provides comprehensive support for installation, start-up and maintenance activities and can consult anytime via remote monitoring from back office.
Beyond our MBR scope of supply, we can also offer solutions for further plant equipment such as:

- Sludge treatment
- Odor control
- Mobile power generator
- Containerized operator room

MBR Package Plant
MW-MR150

Benefits of our MENA-Water MBR Package Plants

- ✓ Well-proven, complete and clean system solution
- ✓ Compact footprint combined with convenient accessibility
- ✓ Minimum works for site installation and civil structures
- ✓ Full automatic system operation with online monitoring facility
- ✓ Adaptable to future demand due to modular system

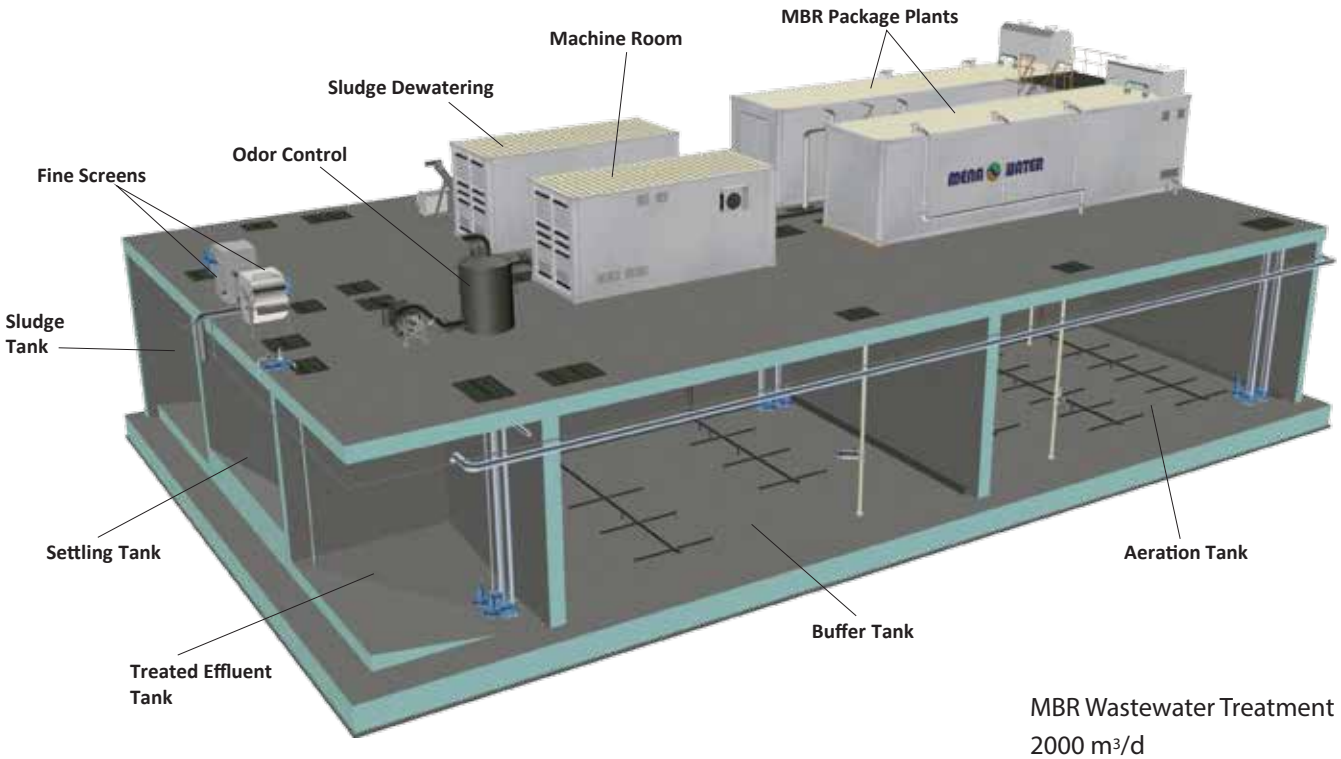
Fields of Application

MENA-Water MBR package plants are capable to handle a wide range of capacities, starting from a daily throughput of a few cubic meters, reaching to some thousands of cubic meters per day. Our plants can be arranged custom-fit to serve your desired wastewater application.

Typical applications are:

- Common municipal sewage treatment
- Independent sewage treatment system for stand-alone operation (hotels / business areas / housing complexes etc.)
- Sanitation solution for outlying locations
- Sanitation solution for close and densely populated residential areas due to minimized smell, dirt and footprint
- Process step for industrial wastewater treatment
- Pre-treatment step for reverse osmosis plants

Standard Sizes	Capacy m^3/d	Population Equivalent	Approx. Footprint
MW-MR10	10	up to 85	8 x 3 m
MW-MR25	25	up to 210	8 x 3 m
MW-MR75	75	up to 625	12 x 4 m
MW-MR150	150	up to 1250	14 x 5 m
MW-MR300	300	up to 2500	14 x 6 m
MW-MR450	450	up to 3750	16 x 7 m
MW-MR600	600	up to 5000	20 x 7 m
MW-MR1000	1000	up to 8300	25 x 7 m



MBR Wastewater Treatment Plant
2000 m^3/d

MENA WATER

OUR AIM - YOUR CONFIDENCE

MENA WATER FZC

P.O. Box: 120881, D3-11, SAIF Zone

Sharjah, United Arab Emirates

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E-Mail: info@mena-water.com

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www.mena-water.de

Member of
German Water Partnership

MBR_En 1017

MENA WATER

OUR AIM - YOUR CONFIDENCE

Mobile Treatment Plant

for Sludge Dewatering

Reduce your Sludge

Pre-Thickened Sludge

Dry Cake

Outlet of Belt Press

MENA-Water - Sludge Handling Plant

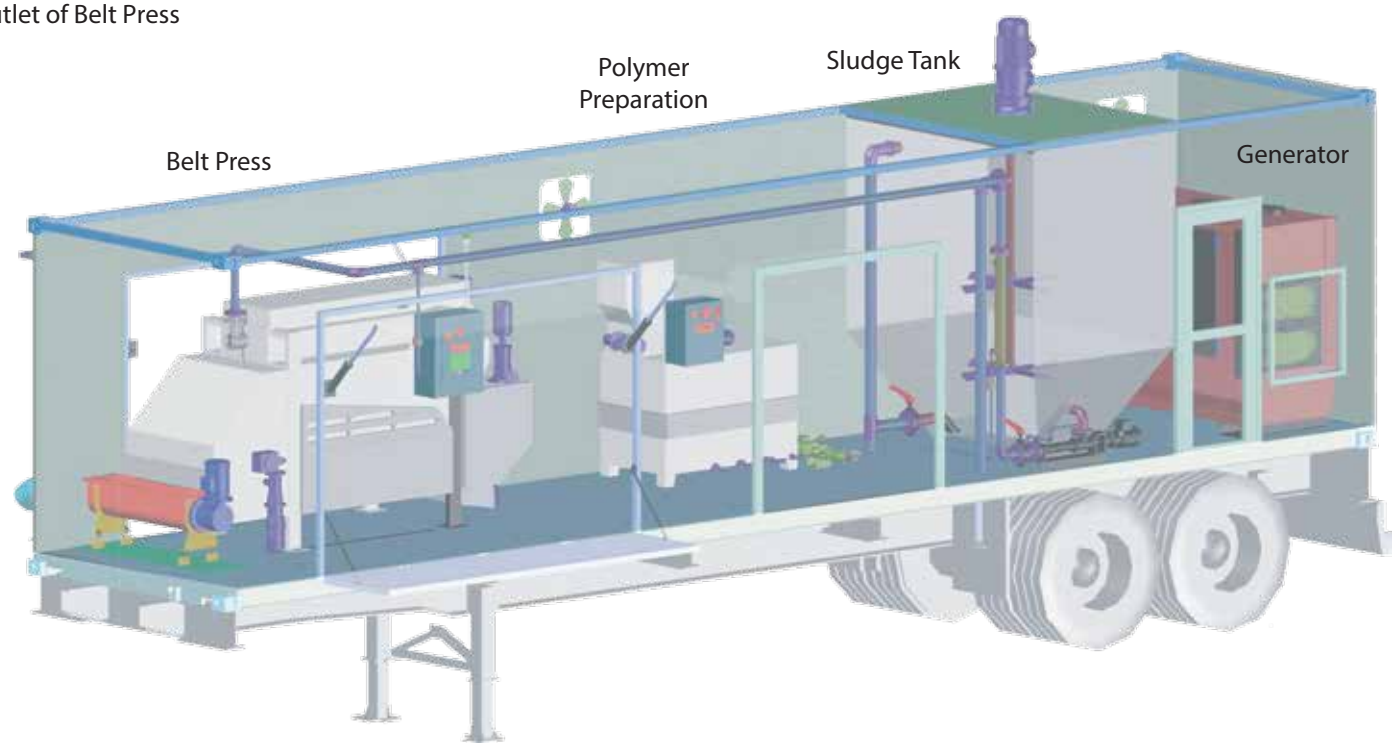
MENA-Water is manufacturer of containerized plants for sludge handling. For every case of application, we offer a solution ready to use mobile or stationary. All process equipment is arranged inside one 40 feet standard container. This enables us to achieve very short realization time. You will get reliable and tested plants and only need plug and play at site. For best performance we use the belt press with pre-thickener completed with polymer preparation, mixer, tanks, pumps included cabling and piping, everything pre-installed.

BELT PRESS

Sludge is pumped, stored and polymer is prepared, dosed and mixed to the sludge flow towards the dewatering machine. Upstream there is the screw pre-thickener which performs the initial solid/liquid separation stage, taking sludge solids concentration from 0.5 - 3% up to 5 - 15 %.

The dewatering in the following belt press occurs firstly in the low pressure zone, then in the wedge zone and finally in the high pressure zone where the filter cake is compressed between the perforated cylinder cloth and the main cloth.

The discharged sludge cake can reach dry solid contents variable between 18 to 30% depending on the type of sludge.



CAPACITIES

- The belt press will handle sludge flow from 2 to 12 m^3 /hour per single unit
- The dry cake will be 18 - 30 % DS due to type of sludge
- High capacities can be achieved through modular arrangement

FEATURES

- Fast delivery and start-up due to the mobile concept
- Quality equipment in stainless steel
- Compact design
- High packing density
- Very good price-performance ratio
- Low maintenance and minimum operation requirements
- Minimum construction work on site and easy to relocate

APPLICATIONS

MENA-Water offers tailor-made containers to treat sludge from different applications.

- Municipal sludge
- Industrial sludge
- For mixed fiber, biological and chemical sludge

Polymer Preparation

Belt Press with Control

SLUDGE PUMPS

Sludge pumps can handle nearly every media from liquid to slow moving media, up to materials including solids.

Sludge Pump

DRY BAG

For small applications we offer this system using drying bags. The very small footprint of the plant allows best placement.

The package plant is completely automatic, with all functions, including sludge conditioning, bag filling and draining cycles, controlled by an integral control panel. The automatic filled bags also act as strong containers for transport of the dehydrated sludge to the disposal point.

Drying Bag Container

Dry Bag

MENA WATER

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Member of German Water Partnership

Slu_En 1217

19.3. Smith & Loveless NZ Ltd

Smith & Loveless, Inc.

14040 Santa Fe Trail Dr.
Lenexa, KS 66215-1284
Phone: (913) 888-5201
Fax: (913) 888-2173

TITAN MBR™ Budget Proposal:

Packaged Membrane Bioreactor
S&L Inquiry # 29322
9/2/2019

Project:

Ohinewai, New Zealand

Consultant:

Woods

Represented by:

Smith & Loveless NZ

Proposal Table of Contents

Understanding Your Treatment System Needs

The TITAN MBR is designed to provide the highest level of treatment with the least amount of operator attention. It is a fully automated system that can be installed in phases to accommodate development growth.

The water characteristics you provided are summarized below:

Flow Conditions	
Flow (Average):	500,000 L/day
Flow (Peak):	1.25 ML/Day
Primary Source / Type:	Domestic
Design Flow Rate:	500,000 L/day

Site	
Elevation:	400 m
Summer Air Temperature:	24º C Max
Winter Air Temperature:	5º C Min
Available Footprint / Area:	N/A

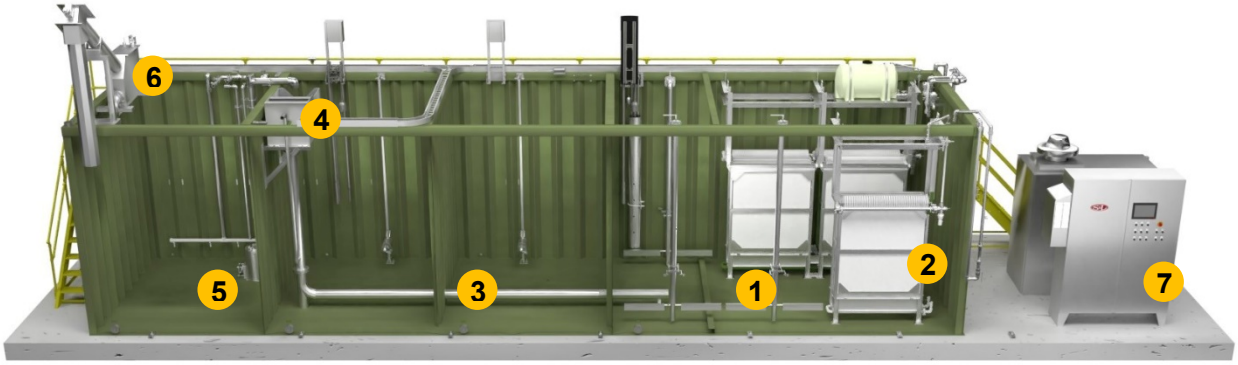
Influent Waste Characteristics	
BOD5:	250 mg/L
TSS:	250 mg/L
TKN:	35 mg/L
TP:	8 mg/L
pH:	6 to 8 pH units
Alkalinity:	300 mg $CaCo_3$/L
Min. Water Temperature:	12º C
Max. Water Temperature:	25º C

Effluent Requirements	
BOD5:	5 mg/L
TSS:	5 mg/L
TN:	8 mg/L
TP:	<1 mg/L
pH:	6 to 8 pH units
Alkalinity (No Less Than):	75 mg $CaCo_3$/L

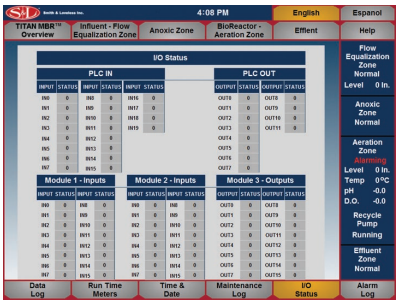
Achieving Results

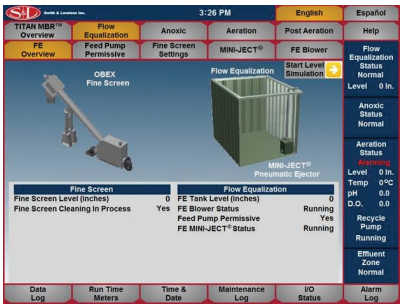
To address the Ohinewai Development's treatment system needs we recommend our **TITAN MBR™** system. This system was designed as two (2) 265,000 L/Day trains and will arrive as four (4) complete sections ready for installation. This arrangement will allow for custom placement on the customer's site. It provides the option of cutting the first phase in half if that is desirable. The system will allow for river or lake disposal with the addition of disinfection.

