GWE
CONSULTING ENGINEERS

RETIREMENT VILLAGE WASTEWATER DESIGN REPORT AND AEE

Riverhead Forest
Riverhead, Auckland

RANGITOOPUNI DEVELOPMENTS LTD

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1 INTRODUCTION

This report has been prepared by GWE Consulting Ltd. (GWE) for Rangitoopuni Development Limited Partnership (RDLP) as our client in support of their resource consent application.

This report is specific to the onsite wastewater treatment and disposal for the proposed retirement village on Lot 2 DP 590677.

Although this is not a hearing before the Environment Court, I record that I have read and agree to comply with the Environment Court's Code of Conduct for Expert Witnesses as specified in the Environment Court's Practice Note 2023. I confirm that this report is within my area of expertise, except where I state that I rely upon the evidence or reports of other expert witnesses lodged forming part of the project's application material. I have not omitted to consider any material facts known to me that might alter or detract from the opinions expressed.

2 DESCRIPTION OF ACTIVITY

GWE have been provided with a drawing set prepared by Crosson Architects Ltd. titled *Rangitoopuni Lifestyle Village Concept Design Presentation Rev 1.* dated 7 March 2025. Included in this drawing set are:

- Site Layouts
- Floor Plans and Unit Plans
- Elevations and Sections
- Communal and Ancillary Facilities
- Landscaping and External Spaces

The development proposed includes the construction and operation of a new retirement village complex on the Rangitoopuni site near Forestry Road, Riverhead. The development comprises multiple residential units with private gardens and outdoor living areas, communal facilities including a swimming pool, gym, dining areas as well as associated services spaces.

The purpose of this report is to assess the wastewater discharge from the proposed development, develop a solution for wastewater treatment and disposal and assess the potential effects on the receiving environment. A statutory assessment of this discharge is also provided under the Resource Management Act (RMA) and the Auckland Unitary Plan (AUP).

3 PROPERTY AND SITE DETAILS

The subject site is Lot 2 DP 590677 located at Forestry Road, Riverhead. The property is situated to the north of Riverhead township with access to the property from Forestry Road as shown in Figure 1 below.

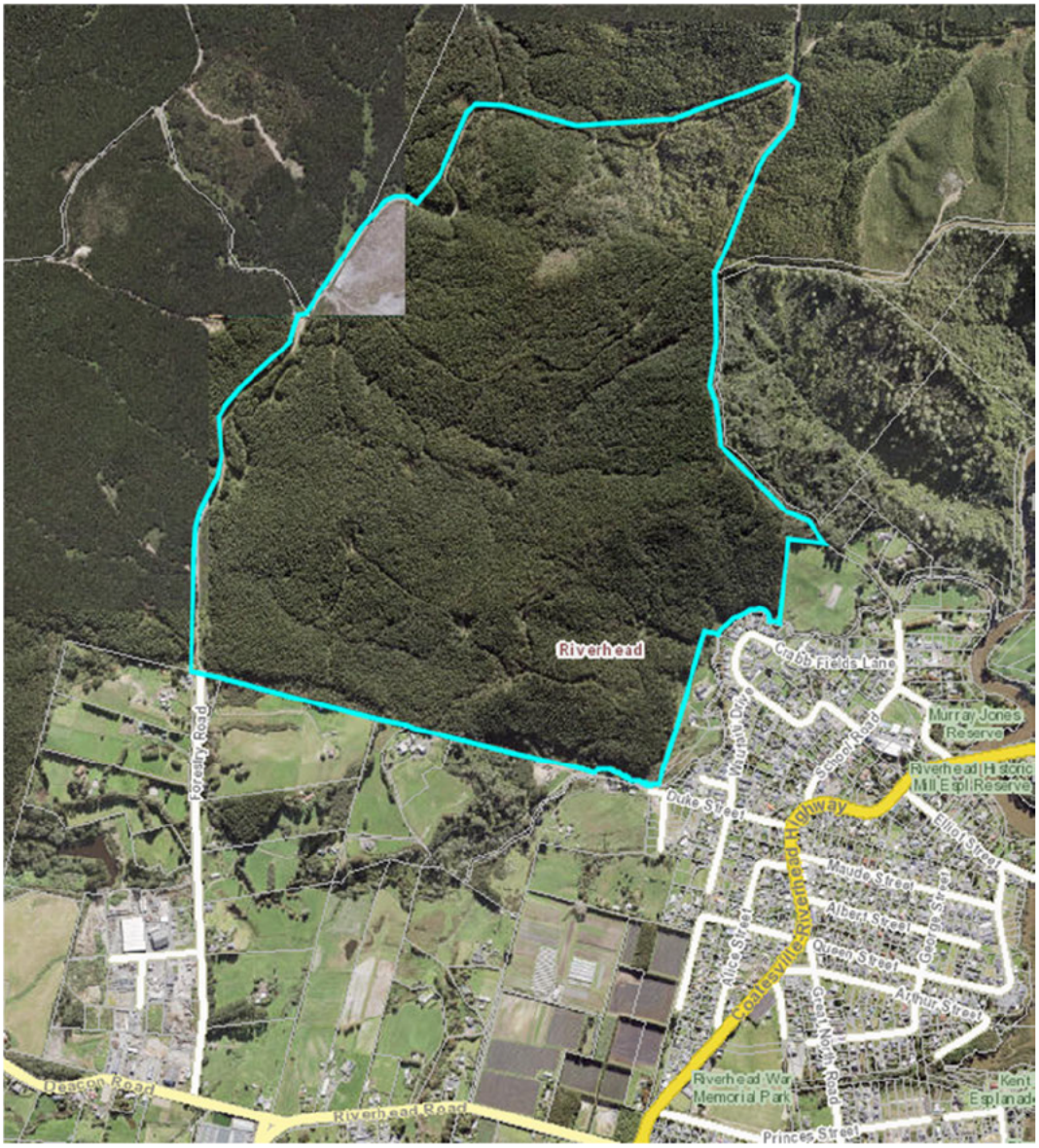


Figure 1: Site Location Plan

3.1 Current Land Use

The property is currently used for commercial forestry. This has been the underlying land use since approximately the 1930's.

3.2 Existing Wastewater Servicing

The existing Riverhead township is serviced by Watercare Services Ltd for water and wastewater. It is understood that as this area is outside the area serviced by Watercare Services Ltd for wastewater.

4 SITE DESCRIPTION

The site consists of rolling to moderately steep terrain, typical of the Waitematā Group landforms found in north-west Auckland. Ridges and gullies are evident, with multiple ephemeral stream corridors traversing the property.

- Slopes vary from gentle, to moderate or steep along some of the ridgelines and gullies though the forested zones.
- The vegetation on the site is primarily production pine forest of varying levels of maturity.
- The surrounding land use to the south and southeast are the residential areas of Riverhead township, north and west of the property is further production forestry
- Several watercourses traverse site, draining toward the lower-lying areas.
- Flooding within the disposal field area is considered to be of low risk.
- Water supply shall be via private supply.

4.1 Subsoil Investigation

GWE have progressed 21 hand-augured boreholes within the disposal field areas to 1.2 m below ground level. The results of these hand augers can be summarised as follows:

Most of the boreholes have a thin surface layer of topsoil or fill, contain a mixture of silt, clay and variable organic matter. Typically, this fill was found to be "uncontrolled" or uncompacted. Refusal was found in one borehole, however this was not encountered again during the investigation.

Underneath the fill/topsoil layer the bore logs generally record natural soils which are generally described as clay or silty clay. The soils display moderate plasticity, with some fine sand and gravel inclusions.

Based on this investigation we have considered the soils to be Category 5/6 silty CLAY and CLAY when assessed against TP 58 (2004) Table 5.1.

Groundwater was not encountered during any of the boreholes. The investigation was undertaken in March 2025 (late summer) after a period of extended dry weather, however there is no evidence that winter groundwater level would be within 1.2 m of the surface.

The bore logs are contained within Appendix C of this report.

5 BASIS OF DESIGN

Wastewater flows from the proposed retirement village has been derived based on TP58 (2004) Table 5.2 A per capita flow allowance of 180l/person/day has been applied. A factor of 1.6 has been applied to allow for inflow and infiltration within the reticulated gravity sewer network in the retirement village.

5.1 Population and Flows

GWE have assessed the occupancy of the property based on the drawings provided by Crosson Architects Ltd (Crosson) titled *Rangitoopuni Lifestyle Village Concept Design Presentation Rev. A 28 March 2025*.

The drawings provided by Crosson show the development of the RV over 4 stages (1-4), and associated facilities. For the purposes of this report, we have considered the final design horizon for assessing the requirements of the discharge consent.

The accommodation typology has been summarised below and occupancy and flow rates applied to each unit type. The design occupancy is in accordance with TP 58 (2004) Table 6.1.

Table 1: Design Flow Volumes

ACCOMMODATION TYPE	NUMBER	OCCUPANCY	PER CAPITA FLOW RATE L/DAY	TOTALS
2.5 Bed	46	2	180	16,560
2.5 Bed	57	2	180	20,520
2 Bed	27	1.3	180	6,318
Duplex	12	1.3	180	2,808
3 Bed	62	2	180	22,320
3 Bed	56	2	180	20,160
Care Suites	36	1	180	6,480
Amenity Building	1	Refer to Table 2: Amenity Building Flow Assessment		10,450
Staff		50	30	1,500
Total				107,116l/day
Total Including Infiltration Factor				**172 m^3/day**

Typical wastewater flow volumes from Retirement Villages and Care Homes range from 160l/person/day to 200l/person/day. Composition of effluent can be approximated from residential wastewater. For the purposes of this application, we have used 425 mg/l for BOD_5 which is considered in the higher range for residential wastewater, which allows for the elevated wastewater streams from the commercial areas within the development.

An allowance for 50 staff has been applied for the retirement village, using a flow rate of 30 l/person/day.

For the purposes of this application, GWE recommend adopting a per capita flow rate of 180 l/person/day. TP58 recommends a flow rate of 200 l/person/day however this is based on standard water use devices which includes 11 litre flush toilets which are not typically in use, and have been replaced with dual flush 6/3 litre toilets. Further to this, water efficiency in washing machines, dishwashers and faucets has improved considerably, and therefore a modest reduction in the per capita flow volume has been applied. On this basis, we still consider the flow allowance to be sufficiently conservative.

5.1.1 Amenity Building

The amenity building is a single storey building design for communal use. It is organised around a central kitchen and reception hub. Wastewater from the building will produced from the following areas:

- Dining areas.
- Lounge/bar areas.

Some minor flows are to be expected from the following areas:

- Activity/Craft areas.
- Staff/admin areas.
- Library.

Flows from the amenity building are described in Table 2 below. An event allowance of 2,000L/day has been applied in addition to the design flows to cater for the any events that may be held at the venue. The nature of this wastewater has been considered in the design of the treatment plant, noting the elevated nature of wastewater concentrations from commercial premises, specifically hospitality venues.

Table 2: Amenity Building Flow Assessment

FACILITY	FLOW RATE	UNIT	TOTAL (L/DAY)
Dining	40L/day	100 people	4,000
Lounge/Bar Patrons	20L/day	150 people	3,000
Activity Rooms/Library	10L/day	100 people	1,000
Staff	30L/day	15 people	450
Events	2000L/day	1	2,000
Total			10,450L/day

5.2 Infiltration and Inflow

A factor of 1.6 has been assumed for infiltration of effluent into the network. As part of the consent we recommend that infiltration is monitored. This can be done by monitoring wastewater discharge, rainfall and water usage data in the village, and investigation into sources of infiltration, should it become an issue, can be done through smoke testing and CCTV inspection of the wastewater reticulation network within the Retirement Village.

5.3 Effluent Characteristics

As this is a new discharge there is no sample analysis available. We have therefore relied on industry practise to determine what the raw effluent is likely to be from the Retirement Village. The key raw effluent parameters are as follows:

- Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)
- Total Suspended Solids (TSS)
- Total Nitrogen (TN)
- Total Phosphorus (TP)
- Ammonia
- Fats, Oils and Grease

This is summarised in Table 3 below.

Table 3: Rangitoopuni - Anticipated Contaminant Concentrations

PARAMETER	RAW WASTEWATER
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	425
Total Suspended Solids (TSS)	475
Total Ammoniacal Nitrogen (NH4-N)	39
Total Kjeldahl Nitrogen (TKN)	67
Total Phosphorus (TP)	17
Fats, Oils and Grease	195
pH	6.5–8.0

Note:
[1]All concentrations in mg/L

5.3.1 Fats, Oils and Grease

Fats, Oils and Grease (FOG) will be generated from any commercial kitchens located within the development. FOG removal shall be carried out as close to the source as possible through the addition of grease traps as necessary. Grease traps shall be specified based on the detailed design of the facilities, to ensure that they are correctly sized and located, and integrated into the wastewater reticulation in accordance with the building code. All grease traps shall have a minimum of 24hours hydraulic retention from each source.

5.4 Target Effluent Quality

GWE have undertaken an assessment of the expected requirements for the proposed receiving environment – discharge to the land via pressure compensating dripper irrigation. Effluent quality limits are expected to be derived from the potential effects on a number of different elements, including overall water quality, ecology and cultural values.

Table 4 outlines the expected average effluent quality targets the WWTP would be expected to reliably achieve under a discharge consent and are in-line with current best practice. The proposed effluent quality limits are as shown.

Table 4: Rangitoopuni – Anticipated Average Effluent Quality Requirements

PARAMETER	RAW COMBINED INFLUENT	TREATED EFFLUENT QUALITY
5-Day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	425	15
Total Suspended Solids (TSS)	475	15
Total Kjeldahl Nitrogen (TKN)	67	15
Ammonia (NH_3)	39	5
Total Phosphorus (TP)	17	12
Faecal Coliforms (FC)	$>1x10^8$ CFU/100 mL	<200 CFU/100 mL

Note:

[1]All concentrations in mg/L unless otherwise stated.

6 TECHNOLOGY ASSESSMENT

As part of our engagement, GWE has undertaken a technology review of suitable technologies that can be used to treat wastewater that meet the requirements for discharge to land in New Zealand. GWE evaluated the available treatment options on the basis of specific key factors to the area including:

- Ease of construction.
- Operational complexity.
- Reliability.
- Potential for staged upgrades.
- Ability to meet stringent current and potential future effluent quality targets (long-term discharge security).
- Use of technologies that are common within a NZ context and consistent with current and emerging technologies.
- Track record of suppliers and technology.

