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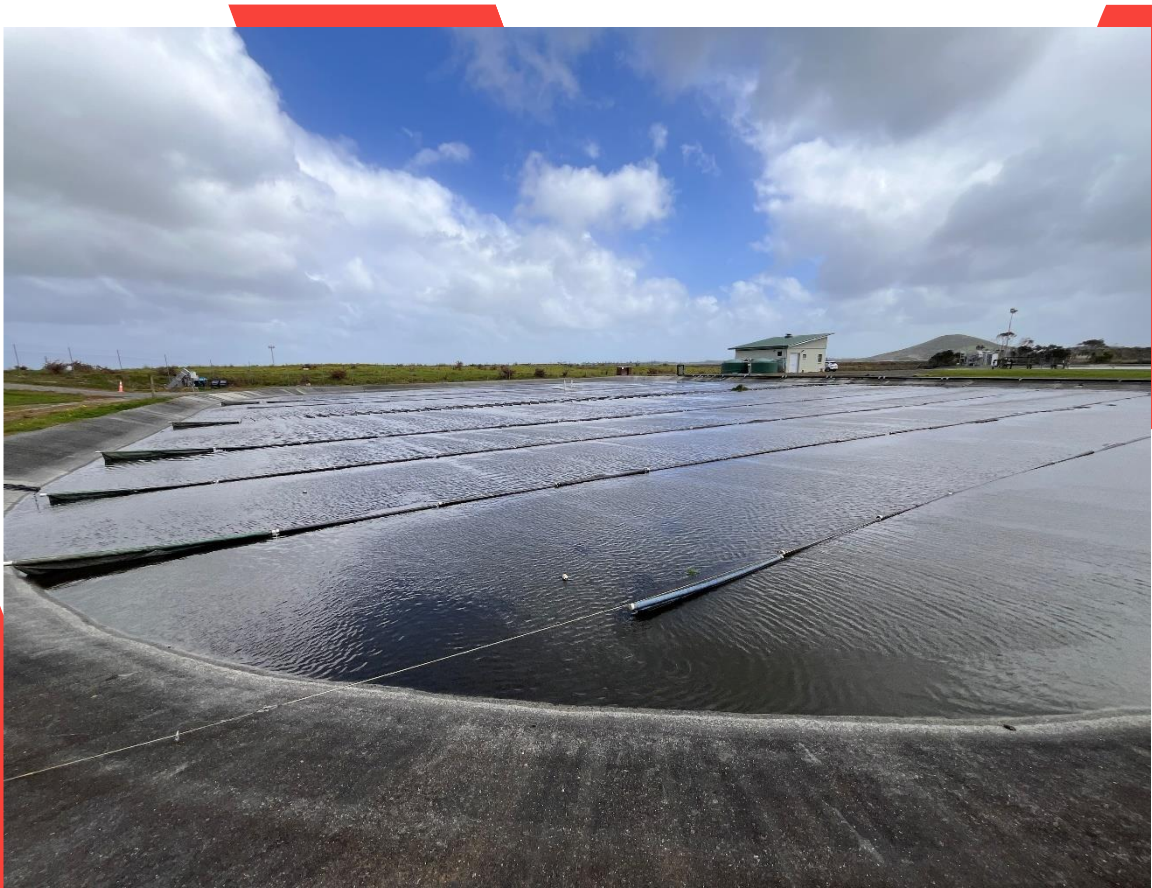
Far North District Council

Whatuwhiwhi WWTP Best Practical Options

Options Assessment

28 May 2025



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ABBREVIATIONS

ADWF	Average Dry Weather Flow
BOD	Biological Oxygen Demand
BPO	Best Practicable Option
DAF	Dissolved Air Floatation
DO	Dissolved Oxygen
FNDC	Far North District Council
IDEAL	Intermittently Decanted Extended Aeration Lagoon
MCA	Multi Criteria Analysis
PDWF	Peak Dry Weather Flow
PLC	Programmable Logic Control
PWWF	Peak Wet Weather Flow
RAS	Return Activated Sludge
SBR	Sequencing Batch Reactor
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UV	Ultraviolet
W-WWTP	Whatuwhiwhi Wastewater Treatment Plant

1 PROJECT BACKGROUND

1.1 BACKGROUND

The Far North District Council (FNDC) holds resource consents (AUT .007203.02.02 and AUT .007203.03.02) for discharges to land and air with the operation of the Whatuwhiwhi WWTP (W-WWTP). The resource consents expire on 30 November 2025 hence WSP has been engaged to prepare applications for replacement resource consents for discharges to air, land and water.

As part of the resource consent renewal process, upgrades to the W-WWTP are assessed to identify upgrade options that can meet the future needs of the community and satisfy the conditions of a new resource consent. The current treatment process is not meeting the required discharge limits on total suspended solids (TSS).

A Best Practicable Option (BPO) assessment for the W-WWTP upgrade has been conducted. The BPO assesses a range of treatment options based on water quality information, discharge standards, community requirements and the local context. The following assumptions were made to inform the BPO process:

- The site location remains the same.
- The discharge location remains the same.
- Phosphorus removal is not required but can be added if necessary.

Based on the above, six long list options for upgrade were identified for the site and further refined to identify the three most appropriate options. These three short list options are:

- Refurbishment to the existing plant with an upgrade to include Dissolved Air Floatation (DAF) for solids removal.
- Packaged sequencing batch reactor (SBR).
- Intermittently decanted extended aeration lagoon (IDEAL).

This report contains the findings of the BPO assessment for the treatment plant upgrade.

2 EXISTING PLANT

2.1 WASTEWATER TREATMENT PLANT OVERVIEW

The Whatuwhiwhi wastewater treatment plant (W-WWTP) is situated about 1 km northwest of Whatuwhiwhi on the Karikari peninsula (refer Figure 2-1). This facility caters to the townships of Tokerau Beach and Whatuwhiwhi. As a coastal community, Whatuwhiwhi experiences significant population fluctuations, with numbers rising during the summer and peaking over the Christmas period. Currently, the plant accommodates a winter population of around 450 and a summer population of up to 1,500.

FNDC have indicated that there are currently 808 connections to the Whatuwhiwhi WWTP (Far North District Council , 2024).