TITAN MBR™ Features



1. **MBR (Aeration) Zone** (with S&L Membrane Modules)
2. **Submerged S&L Flat-Plat Membranes**
3. **Anoxic Zones for Nutrient Removal with Submersible Mixers**
4. **LIQUIDLIFT™ Automatic Anoxic Recycle System**
5. **Flow Equalization Zone**
6. **OBEX™ Automatic Fine Screening**
7. **QUICKSMART™ PLC Touchscreen Controls**

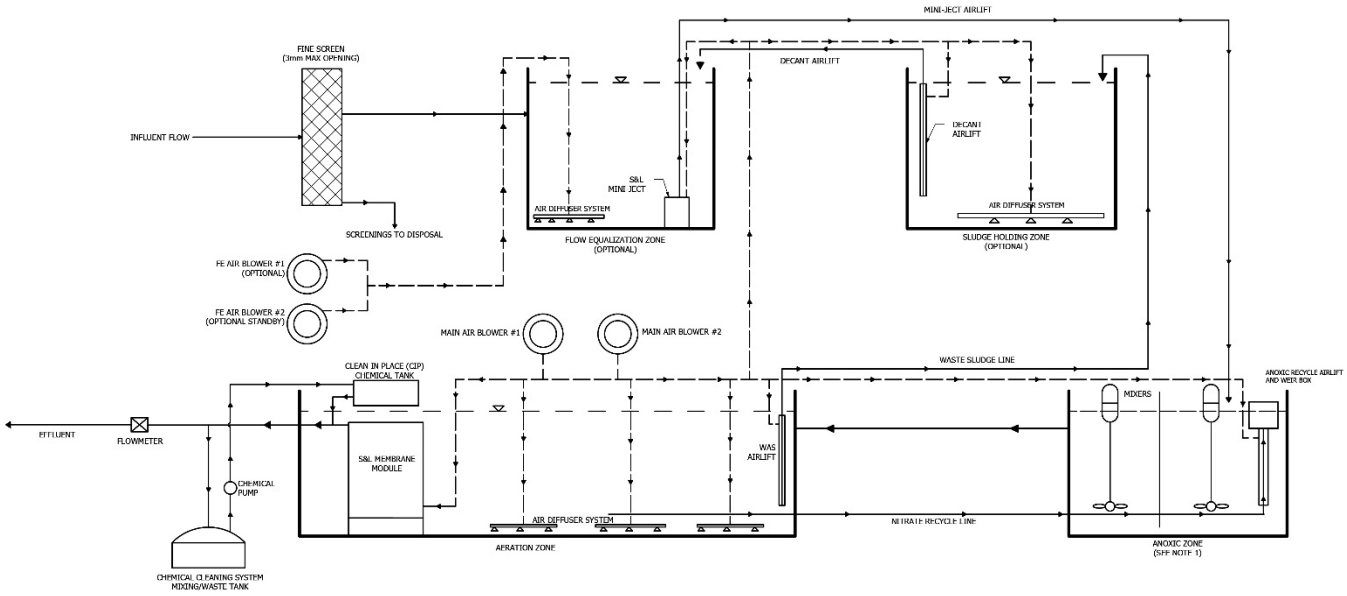




BUDGET PROPOSAL

Online: smithandloveless.com • Phone: 913.888.5201 • FAX: 913.888.2173

Process Flow Scheme & Executive Summary



The treatment plant structure shall be completely factory-built, with bottom, side walls, end plates, partitions and other shell tankage of not less than 1/4” (6 mm) thick structural grade steel plate reinforced to withstand all hydrostatic pressures. The structural reinforcing shall be accomplished by forming the sides, partitions and end plates with V-shapes.

An automatic **OBEX™** Spiral Fine Screen shall be mounted on the optional flow equalization zone. The screen shall consist of perforated metal trough with mesh a maximum of 3 mm opening. The fine screen components shall be of 304 stainless steel with the conveying screw of high tensile steel.

The optional flow equalization zone shall be equipped with coarse bubble diffusers with a Smith & Loveless **MINI-JECT®** pneumatic ejector provided and capable of delivering wastewater into the process train(s).

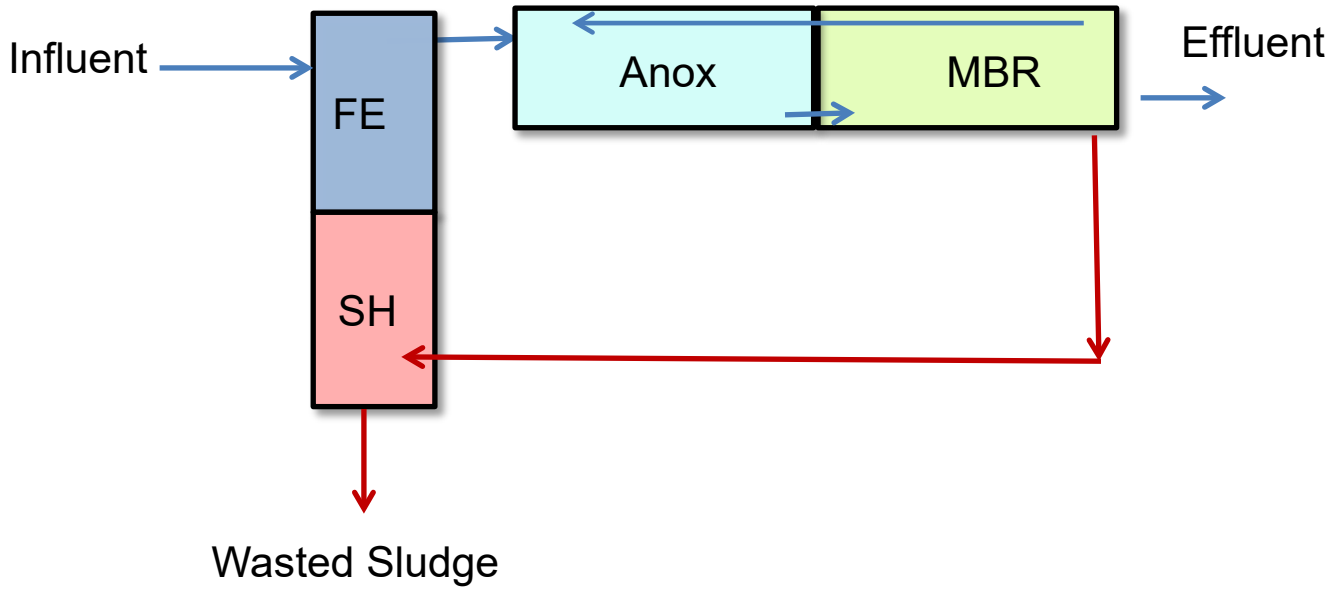
The first step in the process to consist of an anoxic zone properly equipped with submersible mixers with stainless steel guiderails. The anoxic zone to be followed by the aeration MBR process zone. Gravity to be used to pass flow through the membranes. A 316 stainless steel **LIQUIDLIFT™** airlift shall be installed in the first anoxic compartment, capable of delivering recycle from the MBR zone to the anoxic zone. Aeration zones shall be equipped with medium bubble diffusers.

The optional sludge holding zone shall be used for further digestion of wasted sludge and increased operator flexibility.

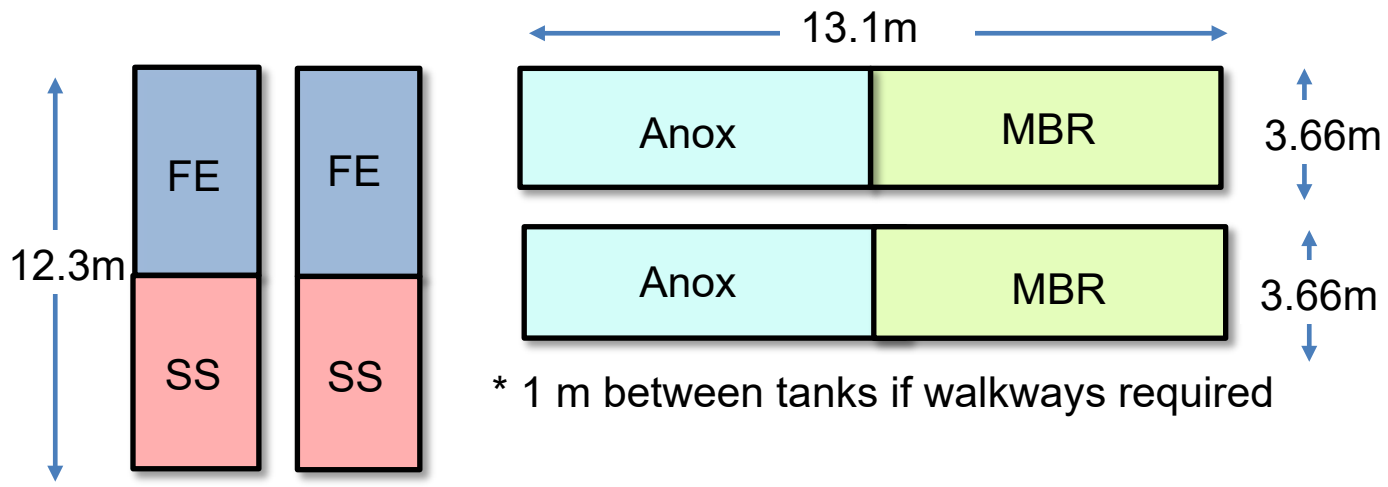
The factory-built **TITAN MBR™** shall have the air supply and wire management system included.

A **QUICKSMART™** PLC Controller shall be included.

Proposed Flow Configuration: Dual Train



Proposed Footprint



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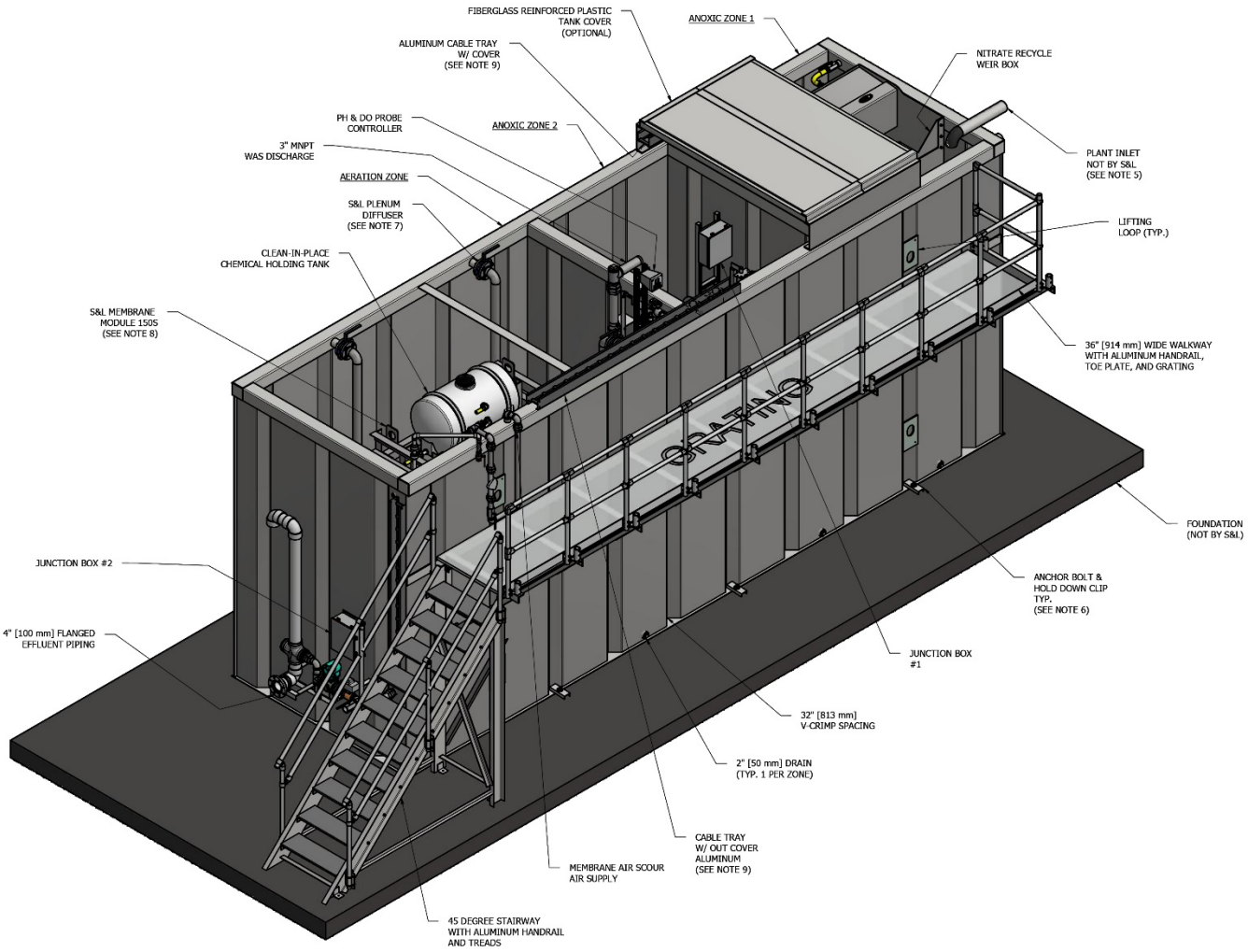
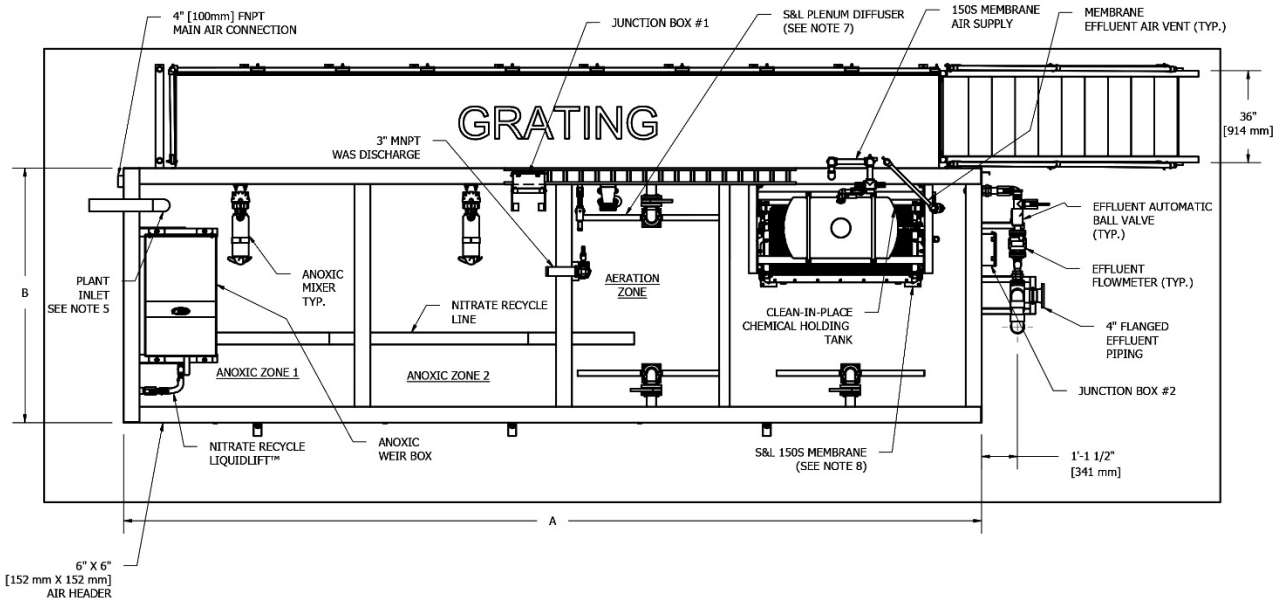
Drawings