The following section provides a summary of these technologies.

6.1 Conventional Activated Sludge

The activated sludge process is widely used in New Zealand for treating domestic wastewater. It involves aerating the wastewater to promote the growth of microorganisms that decompose organic matter. The process begins in an aeration tank where air or oxygen is introduced to the wastewater, encouraging the growth of aerobic bacteria and other microorganisms. These microorganisms form flocs, or clusters, that consume organic pollutants, converting them into carbon dioxide, water, and energy for their growth and reproduction.

After the aeration tank, the mixture of wastewater and biological flocs flows into a secondary clarifier or settling tank. Here, the flocs settle to the bottom, forming activated sludge. The clear, treated water at the top is then discharged. A portion of the settled sludge is recycled back into the aeration tank to maintain the population of microorganisms, while the excess sludge is removed for further processing or disposal. This process effectively reduces the organic content and pollutants in the wastewater, making it safer for discharge into the environment.

Conventional activated sludge is not suitable for the project for the following reasons:

- Large footprint.
- Requires regular (daily/weekly) supervision and operation.
- Generates a large volume of sludge that would require further processing.

6.2 Sequential Batch Reactor (SBR)

The Sequential Batch Reactor (SBR) process is a type of activated sludge treatment that operates in a batch mode, treating wastewater in a series of steps within a single reactor. The process consists of five main phases: fill, react, settle, decant, and idle. During the fill phase, wastewater is added to the reactor. In the react phase, the wastewater is aerated, promoting the growth of microorganisms that break down organic pollutants. This phase is similar to the aeration process in conventional activated sludge systems.

Following the react phase, the settle phase allows the biological flocs to settle to the bottom of the reactor, separating the treated water from the sludge. In the decant phase, the clear, treated water is removed from the top of the reactor. Finally, the idle phase provides a buffer period before the next cycle begins. The SBR process is flexible and can be adjusted to handle varying wastewater volumes and compositions, making it suitable for small to medium-sized treatment plants and facilities with fluctuating wastewater flows.

GWE has not considered this process further because there are no credible suppliers of SBR's in New Zealand with a suitable track record of delivering projects of this size.

6.3 Submerged Aerated Fixed Film (SAF)

The Submerged Aerated Filter (SAF) reactor process is a biological wastewater treatment method that uses submerged media to support the growth of microorganisms. Wastewater flows through the media, which is aerated by diffusers at the bottom of the reactor. The microorganisms form a biofilm on the media, breaking down organic pollutants as the wastewater passes through. This process effectively reduces Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and ammonia levels in the wastewater.

SAF reactors are designed for robustness and minimal maintenance, with no internal moving parts and a high surface area for biofilm growth. The treated water exits the reactor at the top, while the biofilm remains attached to the media, ensuring continuous treatment.

GWE has not considered this process further because there are no credible suppliers of SAF's in New Zealand with a suitable track record of delivering projects of this size.

6.4 Moving Bed Bioreactors

The Moving Bed Bioreactor (MBBR) process is a wastewater treatment method that utilizes free-floating plastic carriers within an aeration tank to support the growth of biofilm. These carriers provide a large surface area for microorganisms to attach and form biofilms, which break down organic pollutants in the wastewater. The aeration system keeps the carriers in constant motion, ensuring efficient contact between the wastewater and the biofilm. This process enhances the degradation of organic matter, reducing Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) levels.

MBBR systems are particularly effective in handling variable loads. The treated water exits the reactor, while the biofilm remains on the carriers, allowing for continuous treatment.

GWE has not considered this process further because there are no credible suppliers of MBBR's in New Zealand with a suitable track record of delivering projects of this size.

6.5 Recirculating Textile Packed Bed Reactors

The Textile Packed Bed Reactor (PBR) process is a type of biological wastewater treatment that uses textile media to support the growth of microorganisms. Wastewater flows through the reactor, where the textile media provides a large surface area for biofilm formation. The microorganisms in the biofilm break down organic pollutants as the wastewater passes through, effectively reducing Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) levels.

This process is highly efficient due to the high surface area of the textile media, which allows for a dense population of microorganisms. The treated water exits the reactor, while the biofilm remains attached to the textile media, ensuring continuous treatment. Textile PBR systems are known for their robustness and low maintenance requirements, making them suitable for various applications, domestic wastewater treatment.

6.6 Preferred Technology

The recirculating textile PBR is the preferred technology for use at the retirement village. There are several suppliers available in New Zealand that have the ability to successfully install and maintain such systems. The advantages of this system are:

- Small footprint.
- The systems are modular and easily expandable as flow increases.
- Does not require regular monitoring and maintenance outside the scheduled (every 3 months) service period.
- High quality effluent that is low in nitrogen.
- Proven track record for use within New Zealand.
- Reacts well to wide fluctuations in flow and organic load.

7 PROPOSED WASTEWATER TREATMENT SYSTEM

It is proposed that the wastewater from the site is collected and treated using a Recirculating Packed Bed Reactor (rPBR) provided by Innoflow Technologies Ltd and based on the Orenco Systems Inc. proprietary treatment process.

7.1 Description of Treatment Train

The following is a description of the proposed process train broken down into each individual stage.

7.1.1 Primary Treatment

The seven septic tanks (25,000L tanks and will provide 175,000 L total) provide primary sedimentation, grease floatation and anaerobic digestion. These tanks remove settleable solids and some dissolved organic matter, reducing the biochemical oxygen demand (BOD_5) load on the downstream biological treatment units (PBRs).

Anaerobic digestion occurs, breaking down solids and producing sludge, which must be periodically removed.

Effluent from the septic tanks flows through 4 Biotube Filters prior to entering into the pre-anoxic tanks. The Biotube filters ensure solids are retained in the septic stage of the treatment plant.

7.1.2 Pre-Anoxic Stage

The pre-anoxic tanks (total 7 x 25,000L tanks and will provide 175,000 L total) facilitate denitrification by providing a low-oxygen environment where facultative bacteria reduce nitrates (NO_3^-) to nitrogen gas (N_2).

The presence of organic carbon (from the septic tank effluent) supports heterotrophic bacteria in denitrifying nitrate.

Effluent flows into the Stage 1 biological process recirculation tanks.

7.1.3 Stage 1 Biological Process

a. Recirculation Tanks (5 x 25,000 L)

These five recirculation tanks (125,000 L total) serve as aerobic buffer tanks and play an important role in managing diurnal peaks. The buffer tanks pump the partially treated wastewater to the AX100 pods for further treatment.

b. AX100 Pods (15 Units)

These fixed-film textile-based biofilters serve as the biological treatment stage.

Microbial growth on the textile media ensures efficient BOD removal and nitrification.

Recirculation pumps return a portion of treated water to maintain biological function. The effluent is recycled at a 4:1 ratio, 4 parts being recycled, 1 part progressing to the next stage of treatment.

7.1.4 Stage 2 Biological Process

a. Recirculation Tanks (2 x 25,000 L)

These recirculation tanks (50,000 L total) receive partially treated effluent from Stage 1.

b. AX100 Pods (5 Units)

These additional fixed-film biofilters provide polishing treatment, reducing residual BOD, ammonia, and nitrogen. Effluent from these pods is directed to the treated effluent tanks.

7.1.5 Treated Effluent Storage (6 x 25,000 L)

The six treated effluent tanks (150,000 L total) store final treated wastewater prior to disinfection and discharge to the land application area. The operating volume of the treated effluent tanks is designed such that there is 24 hours dry weather flow of storage within the tanks. The treated effluent tank is fitted with 2 irrigation pumps which operate in a duty/standby arrangement to provide redundancy in the event of a pump failure.

7.2 Disinfection

Ultraviolet (UV) disinfection shall be used to provide tertiary treatment of the effluent prior to discharge to land. Once the effluent has passed through the PBR it is exposed to a dose of UV light which inactivates bacteria (and other pathogens) reducing them to less than 200CFU/100 ml which is the typical target rate in TP58 (2004).

7.3 Solids Management

Solids are retained within the primary chambers of the wastewater treatment plant. This is monitored during regular service and maintenance of the plant and solids are removed periodically, typically every 3 to 5 years.

7.4 Chemical Systems

Chemical dosing at the treatment plant may be required during operation to supplement the treatment process. It is anticipated however, that this will be limited to alkalinity dosing and supplementary carbon, which can be provided by soda ash and acetic acid (i.e. vinegar) respectively.

7.5 Miscellaneous

7.5.1 Noise

Noise is not anticipated at the treatment plant. The only operating machinery within the system shall be pumps and the UV disinfection unit. These items do not produce significant noise.

7.5.2 Odour

Under normal operating conditions odour is not anticipated at the treatment plant. Within the septic and anoxic stage of the process, the tanks are sealed and the crust that forms on the surface of each septic tank prevents odour from escaping.

Through the PBR the effluent will be maintained in an aerobic state, which does not generate foul odours. The continuous flow and oxygenation through the process by recirculation of the effluent over the media ensures that the effluent is maintained aerobically.

Regular service and maintenance of the project will further ensure that no adverse odours emanate from the system.

7.5.3 Vehicle Movements

Vehicle access within the treatment plant is not required for services and maintenance. Access to the primary stages for pump out shall be provided by a service parking area outside of the treatment plant fencing.

7.5.4 Security

The treatment plant shall be secured behind a perimeter fence with locked gates restricting access to authorised personnel only. Clear signage shall be installed to deter would-be intruders. GWE recommends that access is controlled via keycard, or RFID-based systems.

Monitoring and surveillance shall be installed to alert the operator of unauthorised access.

7.6 Operations and Maintenance

Operation and maintenance of the wastewater treatment plant will be provided by an external service contractor. Typical operation and maintenance for the proposed treatment plant comprises of quarterly maintenance of the treatment plant and disposal field.

Automated controls monitor operating parameters (e.g., UV lamp performance, pump cycles, high-level alarms). Remote telemetry installed within the control panel allows for off-site monitoring of the treatment plant alarms. In the event of any alarms being triggered, a technician can be sent to site to investigate and repair the issue.

Periodic sampling of the treated effluent is undertaken to verify compliance with consent conditions

A detailed operation and maintenance plan will be provided once the treatment plant is installed and commissioned.

7.7 Staging of WWTP

The development of the RV will take place over a period of years before the final design horizon is reached. On this basis, it is likely that the wastewater treatment plant will be installed over a number of stages. This ensures that treatment capacity can closely match the actual flows. This approach is consistent with the modular nature of the rPBR design. The following is an indicative three-stage process:

7.7.1 Stage 1 – Initial Occupancy

Initial occupancy assumes that a flow of up to 40% of the total development is allowed for as part of stage 1. The components are summarised below. The UV disinfection unit will need to be installed at this point to suit all future design horizons.

STAGE 1	TREATMENT COMPONENTS	COMMENTS
Primary	4 x 25,000L Septic	Fitted with outlet filters
Pre-Anoxic	2 x 25,000L	
Recirculation	2 x25,000L	
Biological Treatment	Stage 1 – 6 Pods Stage 2 – 2 Pods	
Tertiary	UV Disinfection Unit Installed	
Disposal Field	40% of Disposal Field Installed	

7.7.2 Stage 2 – Developed Occupancy

Developed occupancy assumes that several of the commercial operations as well as the villas are in operation. Redundancy should be built into each stage to ensure there is capacity as the build progresses.

STAGE 2	TREATMENT COMPONENTS	COMMENTS
Primary	6 x 25,000L Septic	
Pre-Anoxic	6 x 25,000L	
Recirculation	4 x25,000L	
Biological Treatment	Stage 1 – 10 Pods Stage 2 – 4 Pods	
Treated Effluent	4 x 25,000L tanks	
Tertiary	UV Disinfection Unit Installed	
Disposal Field	70% of Disposal Field Installed	Extend the disposal field by 30%

7.7.3 Stage 3 – Final Design Horizon

The final design horizon is as outlined in the consent.

STAGE 3	TREATMENT COMPONENTS	COMMENTS
Primary	7 x 25,000L Septic	
Pre-Anoxic	7 x 25,000L	
Recirculation	5 x 25,000L	
Biological Treatment	Stage 1 – 15 Pods Stage 2 – 5 Pods	
Treated Effluent	7 x 25,000L tanks	
Tertiary	UV Disinfection Unit Installed	
Disposal Field	100% of Disposal Field Installed	

Notes:

- *The number of tanks, pods, or field areas added at each stage can be adjusted in practice according to actual occupancy rates or measured daily flows.*
- *Each stage should be accompanied by a thorough commissioning process to ensure the plant is meeting performance standards before the next build-out.*
- *Regular monitoring (effluent quality, soil sampling, flow measurement) is critical to confirm compliance and detect potential issues early.*
- *A condition for the staged development of the system is proposed in Section 10.6.*

8 LAND APPLICATION AREA

Land application of treated effluent will be undertaken by surface laid pressure compensating dripper irrigation (PCDI). PCDI is considered to be best practice for land application where the land is undulating or steep, as it ensures even distribution of the treated effluent to land.

The areas for land application are shown on the site plans contained within Appendix A. The disposal fields shall be located to the north of the retirement village as indicated on the plans.

Slopes within the proposed disposal fields are approximately 5–10 degrees.

8.1 Loading Rates and Disposal Method

The soils on site have been assessed as category 5/6 under TP 58 table 5.2 and a loading rate of 3 mm/day has been applied. This corresponds to a disposal field area of 58,000 m^2. A reserve disposal field area of 28,500 m^2 has also been allowed for.

Tertiary treated effluent is pumped from the treated effluent tank via the solids filter and UV disinfection unit to the disposal field areas. The treatment process ensures that the effluent quality meets or exceeds the necessary microbiological and nutrient quality requirements for land disposal, particularly under the conditions specified in the Auckland Unitary Plan and relevant guideline documents (TP 58).

8.2 Preparation of the Disposal Field

Prior to the installation of dripline, the disposal field should be cleared of debris material from the forestry operations on site. This includes logs, slash, and any gravel or metal tracks. Areas that have been heavily compacted, may need to be remediated by tilling the soils. It is recommended that prior to the installation of dripline, the area is inspected to confirm suitability of each dripline zone. The inspection should be undertaken by someone with suitable experience in the installation of wastewater disposal fields.