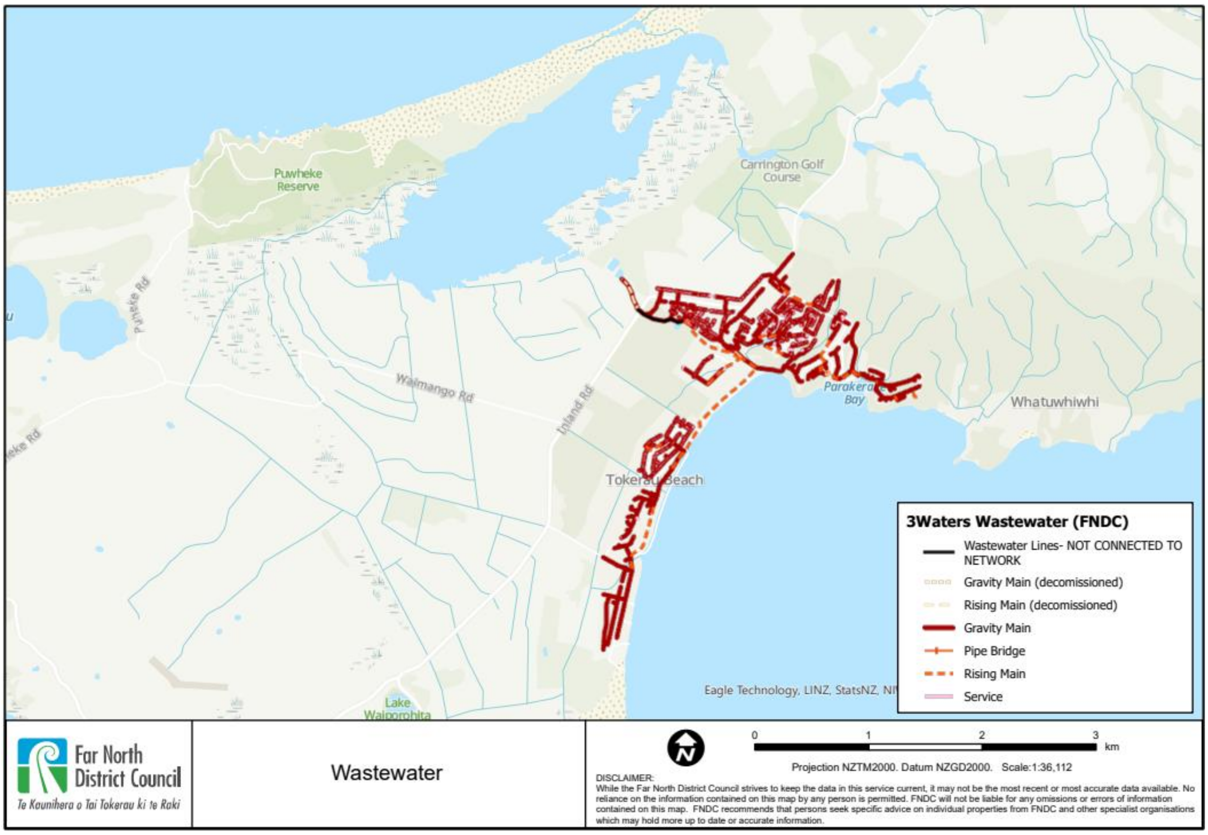


Figure 2-1 Location map showing the Whatuwhiwhi Wastewater Scheme

The wastewater from the communities of Whatuwhiwhi and Tokerau Beach is pumped to the W-WWTP. Initial treatment begins where inorganic solids are screened from the wastewater through an automatic stepscreen for landfill disposal. The wastewater is then treated in two aerobic ponds (Figure 2-2) fitted with “Aquamats” to promote high treatment standards. The wastewater is then treated through an ultraviolet (UV) disinfection system before it is discharged into the adjacent wetland area.

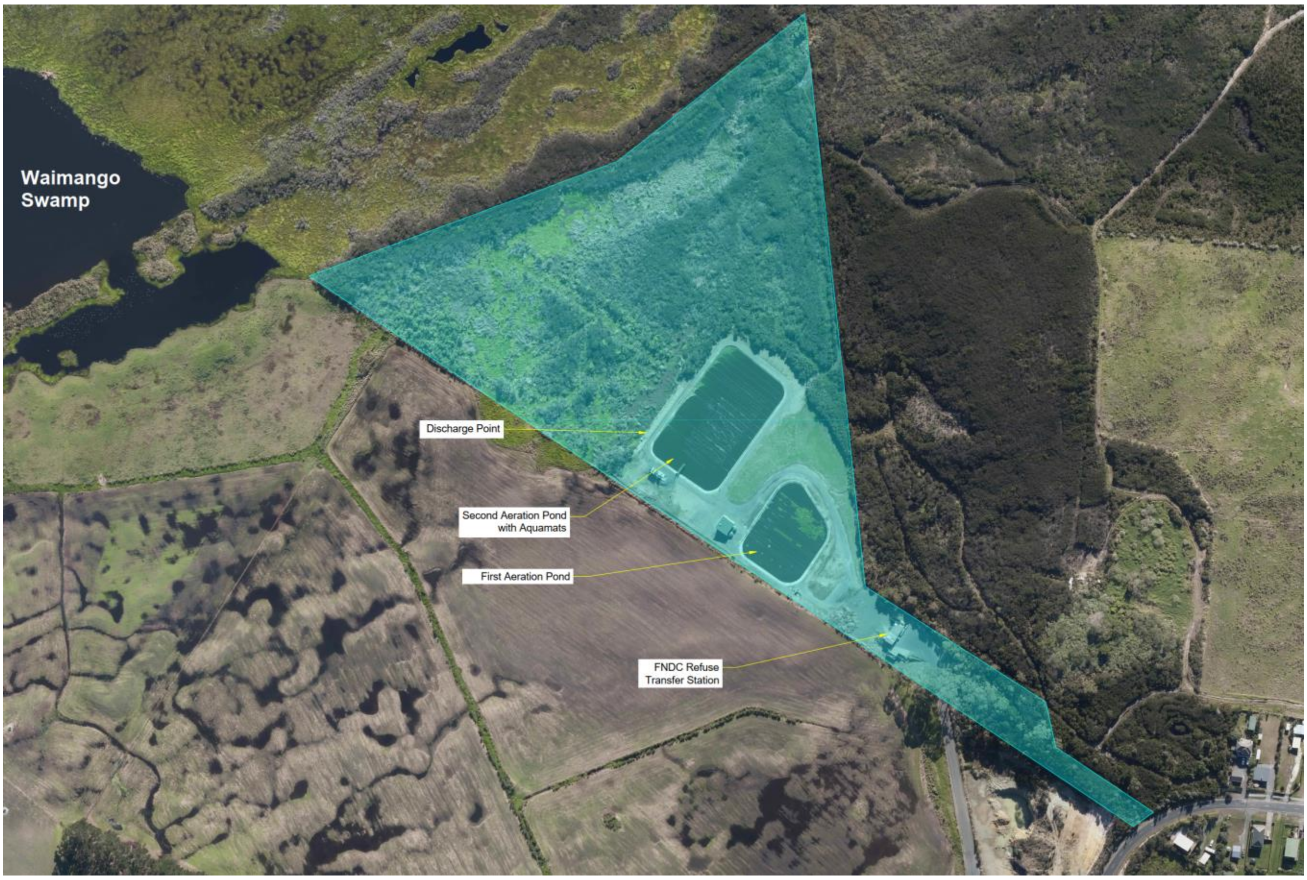


Figure 2-2 Map showing location and features of the Whatuwhiwhi WWTP.