Isometric View

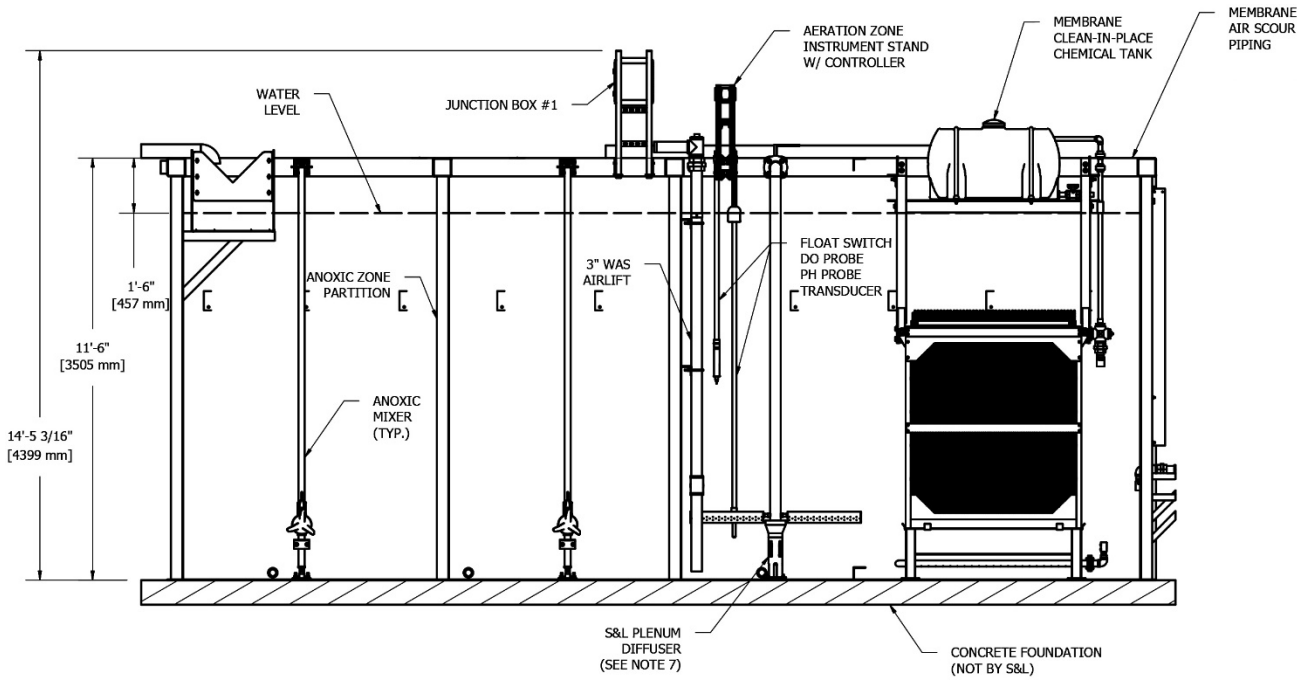


Drawings (Continued)

Plan View

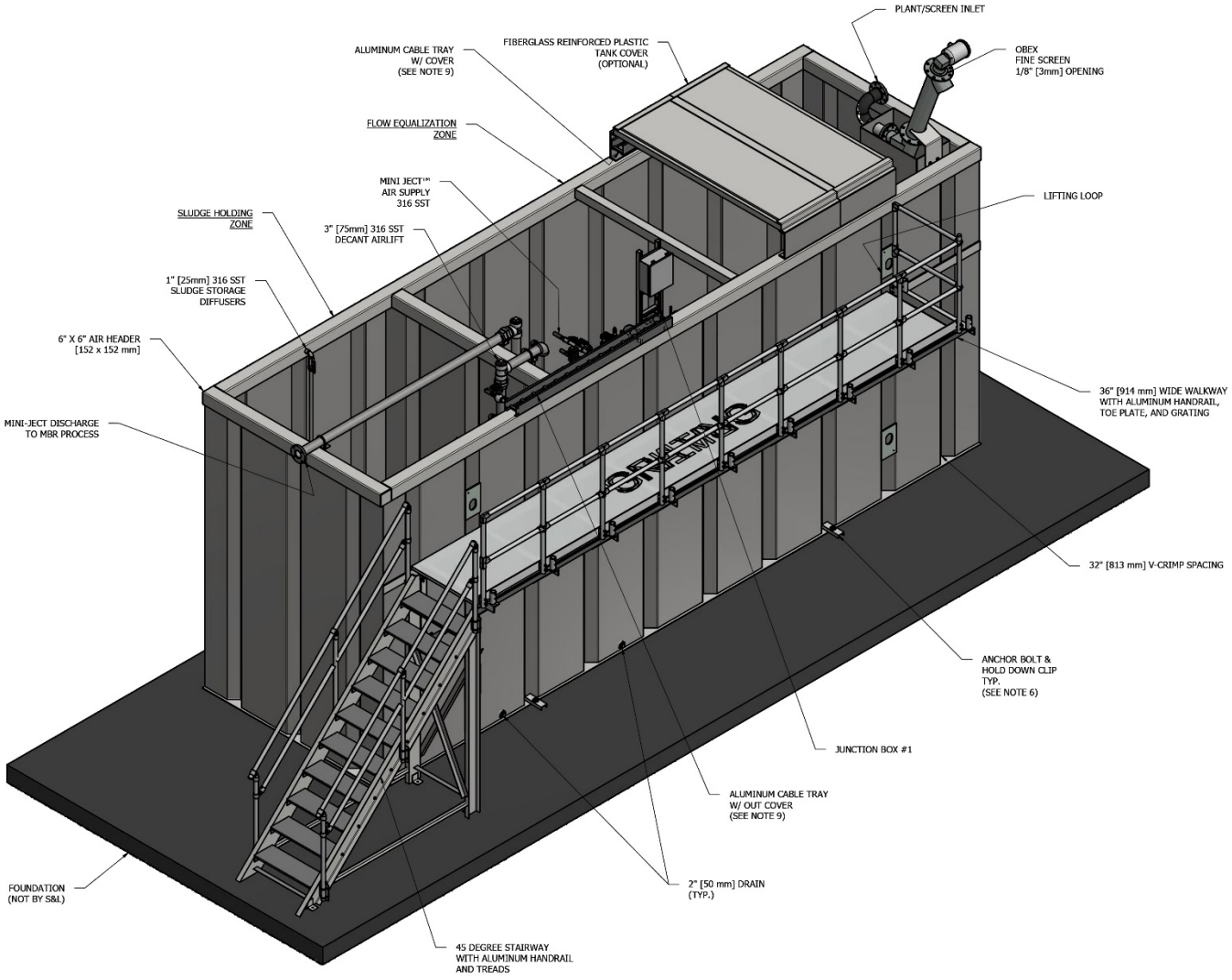


Elevation View



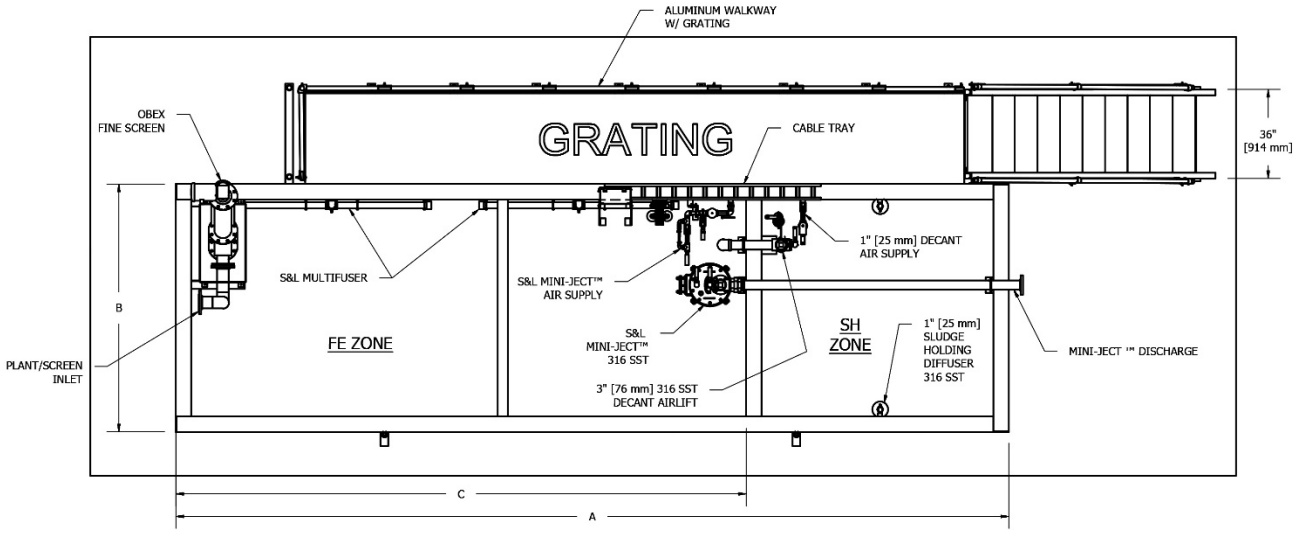
Drawings (Continued)

Flow Equalisation/Sludge Holding Tank (Isometric View)

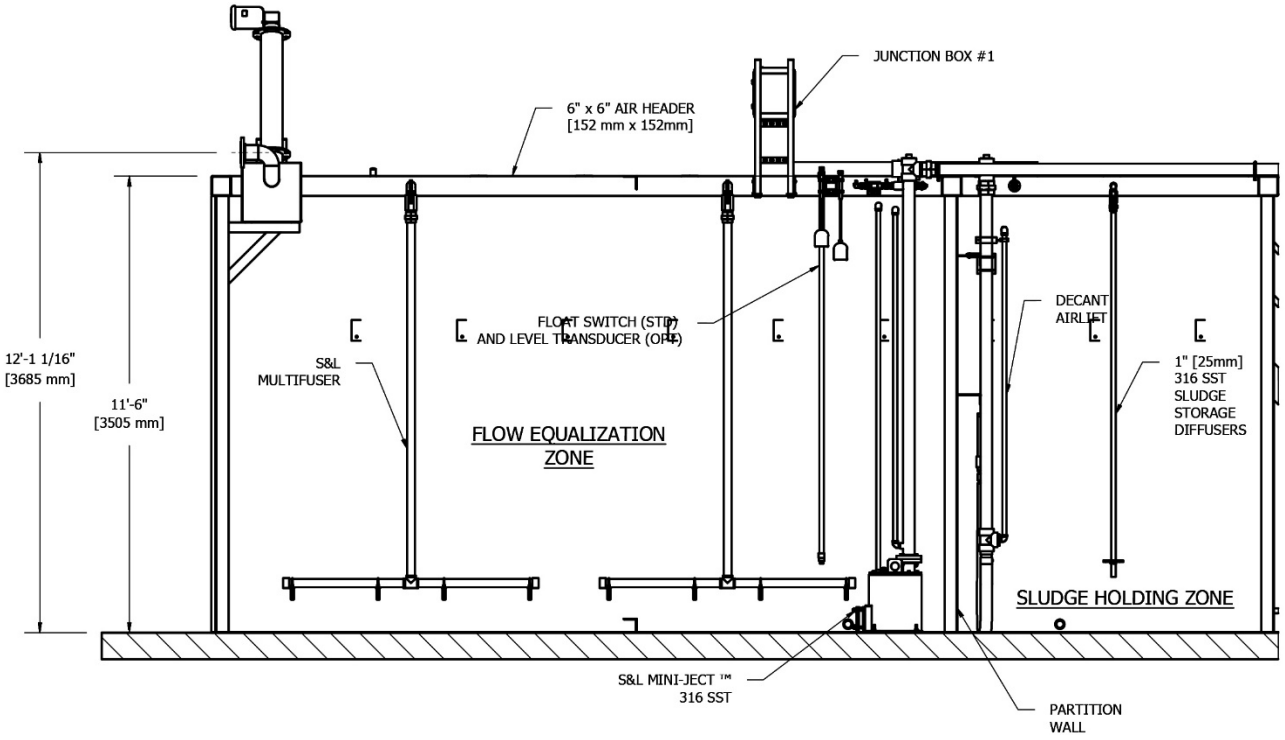


Drawings (Continued)