8.3 Systems Components

The wastewater will be pumped via a rising main network to the disposal field. The rising main shall be surface laid, except where road crossings are required. The disposal field shall be broken down into sectors using a series of sequencing valves to ensure even distribution across the different zones of the disposal field. This also ensures that the effluent is not overloaded to specific zones within the disposal field, as each zone has a period of "rest" once it has been dosed.

Surface dripper irrigation is pressure compensating ensuring even distribution of effluent throughout each zone. The laterals shall be no longer than 70 m in length to ensure effluent is fully distributed through the length of the line.

The effluent will be dosed on a timer setting, rather than conventional demand dosing, to ensure that the effluent is applied to the field over an extended period of time. In effect, small doses of effluent are applied to the soils, which can assimilate into the ground at appropriate intervals throughout the day.

The land disposal system is summarised in Table 5 below.

Table 5: Land Disposal System

LAND DISPOSAL SYSTEM	PCDI	NOTES/COMMENTS
TYPE	Surface laid drip lines at 1 m centres	Measured centre-to-centre between adjacent drip lines in the disposal field.
RISING MAIN AND MANIFOLDS	PN 16 MDPE 32–63 mm OD	Designed for above ground installation to minimise soil disturbance and facilitate maintenance and inspections.
EMITTER SPACING	0.6 m centres	Measured along each drip line; typically standard for many PCDI systems.
EMITTER FLOW RATE	~2 L/hr per emitter (common value).	Actual flow rate depends on manufacturer; often 1.6–3.6 L/hr. Pressure compensating ensures consistent output across the system.
FILTRATION REQUIREMENT	Minimum 120–150 micron filter.	A disk or screen filter is usually installed before distribution to prevent emitter blockage.
SOIL CATEGORY	5/6	

LAND DISPOSAL SYSTEM	PCDI	NOTES/COMMENTS
FLOW RATES	172,000L/day	
LOADING RATE	3 mm/day	
PRIMARY DISPOSAL AREA	58,000 m^2	
RESERVE DISPOSAL AREA	28,500 m^2	
LOADING DEVICE/METHOD	Timer Dosed Pump in duty/standby arrangement.	
INSTALLATION ACCESS	Ensure supply and flushing manifolds are accessible.	Valves and cleanouts must remain reachable for inspection, flushing, and maintenance.
FLUSH VALVES / AIR VENTS	Flush valves at line ends. Air vents at high points.	Facilitates maintenance by removing sediment and preventing vacuum conditions that might draw debris into emitters.

8.4 Management and Maintenance

The land application area will be managed by a third party contractor as part of the management of the treatment plant. Management and maintenance activities will include the following:

- Regular inspections of the disposal field, and associated distribution network, fittings and valves.
- Flushing of the disposal field.
- Vegetation maintenance and removal.
- Visual inspections of the disposal field to ensure the system is correct functionality.

9 ASSESSMENT OF ENVIRONMENTAL EFFECTS

It is anticipated that the tertiary treatment system and surface laid PCDI disposal system will have a less than minor effect on the environment. It is expected that at the proposed loading rate, the soils are conducive to accepting the treated effluent from the treatment plant.

9.1 Surface Water

Auckland Council GIS indicates a number of overland flow paths traverse the property and are mostly associated with the series of stormwater ponds located along the western border.

As a general guideline, TP58 identifies a minimum separation of 5–10 m for tertiary treated wastewater.

The disposal field areas are located a minimum of 15 m from any OLFP or swale, exceeding TP58 requirements. Furthermore, the vegetation/grass will also assist with the retention, breakdown and uptake of effluent at the site and prevent effluent being washed off-site.

The use of surface PCDI and timer dosing of effluent is in accordance with best practice and minimises the potential for any runoff.

Overall, the effects on surface water are assessed as being less than minor.

9.2 Impact on Ground Water

TP58 identifies a minimum separation requirement of 0.6 m to groundwater for tertiary quality effluent.

GWE's subsoil investigations did not encounter groundwater above 0.6m below ground level. The seasonally elevated groundwater table at the site is expected to be >0.6 m below ground level (m bgl). As such, it is expected to meet TP58 requirements.

Furthermore, the tertiary level of treatment will ensure protection of groundwater. Further discussion around the discharge of nutrients to the soils is presented in the following section. However, we note that separation distances to groundwater in accordance with TP58 is maintained.

Overall, the effects on groundwater are assessed as being less than minor.

9.3 Impact on Soils

The land used for the site has been forestry since approximately 1930's. No active ripping or tilling of the soils is proposed but the area will be replanted with native vegetation. The choice of species will be based on TP58 Appendix G and shall include species that can handle "wet feet". Examples of these are harakeke, cabbage trees, sedges and carex grasses. These plants also evapo-transpire significant amounts of water and take up nutrients for growth.

9.3.1 Hydraulic Loading Rate

The underlying soils in the irrigation areas are categorised as 5/6 under TP58 (2004), with slow-moderate drainage characteristics and recommended loading rates of up to 3 mm/day. Category 5/6 soils have relatively high clay content and relatively low infiltration capacity. The loading rate applied in accordance with TP 58 (2004), is not expected to cause ponding or run-off, or saturation of the soils which might compromise the availability of the oxygen within the soils. As noted above, the vegetation will provide evapotranspiration assistance.

9.3.2 Nutrient Loading

The application of highly treated effluent, as proposed, will be effectively managed in the soils. While there will be some residual nutrients, mainly nitrogen and phosphorous, these will be in moderated concentrations. It is expected that decades of pine forest harvesting on the site will have depleted the soils of some nutrients, such that the addition of N and P through the wastewater irrigation system will prove beneficial in the establishment of native vegetation within the disposal field. Microorganisms in the soils breakdown residual organic material, as well as the soils providing some physical filtration of the effluent.

9.3.2.1 Nitrogen

Nitrogen in the effluent will be in the form of nitrate with some ammonium. While nitrate can be mobile, the low permeability of the soils will reduce the mobility through the soils to groundwater, the take up of Nitrogen will be further supplemented by the vegetation within the disposal field.

9.3.3 Phosphorous

Phosphorous tends to sorb onto the soil particles in clayey soils, so the primary risk of phosphorous leaching is likely to be via hydraulic overloading of the soils causing run-off. The risk of this effect occurring is mitigated by the low loading rate of phosphorous to ground provided by the high level of treatment at the treatment plant and the low loading rate proposed for the effluent. It is further recommended that P is monitored as part of the soils sampling regime for the disposal field.

9.3.4 Other Nutrients

The effluent will also contain potassium, sulphur, magnesium and traces of micronutrients. These will generally add to the soil fertility which will help with establishing plants within the disposal field.

Sodium can also be present in treated wastewater, typically from detergents and cleaning agents. This can degrade the soil structure over time. It is therefore recommended that soil sampling includes sodium testing. If the levels do become elevated, gypsum can be added to prevent issues caused by sodicity.

9.3.5 Soil pH

Soil pH is expected to be approximately 5.0–5.5 in line with typical forestry blocks within New Zealand. The slightly acidic nature of the soils is as a result of the degradation of pine needles on the surface soils. The application of treated effluent will likely increase the pH toward 6.0-6.5 which will assist in restoring a more balanced soil chemistry.

9.3.6 Summary

The effluent will provide additional nutrients to the soils which will aid the establishment of native plants within the disposal field. As the native vegetation develops, improved soil structure and stability, in addition to a return of organic matter in the form of leaf litter. It is expected that the area will become healthy native bush.

Hydraulic and nutrient loadings of the soils are mitigated as outlined above.

Overall, the effects on soils are assessed as being less than minor.

9.4 Impact on Amenity Values

The WWTP produces a high-quality effluent and therefore odours are not anticipated at the treatment plant or the disposal field. The volume of treated effluent produced is dispersed over a large disposal area. As outlined above, noise and odour are not anticipated from the treatment plant.

The treatment plant will be located a minimum of 3.0 m from all buildings and a minimum of 3.0 m from the lot boundaries, with no adverse odour and noise effects anticipated.

The visual impact of the wastewater treatment plant will be mitigated through planting and screening of the wastewater treatment plant area.

9.5 Impact on Public Health

The WWTP will treat wastewater to a tertiary level (in accordance with best practice), minimising potential adverse effects if exposure occurs.

Overall, no issues in relation to human health are expected.

9.6 Summary

The system has been designed in accordance with relevant guidelines, and is consistent with the Resource Management Act, Auckland Regional Policy Statement, and the Auckland Unitary Plan – Operative in Part. Furthermore, there are a number of specific design features that will mitigate against environmental effects, including:

- A new wastewater system providing tertiary level effluent.
- Separation distances that meet TP58 (2004) requirements.
- 50% reserve is proposed.
- Several monitoring conditions on the discharge are proposed (Refer to 10.6).

For the reasons outlined above, and throughout the application, insignificant adverse environmental effects are anticipated. Groundwater, surface water, public health, and amenity are all adequately protected. Overall, the proposal to discharge wastewater from the proposed development, is considered to have less than minor adverse effects that can be contained within the boundaries of the site.

On-going maintenance and management of the proposed treatment system in accordance with the supplier's specifications will be required to ensure that no minor adverse effects arise.

10 STATUTORY ASSESSMENT

10.1 Resource Management Act

The Resource Management Act (RMA) 1991 sets out a statutory framework for consideration of resource consent applications which includes National Environmental Standards, National Policy Statements, Regional Policy Statements and Regional and District Plans. An assessment of the proposed activity against the RMA is given below.

The Resource Management Act (RMA) overarches statutory regulation in New Zealand. Part 2 of the RMA promotes the sustainable management of natural and physical resources. Sustainable management is defined as:

Managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—

a. sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

b. safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

c. avoiding, remedying, or mitigating any adverse effects of activities on the environment.

The proposal is the disposal of tertiary treated wastewater associated with the retirement development with ongoing monitoring, by way of consent conditions. The tertiary treatment of wastewater at the development is consistent with best practice and therefore avoids adverse effects on the environment, as per the requirements under Section 17 of the RMA.

10.2 Section 104

Section 104(1) of the RMA requires a consent authority, when considering an application for a resource consent, to have regard to:

- Any actual and potential effects on the environment of allowing the activity (Section 104 (1)(a)).
- Any measure proposed or agreed to by the applicant for the purpose of ensuring positive effects on the environment to offset or compensate for any adverse effects on the environment that will or may result from allowing the activity (Section 104 (1)(ab)).
- Relevant national environmental standards, national and regional policy statements, planning and policy documents and other regulations (Section 104(1)(b)).
- Any other relevant matter (Section 104 (1)(c)).

The actual and potential effects on the environment of the proposal pursuant to Section 104(1)(a) of the Act are set out in Section 9 of this report. Wastewater is treated to a tertiary level under TP58 (2004) standards, in accordance with best practice. Several monitoring conditions are proposed to ensure the activity is carried out responsibly (Refer to Section 10.6).

10.3 Section 105

Section 105 of the RMA requires that where a discharge permit is required, the consent authority must have regard to:

- The nature of the discharge and the sensitivity of the receiving environment to adverse effects; and
- The applicant's reasons for the proposed choice; and
- Any possible alternative methods of discharge, including discharge into any other receiving environment.

This proposal includes an assessment of environmental effects which concluded that the discharge is expected to have *less than minor adverse effects on the receiving environment*.

Alternative methods of wastewater management have been identified and discussed in Section 11 of this report, including the offsite disposal of wastewater. Overall, a land discharge was determined to be the best practical option (BPO).

10.4 Auckland Unitary Plan

In accordance with Table E5.4. of the AUP-OP, the proposal to discharge wastewater from the proposed development via a land disposal system is a **Discretionary Activity** (A6). A discharge consent is required as the wastewater from the proposed facilities is not considered domestic-type wastewater and the flows exceed 6,000 litres/day.

An assessment of effects of the activity was carried out on Section 9 of this report, where it was concluded that the effects will be less than minor.

10.5 Section E1 – Water Quality and Integrated Management

10.5.1 Section E1 - Water quality and integrated management

Section E1 of the AUP-OP identifies the following policies in relation to on-site wastewater treatment and disposal:

(23) Enable on-site domestic-type wastewater treatment and disposal where:

(a) there is no wastewater network available, or it is not practicable to connect into one of the network, or any existing network does not have capacity and it is not practicable to upgrade it; and

(b) the on-site wastewater treatment results in a discharge that is of a quality and volume that avoids significant adverse effects on groundwater, surface and coastal water quality, public health and amenity.

(24) Require proposals for on-site wastewater treatment and disposal to land or water to demonstrate all of the following:

(a) there is no practicable alternative land based disposal option;

(b) significant adverse effects on public and environmental health, water quality and amenity values are avoided and other adverse effects are remedied or mitigated;

(c) an assessment of the site conditions has been undertaken and the proposed system and its design are appropriate for these conditions;

(d) the design of the on-site wastewater system and the proposed volume of discharge will minimise the level of contaminants to the greatest extent practicable;

(e) that adverse effects on Mana Whenua values will be avoided; and

(f) that operations, management and response procedures are in place to ensure the on-going performance of the system and where systems service more than one site, responsibilities for these functions are clearly identified.

(25) Only allow the discharge of treated wastewater to water where all the following are addressed:

(a) there is no practicable alternative land-based disposal option;

(b) the effects on Mana Whenua values;

(c) the discharge quality is of a standard appropriate for discharge to a waterbody and does not affect all of the following:

(i) the use of that waterbody for other purposes;

(ii) public health and amenity; and

(iii) ecosystem health and functioning.

Overall, the proposed activity is considered consistent with the policies of Section E1 due to the following:

- It is not practical to connect to Watercare's reticulation system (Refer to Section 11).
- As noted in Section 9, less than minor effects are expected on surface water, soils, groundwater and amenity values. By discharging to a land disposal system, any potential effects on surface water are greatly reduced.
- The use of tertiary treatment is in accordance with best practice and will minimise the discharge of contaminants. The WWTP will also be serviced regularly, in accordance with the supplier's recommendations and warranty requirements.
- Monitoring of the discharge is proposed to ensure the performance of the system is maintained and verified.
- Establishment of baseline values prior to the discharge commencing, and ongoing monitoring of these parameters is recommended as conditions of this consent.
- Disposing of wastewater to land and relying on natural processes, including evapotranspiration and further treatment within the soil matrix, will avoid adverse effects on Mana Whenua values.