2.2 PROCESS OVERVIEW

2.2.1 INFLUENT SCREENING AND FLOW MEASUREMENT

Raw wastewater arriving at the Whatuwhiwhi WWTP is screened through a Hydropress step screen. The retained screenings are removed periodically to land fill. The influent flows are recorded via a Magflow flowmeter.

2.2.2 POND TREATMENT

The raw influent enters Pond 1 through a distribution header at one end. The partially treated effluent leaves Pond 1 through an outlet at the opposite end and gravity feeds into Pond 2. The pretreated effluent enters Pond 2 through a distribution header at one end and leaves through a weir at the outlet end. The design residence times are between 20 to 40 days. The treatment stage of W-WWTP are described in Table 2-1.

Table 2-1 Treatment stages of the Whatuwhiwhi WWTP

WWTP Stage	Removal Mechanism	Primary Function	Model Pond Type
Pond 1	Oxygenation, Aerobic Digestion, Sedimentation	Biochemical oxygen demand (BOD) removal, Pathogen and Nutrient Reduction	Aerobic
Pond 2 Inlet-Section	Anoxic Digestion	Nutrient Reduction	Secondary Facultative
Pond 2 Mid-Section	Aerobic Digestion, Oxidation	Pathogen and Nutrient Reduction	Aerobic, Maturation
Pond 2 Outlet-Section	Sedimentation	Coalescent Zone	Maturation

Both ponds have AquaMats installed. These suspended mats provide an increased growth area for bacteria that play a significant role in the breakdown of BOD and ammonia. Mechanical aeration provides oxygen to the process and encourages mixing. Air for aeration is provided by two blowers located in the plant building. Effluent flows by gravity through the outlet weir and into the outlet pump wet well. The level in the wet well is controlled by a level sensor. The pumps pump the effluent to a disk filter (Hydrotech 1704-1F). The disk filer to remove suspended solids down to 10 microns in size. From the disk filter treated effluent is sent to a UV reactor for disinfection.

In recent years, the disk filter has been bypassed, sending treated effluent directly to the UV reactor, as the disk filter diaphragm has ruptured frequently due to algae clogging.

2.2.3 UV DISINFECTION

The closed UV reactor (Wedeco LBX90e), designed for drinking water applications, is oversized, this means despite high TSS at times it has still performed well for disinfection resulting low E.coli in the effluent water. Flow control is used to manage flows between minimum and maximum UV reactor design flow rates.

UV treated effluent discharges through an effluent dispersion channel leading through a natural marsh being part of the Waimango Swamp at the north corner of the treatment site (see Figure 2-2).

2.2.4 CONTROL SYSTEM

The Whatuwhiwhi WWTP operates on PLC control. The PLC aims to control different operational modes and control blower operation. Over time, the original operation modes were deemed as too complex and unnecessarily complicating operation of the plant. Today the plant is operating via operator manual settings changing aeration pressure in the two ponds based on flow load observation and treatment performance observations.

The original dissolved oxygen (DO) control failed early in the plant's operational history as the probes were installed on a float in Pond 1. The probe failed often and had no automatic cleaning ability. Frequent cleaning and calibration became impractical and expensive. Hence manual operation is the preferred configuration.

3 BASIS OF DESIGN

3.1 FLOW DATA

Influent flow data from the Whatuwhiwhi WWTP SCADA provided by FNDC was reviewed, data prior to 4/10/2022 was found to be erroneous and was therefore excluded. In addition to this, it was also found that there was a discrepancy between the inlet and outlet flows of ~10 m^3 per day on average, therefore only the inlet flows were used for the design basis. This was deemed acceptable as pond design typically uses average influent flow only.

FNDC advised that the rainfall gauge is not operable at the Whatuwhiwhi site, rainfall data was therefore obtained from the closest Northland Regional Council (NRC) rainfall site (Northland Regional Council, 2024) at the Oruru Bowling Club. The rainfall data was used to identify dry weather flows and wet weather flows.

The dry and wet weather flow data was analysed for the average, median, minimum, maximum, 90th%-ile and 99th%-ile flows. Flows over 300 m^3/day on dry weather days outside of public holidays or the peak tourist seasons were excluded as outliers. Figure 3-1 below shows the wastewater flow more than doubles during the summer peak and shows the lowest dry weather flows are in March each year.

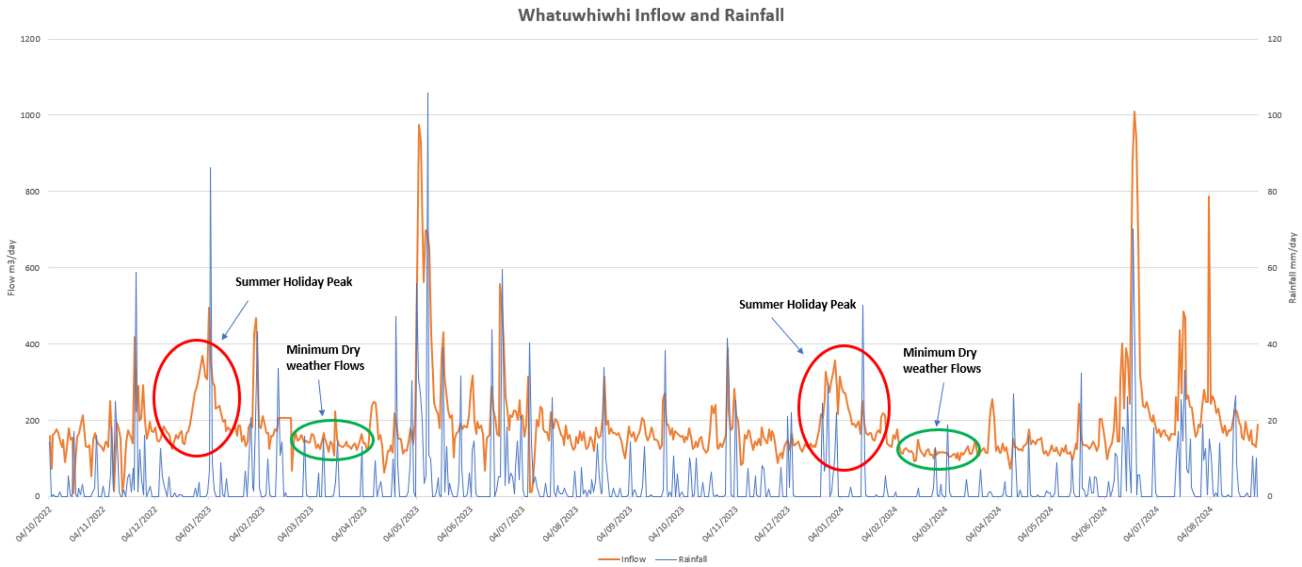


Figure 3-1 Inflow and rainfall data for the Whatuwhiwhi WWTP from 2022 - 2024.