Flow Equalisation/Sludge Holding Tank (Plan View)



Flow Equalisation/Sludge Holding Tank (Elevation View)



Scope of Supply

Process Items Included:

- **MINI-JECT®** pneumatic ejector with adjustment valves.
- Flat-sheet membrane module(s) (Title 22 Approved)
- Medium bubble diffusers with 316 stainless steel drop pipes
- Air distribution headers integral to factory-built tank
- Air supply piping to MBR modules
- 316 stainless steel **LIQUIDLIFT™** anoxic recycle system
- Wasting/decanting sludge airlift
- Valves for diffuser drop pipes
- Flow meter
- Chemical clean in place constant head tank
- DO, pH, temperature sensors
- Turbidity meter (OPTIONAL-not included)
- Total Organic Carbon Analyzer for BOD/ TSS (OPTIONAL-not included)
- Nitrate Analyzer (OPTIONAL-not included)
- 525 gallons chemical holding/mixing/spent chemical tank (OPTIONAL-not included)

Tankage, Mechanical & Miscellaneous Items Included:

- Factory built, epoxy coated tank
- Access staircase and walkway
- 304 stainless steel, 3 mm fine screen
- Anoxic mixers
- Process warranty
- 10 days start-up services
- Flow Equalization and Main Process Air Blowers

Electrical Items Included:

- NEMA 4X Control Panel with **QUICKSMART™** HMI and PLC
- Wire management system via cable trays and factory wiring
- Junction boxes
- Cable tray covers (OPTIONAL-not included)
- Main Process Air Blower VFDs (OPTIONAL-not included)

Items Not Included:

- Unloading and setting of tank(s)
- Interconnecting piping and wiring (outside of tank)
- Any civil work
- Any lighting of the site
- Excavation

Budget and Timeline:

Total Equipment Cost:	
Startup Cost:	Included
Submittal Timeline:	6 Weeks (after receipt of complete details)
Mfg. Timeline:	20-24 Weeks (after receipt in Seller's office of approved Submittal Data)
Delivery Timeline:	6 Week (after Manufacturing Completion)

Additional Price Details:

The estimated cost of this budget proposal constitutes a non-binding estimate for certain goods and/or services and is exclusive of applicable taxes.

CIF Auckland plus any taxes, duties, etc. which may apply. Truck freight to the job site or nearest unloading area to be by Buyer.

Ten days of field services included for inspection of field installed components and initial start-up and operation of MBR system, spread over two (2) trips. If additional days and trips are required, Seller will furnish a factory-trained supervisor at additional cost.

Smith & Loveless, Inc. will provide one electronic copy of the O&M on CD in PDF format and four hard copies of the O&M.

Installation List

Installation	State	Flow (GPD)	BOD (mg/L)	De-Nitrification	Year Shipped
Napa	CA	7,500	7,700	No	2006
Centerville	MA	22,300	350	Yes	2008
Rochester	WA	100,000	350	Yes	2008
Indian Beach	NC	80,000	250	Yes	2010
Acton	MA	35,000	250	Yes	2013
San Antonio	TX	22,000		No	2013
Middleborough	MA	15,300	350	Yes	2014
Anne Arundel Co.	MD	6,000	300	Yes	2018
Preston	MD	20,000	300	Yes	2016
Lampe	MO	20,000	250	Yes	2016
Branson	MO	140,000	250	Yes	2018
Denton Co.	TX	200,000	216	No	2018

Reference #1

Facility Type	Casino
Facility Location	Rochester, WA
Start-up Date	September 2008
MBR Model No.	44-01007
System Capacity (mgd)	0.1
Number of Membrane Elements	600 plates
Number of Membrane Elements per Unit (Cassette)	200 plates per 200W module / 100 plates per 100S module
Number of Membrane Units (Cassettes)	4 modules (2 x 200W, 2 x 100S)
Design Flow Rate (mgd)	0.1
Design Peak Hour Flow Rate (mgd)	0.15
Current Avg. Flow Rate (mgd)	0.033
Design MLSS (mg/L)	10,000
Current Avg. MLSS (mg/L)	10,000
Net Flux at Design Flow (gfd)	11.1
Net Flux at Design Peak Hour Flow (gfd)	16.6

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	5	<3
TSS (mg/L)	5	<3
Total Nitrogen (mg/L)	5	<3
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	350	270
TSS (mg/L)	350	Not measured
TKN (mg/L)	70	Not measured

Reference #2

Facility Type	Nursing Home
Facility Location	Centerville, MA
Start-up Date	April 2009
MBR Model No.	44-01004
System Capacity (mgd)	0.022
Number of Membrane Elements	100 plates
Number of Membrane Elements per Unit (Cassette)	100 plates per 100S module
Number of Membrane Units (Cassettes)	1
Design Flow Rate (mgd)	0.022
Design Peak Hour Flow Rate (mgd)	0.033
Current Avg. Flow Rate (mgd)	0.01
Design MLSS (mg/L)	9200
Current Avg. MLSS (mg/L)	9000
Net Flux at Design Flow (gfd)	14.8
Net Flux at Design Peak Hour Flow (gfd)	22

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	30	2
TSS (mg/L)	30	0.5
Total Nitrogen (mg/L)	10	<5
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	350	305
TSS (mg/L)	100	100
TKN (mg/L)	45	38

Reference #3

Facility Type	Winery
Facility Location	Calistoga, CA
Start-up Date	May 2009
MBR Model No.	44-01010
System Capacity (mgd)	0.01
Number of Membrane Elements	50 plates
Number of Membrane Elements per Unit (Cassette)	50 plates per 50S Module
Number of Membrane Units (Cassettes)	1
Design Flow Rate (mgd)	0.01
Design Peak Hour Flow Rate (mgd)	0.012
Current Avg. Flow Rate (mgd)	0.01
Design MLSS (mg/L)	10,000
Current Avg. MLSS (mg/L)	10,000
Net Flux at Design Flow (gfd)	13.3
Net Flux at Design Peak Hour Flow (gfd)	22

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	5	0.5
TSS (mg/L)	5	3
Total Nitrogen (mg/L)	N/A	N/A
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	7,700	7,700
TSS (mg/L)	1,200	1,200
TKN (mg/L)	Not Measured	Not measured

Reference #4

Facility Type	Winery
Facility Location	Napa, CA
Start-up Date	October 2006
MBR Model No.	44-01000, 44-01001 (two parallel trains)
System Capacity (mgd)	0.015
Number of Membrane Elements	100 plates
Number of Membrane Elements per Unit (Cassette)	50 plates per 50S module
Number of Membrane Units (Cassettes)	2 x 50S modules
Design Flow Rate (mgd)	0.015
Design Peak Hour Flow Rate (mgd)	0.022
Current Avg. Flow Rate (mgd)	0.015
Design MLSS (mg/L)	10,435
Current Avg. MLSS (mg/L)	15,000
Net Flux at Design Flow (gfd)	10
Net Flux at Design Peak Hour Flow (gfd)	22

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	4	<4
TSS (mg/L)	3	<3
Total Nitrogen (mg/L)	N/A	N/A
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	7,700	7,700 (low 900, high 12,000)
TSS (mg/L)	1,000	1,000
TKN (mg/L)	Not measured	Not measured

Reference #5

Facility Type	Condominiums
Facility Location	Indian Beach, NC
Start-up Date	November 2010
MBR Model No.	44-01012
System Capacity (mgd)	0.08
Number of Membrane Elements	400 plates
Number of Membrane Elements per Unit (Cassette)	200 plates per 200W module
Number of Membrane Units (Cassettes)	2
Design Flow Rate (mgd)	0.08
Design Peak Hour Flow Rate (mgd)	0.1
Current Avg. Flow Rate (mgd)	Recently started up
Design MLSS (mg/L)	10,345
Current Avg. MLSS (mg/L)	Recently started up
Net Flux at Design Flow (gfd)	16.6
Net Flux at Design Peak Hour Flow (gfd)	22

Effluent Quality

Parameter	Design	Treated (actual)
BOD_5 (mg/L)	5	Recently started up
TSS (mg/L)	5	Recently started up
Total Nitrogen (mg/L)	10	Recently started up
Turbidity (NTU)	Not measured*	Not measured*

*typical S&L MBR plants <0.2 NTU

Influent Quality

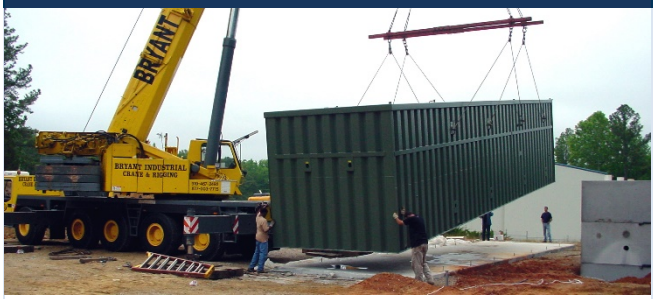
Parameter	Design	Treated (actual)
BOD_5 (mg/L)	250	Recently started up
TSS (mg/L)	250	Recently started up
TKN (mg/L)	45	Recently started up

Installation Overviews:

Residential

Application:	Private Development
Requirements:	Minimal Land Usage, Water Reuse / Reclamation
Peak Flow:	101,000 GPD (382 CMD)

Residential



Application:	Private Development
Requirements:	Minimal Land Usage, Water Reuse / Reclamation
Peak Flow:	101,000 GPD (382 CMD)

Residential

Application:	Housing Development
Requirements:	Minimal Land Usage, Simplified Maintenance
Peak Flow:	35,000 GPD (132 CMD)

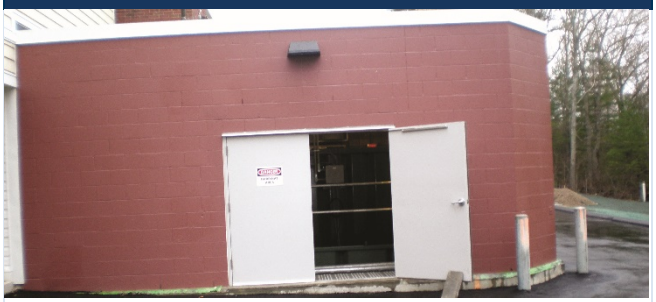
Recreational

Application:	Youth Camp
Requirements:	Minimal Land Usage, Strict Effluent Requirements
Peak Flow:	18,500 GPD (70 CMD)

Casino

Application:	Lucky Eagle Casino
Requirements:	Effluent Quality
Peak Flow:	100,000 GPD (378.5) CMD)

Personal Health Care



Application:	Health Care / Nursing Home
Requirements:	Minimal Land Usage, Nitrogen Reduction
Peak Flow:	22,000 GPD (83 CMD)

Installation Overviews:

Food Processing

Application:	Food Processing – Noodle Production
Requirements:	Strict Effluent Requirements, Water Reuse
Peak Flow:	22,000 GPD (83 CMD)

Food Processing

Application:	Food Processing – Nut Processing
Requirements:	Minimal Land Usage, High Quality Effluent
Peak Flow:	10,000 GPD (38 CMD)

Beverage

Application:	Beverage - Winery
Requirements:	Water Reuse / Reclamation
Peak Flow:	9,500 GPD (36 CMD)

Beverage

Application:	Beverage - Winery
Requirements:	High Quality Effluent Water Reuse / Reclamation
Peak Flow:	5,000 GPD (19 CMD)

Beverage

Application:	Beverage – Winery
Requirements:	High Quality Effluent Water Reuse / Reclamation
Peak Flow:	12,500 GPD (47 CMD)

Beverage

Application:	Beverage – Bottling Facility
Requirements:	High Quality Effluent Water Reuse / Reclamation
Peak Flow:	15,000 GPD (56 cmd) Total

Smith & Loveless Inc.

TITAN™ MBR

Delivering the Best Experience... Packaged for You.

The MBR Packaged for You...

TITAN MBR™

From the Innovator in operator-friendly packaged treatment systems, S&L delivers to you the best available MBR technology for Operation and Maintenance and Total Cost of Ownership.