10.6 Proposed Monitoring Conditions

Establishment of Baseline Data

Given the low loading rate of the discharge, effects on the receiving soils are expected to be less than minor. Similarly, the low loading rate and the dense cover of vegetation should ensure that any impacts on nearby overland flowpaths due to rainfall and sub-surface /groundwater travel, are minimal. However, given the large volume of the discharge, it is prudent to take a cautionary approach and monitor any impacts through the course of the consent. Such an approach will enable action to be taken at the earliest opportunity if it is needed.

Note - all recommended conditions below are given in "*italic quotes*"

Soil Monitoring - Baseline

Retirement villages tend to use more cleaning products than typical residential dwellings, and these products can contain salts (which can act to inhibit drainage in the soils) and phosphorous (which, if in high enough concentrations in the soil, can leach into groundwater). The following soil monitoring condition is therefore recommended:

"Prior to wastewater discharge occurring, the consent holder shall agree a suitably qualified individual to take six soil samples at evenly spaced distances across the disposal field, at 0 to150 mm soil depth. The samples shall be tested for the following parameters:

PARAMETER	UNITS
pH	*Standard units*
Electrical Conductivity	*dS/m*
Olson Phosphorus	*g/m^3*
Sodium	*me/100 g*
Potassium	*me/100 g*
Calcium	*me/10 0g*
Magnesium	*me/100 g*
Sulphate-Sulphur	*µg/g*
Base Saturation	*%*
Exchangeable Potassium Percentage	*%*
Exchangeable Sodium Percentage	*%*
Sodium Absorption Ratio	*-*
Potassium Absorption Ratio	*-*

Soil Monitoring – Ongoing

"Every two years following wastewater discharge at the site, the consent holder shall engage a suitably qualified individual to take six soil samples at spaced appropriately across the disposal field, at 0 to150 mm deep. The samples shall be taken approximately the same location as those selected in the above condition. The samples shall be tested for the following parameters:

PARAMETER	UNITS	FREQUENCY (0 TO 150 mm SAMPLE DEPTH)
pH	*Standard units*	*Every two years at evenly spaced distances on each separately managed area, in approximate location as baseline samples*
Electrical Conductivity	*dS/m*	
Olson Phosphorus	*g/m^3*	
Sodium	*me/100 g*	
Potassium	*me/100 g*	
Calcium	*me/100 g*	
Magnesium	*me/100 g*	
Sulphate-Sulphur	*µg/g*	

PARAMETER	UNITS	FREQUENCY (0 TO 150 mm SAMPLE DEPTH)
Base Saturation	*%*	
Exchangeable Potassium Percentage	*%*	
Exchangeable Sodium Percentage	*%*	
Sodium Absorption Ratio	*-*	
Potassium Absorption Ratio	*-*	

It is also recommended that a condition be included requiring a report be written after ten years which analyses and summarises the sampling results, and recommends actions to be taken if necessary (for example, if the sodium absorption ration is seen to be in continual decline).

Stream Sampling (Baseline)

As above, it is unlikely that there will be more than a minor impact on the main overland flowpaths adjacent to the retirement village, particularly as there will be no direct hydrological connection between the discharge and the overland flowpath. However, to give effect to relevant AUP objectives and policies, together with those of the NPS-FM it is recommended that the following monitoring condition (and advice note) be included, to provide a 'baseline' against which any future impacts can be measured;

"Prior to discharge taking place, water samples shall be taken from two representative sample points monthly for 12 months, with weather conditions and a description of the water flow rate on the day being recorded. The samples shall be tested for the following:

PARAMETER	UNITS
pH	*-*
Temperature	*degrees Celsius*
5 day Biochemical Oxygen Demand (BOD_5)	*mg/L*
Total Suspended Solids (TSS)	*mg/L*
Escherichia Coli (E. Coli)	*cfu/100mL*
Total Nitrogen (TN)	*mg/L*
Total Kjeldahl Nitrogen (TKN)	*mg/L*
Ammoniacal Nitrogen (NH_3-N)	*mg/L*
Nitrate Nitrogen (NO_3-N)	*mg/L*
Nitrite Nitrogen (NO_2-N)	*mg/L*
Total Phosphorous (TP)	*mg/L*

Stream Sampling – Ongoing

"Water samples shall be taken from the two representative baseline sample points at six monthly intervals in July and January of each year. The samples shall be tested for the following parameters:

PARAMETER	UNITS
pH	-
Temperature	*degrees Celsius*
5 day Biochemical Oxygen Demand (BOD_5)	*mg/L*
Total Suspended Solids (TSS)	*mg/L*
Escherichia Coli (E. Coli)	*cfu/100mL*
Total Nitrogen (TN)	*mg/L*
Total Kjeldahl Nitrogen (TKN)	*mg/L*
Ammoniacal Nitrogen (NH_3-N)	*mg/L*
Nitrate Nitrogen (NO_3-N)	*mg/L*
Nitrite Nitrogen (NO_2-N)	*mg/L*
Total Phosphorous (TP)	*mg/L*
Dissolved Reactive Phosphorous (DRP)	*mg/L*

It is also recommended that a condition be included requiring reporting on the results of the ongoing sampling compared against the baseline results.

Effluent Sampling

"Samples of treated wastewater shall be collected and analysed every three months for the following parameters.

PARAMETER	UNITS
5-day Biochemical Oxygen Demand (BOD_5)	*mg/L*
Total suspended solids (TSS)	*mg/L*
Escherichia coli (E. coli)	*cfu/100ml*
Total Nitrogen (TN)	*mg/L*
Total Kjeldahl Nitrogen (TKN)	*mg/L*
Nitrate Nitrogen (NO_3-N)	*mg/L*
Nitrite Nitrogen (NO_2-N)	*mg/L*
Ammoniacal nitrogen (NH_3)	*mg/L*
Total phosphorus (TP)	*mg/L*
Dissolved Reactive Phosphorous (DRP)	*mg/L*

Staged Upgrades to Wastewater Treatment Plant and Disposal Field

Flow Monitoring and Capacity Thresholds

a. *The consent holder shall continuously monitor the daily volume of wastewater received at the wastewater treatment plant.*

b. *When the average daily flow over any three-month period reaches or exceeds 80% of the design capacity (as certified in the accepted engineering plans), the consent holder shall, within three months, submit to the Council's Compliance Manager (or equivalent) a detailed upgrade plan.*

c. *The upgrade plan shall set out how the wastewater treatment plant and/or disposal field will be expanded or enhanced to accommodate projected increased flow volumes, and shall include a timetable for implementing the upgrade*

Effluent Quality and Performance Limits

a. *The consent holder shall test the treated effluent for compliance with all parameters and limits specified in Condition [reference to relevant condition: e.g., "Effluent Quality Standards"].*

b. *Should monitoring results over three consecutive sampling periods show non-compliance with any parameter by more than 20% of its specified limit (e.g., BOD_5, suspended solids, or microbiological parameters), the consent holder shall, within three months, submit to the Council's Compliance Manager a report prepared by a suitably qualified wastewater engineer.*

c. *The report shall:*

   i. *Identify the likely causes of the non-compliance,*

   ii. *Recommend treatment plant or operational upgrades (including improvements to the disposal field if necessary),*

   iii. *Include an implementation schedule for any recommended upgrades.*

Disposal Field Capacity and Loading Criteria

a. *The consent holder shall ensure the disposal field loading rate does not exceed the design infiltration or hydraulic loading rates specified in the approved design plans.*

b. *Where field monitoring indicates the loading rate is trending towards 80% or more of the design limit over a three-month period, the consent holder shall commence planning for the disposal field expansion in conjunction with any necessary treatment upgrades.*

c. *Construction and commissioning of any required disposal field expansion shall be completed within 12 months of the date on which the Council's Compliance Manager receives written notification from the consent holder that the threshold has been (or is about to be) exceeded.*

Upgrade Implementation and Certification

a. *Within one month of completing any upgrade, the consent holder shall provide the Council's Compliance Manager with:*

   i. *As-built drawings certified by a suitably qualified engineer,*

   ii. *A commissioning report confirming the treatment plant and/or disposal field meets or exceeds the specified performance standards.*

Review Provision

a. *Pursuant to sections 128 and 129 of the Resource Management Act 1991, the Council may, at any time, review the conditions of this consent if monitoring data indicate ongoing or significant non-compliance with consented discharge quality limits, or if the volume of wastewater exceeds design thresholds in a way not anticipated by the original consent application.*

Sampling Protocols

"All samples shall be collected and analysed in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater", a joint publication of the American Public Health Association, Water Environment Federation and the American Water Works Association; or an alternative method that has been approved in writing by the Auckland Council.'"

Inflow and Infiltration Monitoring

"The consent holder shall record daily rainfall depth from the nearest National Institute for Water and Atmosphere (NIWA) weather station and report this data together with daily discharge flow information in the annual report. Should the discharge flow data exceed the consented daily volume, and the incidence of peak daily flows corresponds with days where there is rainfall, the consent holder shall engage a suitable qualified expert to provide advice and recommendations on addressing these exceedances."

5 yearly Audits of the Wastewater System

"An audit of the condition, operation, and performance of the wastewater treatment and land disposal system shall be undertaken by a suitably qualified wastewater professional every 5 years. The audit shall include:

- *An assessment of the condition of the wastewater treatment and land disposal system.*
- *An assessment of the adequacy of the system to treat and dispose the consented wastewater volume.*
- *An up-to-date list of the components of the wastewater treatment and land disposal system.*
- *Recommendations including timeframes for any changes, upgrades or remedial works to the treatment and land disposal system or process.*

A copy of the assessment report shall be provided to the Auckland Council by no later than 30 September of the year in which the assessment is undertaken"

Vegetation Monitoring

"The consent holder shall undertake a visual inspection at least once per year to assess the health of the vegetation on the disposal field area."

11 ASSESSMENT OF ALTERNATIVE OPTIONS

11.1 Discharge to Public Wastewater Network

11.1.1 Technical Viability

At about 2 km away, extending sewer infrastructure could be logistically challenging, requiring significant trenching, pump stations, and easements. Further to this, the initial startup of the development may require management of septicity within the delivery line until such point that a critical load can be achieved reliably.

11.1.2 Environmental and Social Effects

If connected, most environmental effects onsite are largely eliminated, as wastewater is treated offsite at centralised facilities. However, pipeline construction could disrupt the forest environment, stream crossings, and possibly culturally sensitive sites.

11.2 Discharge to Surface Water

11.2.1 Technical Viability

GWE does not consider this to be a technically practical solution given that the level of treatment required for a discharge to surface water would require a more complex treatment plant, which may prove impractical to operate.

11.2.2 Environmental and Social Effects

In accordance with the policies and objectives of the AUP in section E1 as follows:

(25) Only allow the discharge of treated wastewater to water where all the following are addressed:

(a) there is no practicable alternative land-based disposal option;

we consider there to be an alternative option on land-based disposal for the site as outlined in this proposal, and therefore the discharge to surface water is not considered a viable option.

11.3 Assessment Against BPO Criteria

Under the RMA, the "best practicable option" should balance environmental, cultural, social, and economic factors while considering the nature of the discharge, technology available, and the sensitivity of the receiving environment.

Environmental Protection: Onsite land application via PCDI is well-matched to protect wetlands and streams, and the receiving soils given adequate buffers and careful design.

Cultural Alignment: Land-based discharge is preferable to surface water discharge for cultural reasons.

Technical Feasibility: A recirculating packed bed reactor with UV disinfection is a proven setup for commercial wastewater and land application is feasible on category 5/6 soils, in accordance with the relevant guideline document TP 58 (2004).

Cost and Practicality: While not the prime consideration at this stage, connecting to Watercare would require extensive infrastructure and is likely more expensive and disruptive. Surface water discharge is not culturally or environmentally preferable.

Operational Reliability: With proper maintenance and monitoring, onsite systems can reliably meet discharge consent limits. A robust operation and maintenance plan should be provided prior to initiating the discharge.

12 CONCLUSIONS AND RECOMMENDATIONS

Based on the detailed assessment of site conditions, wastewater flows, and regulatory requirements, it is concluded that:

12.1 Wastewater Treatment and Disposal Feasibility

The proposed retirement village can be effectively serviced by an on-site wastewater treatment and land application system. The combination of recirculating packed bed reactors (rPBR) and ultraviolet (UV) disinfection is suitable for achieving a consistently high effluent quality that meets or exceeds the requirements of TP58 (2004).

12.2 Environmental Effects

With tertiary treatment, timer dosing, and drip irrigation across a sufficiently large disposal field, adverse effects on groundwater, surface water, soils, and amenity values are assessed as less than minor. Monitoring and maintenance requirements outlined in this report ensure potential effects remain appropriately managed.

12.3 Regulatory Consistency:

The activity is consistent with relevant sections of the Resource Management Act (RMA) 1991 and the Auckland Unitary Plan, provided the system is constructed and operated in accordance with the design and performance criteria detailed herein. The discharge to land is aligned with Section E1 – Water quality and integrated management, as well as relevant wastewater disposal policies and provisions.

12.4 System Design and Monitoring

12.4.1 Design

The proposed modular rPBR-based treatment plant, followed by pressurised drip irrigation (PCDI), is both technically feasible and robust, delivering tertiary-level effluent quality.

12.4.2 Monitoring

Regular sampling of treated effluent, soils, and, if required, nearby watercourses is recommended to verify ongoing performance and detect any emerging concerns.

12.4.3 Maintenance

Scheduled inspections and audits ensure the plant and disposal field remain in good condition and function effectively.

12.5 Recommendations

12.5.1 Implementation

Progress with the proposed rPBR-based wastewater treatment plant and drip irrigation system, including the staged commissioning of treatment capacity to match village occupancy growth.

12.5.2 Consent Conditions

Adopt the monitoring regime and design features proposed (Section 9.3 and related discussion) as part of the consent conditions to provide certainty and ensure compliance with performance targets.

12.5.3 Soil Preparation

Clear and remediate (as necessary) disposal field areas of debris and compaction. Establish suitable planting to enhance evapotranspiration and nutrient uptake.