3.2 POPULATION ESTIMATES

3.2.1 2024 RESIDENT POPULATION

The permanent resident population was estimated using the provided flow data and verified against 2022 Statistics NZ population data for the catchment area (Datafinder Stats NZ, 2024).

The resident population for 2023 and 2024 was estimated using flow data from March of each year because these months had the lowest flows and were notably dry. The Far North Standard of 140 L/h/d for populations relying on tank water was applied to estimate the population for these months.

Although incoming contaminant load data is the ideal method for estimating the population in a catchment, flow data was used due to the absence of load data. The flow-derived population was checked against the Statistic NZ resident population 2022 data (Datafinder Stats NZ, 2024) and was in very close agreement, indicating that the level of inflow and infiltration of this small network is likely very low, and for that reason, flow data has provided an accurate estimate.

3.2.2 2024 PEAK DAY POPULATION

Whatuwhiwhi is a popular summer tourist spot, so the population increases considerably during the summer holiday season. It is important to understand the peak population on these days to understand the peak load the plant will need to treat. To find the peak daily population the 99%ile dry weather flow was used and divided by the per person flow contribution (140 L/h/d) to approximate the peak daily population.

3.2.3 POPULATION FORECAST TO 2059

The maximum consent period is 35 years, for this reason the resident population was projected to 2059 using the 0.7 annual population growth factor identified in the memo "*Treatment Plant Capacity Assessment, September 2024*" (Glaser, 2024) provided by FNDC. The growth factor was also applied to the peak daily population to forecast the peak daily population for 2059.

3.2.4 POPULATION SUMMARY

Table 3-1 shows the population summary calculated for W-WWTP based on the approach in section 3.2.3.

Table 3-1 Populations estimates used for the 2024 and 2059 Basis of Design

Population Estimates	
Resident Population Based on March ADWF 2023	979
Resident Population Based on March ADWF 2024	863
Resident Population Based on Stats NZ for 2022	879
Resident Population used for 2024 Basis of Design	900
Peak Daily Population used for 2024 Basis of Design	2250
Resident Population used for 2059 Basis of Design	1149
Peak Daily Population used for 2059 Basis of Design	2872

3.3 FLOW AND LOAD PROJECTIONS

The average dry weather flow (ADWF) was determined based on the dry weather flows between 4/10/2022 and 31/08/2024, peak dry weather flow (PDWF) was taken as the 99%-ile total daily flow over this time. Peak wet weather flows (PWWF) were taken as the 99%-ile of the wet weather flows over the same period. The 99%-iles have been chosen as this represents approximately one day in the year when the flows are high. This is a conservative approach to ensure the plant is adequality sized. See Table 3-2 for the basis of design flows for the current plant as of 2024 and the flow projection to 2059.

Table 3-2 Basis of design flows for 2024 and 2059

Flow Scenario	2024 Flow [m3/d]	2059 Flow [m3/d]
ADWF	154	197
PDWF	315	402
PWWF	927	1184

Loads were derived from the 2024 population and standard per person containment loads (Eddy, 2014). The resident population was used to derive the minimum daily load, and the peak total daily load was derived by using the peak daily population. See Table 3-3 for the basis of design loads for the current plant as of 2024 and the load projections to 2059.

Table 3-3 Basis of design loads

Parameter	P.E Loads (g/hd/d) (Eddy, 2014)	Loads (kg/day)			
		2024		2059	
		Minimum	Peak	Minimum	Peak
BOD	70	63	158	80	201
TSS	70	63	158	80	201
NH3-N	7.5	7	17	9	22
TKN	13	12	29	15	37

3.4 EFFLUENT QUALITY REQUIREMENTS

The following discharge standards are recommended for the upgraded W-WWTP. The recommendations are sourced from the Water Quality Assessment completed by WSP (WSP, 2025). The recommended discharge standards at the point of discharge of the upgraded W-WWTP is given in Table 3-4. The recommended discharge standards at the point of reasonable mixing[1] of the upgraded W-WWTP is given in Table 3-5.

Table 3-4 Recommended discharge standards at the point of discharge.

Parameter	Units	Annual Median	Annual 95th%-ile
E. Coli	MPN/100ml	130	1,200
Total Suspended Solids (TSS)	mg/l	10	15
Biological Oxygen Demand (BOD_5)	mg/l	15	25

[1] The point of reasonable mixing should be identified in consultation with the NRC, however as a starting point, this could be considered as 50m from the point of discharge, given the discharge appears to be flowing water at this point.

Table 3-5 Recommended discharge standard at the point of reasonable mixing.

Parameter	Units	Annual Median	Annual 95th%-ile
Ammoniacal Nitrogen (NH_3-N)	mg/l	0.24	0.4
Nitrate (NO_3-N)	mg/l	2.4	3.5
Copper and Zinc	To be assessed against appropriate guideline values in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Annual median concentrations not to exceed the 95% species protection thresholds therein following adjustment		

4 CAPACITY ASSESSMENT

4.1 ORIGINAL DESIGN FLOW AND LOAD

The original design of the W-WWTP intended future expansion and/or upgrades to be staged to cope with population forecasts up to 2026.

When the WWTP was built in 2009 most of the mechanical, civil, structural and hydraulic works were sized for catchment growth up to 2026. However, the number of Aquamats installed was to be phased, with more Aquamats being added as the population grew. Initially enough Aquamats were installed for the 2008 loads and were to be increased in 2016 and in 2026. The aeration system was designed initially with two blowers with the requirement to add a third for the 2016 loads onwards (Opus International Consultants Ltd, 2007).

The anticipated growth in the catchment did not take place to the level that was predicted, and the number of installed Aquamats has never been updated since 2008. This capacity assessment is therefore based on the 2008 configuration currently installed.

The design flows and loads for 2008 through to 2026 and the current flows and loads for 2024 and the projected flows and loads to 2059 are shown in Table 4-1 below. Note that the original design assumed particularly concentrated person equivalent (PE) loadings for calculating the loads to the plant, these PE loads have been adjusted for the 2024 to 2059 loads, utilising loads at the upper end of what would be expected for this predominantly domestic catchment (Eddy, 2014).