Performance with Smart Automation

- Achieve efficient treatment for high quality effluent and reuse
- Automation features include decanting and chemical cleaning
- Color touchscreen PLC controls offer intuitive monitoring & control

Easiest Operation & Maintenance of all MBRs

- Infrequent & simplest membrane cleaning of any MBR
- Easily accessible PLC, electrical & process components
- No internal mechanical pumps eliminate O&M tasks & costs

Robust System Design

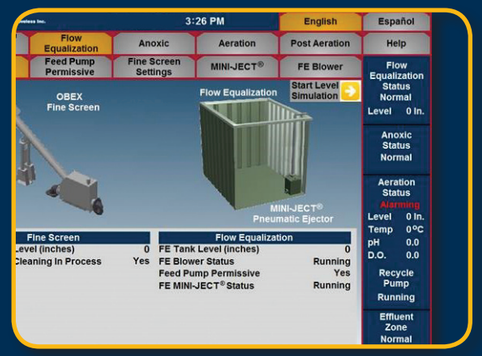
- Quality-controlled manufacturing with stainless steel components
- Flat-sheet membrane construction for less breakage & longer life
- Pre-wired, compact models ideal for shipping & site requirements

Creating Value for You

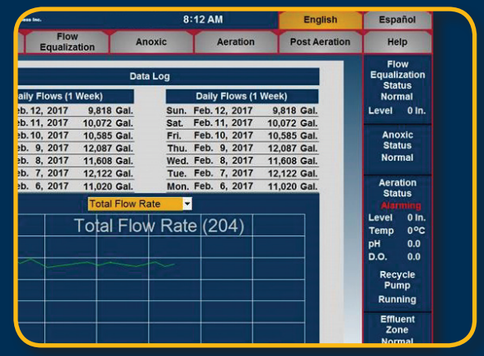
- Superior total cost of ownership with simplified O&M
- Best Available Technology: achieves water reuse quality effluent
- Single-source support comes from company with 70+ years

Sample Screenshots

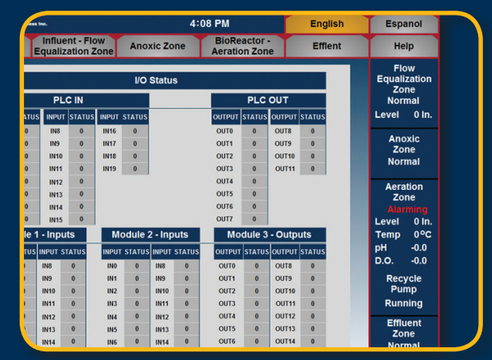
[Entire screen not displayed here]



System Overview



Data Log



I/O Status

QUICK SMART™ System Controls

Main Features

- 9.7" (24.6 cm) 65K-Color TFT LCD Touch Screen HMI
- PLC/Microprocessor-Based Controller
- NEMA 4 Rated when Installed in Enclosure
- UL Certified
- Protected by Surge Protective Device (SPD)
- English/Spanish Toggle
- More than 15 Different Screen Selections
- Data, Maintenance, and Alarm Logging
- Complete "Help" Menu and Support Screens

RemoteView™ Cloud Services through QUICKSMART™

Gain remote access monitoring and troubleshooting services with RemoteView™ from S&L. We are here to help you make owning and operating an MBR the easiest of any

Intuitive PLC Controls

featuring

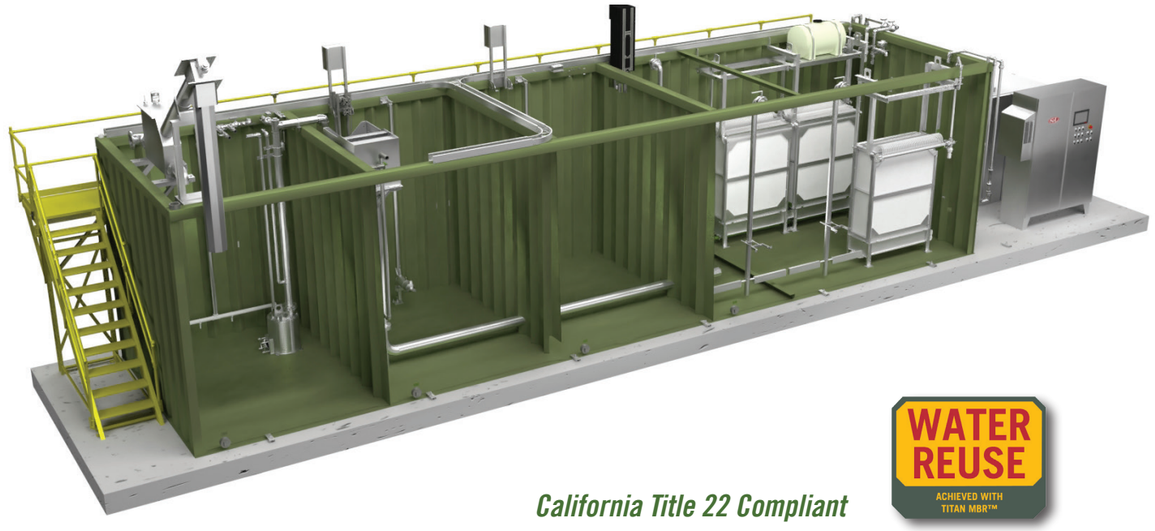
QUICKSMART™ System Controls

- Superior Graphics
- Easy-to-Navigate
- Remote Automation

Delivering simplified operation yet powerful TITAN MBR™ control, **QUICKSMART™** System Controls provide unparalleled ability to monitor and adjust all of your treatment system functions, including:

- **Troubleshooting** support comes standard with new I/O Status screen that displays controller digital and analog I/O status.
- **Maintenance Log** - Displays recommended O&M instructions and makes suggestions based on actual system operation.
- **Automated Decanting** - Automatic sludge storage decanting airlift with timer controlled by QUICKSMART™ PLC with HMI operator adjustment. Air to sludge storage zone is shut down automatically before decanting airlift runs.
- **RAS Automation** - Adjusts the recycle LIQUIDLIFT™ [when anoxic zones are present] to accommodate lower flow conditions to maintain high levels of nitrification.
- **Dual-language toggle** provides control screens fully in Spanish and English with a simple toggle button.

System Overview



California Title 22 Compliant

WATER REUSE
ACHIEVED WITH TITAN MBR™

Achieve Superior Effluent Quality

BOD:	< 3 mg/l
TSS:	< 1 mg/l
Turbidity:	< 0.2 NTU
TN:	< 3 mg/l*
NH_3:	< 1 mg/l
TP:	< 0.05 mg/l*

** achievable with optional process selections*

S&L Flat-Plate Membrane Data [Typical]

Type:	Submerged, PVDF+PET Flat-Plate
Design Flux:	13 gpd/sf [22.1 lmh]
Pore Sizing:	0.08 microns [MF]
TMP Range:	[Trans Membrane Pressure] 0.50 - 2.00 psi [35 - 138 mB]
Cleaning:	In-Place; Semi-annual cycle**; 4 hrs.

*** depending upon the influent*

Flow: 5,000 gpd - 0.1 MGD / 19 cmd - 378 cmd

Standard Systems

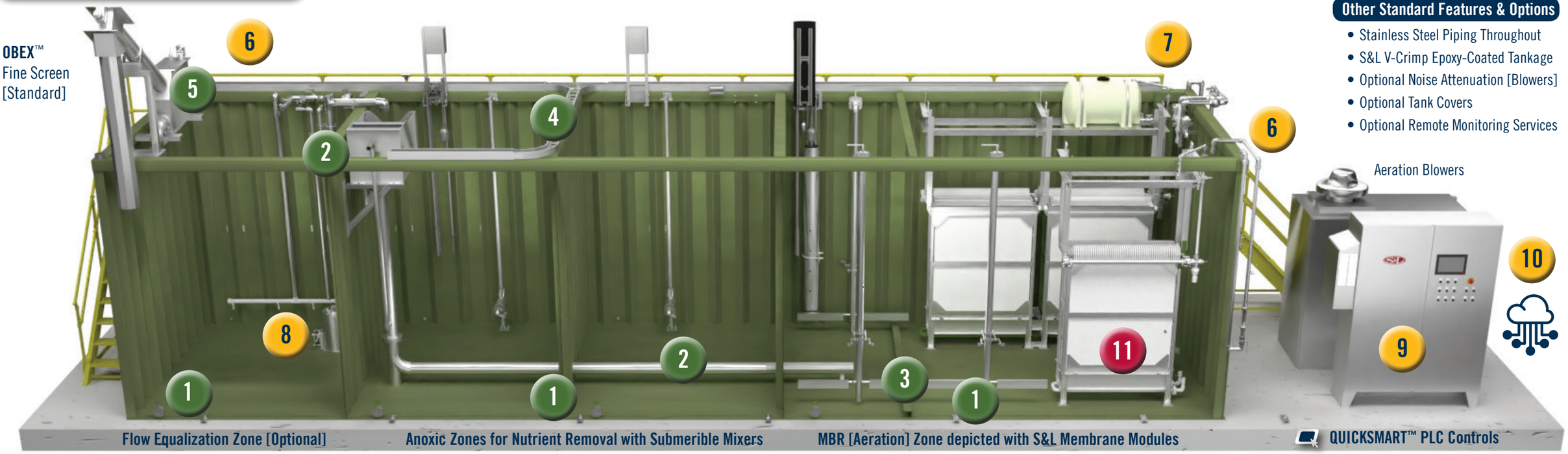
Each American factory-built **TITAN MBR™** System includes robust, epoxy and polyurethane coated S&L V-Crimp tankage, configured process and MBR zones with S&L flat-plate Membranes, automatic fine screening (if selected), stainless steel internal components, pre-wired instrumentation, and **QUICKSMART™** Touchscreen PLC Controls. The result provides best-available MBR technology with superior O&M ease.

Featured Options

- Enhanced Remote Monitoring
- Process Instrumentation
- Zones for Enhanced Nutrient Removal
- Tank Covers / Weatherization Packages
- Skid-mounted Chemical Cleaning Tank
- Covers for Instrumentation
- Aluminum or 316 Stainless Steel Cable Trays

System Diagram & Features

*Designed with robust stainless steel piping, smart automation and O&M cost-saving features, **TITAN MBR**™ delivers the best in MBR experience.*



Other Standard Features & Options

- Stainless Steel Piping Throughout
- S&L V-Crimp Epoxy-Coated Tankage
- Optional Noise Attenuation [Blowers]
- Optional Tank Covers
- Optional Remote Monitoring Services

System Process & Construction Features

1 Flexible Process Zones, Configured

TITAN MBR™ comes configured to meet your effluent goals. Optional Flow Equalization, Anoxic & Sludge Storage Zones complement the MBR Zone. California Title 22 compliant, achieving water reuse.

2 Automatic Anoxic Recycle System

Adjustable recycle stainless steel **LIQUIDLIFT**™ accommodates lower flow conditions to maintain high levels of nitrification. Automatically controlled by the PLC with HMI operator input.

3 Robust, Efficient Aeration

Stainless steel, medium-bubble aeration lowers operating costs while eliminating the fouling and maintenance costs associated with fine bubble type diffusers.

4 Smart Wire Management System

Factory-installed and strategically located instrumentation and cable wireways minimize field wiring for easier installation. Optional instrumentation covers [shown above] are available.

5 Simple, Automatic Fine Screening

Any **TITAN MBR**™ model with Flow Equalization comes standard with integral **OBEX**™ fine screening.

Operation & Maintenance Features

6 Safe & Easy O&M Access [Factory-Supplied]

S&L stairway access to walkway for easy O&M. All maintenance tasks can be safely and comfortably accomplished from here—protected by OSHA standard 42" high [106 cm] safety railing.

7 Easy, Infrequent Membrane Cleaning

Membrane clean-in-place [CIP] system, typically conducted semi-annually for less than 4 hours, features easy to access tankage for feed and spent chemicals.

8 Influent Transfer Eliminates Pump O&M

S&L **MINI-JECT**™ influent transfer with no moving parts eliminates need for mechanical pumps and associated maintenance & replacement costs. Provides constant flow regardless of flow level.

9 QUICKSMART™ PLC Touchscreen Ease

QUICKSMART™ System Controls provide unparalleled ability to monitor and adjust all of your treatment system functions with a highly intuitive, easy-to-navigate touchscreen PLC interface.

10 RemoteView™ Cloud Remote Monitoring

Cloud-based **RemoteView**™ monitoring services are available from Smith & Loveless Inc. We are here to help you!

S&L Flat-Plate Membrane Features

11 Robust Submerged S&L Flat-Plate Membranes [MBR Zone]

TITAN MBR™ Flat-Plate Membranes (MF) maintain high permeability and flux rates even at peak-day rates. They stack within a fully submerged module inside the aeration zone. Transmembrane pressure created by gravity drives the flow through the membranes. Clean water discharges while blocked solids remain in the aeration zone. Diffusers beneath the module scour the membranes while also providing air supply to the bacteria. Chemical cleaning occurs efficiently in-place—typically on a semi-annual basis—with simple chemical injection. No permeate pumps are required, saving energy and maintenance compared to most other MBR systems.

Compare Submerged S&L Flat-Plate Membranes vs. Hollow-Fiber & Other Types

- Lower fouling rate because of better air scour with the flat sheet
- Cleaned in place; no need to remove membranes
- Less chemicals needed to clean
- Less time to clean
- No breakage issues; more durable
- No issues with stringy solids like hair
- No backwash or back pulse required
- No air integrity testing or pinning of fibers

Achieves Title 22 Water Reuse

Type:	Submerged, PVDF+PET Flat-Plate
Design Flux:	13 gpd/sf [22.1 lmh]
Pore Sizing:	0.08 microns [MF]
Trans Membrane Pressure:	0.50 - 2.00 psi [35 - 138 mB]
Cleaning:	In-Place; Semi-annual cycle; 4 hrs.

TITAN™ MBR

Delivering the Best Experience...Packaged for You

Performance

TITAN MBR™ provides high oxygen transfer and a stable process tailored to your requirements, and is capable of achieving superior effluent quality and Title 22 approved water reuse.

Easiest MBR O&M

Experience the best O&M of any MBR through quick component access, smart instrumentation, remote data monitoring, reduced process complexity, & streamlined [CIP] membrane cleaning.

Robust Design

Rugged tank and flat-sheet membrane construction with expanded stainless-steel componentry and streamlined electrical design. Intuitive graphical touchscreen **QUICKSMART™** PLC provides easy control.