12.5.4 System Operation

Engage qualified personnel to undertake scheduled servicing, sample collection, and data analysis. This includes periodic soil and effluent quality testing, as recommended in this report.

12.5.5 Adaptive Management

Should monitoring indicate rising nutrient levels or decreased infiltration in the disposal field, additional measures such as gypsum application or a revised irrigation strategy may be required to maintain optimal performance.

12.6 Conclusion

Overall, the proposed wastewater treatment and disposal system is assessed as the best practicable option for the site, providing a sustainable long-term solution that safeguards public health and environmental values.

13 LIMITATIONS

This report has been prepared for the sole benefit of **Rangitoopuni Developments Ltd** as our Client, and their appointed representatives, according to their instructions, for the specific objectives described herein. This report is qualified in its entirety and should be considered in the light of our Terms of Engagement with the Client and the following:

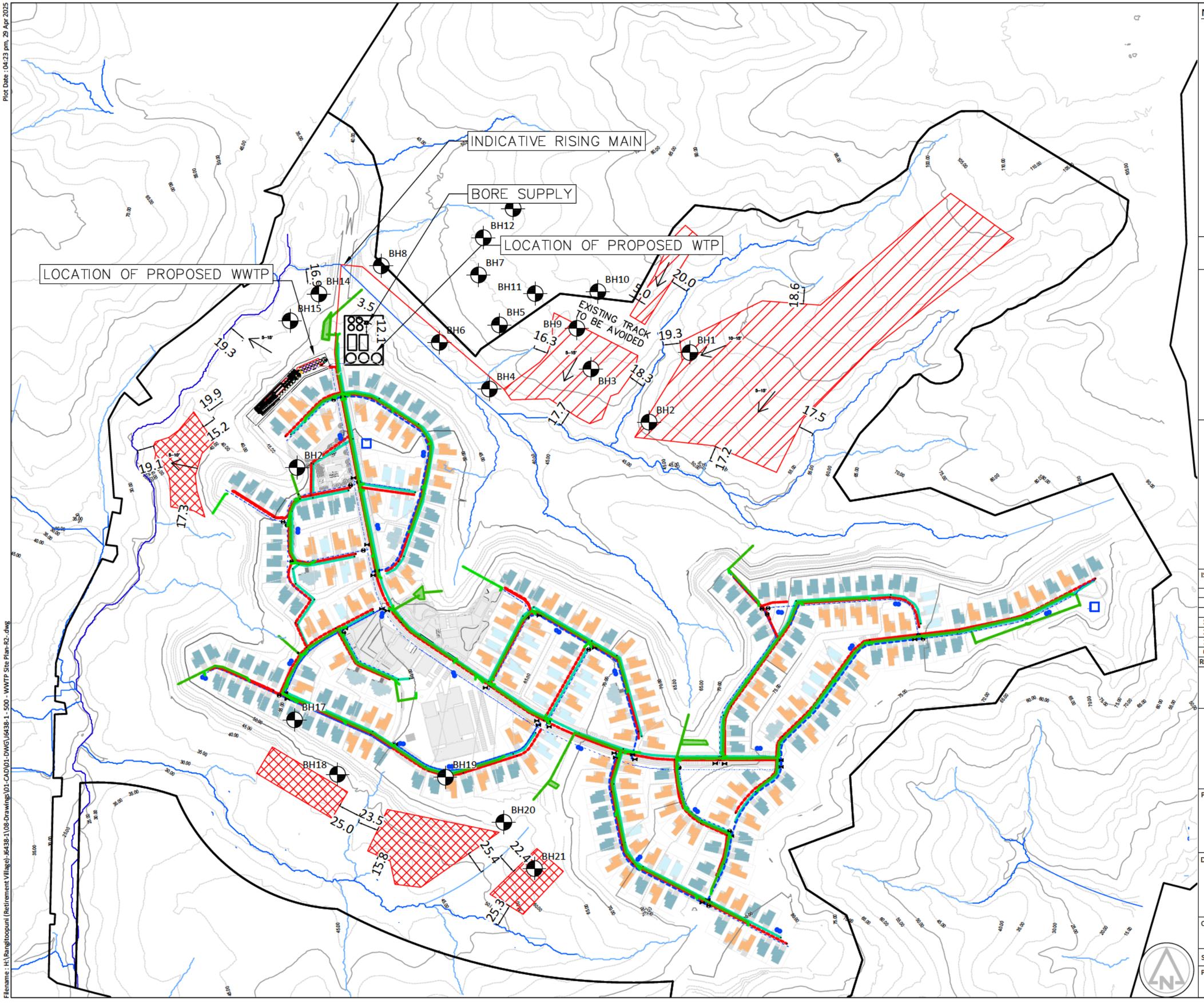
a. Data or opinions contained within the report may not be used in other contexts or for any other purpose without our prior review and written agreement. Any reliance will be at the parties' sole risk.

b. No responsibility is assumed for inaccuracies in reporting by the information providers. In no event, regardless of whether GWE 's consent has been provided, does GWE accept any liability, whether directly or indirectly, for any liability or loss suffered or incurred by any third party to whom this report is disclosed placing any reliance on this report, in part or in full.

c. GWE has relied on information provided by the Client and by third parties to produce this document and arrive at its conclusions. GWE has not verified information provided (unless specifically noted otherwise) and we assume no responsibility and make no representations with respect to the adequacy, accuracy, or completeness of such information.

APPENDIX A

WASTEWATER SITE PLAN



NOTES:

1. DRAWING IS BASED ON SITE PLAN PREPARED BY CROSSON LTD.
2. ADDITIONAL DATA FROM AUCKLAND COUNCIL GEOMAPS (CAPTURED 25/12/2025).
3. LOCATION OF FEATURES ARE INDICATIVE ONLY.
4. WASTEWATER FLOW: 172 M^3/DAY
5. CATEGORY 5/6 SOILS
6. TERTIARY TREATMENT SYSTEM
7. SURFACE PCDI
8. WASTEWATER DISPOSAL RATE: 3 MM/DAY
9. PROPOSED PRIMARY DISPOSAL AREA: 5.8 HA (100%)
10. PROPOSED RESERVE AREA: 2.85 HA (50%)
11. DO NOT SCALE FROM THIS DRAWING

LEGEND

- PROP. PRIMARY DISPOSAL AREA
- PROP. RESERVE AREA
- OVERLAND FLOW PATH
- HAND AUGER BOREHOLE (AH1)

ISSUE STATUS: FINAL

REV	AMENDMENT	CAD	ENG	APPD	DATE
3	REVISION	PH	PO	PO	29/04/25
2	REVISION	MM	PO	PO	31/03/25
1	REVISION	NG	PO	PO	24/03/25
0	FIRST ISSUE	PO	PO	PO	17/03/25

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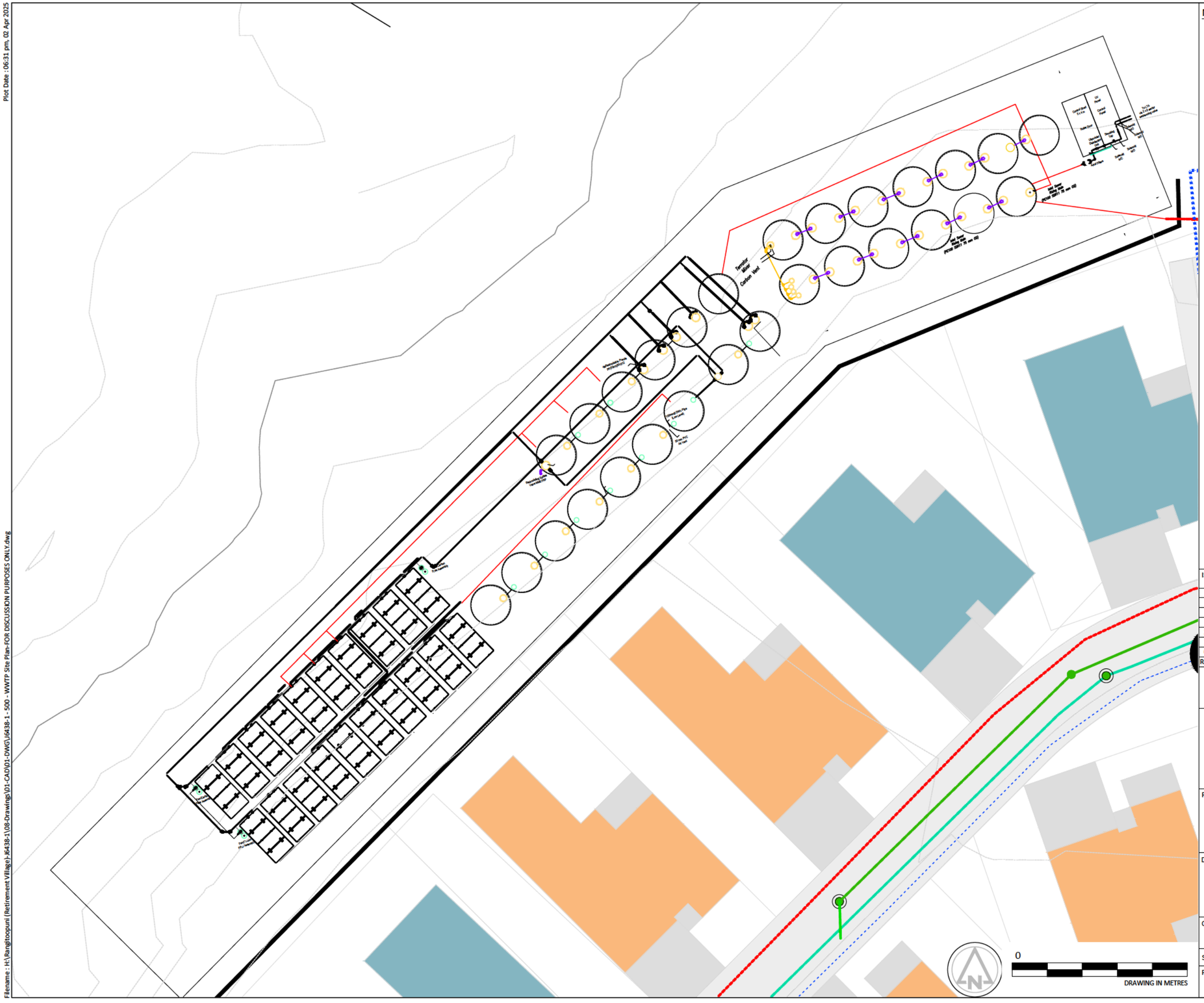
PROJECT ADDRESS:
RANGITOOPUNI RETIREMENT VILLAGE

DRAWING TITLE:
PROPOSED RETIREMENT VILLAGE WASTEWATER PLAN

CLIENT NAME:
RANGITOOPUNI DEVELOPMENTS LP

SCALE: 1:4000		A3
PROJECT No: J6438-1	DRAWING No: 500	REV 3

Plot Date : 06:31 pm, 02 Apr 2025



NOTES:

1. DRAWING IS BASED ON SITE PLAN PREPARED BY CROSSON LTD AND ADVANTEX WASTEWATER TREATMENT PLANT PLAN PREPARED BY INNOFLOW.
2. DO NOT SCALE FROM THIS DRAWING

0

DRAWING IN METRES

ISSUE STATUS: FINAL

REV	AMENDMENT	CAD	ENG	APPD	DATE
2	REVISED WWTP	PH	PO	PO	02/04/25
1	REVISED	NG	PO	PO	24/03/25
0	FIRST ISSUE	PO	PO	PO	17/03/25

GWE CONSULTING ENGINEERS
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PROJECT ADDRESS:
RANGITOOPUNI (RIVERHEAD VILLAGE)

DRAWING TITLE:
PROPOSED RETIREMENT VILLAGE - WWTP LOCATION

CLIENT NAME:
RANGITOOPUNI DEVELOPMENTS LP

SCALE: 1:300		A3
PROJECT No: J6438-1	DRAWING No: 501	REV 2

Filename : H:\Rangitoopuni (Retirement Village)-J6438-1\08-Drawings\01-CAD\01-DWG\J6438-1 - 500 - WWTP Site Plan-FOR DISCUSSION PURPOSES ONLY.dwg

APPENDIX B

WASTEWATER TREATMENT PLANT

wastewater specialists

RANGITOOPUNI RETIREMENT VILLAGE

WASTEWATER PLANT SPECIFICATION REPORT

Proposal prepared for: GWE Consulting Ltd

Proposal prepared by: [redacted], Innoflow Technologies NZ Limited

Date: 2nd April 2025

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1.0 INTRODUCTION

Innoflow Technologies NZ Ltd (Innoflow) present this report which outlines the specification details for the proposed wastewater treatment plant to service a new retirement village complex on the Rangitoopuni site located in Riverhead, Auckland. This design includes a communal wastewater treatment plant and land application system. This report details the design aspects of the proposed wastewater treatment plant and land application area. A set of drawings have been provided to visualise the proposed system.

2.0 WASTEWATER MANAGEMENT DESIGN

The wastewater management design proposed for this development is designed to treat wastewater generated by residents, café patrons and associated staff and visitors.
The scheme incorporates the following key components:

Wastewater Treatment Plant

- 7 x 25,000 L Septic tank with effluent filter
- 7 x 25,000 L Pre-Anoxic tank
- 6 x 25,000 L Recirculation tank with dosing pumps
- Stage 1 - 15 x AdvanTex AX100 packed bed reactor pods and activated fan vent
- Stage 2 – 5 x AdvanTex AX100 packed bed reactor pods and activated fan vent
- 6 x 25,000L Treated effluent tank with irrigation pump
- 1 x Pulse Water Meter
- 1 x TCOM control panel
- 1 x UV Disinfection unit

Land Application System

- 2 zones each utilising 1 x 6-Sector sequencing valve
- Pressure Compensating Dripper Line (58,000 linear meters with dripline laterals at 1m spacing, emitters at 0.6m centers, and a dripper rate of 2.0 L/Hr)

3.0 DESIGN PARAMETERS

3.1 Peak Design Wastewater Production

The wastewater treatment plant system has been designed based on influent strength and daily flow stipulated below.