Table 4-1 Original design flows and loads in comparison with current 2024 and projected 2059 flows and loads.

	2008		**2016**		**2026**		**2024 Actual**		**2059 Forecast**	
	Min	Peak	Min	Peak	Min	Peak	Min	Peak	Min	Peak
Population	600	1400	1250	2400	1890	3500	900	2872	1149	2872
ADWF (m^3/d)	110	250	230	437	348	623	154	315	197	402
PWWF (m^3/d)	800		1400		2000		924		1184	
BOD Load (kg/d)	54	123	113	215	171	307	63	158	80	201
TSS Load (kg/d)	64	147	135	256	204	365	63	158	80	201
NH3-N Load (kg/d)	10	22	20	39	31	55	7	17	9	22
TKN Load (kg/d)	11	25	23	44	35	62	12	29	15	37

The flows and loads determined for 2024 and out to 2059 have been reviewed against meeting the current consent discharge limits, the assessments below are based on the W-WWTP being in a well maintained and working condition. The purpose of the capacity assessment was to determine if the current plant can cope with future flows and loads as it is designed or whether it will require modification or replacement. Any required maintenance, modifications, or replacements will be addressed in section 6.

4.2 FLOWS

The W-WWTP was originally designed for flows projected up to 2026 based on population assumptions made in 2008. However, this projected population growth has not materialized. For the upcoming consent application, the population has been reforecast and extended to 2059 and remains well below the original population projections for 2026. This indicates that the plant's flow and hydraulic capacity are sufficient for the next 35 years, and no further upgrades are required to manage the future projected flows.

4.3 LOADS

The current estimated loads exceed the W-WWTP's 2008 design capacity and given that the plant is still in its 2008 configuration it means that the current loads exceed the current available capacity. The W-WWTP was designed for phased addition of Aquamats and a third blower which would have catered for an ultimate 2026 capacity, but this has never materialised.

The forecast 2059 loads are well within the WWTP's 2016 design capacity, therefore with the addition of the extra Aquamats as well as the third blower envisaged with the original 2016 upgrade the plant would have capacity for treating the loads out to 2059 based on the current consented required effluent quality standards.

4.4 SUMMARY

The current W-WWTP if maintained and functioning in good condition, has capacity to 2059 for the projected increase in flow.

The current W-WWTP is already under capacity in terms of load treatment. If the original 2016 design configuration is implemented (more Aquamats and an additional blower) then, based on the original design, the plant would have sufficient capacity to treat loads out to 2059 based on the projected population increases.

The capacity assessment assumed that the original design of the plant was appropriately sized and specified, the original design calculations or assumptions were not reviewed as part of the assessment.

5 LONG LIST OPTIONS EVALUATION

5.1 ASSUMPTIONS

A long list of options was identified that would be suitable to serve a population of the size and nature of the Whatuwhiwhi wastewater catchment. In identifying the long list options, the following assumptions were made:

- **Site Location**

  It has been assumed the treatment plant will remain at its current location. For several reasons the relocation of the W-WWTP to a different location has not been considered as a viable option.

  The current site has several advantages over alternative locations, the site is flat, is relatively large allowing for future expansion and upgrade, geographically located at a low point allowing for energy efficient pumping of wastewater, is situated away from public view behind the refuse transfer station, is not in proximity to residential housing, and is outside of 50-year and 100-year flood hazard zones.

  Moving the W-WWTP to a new location would present several major challenges, such as significant costs, disruption for the community, and a large amount of wastewater infrastructure in terms of piping and pump stations would require relocation and modification, resulting in a large financial burden for rate payers and the community.

  It is acknowledged that the community has a desire to move the treatment plant discharge point. If the discharge point is moved in the future, it will likely be more cost effective to move the discharge point than to move the W-WWTP.

- **Discharge Location**

  It has been assumed for the long list options selection that the discharge point will remain in the same location (see Figure 2-2). However, if the discharge was to change (eg. land disposal) then all the options will be suitable with or without modification. Suitability for future land disposal was considered further for the short-listed options.

- **Phosphorus**

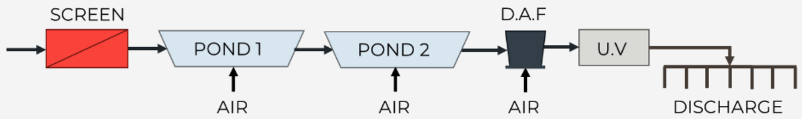
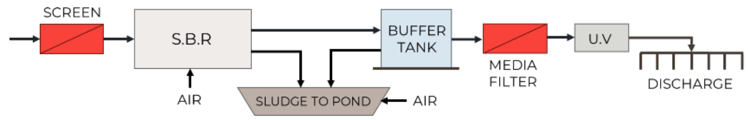
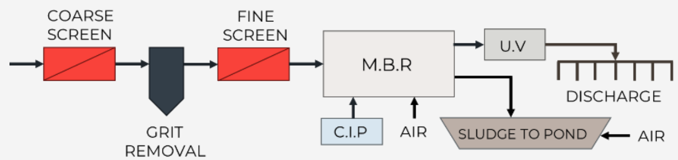
  Currently no additional phosphorus removal has been allowed for. Should enhanced phosphorus removal be required in future then all treatment options support the additon of phosphorus removal technology such as chemical dosing or electrocoagulation.

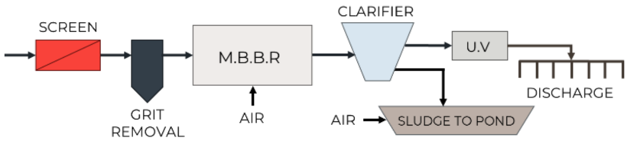
5.2 LONG LIST OPTIONS SELECTION

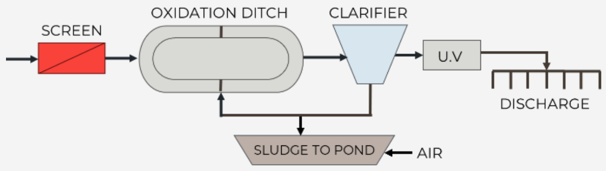
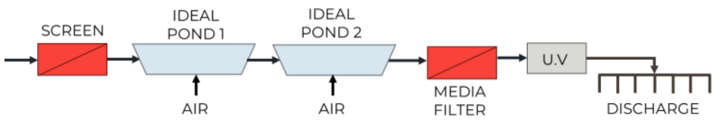
There are many available treatment technologies that can achieve the standard of treatment required to serve a community the size of Whatuwhiwhi and treat the effluent to a high standard to comply with future consent requirements. However, some technologies have limitations meaning they are unlikely to be an acceptable solution for the community. These limitations include producing large amounts of unstable primary sludge, or being extremely expensive or difficult to operate, or technologies that are untested in the market.