Value

Increased energy effiency [up to 30%] with updated process & automation & no permeate pumps. Backed by complete single-source technical support, from pre-design to installation and beyond.

wef member association · UL LISTED · CE · UVDB Registered · WATEREUSE

TITAN MBR™ *arrives in compact factory-built system models now with significantly less field assembly for swifter installation and start-up. Every system is backed by complete single-source technical support, from pre-design to installation and beyond, from Smith & Loveless, a company with more than 70 years experience and a strong reputation for reliability.*

Smith & Loveless Inc.
www.SmithandLoveless.com

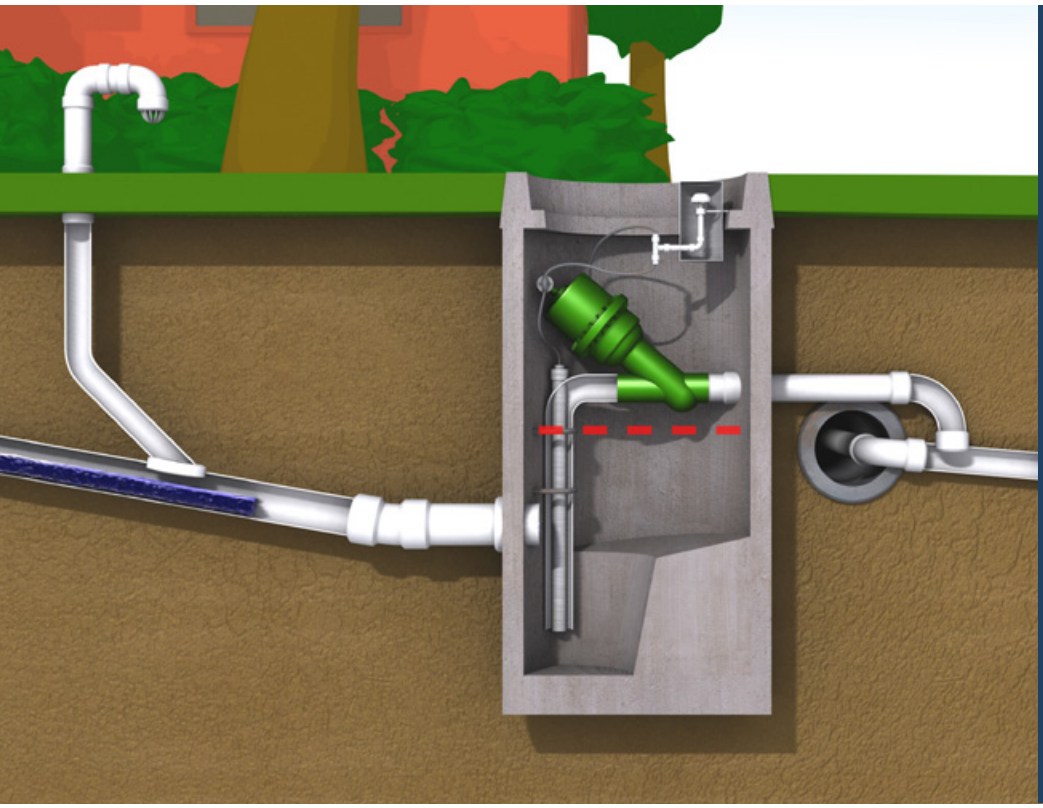
Phone: (913) 898-5201
Fax: (913) 888-2173

14040 Santa Fe Trail Dr.,
Lenexa, KS USA 66215-1284

20. Appendix H – Local Reticulation Details

aquate
water reticulation solutions

Flovac Vacuum Sewer Systems



Applications

Vacuum Systems are ideal for sewage reticulation systems where infiltration is a concern, flat areas with a high water table or areas with difficult ground conditions.

Features

- Shallow trenching
- Lower cost installation
- Small diameter pipes
- Easy maintenance
- Environmentally friendly
- No infiltration, inflow or exfiltration
- Low initial capital costs
- No power required at the home

Flovac vacuum systems are a cost-effective, environmentally friendly alternative to traditional gravity sewers and low pressure solutions, providing low maintenance, efficient and reliable sewage reticulation.

Vacuum systems utilise a central pump station that creates a vacuum in the shallow pipe network. A series of valve pits collects the sewage from multiple homes and this sewage is propelled to the central pump station where it is transported to the Wastewater Treatment Plant for treatment.

Vacuum sewer systems have been accepted in over 40 countries since the 1960's as a low cost environmentally friendly method of transferring wastewater from houses to treatment plants.

Flovac Vacuum Sewer Systems

aquate
water reticulation solutions

How It Works

The shallow, small diameter vacuum sewer lines in a Flovac System are under a vacuum of -50kPa to -70kPa created by the vacuum pumps located at the vacuum pump station.

Sewage flows by gravity from homes into a collection sump. When 40 litres accumulates in the sump, the vacuum interface valve automatically opens and differential air pressure propels the sewage from the sump into the vacuum main. Sewage flows through the vacuum lines and into the collection tank at the vacuum station. Sewage pumps transfer the sewage from the collection tank to the wastewater treatment facility. There are no electrical connections required at the home. Power is necessary only at the vacuum station.

Cost savings

A vacuum system almost always costs less to install than a gravity flow system because the vacuum system uses small pipe in shallow, narrow trenches, and there are no manholes. Once installed, it continues to save money because the system eliminates inflow and infiltration. This is even more important if you are charged by the litre when treatment is by others.

State-of-the-art Technology

Vacuum sewer systems are used all over the world and their use has risen dramatically over the past ten years. Many now view vacuum as the system of choice because initial costs and on-going operating expenses are low.

The system requires no manholes and eliminates exposure of operators to raw sewage. With minimal disruption to the surrounding environment during installation, the technology is also starting to gain world wide recognition for its low carbon footprint.

FLOVAC SYSTEMS are ideal for flat, coastal developments.

INSTALLATION Shallow trenches ensure low installation costs.

Design Expertise

Flovac are experts in solving difficult wastewater engineering problems in unique geographic areas or in environmentally sensitive areas. All Flovac Vacuum Systems are designed to meet Australian and New Zealand Standards. Flovac works closely with engineering consultants and water authorities to cater for individual site-specific needs.

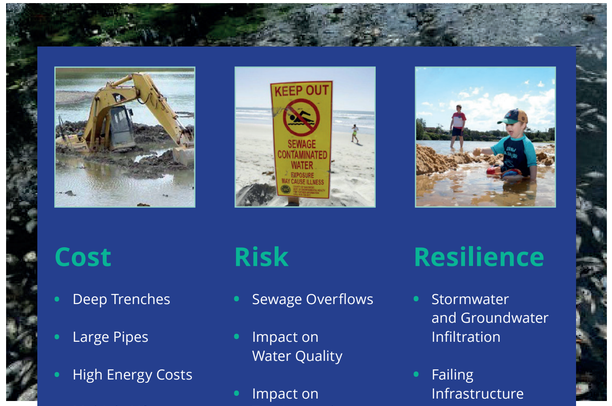
Maintenance

Extremely low breakdown, callout and maintenance costs have made Flovac systems the industry leader in the 'whole of life' cost for sewerage systems. The valves have been designed to be extremely robust and therefore come with an unprecedented 10 year warranty.

FLOVAC SYSTEMS

Aquate Limited is the official New Zealand destributer for Flovac Vacuum Systems PTY LTD.

Aquate Limited PO Box 87152, Meadowbank, Auckland 1742
P (09) 5222 195 **M** (0275) 27 82 83 **E** peter@aquate.co.nz
www.**aquate**.co.nz



Cost

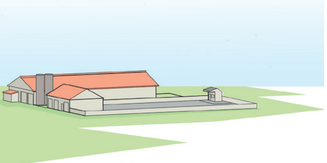
- Deep Trenches
- Large Pipes
- High Energy Costs
- Multiple Lift Stations

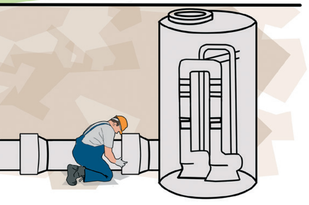
Risk

- Sewage Overflows
- Impact on Water Quality
- Impact on Tourism and Aquaculture

Resilience

- Stormwater and Groundwater Infiltration
- Failing Infrastructure
- Health Risks





"Our global engineering team understands the importance of local and project specific issues, whether it's droughts or floods, hurricanes or earthquakes Remote or urban, operational issues or environmental issues. The Flovac team will deliver the best solution for your town."
John Radinoff CEO Flovac Group

THE SMARTER SEWERAGE SOLUTION

The Low Cost, Green Future of Sewerage Collection

info@flovac.com

www.flovac.com

FLOVAC
VACUUM SEWERAGE SYSTEMS

FLOVAC VACUUM SEWERAGE SYSTEMS

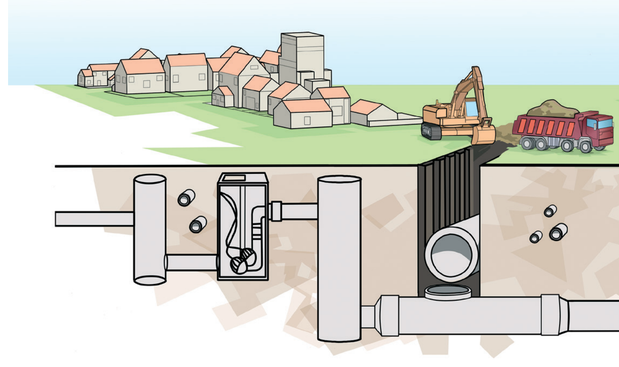
The smarter sewerage solution

Now the most commonly installed sewerage systems for Towns and Residential Developments close to Lakes, Rivers and Coastal Areas.

FLOVAC
VACUUM SEWERAGE SYSTEMS

Traditional gravity sewers

Many towns located close to lakes, rivers and coastal areas still use septic tanks or have no proper sewerage system. This is due to the high installation cost of traditional systems which are prone to overflows into protected waterways and allow ground water and storm water to enter the system.



FLOVAC VACUUM SEWERAGE SYSTEM

How it works

A Vacuum sewage collection system is very similar to a water distribution system, but in reverse. Flovac takes the used water away from houses collecting it within a collection pit located outside the property boundary. Pneumatic valves (vacuum interface valves) located within the collection pits are activated by water pressure and a mix of water and air is transported via a difference in pressure at high velocity to the pump station (VPS).

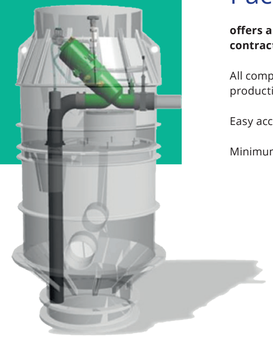
By adding a set of vacuum pumps to a pump station a negative pressure is created in the tight PE or PVC pipe network in the town. As the velocity is high no manholes are required and septicity does not occur.

As pipework is under a negative pressure, sewage cannot leak out and importantly as all pipework is leak tight, no ground water or stormwater can enter the system.
A single pump station can cater for up to 10,000 people.

How sewage enters the system

Sewage flows from houses via a normal plumbed gravity line to a Collection Pit located on public land.

The valve does not require any outside power source and operates pneumatically once 40 litres (10 gallons) enters the sump from 4-6 houses the valve opens and air and sewage enters the system at a high velocity as the pressure in the pipe looks to equalize.



The Flovac Valve Pit Package

offers a new level of Safety in Design for contractors and operators.

All components are fully fitted out at the Flovac production facility and is light and easy to install.

Easy access to sump area

Minimum of 4 hours emergency storage

The Vacuum Mains

(either PE or PVC) are designed to be as shallow in the ground as possible and are laid at a 1/500 grade. The contractor builds steps in the pipe work to keep the mains from getting too deep. The more steps that are installed, the more hydraulic losses are created, lessening the distance that the mains can go. Correctly designed mains can extend over 3 miles (5 km).

A difference in pressure will drive the sewage towards the pump station at a high velocity with no chance of leaks in the pipe work or infiltration occurring.

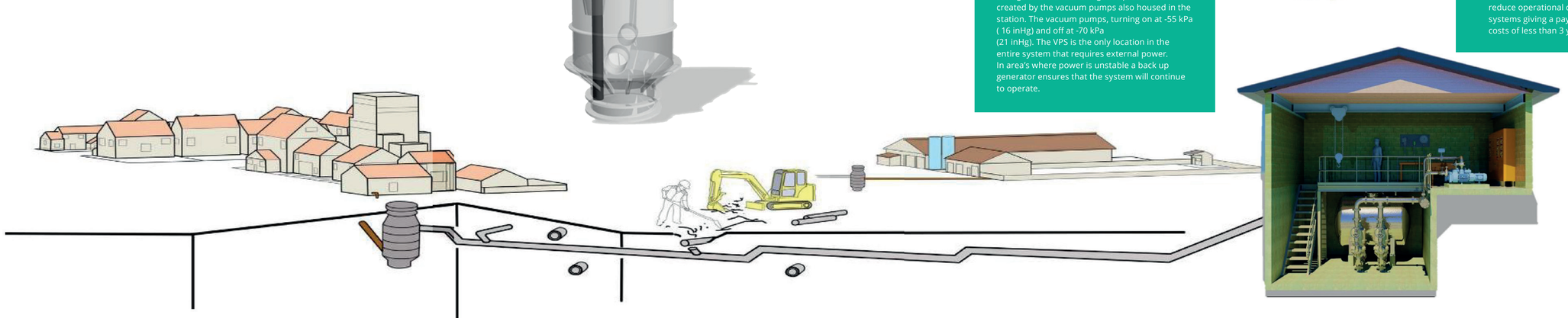
The Vacuum Pump Station (VPS)

does a similar job to a gravity pump station, in that it forwards the sewage via a force main to the treatment plant. Additionally the VPS has a stainless steel tank that receives the sewage and is under a negative pressure which is created by the vacuum pumps also housed in the station. The vacuum pumps, turning on at -55 kPa (16 inHg) and off at -70 kPa (21 inHg). The VPS is the only location in the entire system that requires external power. In area's where power is unstable a back up generator ensures that the system will continue to operate.

FMS Flovac Monitoring Systems The smarter sewerage solution

- By detecting the point of any I&I entering your system, you can ensure that your Pump Station and Treatment Plant is not overwhelmed during wet weather events.
- Ensure the best mix of air and sewage enters your system during seasonal periods to keep energy costs at a minimum
- Quickly locate any system failures or potential overflows, eliminate risks to homeowners and the environment.
- Allow for full integration into your SCADA or Smart City network.
- Wired and Wireless Solutions

The installation of a monitoring system can reduce operational costs by 30-50% in certain systems giving a payback period for the capital costs of less than 3 years.