Table 1- Design Peak Daily Flows

Input Design Parameters		
Qaverage	m^3	**86**
Qpeak	m^3	**108**
Qpeak(I&I Factor = 1.6)	m^3	**173**

For design purposes a peak daily flow shall occur no more than once in any seven-day period, and an average flow is a 30-day average.

3.2 Design Influent Parameters

Influent wastewater generated from the site shall be domestic strength in nature, with the following combined maximum influent strengths.

Table 2- Design Equivalent Mass Loads

Equivalent Mass Loads per Person per Day		
BOD_5	grams	85
TSS	grams	95
TKN as N	grams	13.3
NH_3	mg/L	7.8
Total P as P	grams	3.3

Note 2 - From Crites & Tchobanoglous 1998, Table 4-12

Table 3-Design Influent Strength (Maximum)

Raw Influent Strength (Maximum)		
BOD_5	mg/L	425
TSS	mg/L	475
TKN	mg/L	67
NH_3	mg/L	39
TP	mg/L	17
FOG	mg/L	165
Escherichia coli (E. coli)	cfu/100mL	200
Temperature	°C	>10.0
Alkalinity as $CaCO_3$	mg/L	-

3.3 Design Effluent Quality

The following tables describe the design effluent quality from the treatment plant.

Table 4- Target Effluent Quality Limits

Final Effluent Quality *(12 month rolling median)*		
$cBOD_5$	mg/L	15
TSS	mg/L	15
TN	kgN/Ha/Yr	-
NH_3	mg/L	-
TP	mg/L	-
E.coli	cfu/100 mL	1000

3.4 Toxicity

The assumption has been made that the influent strength detailed in the table above is domestic in nature and does not contain concentrations of toxic substances that may adversely affect the performance of the biological processes required for the system to operate. Below is a list of toxic compounds that are known to negatively impact the system and are not to discharge into the treatment plant. Note: This is not a complete list, other harmful compounds are likely to exist that will adversely affect the performance of the plant.

Table 5- List of chemicals not to be discharged into wastewater system.

Toxic Compound(s)	Example	Result
Heavy Metals	Copper, Nickel, Zinc, Cadmium, Chromium	Stop ammonia oxidation (reversible)
Metal-binding compounds[1]	Sodium Sulfide	Stop ammonia oxidation (reversible)
Bind heme and proteins[1]	Ethyl xanthate (mining industry)	Stop ammonia oxidation; cell death
Hydrazine (H_2N_2)[1]	Rocket fuel	Stop ammonia oxidation
Chlorination		Cell death
Uncouplers of oxidative phosphorylation and inhibitors of electron transport[1]	DNP (2, 4-Dinitrophenol) MCCP (m-Chlorocarbonyl-cyanize phenylhydrazone)	Cell death
Short-chain alcohols and amines[1]	Methanol, Ethanol, n-butanol	Cell death
Phenol[2]		Stop ammonia oxidation; cell death
Nitrous oxide (N_2O)[1]	Aerosol propellants	Stop ammonia oxidation
High levels of nitrite (NO_{2-})		Stop ammonia oxidation
Quaternary amines	Disinfectant, surfactant, fabric softeners, shampoo	Cell death
UV light[3]		Stop ammonia oxidation

Toxic Compound(s)		Concentration resulting in 50% inhibition (mg/L)
L-Histidine		0.5
Thiosemicarbazide		0.9
Nitrourea	***	1
Allylthiourea		1.2
8-Quinolinol		1.5
L-Arginine		1.7
L-Valine		1.8
Diethyldithiocarbamate		2
L-Threonine		3.6
L-Lysine		4
Quinacrine	***	5
Diphenylthiocarbazone		7.5
L-Methionine		9
o-Phenanthroline		9
Phenazine methosulfate		10
Dicyclohexylcarb-diimide		10
2-Chloro-6-trichloromethyl-pyridine		11
Ethyl xanthate		12
Dipryidyl		16
2,4-Dinitrophenol	**	37
3-Aminotriazole		70
Aminoguanidine	**	74
Methanol	*	160
Dichlorophenolinde-phenol		250
Hydrazide		300
Methylamine		310
Trimethylamine		590
Tetremethylammonium Chloride		2200
Ethanol		4100
Acetone	*	8100
N-Butanol	*	8200
Aminoehtanol		12000
Ethyl Acetate	*	18000
N-Propanol	*	20000

* Included in the list of significant chemicals

** Inhibitors of both NH_3 and NO_2 oxidation

*** Inhibitors of NO_2 oxidation

All others inhibit NH_3 oxidation

4.0 Primary Wastewater Treatment

The primary treatment portion of the system includes:

- 7 x 25,000 L Septic tank with a Biotube effluent filter fitted at the outlet
- 7 x 25,000L Pre-anoxic tank

4.1 Septic Tank & Biotube Effluent Filter

7 x 25,000 L concrete septic tank is proposed to provide primary treatment of the wastewater retirement village. The tanks provide 1.5 days of peak flow hydraulic retention time, allowing for sufficient primary treatment via anaerobic digestion of sludge and physical settlement. The effluent is to gravity flow to the pre-anoxic tank.

A Biotube effluent filter is proposed to be installed at the outlet of the septic tank at the treatment plant to screen solids greater than 3mm in diameter. Particles larger than 3 mm are screened out and retained for further treatment (in fact biological growths on the screen filter out even smaller particles). The Biotube effluent filter is expected to reduce total suspended solids by about 67%.

Table 6 –Septic Tank Specification

Tank Manufacturer	Duracrete
Number of Tanks	7
Tank Volume	25m³
Dimensions	Height: 2650 mm Diameter: 3700mm
Biotube Model	4 x FT1254-36
Access Risers	2 x 610mm dia x 450mm high Fibreglass access risers (Model: RF2418) per tank
Access Lids	3 x 610mm dia fiberglass lid and bolts (model FL24g) per tank

4.2 Pre-Anoxic Tank

There are 7 x 25,000 L pre-anoxic tanks proposed to be added at the wastewater treatment plant. These tanks provide an anoxic zone, where a portion of partially treated filtrate from the recirculation tank is returned via a filtrate return pump back to the pre-anoxic tanks. This returns up to 100% of the influent alkalinity back into the system, which is required for and enhances the denitrification process.

Table 7 - Pre-Anoxic Tank Specification

Tank Manufacturer	Duracrete
Number of Tanks	7
Tank Volume	25m³
Dimensions	Height: 2650 mm Diameter: 3700mm
Access Risers	2 x 610mm dia x 900mm high Fibreglass access risers per tank
Access Lids	2 x 610mm dia fiberglass lid and bolts (model FL24g) per tank

5.0 SECONDARY TREATMENT WASTEWATER TREATMENT

It is proposed to install an AdvanTex® recirculating textile packed bed reactor (rtPBR) wastewater treatment plant to provide advanced secondary treatment, shown in the schematic below. Recirculating packed bed reactors recognised as one of the most stable treatment processes available, able to produce a consistently high-quality effluent, even under widely fluctuating loads and wastewater strengths.

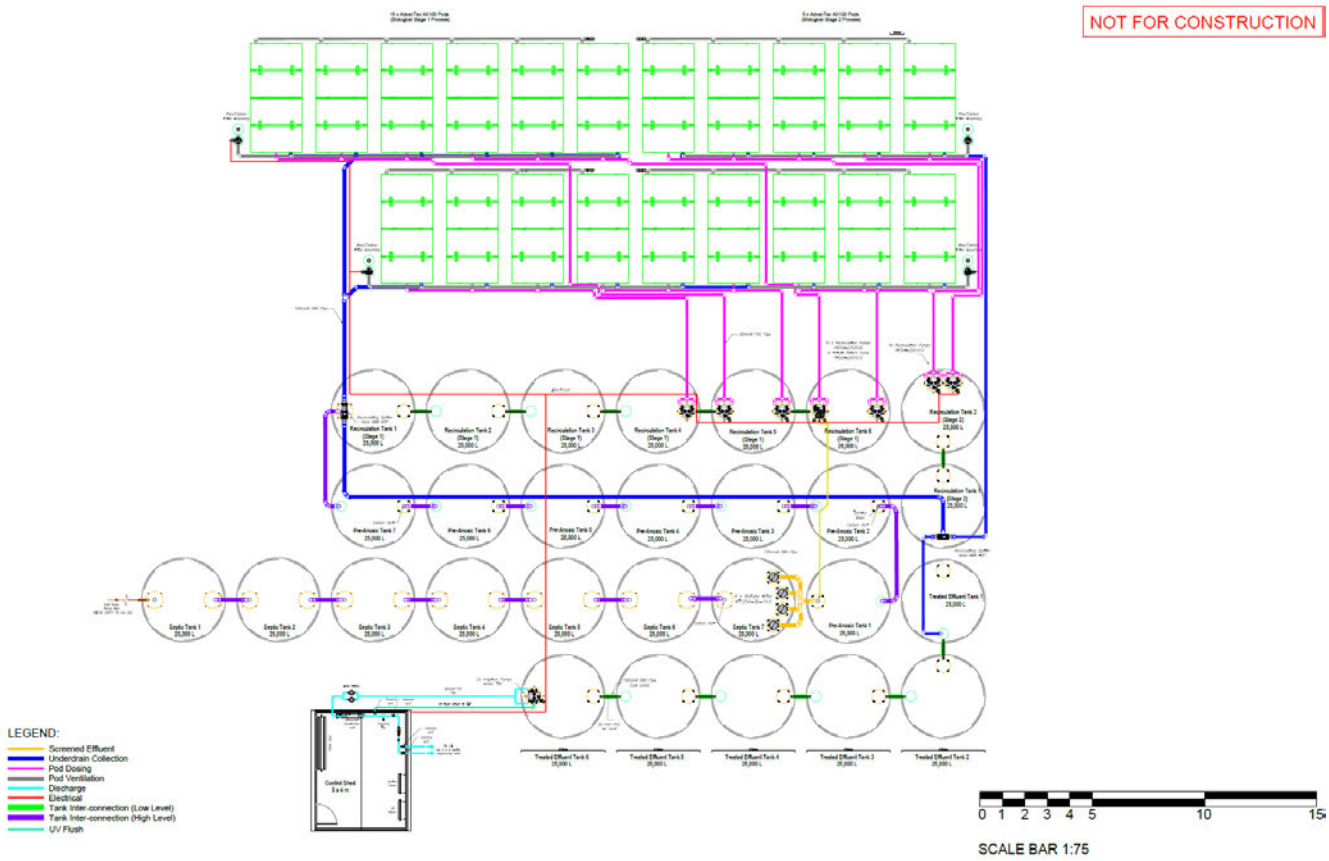

Figure 1 - Snapshot of Proposed Wastewater Treatment Plant

5.1 Recirculation Tank – Stage 1 and 2

There are 8 x 25m³ recirculation tanks proposed (6 for stage 1 and 2 for stage 2) to dose the stage 1 and 2 AX100 packed bed reactors. These tanks are fitted with timer dosed pumps that pump a blend of effluent over the textile filters in the packed bed reactor in a timer controlled and flow equalised fashion. A recirculation splitter float valve assembly is also installed in these tanks to ensures that the optimal recycle ratio is always maintained, maximising treatment efficiency for a consistently high-quality effluent.

In this way, the recirculation tank ensures that the packed bed reactor receives a continuous source of oxygen and food during periods of little or no flow, ensuring that the micro-organisms are maintained at peak condition, ready to receive shock or varying that provide the necessary flow rates to dose the textile with effluent.

Table 8 - Recirculation Tank 1 and 2 Specification Table

Tank Manufacturer	Duracrete
Number of Tanks	8
Tank Volume	25m³
Dimensions	Height: 2650 mm Diameter: 3700mm
Hydraulic Retention Time @ Peak	>1 days
Pump Manufacturer	Orenco
Number of Pumps (Stage 1)	12
Recirc Pump Model (Stage 1)	PF (50Hz)752034
kW	1.49kW
Voltage	230 V
Amperage	7.3 A
Hz	50 Hz
Operating Range	1.0-4.0 L/s
Flow Rate at TDH	approximately 3.0 L/sec @ 15 m
Outlet Diameter	50 mm
Motor Protection	IP68
Float Arrangement	High Level, Timer Override, Low level/redundant off
Number of Pumps (Stage 2)	2
Recirc Pump Model (Stage 2)	PF (50Hz)501512
kW	1.12 kW
Voltage	230 V
Amperage	9.1 A
Hz	50 Hz
Operating Range	2.25-4.25 L/s
Flow Rate at TDH	approximately 2.25 L/sec @ 10m
Outlet Diameter	50 mm
Motor Protection	IP68
Float Arrangement	High Level, Timer Override, Low level/redundant off
Number of Pumps	1
Filtrate Return Pump Model	PF (50Hz)501012
kW	0.75 kW
Voltage	230 V
Amperage	7.3 A
Hz	50 Hz
Operating Range	0.3-0.7 L/s
Flow Rate at TDH	approximately 0.6 L/sec @ 20 m
Outlet Diameter	50 mm
Motor Protection	IP68
Access Risers (at each tank)	1 x 610mm dia x 450mm high fiberglass access risers (Model: RF2418) 1 x 760mm dia x 450mm high fiberglass access risers

	(Model: RF3018)
Access Lids (at each tank)	1x 610mm dia fiberglass lid and bolts (model FL24g) 1x 760mm dia fiberglass lid and bolts (model FL30g)

5.2 AdvanTex® Recirculation Textile Packed Bed Reactor – Stage 1 and 2

It is proposed to install 20 x AdvanTex AX100 packed bed reactor pods for the (15 for the first stage and 5 for the second) stage of treatment. The accumulation of these pods provides approximately 2000 sqft of textile. The textile is loaded in the following manner. The first stage process provided treatment to an advanced secondary level (effluent $cBOD_5$ <20 mg/L and TSS <30 mg/L). The second stage of the system provides another layer of treatment and is expected to treat effluent to an advanced secondary level (that is <15mg/L of both parameters respectively).

The AdvanTex rtPBR is essentially a bed of highly specialised textile nestled in a pre-made Pod to which the effluent is uniformly dosed through a pressure distribution system using a timer-controlled dosing regimen. These small precise doses at multiple point sources across the reactor bed ensure thin film application of the effluent maximising retention times within the reactor for renovation.