For these reasons the criteria for the six longlist options have been based on selecting well tested technologies that will be capable of producing high-quality treated water, are suitable for the site size constraints, do not produce unstable primary sludge, work well at the size of flows and loads expected at the plant, and can be easily operated and supported within New Zealand. Table 5-1 provides a summary of the longlist options. Refer to the Whatuwhiwhi WWTP Long List Options Memo (WSP, 2025a) for more details.

Table 5-1 Summary of the Whatuwhiwhi WWTP long list options.

Option	Title	Description	Schematic
1	Refurbish existing plant with solids removal upgrade	Refurbishment and upgrades required are: • Additional blower for air supply • Additional Aquamats or suspended media for contaminant removal • Desludging of ponds • Acid clean and inspection/replacement of diffusers and plastic airlines • Improved solids removal with Dissolved Air Floatation (DAF) • Geobag sludge storage and dewatering area	
2	Replace existing plant with packaged sequencing batch reactor (SBR)	An SBR system would include screening of incoming wastewater, biologically treating the wastewater in batches, and decanting clarified water for further treatment. The process includes: • Screening for gross solids removal • Biological treatment in the SBR • Settling and decanting clarified water • Further treatment in a buffer tank and media filter • UV disinfection and discharge Excess sludge is stored in converted ponds for long-term breakdown. The current inlet screen, one pond, and the UV treatment system can potentially be reused.	
3	Replace existing plant with packaged membrane bioreactor (MBR)	This option uses a biological activated sludge treatment process followed by a fine filtration membrane to retain sludge and remove solids. The process includes: • Coarse and fine screening to remove particles	

Option	Title	Description	Schematic
		• Biological treatment in an activated sludge reactor • Fine membrane filtration prior to UV treatment and discharge • Periodic membrane cleaning with a chemical system Excess sludge is stored in converted ponds for long-term breakdown. The existing inlet screen, UV system, and at least one pond can potentially be reused. This option produces the highest quality effluent, filtering out pathogens and providing consistent quality regardless of incoming water variations.	
4	Replace existing plant with packaged moving bed bioreactor (MBBR)	The Moving Bed Biofilm Bioreactor (MBBR) process uses floating plastic media on which biofilm attaches and grows to treat wastewater efficiently in a small footprint. The process includes: • Wastewater flows through the current inlet screen and grit removal system • Treatment in a tank with suspended plastic media and biofilm • Air added to support contaminant removal • Clarification and aerated storage of settled solids in existing ponds • UV disinfection and discharge of clarified water The MBBR is a high-capacity treatment plant that reliably produces high-standard effluent.	

Option	Title	Description	Schematic
5	Replace existing plant with oxidation ditch	This option replaces a pond with an oxidation ditch, where wastewater circulates in an oval-shaped ditch with rotating brush aerators or mixers providing oxygen for the biological process. This system offers excellent ammonia and total nitrogen removal. Treated sludge flows into a clarifier, with solids settled out and returned to the ditch. The treated wastewater then goes through UV treatment and discharge. Continuous sludge is stored in converted ponds for long-term aeration. This system could potentially reuse the existing inlet screen, UV system, and a pond for sludge storage, resulting in high-quality effluent.	
6	Replace existing plant with intermittently decanted extended aeration lagoon	This option is an augmented pond system, similar to the existing one but more dependable in providing high-quality effluent with elevated ammonia and total nitrogen removal. The process includes: • Screening for gross solids • Sequential filling and decanting with aeration, similar to an SBR • Further treatment and solids settling in subsequent ponds • Media filter for solids removal prior to UV disinfection and discharge This system could potentially reuse existing assets like the inlet screen, blower building, UV treatment, and ponds, achieving higher treatment performance than the current system.	

5.3 EXPECTED EFFLUENT QUALITIES

The expected effluent qualities for the long list options are shown in Table 5-2.

Table 5-2 Estimated effluent qualities for the long list options

Option	Description	BOD5 (mg/l)	NH_3-N (mg/l)	TN (mg/l)	TSS (mg/l)	TP (mg/l)	Faecal Coliform (MPN/100 ml)
Current	Current median consent limit	30	30	NA	30	NA	500
1	Existing plant refurbishment and DAF upgrade	25*	20	35	10	16	<100
2	Sequencing Batch reactor (SBR)	10	3	10	5	14	<100
3	Membrane Bioreactor (MBR)	5	3	10	3	14	<20
4	Moving Bed Biological Reactor (MBBR)	15	3	35	5	14	<100
5	Oxidation ditch	15	3	15	5	14	<100
6	Intermittent Decanting Extended Aeration Lagoon (IDEAL)	20	5	20	5	14	<100

* This option was selected early in the process before the recommended effluent quality requirements were known, and while outside the bounds of the Taumata Arowai Wastewater Standards listed in the Discussion Document, it has been included as the final limits are yet to be determined.

5.4 QUALITATIVE MULTI CRITERIA ANALYSIS (MCA)

To move from a long list of options to a short list of options a qualitative multi criteria analysis (MCA) was completed. The MCA intended to identify three options using a using a high-level, qualitative analysis based on stakeholder feedback, WSP's industry experience and technical expertise. The six long list options were ranked using the unweighted qualitative ranking as shown in Table 5-3.

Table 5-3 Long list options MCA scoring

Category	Criteria	Notes	Option 1: Refurbish existing plant with solids removal upgrade	Option 2: Packaged Sequencing Batch Reactor	Option 3: Packaged Membrane Bioreactor (MBR)	Option 4: Packaged MBBR	Option 5: Oxidation Ditch	Option 6: Intermittently Decanted Extended Aeration Lagoon (IDEAL).
			Score	Score	Score	Score	Score	Score
Cultural & Community	Resilience to power outages	Resilience to power cuts without a generator						
	Suitability for future land disposal							
Environmental	Effluent Quality							
Financial	CAPEX	High level - indicative only						
	OPEX	High level - indicative only						
Regulatory	Future regulatory compliance	Related to effluent quality, and potential future regulatory changes						
Social	Visual	Effect on the built environment – visual impact of treatment option						
	Odour	Potential for odours						
	Vectors	Attract flies and other vectors						
Technical	Future Proofing	Ease of expansion or modification						
	Sludge management/volumes							
	Operability	Reflects the need for operator input, training level, and site visits						
	Loss of communications	Telemetry goes down						
	Loss of access	Operator cannot access site e.g. weather event						
	Maintenance	Reflects anticipated frequence and cost of maintenance						
	Constructability	Considers the site constraints as well as ease of commissioning						
	Proven technology	Supported in NZ and NZ installations						
	Wet weather flow events	Impact of peak flow events on process						
	Peak loads	Impact of peak flow events on process						
	Footprint	Suitability to site layout						

Key		Total Score	Total Score	Total Score	Total Score	Total Score	Total Score
Excellent		13	11	10	9	10	12
Satisfactory		6	8	3	9	4	7
Unsatisfactory		1	1	7	2	6	1

The three short list options were identified by selecting the options with highest number of “Excellent” ratings, and the least number of “Unsatisfactory” ratings.