FLOVAC SYSTEMS

Company Credentials

Flovac Vacuum Sewerage Systems Pty Ltd

Introduction

John Radinoff - CEO

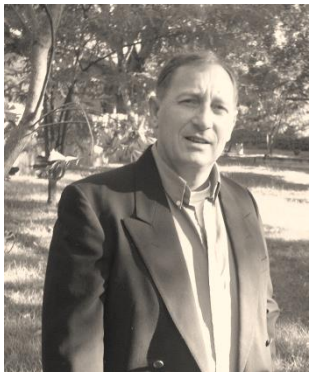
Flovac Systems are experts in solving difficult wastewater engineering problems in unique geographic areas and in areas which are environmentally sensitive, using vacuum technology.

Established in 2005 from the merger of three of the pioneers of the vacuum industry, Gooren bv (The Netherlands), established in 1988; and Airvac-RSM (Australia), established in 1984 and Vogt bv (Germany). The Flovac team has specialised in municipal sewage schemes and has been involved in more than 350 projects in 21 countries.

Willem Gooren - Chairman

A number of Flovac's projects have been recognised with major environmental and engineering awards, and Flovac was listed as one of the most innovative companies in Australia in 2011.

The strength of the company is in its 'System" approach to any project ensuring involvement from design through to operational excellence.



Peter Radinoff – Chief Operating Officer

Burkhard Vogt – General Manager

- Front Cover photo: Tea Gardens, NSW, Australia 130 l/s

Project Awards

- UDIA “National Presidents Award”
- UDIA Award for Excellence “Best Residential Development in Australia”
- Prime Ministers Award for Excellence in Community Partnerships
- Gold Coast Urban Design Award
- Conde Nast Traveller Ecotourism Award
- National Landcare Award
- Institute of Engineers ‘Excellence in Smart Engineering”
- CASE Earth Award
- Institute of Surveyors Award for Excellence
- Institute of Engineers “Engineering Project of the Year”
- Marina of the year
- Award for Environmental Excellence
- Top 100 Most Innovative Company

About Flovac

Engineering Expertise

Our global engineering team understands the importance of local and project specific issues, whether its droughts or floods, deserts, cyclones or earthquakes, remoteness, operational issues or environmental issues. Our engineering group helps develop standards to meet local conditions and educates local engineers in design and planning. CFD modelling and hydraulic analysis ensures optimised results for our clients.

Product Development and Supply

Our manufacturing centres in Holland, Australia, Poland and Puerto Rico work closely with the research and development group in ensuring that all products are cutting edge and operationally superior. Our production group has ISO 9001 accreditation and works in association with sheltered workshops, in support of the disabled in our main workshop in the Netherlands

Operational Strengths

Our operations teams maintain a number of vacuum systems for clients and the expertise gathered through this and our relationship with clients has led to the development of a number of unique cutting edge products and system improvements. All clients get access to the 24 hour hotline for operational support and our asset management program allows for ongoing training and education.

PROJECTS

Municipal Sewerage Schemes

Old Cities and Towns

Residential Developments

Resorts

Marinas

Deployable Sewerage Networks

Indoor Vacuum Systems

Madinet Jumeirah Resort Dubai

Engineering Group

The engineering group has designed vacuum systems in over 20 countries with many award winning projects. One of the key strengths of the group is its recognition that each project will be different and of how important local conditions are to the impact on a project.

Our group has been involved in the establishment of standards in Europe, Australia, Malaysia and a number of other countries.

Some of the key aspects of delivering a system are as follows: -

- Concept design and budget
- Whole of life analysis and comparative studies along with carbon footprint analysis
- Catchment planning and master planning
- Authority design and planning training courses
- CFD and hydraulic modelling
- Local standards development and assessment
- Hazard and operability study with safety analysis
- Vacuum pump station electrical and mechanical designs
- Reticulation plans and long section design
- Master plan management

Training Course on Asset Management and Planning, Sydney Australia

Hydraulic Modelling

Products

All Flovac products are supplied into projects that have only been approved by the engineering or operations group.

Flovac Vacuum Interface Valve

78mm internal diameter

Colour coded tubing and connectors for easy assembly

“Easy clip “application of controller

Simplified one way connector pins in controller

Highest Cv rating on market with less friction losses

10 year standard warranty on all components

Flovac Vacuum Interface Valve

Flovac PE Collection Pit

Separated valve and sump chamber ensuring that operators do not come into contact with sewage

Leak proof seal to avoid all infiltration

Pre-assembled with Flovac valve, suction and sensor pipes.

Easy installation with no heavy equipment required

“Fat_free” set up

Installing a pre-assembled PE Pit, Rakova Jelsa, Slovenia

Flovac Monitoring System

Monitoring Systems can monitor just the pump station or include the reticulation network as well. These systems can be hard wired, web based or wireless, depending on local requirements.

Identity the location of breaks or leaks in the vacuum main

Overflow risk warning alarm at the collection chamber

Monitor the opening and closing of the vacuum valve, with an alarm notification of a valve jammed open

Record the open time of the vacuum valve and monitor the air/liquid ratio

Monitor temperature at each collection chamber

Monitor energy consumption at the vacuum pump station

Monitor electrical equipment at the vacuum pump station

Monitor and graph the vacuum pressure within the system

Detect any inflow or infiltration into the vacuum system

Monitor odour emissions at the vacuum pump station

Monitoring the operation of the valve, Zary, Poland

Touch screen operation at the vacuum pump station. Goolwa, South Australia

Vacuum Pump Stations

To reduce the carbon footprint of our systems, our goal is to incorporate as many locally produced components as possible.

Certain components such as vacuum pumps and sewage pumps come from suppliers we have tried and tested over a number of years to ensure good ongoing support. Local support from these suppliers is critical.

The components sourced locally are done under the strictest guidelines needing to adhere to local or globally recognised standards.

When supplying to remote or difficult to install locations pump stations are commonly installed onto skids for ease of transportation. These are pre-tested at our factory, so that a skid can be dropped into place, connected and started without any delays or risks.

Our engineering group helps with suggestions on architectural building designs, odour, ventilation, and lighting. The operations group has input with health, safety and operability as well as suitability for local conditions.

Pre-tested skid mounted pump station in Croatia

Community involvement at the vacuum pump station in Klausdorf, Germany

Operations Group

Members of the global operations group have had over 40 years experience with vacuum systems and have upgraded and repaired a number of other system suppliers' projects. Our group has maintained a number of systems and holds regular training for operators around the world.

Some of the critical work undertaken by the operations group includes: -

- System maintenance (operating and maintaining systems)
- System Audits
- Energy Optimisation and system tuning
- Operator training
- System upgrading
- Asset management support
- Remote analysis via web based monitoring systems
- Parts supplies (all vacuum systems)
- 24-hour phone support
- Contractor and plumber accreditation courses

System audit and training in Malaysia

Operator training course with presentation by Cairns Water, Flovac Operator of the Year

Project installation at Prahia da Rochas, Portugal

Municipal Sewerage Systems

Replacing septic tanks and aging gravity sewers

Reducing the installation impact on residents

Eliminating Infiltration into the sewers

Improving the health of the community

Reducing long term operational costs

Ease of installation in areas where construction may cause damage to buildings, infrastructure or the environment

Bilad Seet, Oman

Sta Pola, Spain

Ingenio, Puerto Rico

Residential Housing Developments

"The efforts, risk, costs and quantum of infrastructure associated with continuing to deliver gravity sewer in a flat, coastal an high water table area meant we had to keep pressing for a better long term solution. The community will get a state of the art, aesthetically pleasing building within a parkland setting. Cairns regional council, a state of the art single piece of infrastructure delivering a high quality effluent product rather than 4 or 5 more deep sewerage pump stations. The Flovac system will produce far simpler construction for the life of the project and result in the easier delivery of land to the market a win for all concerned."

Adam Gowlett, Satterley Property Group State Manager, Queensland

Port Mandurah, Western Australia

Increased speed of construction and reduced construction costs	Overall reduction of costs to the developer
Innovations to improve the health and safety of the operators	Reduced operational costs to the council
Improved environmental outcomes for the community	Enhanced amenity for residents

Busayteen, Bahrain

Hope Island, Queensland, Australia

Resorts and Housing above Water

The use of air to transport wastewater allows engineers to install separated black and grey water systems; this ensures lower energy use and the ability to re-use water when necessary.

Flexibility of installing the pipework above the water line and below decking with no odour risk or noise is why the use of vacuum sewers in floating villages is often the only option.

That vacuum sewers cannot leak is critical in resorts which may be protecting environmentally sensitive areas and swimming or fishing recreational areas.

Our group has broad experience with resort projects and works closely with engineering groups on a global basis to come up with standardised designs to ensure easy installation and incorporation with other infrastructure in remote locations

Low Cost Installations

Small Carbon Footprint

Couran Cove eco-resort
Queensland

Kampong Ayer, Brunei

Deployable Sewerage Systems

Temporary camps, whether emergency, workers accommodation, mining, military or refugee need to transport sewage from ablution blocks, kitchens and laundries. Installation of pipework can be time consuming, expensive and be damaging to the environment.

Flovac's deployable vacuum system can be deployed to site and established within 24 hours. Upon redeployment can be packed and ready for transport within 24 hours, leaving the site as you found it.

Camp Bastion, Afghanistan

All equipment supplied in 20 ft standard containers	Collection pipework laid above the ground or buried at minimum depth
All systems pre-tested and commissioned prior to delivery and suitable for all climates	No leaks and no overflows
Low cost with leasing options	Fully monitored
Low maintenance	Easy Installation with no heavy equipment required

British army camp, United Kingdom

Marina and Harbour Systems

Vacuum pump-out systems have been used at marinas around the world for over thirty years and Flovac has been at the forefront of their development.

Vacuum systems can handle either small or luxury boats, larger commercial vessels or ferries.

- Easy to install
- No odours
- No sewage leaks
- Incorporate flows from buildings in the marina precinct

Flovac has installed over thirty marina systems

America's Cup Marina, Valencia, Spain

Flisvos Marina, Greece

Barrack Street Pier, Perth Western Australia

Vacuum Drainage Systems inside Buildings

The use of vacuum drainage systems inside buildings opens up shifts in architectural design as well as energy and water savings. It allows for the use of grey and black water systems and flexibility in design. Vacuum toilets are also often used. These toilets can use less than 1 litre per flush saving up to 80% of water use in commercial buildings.

Green Buildings	Historic Building refurbishments
Supermarkets and Shopping Malls	Pharmaceutical Laboratories and Hospitals
Hotels	Sporting Venues
Train and Bus Stations	Island Resorts
Prisons	Airports

VIP vacuum toilets at Le Mans Racetrack in France

Merck, Sharp & Dohme production facility, Australia

Reef Island, Bahrain

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Flovac PE Collection Pit

Vacuum system installers prefer the Flovac PE pit because of its ease of installation, low cost and that it comes pre-assembled to site. Operators prefer the Flovac PE pit as it restricts any contact with sewage, there are no odours and infiltration is eliminated. Confined spaces are not an issue and dropping things in the pit (like mobile phones) no longer means that they disappear down the sewer line.

Advantages

- The Flovac PE pit houses both the Flovac valve and sump in a single unit.
- The cost of the single PE pit incorporating all pipework and valves is significantly cheaper than any alternative.
- There are no confined space issues for the operator.
- Sewage can never enter the top section of the pit housing the valve.
- There is an easy access hatch allowing operators to see clearly if anything is in the sump, allowing for easy extraction.
- No gases or odours can emit to the top section of the pit.

- Pits are delivered to site with valves and all pipework fully installed correctly at the factory.
- Lightweight design makes installation easier at 86 kg.
- Resistant to H2S gases and acid sulphate soil corrosion.
- Water tight from infiltration
- Cheaper Installation costs and capital costs

www.flovac.com

The Flovac PE Pits come in three sizes.

FP 01 is a standard 1.9 metre (6 ft) deep pit which incorporates the Flovac Valve and all pipework. Typically 4 houses are connected to the standard PE Pit. The Emergency storage volume is 400 litres (100 gallons).

FP 02 is a deeper 2.4 metre (8 ft) collection pit which includes the Flovac valve and all pipework and is used with higher flows, whether a higher number of houses or a commercial premises where the incoming gravity line is likely to be deeper in the ground. The emergency storage volume is 650 litres (170 gallons).

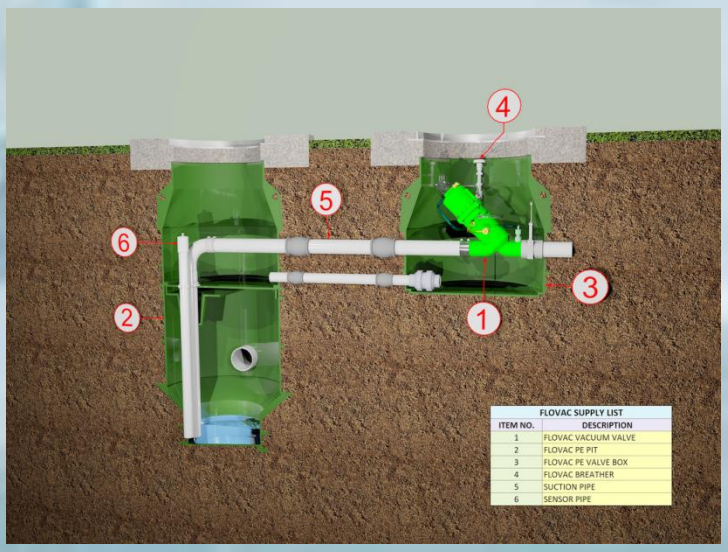
FP 03 is a half pit and used as a valve chamber to house the Flovac Valve. It is used in conjunction with the FP 01 or an FP 02 which is then used solely as a sump for the collection and storage of the sewage.

The FP 03 is also used when the ground surface level has been changed to ensure that the valve remains at a height easily reached by operators.

Standard Flovac PE Pit

High Flow Pit FP 03

Emergency Storage – 1025 litres (270 gallons)



www.flovac.com

eone SEWER SYSTEMS

OVER 10,000 INSTALLATIONS NATIONWIDE

ABOUT ECOFLOW

Ecoflow is New Zealand's largest pressurised sewer supplier. Founded in 2007 by two wastewater engineers, with their goal to become New Zealand's leading pressurised sewer system specialist.