This unique complex fibre structure of the textile media has an immense surface area for biomass colonization, (up to 5 times greater than sand) and a much greater void space (~3 times higher than sand) to ensure free flow of oxygen through the media interstices. Its high field moisture capacity ensures long, intimate, contact times of the wastewater with the biomass for almost complete renovation.

Figure 2 - Example of AX100 installation

Table 9 - AX100 Pod Specification Table

Manufacturer	Orenco Systems Inc.
Model	AdvanTex AX100
Textile Surface Area per Pod	9.6 m²
Number of Pods	20
Number of Spray Nozzles per Pod	8
Ventilation Fan Model	CF1818
Number of Fans	4
Phase	Single
Voltage	230V
Amperage	1.8A
Hz	50Hz
Operation	Continuous
Air Flowrate	5.8 m³/min
RPM	2900/min
Maximum Power Consumption	0.06 kW
Activated Carbon	Granular cracked carbon

5.3 Fresh Air Ventilation

Each unit contains a fresh air inlet point, designed to allow air ventilation throughout the hanging textile. Venting each pod involves drawing fresh air through the inlet at the end of each pod, through the textile sheets, and out through an activated carbon filter/fan. The fan used to circulate the fresh air is a small 110 watt "ducting type" fan, designed for continuous operation.

In order to maintain a steady state in each pod, the fan will operate continuously. It should be noted that the fan is not designed to provide an artificially high population of microbes inside the AdvanTex® pods. Since the fan is small, the airflow is only slight and simply required to prevent stagnant conditions. The carbon filter, ventilation fan and heater will be housed inside a green fibreglass enclosure installed at the same height as the AdvanTex® pods.

Odours do not generally permeate from an rtPBR unless there is a serious issue. To help control and scrub any air that is forced out of the plant, carbon filters are included on access lids to allow the balancing and diffusion of air as water levels rise and fall within the tanks.

6.0 Treated Effluent Storage Tank

Treated effluent from the wastewater treatment plant will be collected and stored in 6 x 25m³ treated effluent storage tanks. Pumps will be fitted in this tank which is suitably sized for the land application field (specifications below). A pulse effluent flow water meter will be installed in the pumped outlet of the tank.

Table 10 - Treated Effluent Tank Specification Table

Tank Manufacturer	Duracrete
Number of Tanks	6
Tank Volume	25m³
Dimensions	Height: 2650 mm Diameter: 3700mm
Hydraulic Retention Time @ Peak	>1 days
Number of Pumps	2
Pump Model	PF (50Hz)501512
kW	1.12kW
Voltage	230 V
Amperage	9.1 A
Hz	50 Hz
Operating Range	1.0-4.0 L/s
Outlet Diameter	approximately 3.0 L/sec @ 15 m
Motor Protection	50 mm

Float Arrangement	IP68
Access Risers	2 x 610mm dia x 450mm high fiberglass access risers (Model: RF2418)
Access Lids	2 x 610mm dia fiberglass lid and bolts (model FL24g)

7.0 TERTIARY TREATMENT

7.1 UV Disinfection

A UV disinfection system has been proposed to provide added protection as the land application area will also be used for recreational activities.

We propose to supply and install a single We deco LBX10 pressure UV disinfection unit. Details of this system is listed below.

Dose = 400 Joule/m^2 at flowrate Q – 11.4m^3/h

SSK_{254} = 15.5 $1_{1/m}$ ($T_{1cm,254\ nm}$ = 70%) at the end of lamp lifetime

- Multiple lamp system
- Stainless steel reactor with concentrically arranged UV lamps.
- Calibrated UV intensity monitoring system displaying W/m^2 and standard output signal.
- Soft start ignition system for a long lamp lifetime
- Electronic ballasts
- H/A- Control (Pump, solenoid valve or delay relay)
- Electronic single-lamp-surveillance
- Digital hours run meter and switch impulse counter.
- Cleaning and combined alarm signal
- Rinsing and draining/exhaust valve
- Automatic wiping system
- Sampling Valve

Figure 3 - Picture of Proposed UV Disinfection Unit

UV energy, predominantly at 254 nm wavelength has the unique ability to destroy the majority of micro-organisms that are exposed to this light. The ultraviolet rays penetrate the outer membrane of the bacteria, virus, yeast, mould or algae and destroys the D.N.A that allow the organism to replicate. There is no possibility of receiving water contamination due to overdosing and it is not affected by pH changes.

8.0 CONTROLS AND TELEMETRY

8.1 Custom TCOM Control Panel

A custom control panel will be supplied to control the wastewater treatment plant. The control panel is purpose built to attend to the functions and requirements of the specific wastewater Treatment Plant.

As well as general operations of the plant such as pump run times, fan run, water meter readings and monitoring of sensors, the panel allows for automatic call-out to pagers, SMS via Cell phone and/or emails during alarm conditions or when the panel detects trends that could lead to system failure. It has the ability to maintain logs for

system conditions and events, such as Pump Run Time, Pump Cycles, and Alarm Conditions and Downloadable logs into a *. dive or ASCII format for simple conversion to common spreadsheet or word processor programs. Please refer to attachments for samples of reports that can be generated through Hyper Terminal and downloaded to a spreadsheet program.

The Control panel can be set to run in three options- Manual, off or Automatic. In Automatic, the programmed settings control the on/off time of the nominated pump. Set to off, it will turn off the nominated pump, or set in manual, it will allow the nominated pump to run whilst the manual switch is engaged.

8.2 Networking Protocols

Ethernet (permits peer-to-peer communications, up to 16 peers)

- Modbus (permits our controller to serve as master or slave)
  a. When “master,” permits connection to off-the-shelf Non-proprietary devices that support Modbus protocols. Can control and monitor up to 32 slaves.
  b. When “slave,” permits connection to and communication with Modbus masters.

An IBM compatible interface is standard and Item™ or hyper terminal will interface with the panel enabling the backup for programming and data downloads.

8.3 Telemetry

Telemetry is a technology that allows the remote measurement and reporting of information. Innoflow Technologies NZ Limited provides its telemetry through Digital Telemetry, who are a company specialising in the provision of wireless telemetry services for your remote equipment. They connect to our remote, unattended equipment wirelessly using proven Siemens wireless controllers and modems connected to their network of management servers, through which customers can securely access their equipment using RS232/serial, digital I/O, analogue input or current loop (4-20mA) from any Internet connection in the world.

9.0 LAND TREATMENT AREA

Based on soil categorization determined by GWE Consulting, a soil loading rate of 3 L/m^2 has been applied. The proposed land application method is Pressure Compensating Dripper Line.

The effluent from the treatment plant is collected and stored in the 25,000 L treated effluent tank described in previous sections, which is pumped to ground via Pressure Compensating Dripper Lines (PCDL). Since it's surface laid, this method utilizes both soakage into the ground and evapotranspiration by vegetation cover. The low loading rate and pulse dose loading over an extended period minimize the potential for saturation of the ground.

Figure 4- Land Application Design Specification

Design Parameters		
Peak Flow	173000	L/d
Soil Loading Rate	3	mm
Land Treatment Area	57667 (round 58,000)	m^2
Number of Zones	2	
Number of Sectors per zone	6	
Emitter Flow Rate	2	L/h
Emitter Spacing	0.6	m
Dripline Spacing	1.0 m	
2-Zone Flow Rate	192222	L/h
Each Zone Flow Rate	96111	L/h
Per Sector Flow Rate	4.45	L/sec @ 20m TDH

9.1 Sequencing Valves

Distribution to the land application system for each site will be achieved through two of Orenco's automatic sequencing valve assemblies. These valves are useful for distributing effluent to multiple zones so as to simplify the design and installation of the distribution system and reduce ongoing operating costs. This is particularly true where a distributing valve assembly is used instead of multiple pumps and/or electrically operated valves.

Additionally, a reduction in long term operation and maintenance costs is realised due to a reduced size and/or number of pumps.

The valve itself has only a few moving parts, requires no electricity, and alternates automatically with each cycle. The sequencing valves operate on a hydraulic cam system. As water pressure is applied to the cam it lifts up and remains open, dosing only one sector, as the pressure drops once the pump stops, the cam rotates and closes ready to dose the next sector in the sequence.
The sequencing valve will be installed at the highest point of the land application system to avoid any back pressure disturbing the cam operation.
To minimise the visual impact and to protect the valve, the entire assembly will be enclosed within a PVC access riser and covered with a fibreglass lid.

9.2 Header Pipe

The treated effluent will be conveyed to the zone sequencing valve in the land application system via a buried 50mm MDPE pipe connected to the effluent discharge pump.

9.3 Pressure Compensating Drip Line

It's proposed to lay dripline at 1 m centers, resulting in a total lineal of 50,000 m. Netafim UNIRAAM17 pressure-compensating drip irrigation lines will be used to evenly distribute effluent over the entire land application areas of both sites. The drip line proposed is Raam17 with a drip emitter every 0.6m designed to consistently discharge 2.0 litres per hour. These emitters are pressure compensating up to 35 m, which means the entire sector must be pressurized before any discharge and when discharge occurs, all emitters discharge together.

9.4 Tube Non-Leakage Valves

Tube Non-Leakage Valves (TNL) will be installed at the beginning of each drip line lateral. These in-line valves have a self-locking mechanism to prevent the upper drip lines and manifold pipes from draining into the lower lines when the pump stops, and pressure drops.

Closing Pressure	-	0.4 bar
Operating Pressure	-	1.0 bar
Check Valve	-	0.3 bar

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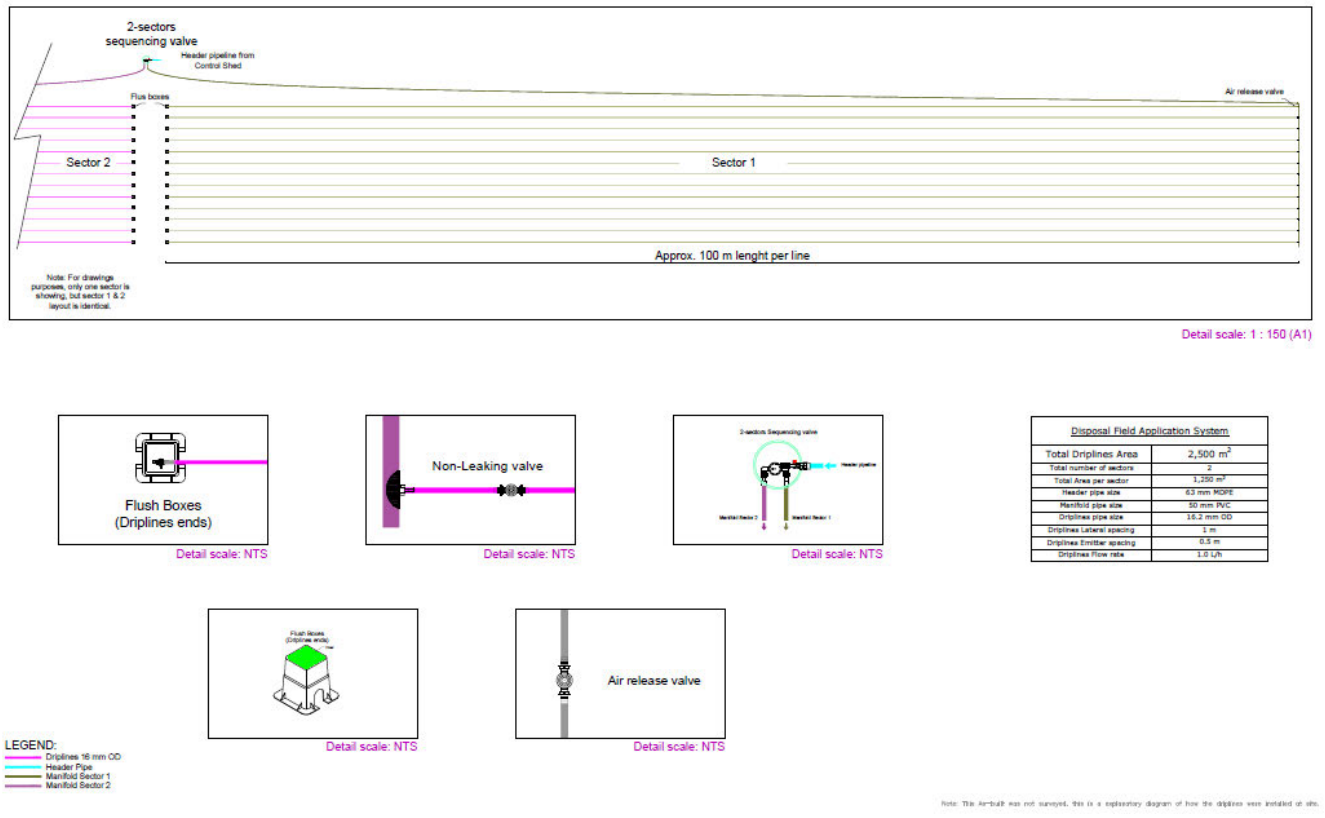

Figure 5 - Snapshot of Typical Drip Irrigation Lines

9.5 Manual Flushing Valves

Innoflow propose to terminate each dripper irrigation line with a manual flush valve covered by a flush valve box. As part of periodic maintenance, the dripline irrigation lines should be flushed – it's proposed that the driplines should be flushed on an annual basis.

Innoflow proposes to achieve the required flushing frequency whilst flushing one sector of the drip irrigation field at each maintenance visit – i.e. over the year the entire sectors of the drip irrigation field will be flushed at least once given the quarterly maintenance regime.

The drip irrigation line manifold flush taps shall be opened while the discharge pump is running and any solid build-up at the end of each line will be flushed out. The flushed lines will result in a small amount of liquid disposed on the ground, however, given the volume will be very small (estimated at say 2-4 litres) Innoflow does not believe any environmental impact will be as a result and propose no method of capturing or dealing with this liquid in the likes of soak holes.

9.6 Air Release Valves

Each dripline sector shall contain an Air release valve to ensure all air can properly escape from the pipework which ensure even distribution of effluent throughout the entire sector.

10.0 OPERATION AND MAINTENANCE

Maintenance of key components shall be carried out every three months. We propose to use S3 Limited, a wholly owned subsidiary of Innoflow Technologies Limited, to carry out the required maintenance. Emergency call outs shall be carried out shall be handled by S3. Sample collection, packaging, and submission to the laboratory shall be carried out by the local environmental sampling agency, if required. It is expected that grounds maintenance shall be carried out by others. Below is a table showing the required checks at each service.