Based on the MCA, the following three options were short-listed for further development,

— Option 1: Refurbish the existing plant with an upgrade to dissolved air floatation (DAF) for solids removal

— Option 2: Modular sequencing batch reactor (SBR)

— Option 3: Intermittently Decanted Extended Aeration Lagoon (IDEAL)

6 SHORT LIST OPTIONS

6.1 OPTION 1: UPGRADE EXISTING PLANT WITH SOLIDS REMOVAL UPGRADE

6.1.1 PROCESS DESCRIPTION

This option proposes retaining and upgrading the existing pond treatment system. The proposed upgrades are similar to the original design, however with a new pond augmentation system to replace the redundant Aquamats. This option proposes implementing an OPTAER™ Wastewater Treatment System (by Nexom) or similar, applied to the existing lagoon-based facility. The process configuration includes:

- Screening and de-gritting using existing equipment
- Retention of the existing two lagoons, divided into sub-cells using floating impermeable baffles:
  - Pond 1: Split into 1a and 1b
    - 1a: Fine bubble complete mix aeration
    - 1b: Fine bubble partial mix aeration
  - Pond Cell 2: Split into 2a and 2b
    - 2a and 2b: Fine bubble partial mix aeration
    - 2b also includes a settling function
- Solids removal via dissolved air floatation (DAF)
- UV disinfection via the existing UV reactor.

This configuration allows for combined aerobic treatment and solids settling, and improved treatment performance while retaining much of the existing infrastructure. Due to the improved treatment and solids settling zone in Pond 2b, it is proposed to return the DAF sludge to the treatment ponds. While this practise may result in sludge accumulation, it is anticipated that with the additional aeration and settling, additional solids digestion will occur. Sludge levels are recommended to be monitored, and pond desludging frequency is increased if deemed necessary, e.g. every 7 years compared to every 10 years.

This option is expected to produce effluent of the quality as shown in Table 6-1.

Table 6-1 Expected effluent quality for Option 1.

Parameter	Units	Value
BOD	mg/l	25*
NH3-N	mg/l	20
TN	mg/l	35
TSS	mg/l	10
TP	mg/l	16
Faecal Coliforms	MPN/100 ml	<100

* This option was selected early in the process before the recommended effluent quality requirements were known, and while outside the bounds it has been included as the final limits are yet to be determined.

6.1.2 SCOPE OF UPGRADE

The scope of the proposed upgrades include:

- Desludging both ponds
- An additional blower, required to supply enough air to the treatment process
- Acid clean and inspection and/or replacement of all plastic airlines
- Within Pond Cell 1a:
  - Floating aeration laterals with HDPE piping and anchoring
  - High-density fine bubble diffusers with associated anchoring, piping, and retrieval rope
  - One flow diversion baffle
- Within Pond Cell 1b:
  - Floating aeration laterals with HDPE piping and anchoring
  - Medium density fine bubble diffusers with associated anchoring, piping, and retrieval rope
- Within Pond Cell 2a:
  - Floating aeration laterals with HDPE piping and anchoring
  - Medium density bubble diffusers with associated anchoring, piping, and retrieval rope
  - One flow diversion baffle
- Within Pond Cell 2b:
  - Floating aeration laterals with HDPE piping and anchoring
  - Low density bubble diffusers with associated anchoring, piping, and retrieval rope
- Dissolved Air Floatation (DAF) unit for improved solids removal on the back end of the plant prior to the UV
- Geobag sludge storage and dewatering area for pond desludging.

6.1.3 PROPOSED LAYOUT

The proposed layout for this option is shown in Figure 6-1 and process flow diagram is shown in Figure 6-2.

Figure 6-1 Proposed layout for Option 1.

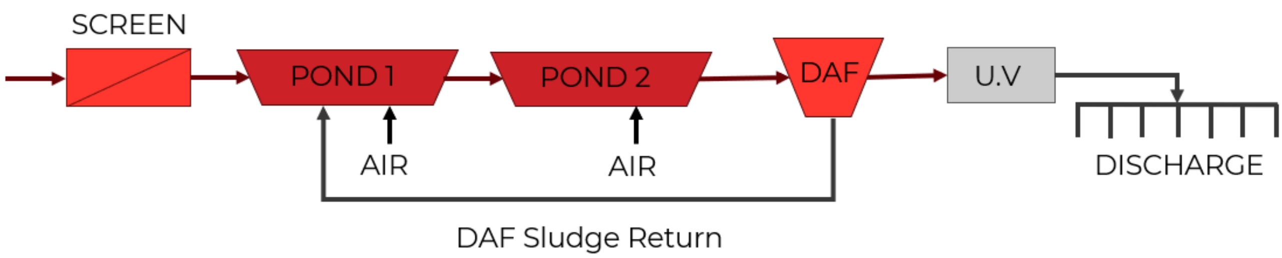


Figure 6-2 Process flow diagram for Option 1.

6.1.4 ADVANTAGES AND DISADVANTAGES

Advantages:

— Proven technology

— With new DAF will produce a high-quality low solids effluent with a satisfactory level of contaminant removal

- Copes well with fluctuating flows during rain events
- Simple to operate – similar to current operation
- Allows for reuse of existing assets**, reducing capital cost and construction effort.**
- Requires small amount of new capital works
- Modular aeration system with floating laterals allows for flexible installation and maintenance.
- Baffle-driven flow segmentation improves hydraulic performance and treatment efficiency.
- Partial mix and complete mix zones allow tailored treatment intensities

Disadvantages:

- Ammonia removal performance is temperature-dependent and not guaranteed — nitrification is expected only in summer.
- Requires more regular maintenance in terms of DAF operation
- Will require some chemical addition for the DAF
- Requires increased energy for air supply to the DAF

6.1.5 COST ESTIMATE

A cost estimation for the capital cost was carried out using the Wellington Water Cost Estimation Manual (Water, 2019), this manual is a useful resource, is relevant to the New Zealand Water sector and provides robust cost estimates in line with similar industry cost estimation practices. The cost estimation was a Level Two estimate, which consists of a base estimate that is the sum of all the elements that make up the cost of the project (i.e. scope of the upgrade), it does not include any contingency for unknowns or funding risk. The expected estimate was calculated by adding 20% contingency to the base estimate, the expected estimate is the mean estimated cost, representing the mean of risks and opportunities. A further 30% was added to the expected estimate to arrive at the 95%ile estimate or the "worst case scenario estimate" it represents the difference between the mean and the 95%ile of the risks and opportunities.