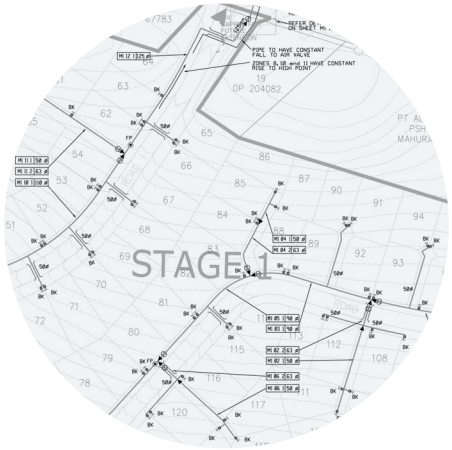
We are proud distributors of the Environment One (E/One) system, E/One are world leaders in low pressure sewer systems having over 600,000 grinder pumps operating globally in 42 countries.

Ecoflow have installed over 10,000 E/One pressure sewer systems throughout New Zealand in both council projects as well as green-field subdivisions.

Our success is simple, we are the most knowledgeable in our field using market leading equipment. We are focused on building strong relationships with our clients offering exceptional service and support.

WHY COUNCILS AND DEVELOPERS ARE CHOOSING E/ONE PRESSURE SEWER SYSTEMS

- Better for New Zealand's environment
- Minimal impact on councils existing sewer networks
- Ideal alternative to deep gravity sewer mains
- More resilient to seismic activity – earth quakes.
- Eliminates large public sewer pump stations



ecoflow
Pressure Sewer Specialists

RESPONSIBLE FOR 95% OF NZ'S PRESSURE SEWER SYSTEMS

E/ONE QUALITY

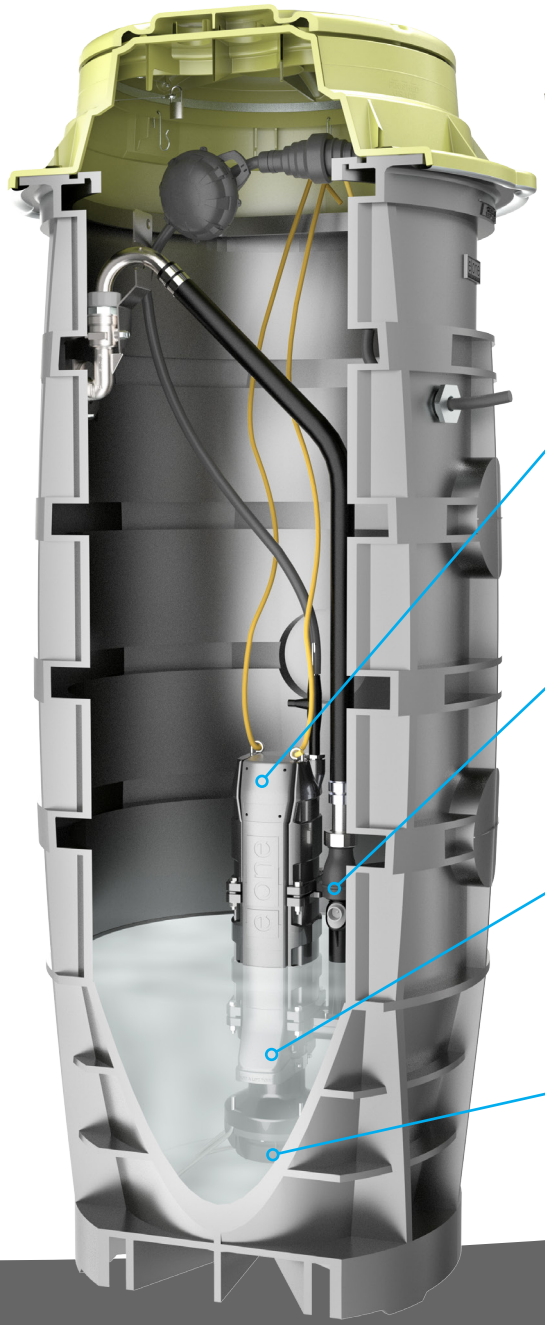
For over 50 years the E/One name is synonymous with reliable, maintenance free grinder pump systems, designed with longevity in mind. Before a product is released it is subjected to meticulous performance tests. The heavy duty cast iron grinder pump is ANSI/NFS 46 Certified. It's an industrial grade pump for residential use. E/One's tank is manufactured in New Zealand and is designed and certified to AS/NZS1546 specifications. It features an integrated stainless steel ball valve with pressure relief.

SERVICE CAPABILITIES

Ecoflow is known for offering end-to-end service. We have close relationships with architects, housing companies, builders, plumbers, drain layers and electricians to achieve a superior level of customer service.

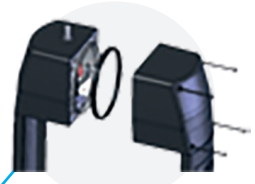
SERVICES INCLUDE:

- Network Design
- Project Management
- Supply of Quality E/One Equipment
- On-Site Delivery
- On-site Installation Training – Approved Drain layers
- Pump Installation and Commissioning
- Supply of Warranty/Consent Documentation
- On-going 24/7 Service



E/ONE ALARM PANEL

To maximise reliability and convenience, the E/One installation includes an IP65 weather proof alarm panel which also protects the pump from low voltage, running dry, and over pressure situations.



PRESSURE SWITCH HOUSING

Pressure switches in the head of the pump for starting and stopping are similar to washing machine controls, eliminating the need for float switches which commonly fail due to fats, hair and rags.

INTEGRATED VALVES

The integral non-return valve protects against system back pressure and the anti-siphon valve facilitates downhill pumping applications.

PROGRESSING CAVITY PUMP

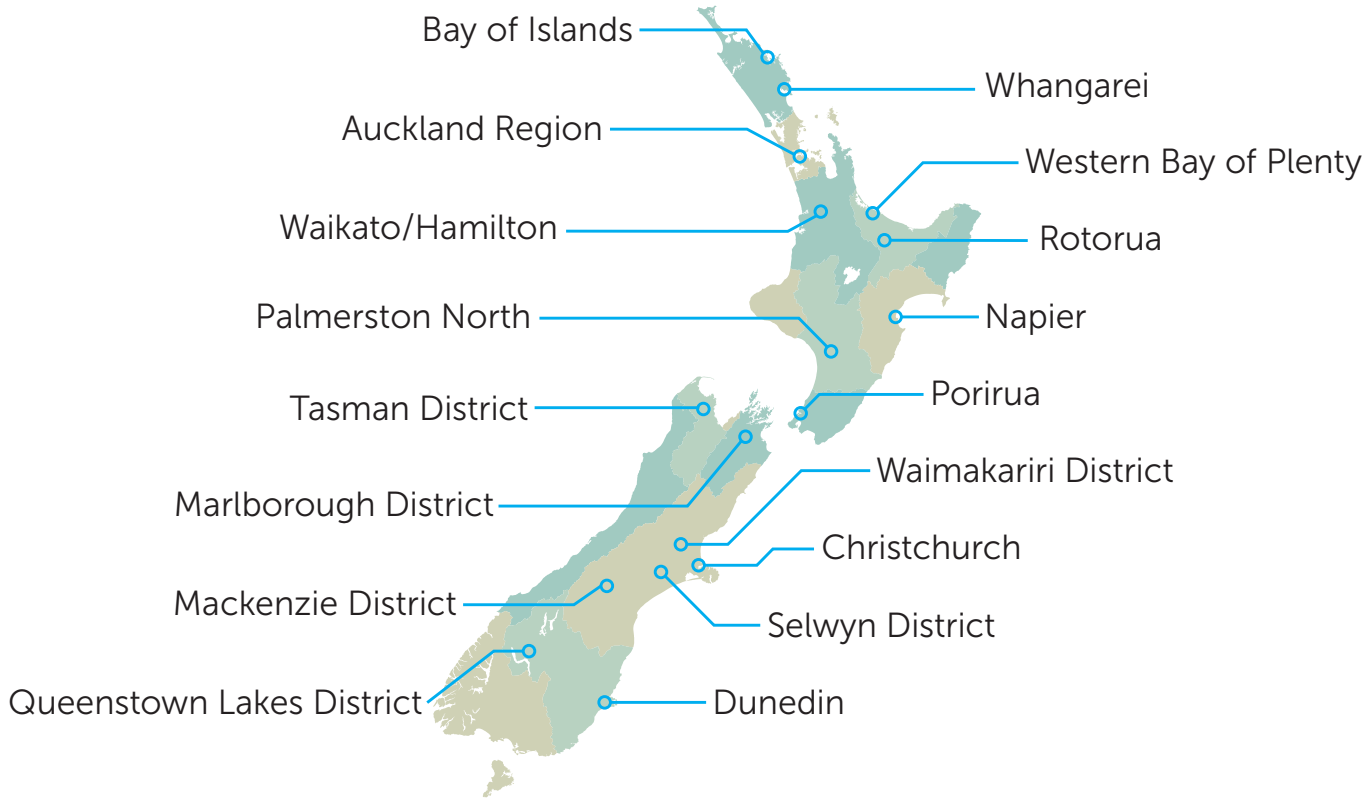
This deceptively simple design produces a nearly constant flow under a wide range of continuously varying conditions.

GRINDER WHEEL AND SHREDDER RING

Hardened forged alloy steel cutter bars and teeth create a shearing action coupled with the high torque pump to help eliminate blockages.

- Environmentally friendly
- No preventative maintenance
- Unobtrusive, low profile installation
- Extremely low noise and odour levels
- 24 Hour emergency storage capacity
- Low power consumption $20 to $30 per annum

NEW ZEALAND'S LEADER IN PRESSURE SEWER



10,000 NEW ZEALAND INSTALLATIONS

2 YEAR WARRANTY

24 SEVEN SERVICE LINE

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Pressure Sewer Specialists

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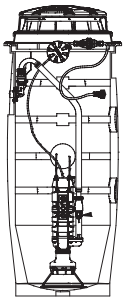
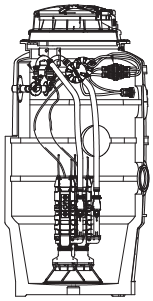
Email: info@ecoflow.co.nz
Website: www.ecoflow.co.nz
24/hr Service: 0508 528 3725

PRESSURE SEWER SYSTEMS

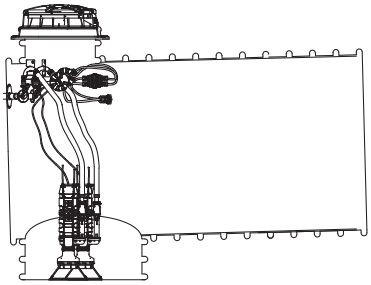
SYSTEMS



E/One Simplex 2010iP - single pump
designed for residential market
Standard storage/flows



E/One Duplex 2014iP - dual pump
designed for commercial or industrial areas
Greater storage/flows



Custom - multiple pump systems
designed for commercial or industrial areas
Custom design storage/flows

TANK SPECS

Simplex 2010iP	
Diameter (mm)	815
Height (mm)	2130
Weight (kg)	74
Total Capacity (L)	718

Duplex 2014iP	
Diameter (mm)	1140
Height (mm)	2030
Weight (kg)	132
Total Capacity (L)	1337

Custom Tank
Ecoflow can design a system solution that meets your storage/flow rate needs

CONSTRUCTION

E/Ones tanks are a purpose built 'wetwell' design made of high quality polyethylene (PE), a material that's fit for purpose. The E/One tanks have been certified to AS/NZS 1546.1:2008 and have been tested to twice the hydrostatic load required. Simply put, these are the most robust tanks on the market. Ecoflow also supply riser necks where deeper invert levels are required.

OTHER E/ONE FEATURES INCLUDE

- Small 600mm Lid Rated to 510kg
- Integrated 'Stainless Steel' Isolation Valve
- Tapered Sump to Reduce Retained Volume
- Integrated Ballast Flange
- Factory Assembled and Tested to Ensure Water Tightness

PUMP

E/One Extreme - Grinder Pump

The E/One Extreme grinder pump is the only purpose built grinder pump for pressure sewer systems. The unique larger diameter, low velocity, high torque grinder makes light work of solids and never requires sharpening. The vertical rotor progressive cavity pump generates the pressure to overcome the challenges of flat or hilly terrain. The pump rotor is through-hardened stainless steel while the pump stator is a proprietary compounded synthetic elastomer designed for the sewerage application and offers market leading wear resistance. The pump housing castings are fully epoxy coated to resist corrosion and designed to last for decades.

Motor Type	Single Phase, 240V, 50Hz, 0.75kW
Standards	NSF46, AS/NZS 60335.2.41:2004
Design Head	56m
Pump Flow	0.4l/s @ 55m TDH 0.75l/s @ 1m TDH
Speed	1450 rpm
Start Currant	26.4 Amps
Starting Torque	15.6 Nm
Check Valve	Swing Check Valve
Anti-siphon Valve	Integral anti-siphon/Check Valve

CONTROL PANELS

E/One Simplex/Duplex Protect Plus Panel

Alarm/Monitor panel. The Sentry Protect Plus panel monitors for the following operating conditions:

1. Pump Run Dry Condition – Pump running continuously
2. Pump Overpressure Condition – Pump operating at abnormally high wattage level
3. Brownout Condition
4. Overvoltage Condition – Mains voltage above 12% of nameplate rating
5. High Level Alarm Condition
6. Real time pump performance on LED screen

Note: 'Duplex Alternating Pump Duration' - This field allows selecting the time-based alternating pump duration mode. The default setting for this option is 24 hours.

OneBox® Panel

The OneBox® telemetry system gives complete control of your fleet of pressure sewer pumps from your office desktop or smartphone. Improve your customer service, identify issues as they arise, and dramatically improve waste water efficiency.

With OneBox® you can:

1. Monitor and control individual sewer pumps in real-time, remotely
2. Receive email/txt notifications even before the customer becomes aware of any issue
3. Analyse trends, generate reports and determine your peak flow demand
4. Optimise maintenance response
5. Smooth out peak flows and maximise capacity & performance of the downstream infrastracture
6. Real-time information at your finger tips.

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