Table 11 - Operation and Maintenance Tasks

Component	Maintenance Frequency
STEP tanks/Septic Tank and Grease Trap	
Inspect tank levels and integrity	1 x per 3 months
Inspect and Clean Tank Biotube Vault & clean if required (Septic Tanks)	1 x per 3 months
Measure and Log Biomass/Grease Level in Septic Tank	1 x per 3 months
Recommend Removal Accumulated Biomass/Grease	1 x per 3 months
Visually inspect operation of odour control	1 x per 3 months
Buffer tank	
Complete sludge/scum testing of each tank	1 x per 3 months
Check operation & clean all pumps	1 x per 3 months
Clean & check operation of all control floats	1 x per 3 months

Verify timer operation settings (advise from Innoflow engineer)	1 x per 3 months
Check outlet pipe work to downstream components	1 x per 3 months
Recirculation tank & AdvanTex recirculating textile packed bed reactor	
Inspect flow pattern of pod spray nozzles	1 x per 3 months
Inspect integrity of pod lids/lid hardware	1 x per 3 months
Flush pod distribution laterals	1 x per 3 months
Complete sludge/scum testing of each tank	1 x per 3 months
Check operation & clean all pumps	1 x per 3 months
Clean & check operation of all control floats	1 x per 3 months
Check operation of fan & ventilation systems (vents etc.)	1 x per 3 months
Check splitter valve operation	1 x per 3 months
Verify timer operation settings (advise from Innoflow engineer)	1 x per 3 months
Check outlet pipe work to downstream components	1 x per 3 months
Treated effluent tank & water meter	
Inspect tank levels and integrity including access risers etc.	1 x per 3 months
Inspect and clean treated effluent tank floats and alarms	1 x per 3 months
Inspect and clean treated effluent tank pump	1 x per 3 months
Measure and log biomass level in treated effluent tank	1 x per 3 months
Ensure water meter operation, ensure pulse signals to TCOM panel	1 x per 3 months
TCOM control panel	
Check enclosure integrity & for any moisture	1 x per 3 months
Visually check all electrical components for signs of fatigue or failure (burning/melting etc)	1 x per 3 months
Ensure communications	1 x per 3 months
Land Application system	
Inspect, clean & assure operation of sequencing valves	1 x per 6 months
Flush distribution laterals	Annually
Assess wastewater irrigation fields for any obvious leaks	Annually
Reporting	
Forward maintenance inspection summary to client	1 x per 3 months

11.0 COMPONENT LIFE EXPECTANCY

Table 12 - Component Life Expectancy

Recirculating packed bed reactor textile filters	>50 years
Recirculating packed bed reactor pod	>50 years
Concrete tanks	>50 years
Recirculating packed bed reactor pod lids	>35 years
Recirculation tank splitter valve	>25 years
Orenco systems inc. STEP Tank pumps	>25 years
Control panel mother board	>25 years
Biotube effluent filter	>25 years
Recirculating packed bed reactor pod lid struts	>20 years
Pvc and pe pipework and fittings	>20 years
Pump discharge assemblies	>20 years
Pulse water meters	>20 years
Control panel	>20 years
Orenco systems inc. Treated effluent pumps	>15 years
General electrical components	>15 years
Pvc access riser and fibreglass lids	>10 years
Orenco systems inc. Recirculation pumps	>10 years
Float switches	>10 years
Active carbon fan vents	> 5 years

12.0 STATEMENT OF LIMITATIONS

This report has been prepared for the sole benefit of the appointed Consultant to support Discharge Consent and Building Consent applications to Council. The design parameters, including but not limited to; occupancy, peak and average flows, soil loading rates and available land stipulated in this report have been determined and/or supplied to Innoflow by the client. Innoflow does not hold any obligation regarding verifying the accuracy of the information provided. The reliance by other parties on the information or opinions contained in the report shall, without prior review and agreement in writing, be at such party's sole risk.

APPENDIX C
BORE LOGS

WASTEWATER TEST No. 1

SOIL DESCRIPTION

GRAPHIC LOG	SOIL DESCRIPTION	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	FILLING: Mixture of Clay, Silt and Tree bark. Whitish grey mottled pinkish brown, uncontrolled, moist.		Filling			No Groundwater
	clayey SILT. Reddish brown mottled light grey, moist, moderately plastic. Becoming yellowish brown mottled light grey @ 0.5m. " " " " reddish brown @ 0.7m. " light yellowish brown mottled light grey and reddish brown @ 1.0m. Containing some fine sand @ 1.2m.	1 2	East Coast Bays Formation			
	Bottom of Bore Hole completed 24/03/2025	3				

WASTEWATER TEST No. 2

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

GRAPHIC LOG	SOIL DESCRIPTION	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	silty CLAY. Reddish brown, moist, moderately plastic.	1 2	East Coast Bays Formation			No Groundwater
	Bottom of Bore Hole completed 24/03/2025	3				

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 1 & 2

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-1

WASTEWATER TEST No. 3

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
TOPSOIL.		TS			
silty CLAY. Yellowish brown mottled reddish brown, moist, slightly iron stained, slightly plastic. Becoming light grey mottled light yellowish brown and moderately plastic @ 0.4m.	1 2 3	East Coast Bays Formation			No Groundwater
Bottom of Bore Hole completed 24/03/2025					

WASTEWATER TEST No. 4

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
FILLING: Mixture of Clay, Silt and Tree bark. Greyish brown, uncontrolled, moist.		Fill			
SILT with some clay. Light grey, dry to moist. Becoming slightly iron stained @ 0.4m. Containing fine to medium gravel @ 0.5m.					
silty CLAY. Yellowish brown mottled light grey, moist, moderately iron stained, moderately plastic.	1 2 3	East Coast Bays Formation			No Groundwater
Bottom of Bore Hole completed 24/03/2025					

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 3 & 4

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-2

WASTEWATER TEST No. 5

SOIL DESCRIPTION

clayey SILT. Yellowish brown mottled light grey, dry, slightly plastic, slightly iron stained.
Becoming moist @ 0.3m.
" highly plastic and whitish grey @ 0.6m.

Bottom of Bore Hole completed 24/03/2025

East Coast Bays Formation

No Groundwater

WASTEWATER TEST No. 6

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

SILT with minor clay. Light greyish brown, dry to moist.

silty CLAY. Greyish brown, moist, slightly iron stained, moderately plastic.
Becoming highly plastic @ 0.4m.
" yellowish brown @ 0.6m.
Containing fine to medium gravel @ 0.8m.

Bottom of Bore Hole completed 24/03/2025

East Coast Bays Formation

No Groundwater

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 5 & 6

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-3

WASTEWATER TEST No. 7

SOIL DESCRIPTION

GRAPHIC LOG		DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	FILLING: Mixture of Silt, Topsoil and Tree bark. Dark brown mottled orangey brown.		Fill			No Groundwater
	clayey SILT. Yellowish brown mottled whitish grey, moist, slightly plastic, moderately to highly iron stained.		East Coast Bays Formation			
	silty CLAY. Yellowish brown mottled whitish grey, moist, moderately to highly iron stained, highly plastic	1				
	Bottom of Bore Hole completed 24/03/2025	2				
		3				

WASTEWATER TEST No. 8

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

					1 2 3 4 5 6 7 8 9 10	
	SILT with some clay. Dark brown mottled greyish brown, moist, slightly organic.		East Coast Bays Formation			No Groundwater
	clayey SILT. Greyish brown, moist, slightly plastic, slightly iron stained. Containing fine to medium gravel @ 0.7m. Becoming light grey @ 0.6m.	1				
	Bottom of Bore Hole completed 24/03/2025	2				
		3				

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 7 & 8

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-4

WASTEWATER TEST No. 9

SOIL DESCRIPTION

GRAPHIC LOG	SOIL DESCRIPTION	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	FILLING: Mixture of Silt and Tree bark. Dark brown mottled orangey brown, uncontrolled, moist.		Filling			No Groundwater
	original TOPSOIL.		Topsoil			
	silty CLAY. Yellowish brown, moist, slightly plastic.	1	East Coast Bays Formation			
	Bottom of Bore Hole completed 24/03/2025	2				
		3				

WASTEWATER TEST No. 10

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

GRAPHIC LOG	SOIL DESCRIPTION	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	FILLING: Stockpiled Tree fellings.		Filling			No Groundwater
	silty CLAY. Light grey mottled light brown, moist, moderately plastic.	1	East Coast Bays Formation			
	Bottom of Bore Hole completed 24/03/2025	2				
		3				

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 9 & 10

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-5

WASTEWATER TEST No. 11

SOIL DESCRIPTION

GRAPHIC LOG		DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	FILLING: Mixture of Silt and Tree bark. Dark brown, uncotnrolled, moist.		Fill			No Groundwater
	clayey SILT. Yellowish brown mottled light grey, moist, slightly plastic, moderately iron stained. Becoming light grey mottled reddish brown @ 0.8m.	1	East Coast Bays Formation			
	Bottom of Bore Hole completed 24/03/2025	2				
		3				

WASTEWATER TEST No. 12

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

					1 2 3 4 5 6 7 8 9 10	
	FILLING: Mixture of Silt and Tree bark. Dark brown, uncontrolled, moist.		Fill			No Groundwater
	original TOPSOIL.					
	silty CLAY. Light grey mottled yellowish brown. Moist, moderately plastic. moderately iron stained. Becoming reddish brown mottled light grey @ 0.9m.	1	East Coast Bays Formation			
	Bottom of Bore Hole completed 24/03/2025	2				
		3				

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 11 & 12

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-6

WASTEWATER TEST No. 13

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
FILLING: Mixture of Silt and Clay. Dark brown, uncontrolled, moist, slightly organic.	0	Fill			No Groundwater
clayey SILT. Yellowish brown mottled light grey, moist, slightly plastic.	1	East Coast Bays Formation			
Bottom of Bore Hole completed 24/03/2025	2				
	3				

WASTEWATER TEST No. 14

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
TOPSOIL.	0	TS			No Groundwater
clayey SILT. Grey mottled yellowish brown. Moist, slightly plastic. moderately iron stained. Containing trace fine sand @ 0.7m. becoming heavily iron stained @ 0.7m.	1	East Coast Bays Formation			
Bottom of Bore Hole completed 24/03/2025	2				
	3				

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 13 & 14
LOCATION: refer Site Plan RL (m):
SHEET: 1 OF 1 Fig. No. A-7

WASTEWATER TEST No. 15

GRAPHIC LOG	SOIL DESCRIPTION	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
× × × × × × × × × × × ×	clayey SILT. Yellowish brown mottled light grey, moist, slightly plastic.	1 2 3	East Coast Bays Formation			No Groundwater
	Unable to penetrate					
	Bottom of Bore Hole completed 24/03/2025					

WASTEWATER TEST No. 16

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

GRAPHIC LOG	SOIL DESCRIPTION	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
	FILLING: Mixture of Silt and Clay. Dark brown, uncontrolled, moist.	1 2 3	Filling			No Groundwater
× × × × × × × × × × × ×	clayey SILT. Dark grey, moist, slightly organic. Becoming greyish brown @ 0.9m.		East Coast Bays Formation			
	Bottom of Bore Hole completed 24/03/2025					

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 15 & 16

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-8

WASTEWATER TEST No. 17

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
silty CLAY. Light grey, moist, moderately plastic, slightly iron stained. Becoming moderately iron stained @ 0.8m.	1	East Coast Bays Formation			No Groundwater
Bottom of Bore Hole completed 24/03/2025	2				
	3				

WASTEWATER TEST No. 18

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
FILLING: Mixture of Silt, Clay and Tree bark. Dark brown mottled yellowish brown, uncontrolled, moist.		Filling			No Groundwater
silty CLAY. Light grey mottled yellowish brown, moist, moderately plastic, moderately iron stained. Becoming slightly iron stained and light grey @ 0.8m.	1	East Coast Bays Formation			
Bottom of Bore Hole completed 24/03/2025	2				
	3				

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 17 & 18

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-9

WASTEWATER TEST No. 19

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
silty CLAY. Light grey mottled yellowish brown, moist, moderately plastic, moderately iron stained.	1	East Coast Bays Formation			No Groundwater
Bottom of Bore Hole completed 24/03/2025	2				
	3				

WASTEWATER TEST No. 20

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
FILLING: Mixture of Silt and Tree bark. Dark brown, uncontrolled, moist.	1	Filling			No Groundwater
silty CLAY. Yellowish brown, moist, moderately plastic, moderately iron stained. Becoming yellowish brown light grey @ 0.8m.		East Coast Bays Formation			
Bottom of Bore Hole completed 24/03/2025	2				
	3				

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TESTS 19 & 20

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-10

WASTEWATER TEST No. 21

SOIL DESCRIPTION

GRAPHIC LOG	DEPTH (metres)	GEOLOGICAL FORMATION	UNDRAINED SHEAR STRENGTH/ REMOULDED (Kpa)	SCALA PENETROMETER (blows/100mm) 1 2 3 4 5 6 7 8 9 10	PIEZOMETER / WATER LEVEL
silty CLAY. Light grey mottled light yellowish brown, moist, slightly plastic, Containing rootlets @ 0.5m. Becoming moderately plastic and yellowish brown @ 0.8m.	1	East Coast Bays Formation			No Groundwater
Bottom of Bore Hole completed 24/03/2025	2				
	3				

NOTES
- The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
- Scala test was carried out in 1.0 metre depth increments.

1 2 3 4 5 6 7 8 9 10
1
2
3
No Groundwater

JOB NAME: RANGITOOPURI RETIREMENT VILLAGE
JOB LOCATION: Forest Road, Riverhead
JOB NUMBER: J6438-1

DRILL METHOD: Hand Auger
RIG:
DRILLER: RS/SP

LOGGED: RS/SP PLOTTED: RS
DATE LOGGED: 24/03/25
CHECKED:

GWE CONSULTING ENGINEERS

BOREHOLE LOG

WASTEWATER TEST 21

LOCATION: refer Site Plan RL (m):

SHEET: 1 OF 1 Fig. No. A-11