The cost estimate summary for Option 1 is shown in Table 6-2.

Table 6-2 Cost estimate summary for Option 1.

Project Estimate	Value*
Base Estimate	**$2,800,000**
20 % Contingency	$550,000
Project Expected Estimate	**$3,400,000**
30% Funding Risk Contingency	$820,000
95th percentile Project Estimate	**$4,200,000**

* Numbers rounded for clarity

6.2 OPTION 2: PACKAGED SEQUENCING BATCH REACTOR (SBR)

6.2.1 *PROCESS DESCRIPTION*

This option proposes a new sequencing batch reactor (SBR) system with new tanks installed. The existing lagoon one would be repurposed as flow balancing and lagoon two repurposed for sludge storage and treatment.

The process configuration includes:

- Screening and de-gritting using existing equipment
- Flow balancing using the existing pond 1
- Conveyance of screened influent to SBR via a new wet well and pumps
- Batch biological treatment via SBR system with aeration phase occurring within one reactor at one time
- Further treatment in a supernatant buffer tank
- Refurbish existing tertiary disk filter for solids removal
- UV disinfection via the existing UV reactor
- Solids stored in repurposed pond 2 for long-term breakdown.

This configuration allows for aerobic treatment and solids separation in the same tank and removes the need for a RAS stream.

This option is expected to produce effluent of the quality as shown in Table 6-3.

Table 6-3 Expected effluent quality for Option 2.

Parameter	Units	Value
BOD	mg/l	10
NH3-N	mg/l	3
TN	mg/l	10
TSS	mg/l	5
TP	mg/l	14
Faecal Coliforms	MPN/100 ml	<100

6.2.2 *SCOPE OF UPGRADE*

The scope of the proposed upgrades include:

- Desludging both ponds & reducing the size of pond
- A new wet well with pumps to convey screened influent and draw from flow balancing pond
- Two new SBR stainless steel tanks with fine bubble diffusers installed
- One new post anoxic tank also functioning as a supernatant buffer tank

- Recommission the existing tertiary disk filter
- Acid clean and inspection and/or replacement of plastic airlines in pond two
- Control panel for the entire treatment plant

6.2.3 PROPOSED LAYOUT

The proposed layout for this option is shown in Figure 6-3 and process flow diagram in Figure 6-4.

Figure 6-3 Proposed layout for Option 2.

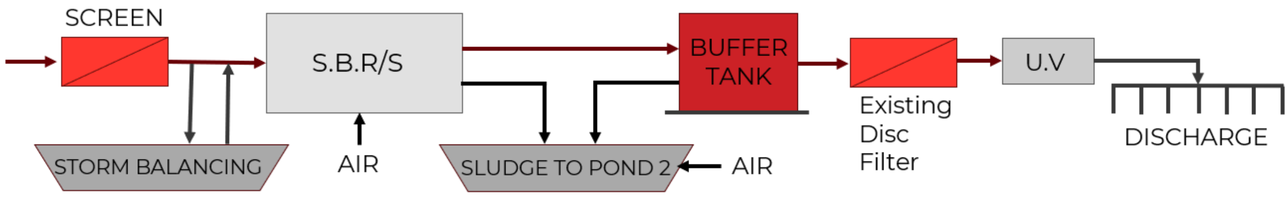


Figure 6-4 Process flow diagram for Option 2.

6.2.4 ADVANTAGES AND DISADVANTAGES

Advantages:

- Proven technology and highly reliable technology
- Simple treatment system layout
- Mixed liquor solids will not likely be washed out due to flow equalization and flow buffering
- Copes well with fluctuating loads
- Modular nature so can easily expand by adding more reactors
- Efficient at removing both ammonia and TN

Disadvantages:

- More operationally complex than a pond system
- Peak flows can disrupt operation
- Creates a continuous stream of sludge

6.2.5 COST ESTIMATE

A cost estimation for the capital cost was carried out using the Wellington Water Cost Estimation Manual (Water, 2019), this manual is a useful resource, is relevant to the New Zealand Water sector and provides robust cost estimates in line with similar industry cost estimation practices. The cost estimation was a Level Two estimate, which consists of a base estimate that is the sum of all the elements that make up the cost of the project (i.e. scope of the upgrade), it does not include any contingency for unknowns or funding risk. The expected estimate was calculated by adding 20% contingency to the base estimate, the expected estimate is the mean estimated cost, representing the mean of risks and opportunities. A further 30% is added to the expected estimate to arrive at the 95%ile estimate or the “worst case scenario estimate” it represents the difference between the mean and the 95%ile of the risks and opportunities. The cost estimate summary for Option 2 is shown in Table 6-4.

Table 6-4 Cost estimate summary for Option 2.

Project Estimate	Value*
Base Estimate	**$2,100,000**
20 % Contingency	$430,000
Project Expected Estimate	**$2,600,000**
30% Funding Risk Contingency	$650,000
95th percentile Project Estimate	**$3,200,000**

* Numbers rounded for clarity

6.3 OPTION 3: UPGRADE EXISTING PLANT WITH SOLIDS REMOVAL AND POST POND MBBR

6.3.1 PROCESS DESCRIPTION

At the end of the long list options stage, Option 3 was replacing existing plant with intermittently decanted extended aeration lagoons (IDEAL), however after engaging with suppliers on the design for the Whatuwhiwhi WWTP it became evident that an IDEAL system would not be appropriate as the Whatuwhiwhi WWTP ponds are too shallow to accommodate an IDEAL system. After further engagement with suppliers the option that would provide similar effluent quality while using the existing ponds is an augmented pond system with a post pond moving bed bioreactor (MBBR) and a DAF unit for solids removal.

The proposed upgrade combines lagoon-based aeration with an advanced Moving Bed Biofilm Reactor (MBBR) system, supplemented by solids clarification via Dissolved Air Flotation (DAF). Key components include:

- Screening and de-gritting using existing equipment
- Retention of the existing two lagoons, each divided by impermeable floating baffles into sub-cells:
  - Pond 1a & 1b: fine bubble partial mix aeration
  - Pond 2a: fine bubble partial mix aeration
  - Pond 2b: solid settling zone
- Post Pond MBBR:
  - Two-stage biological treatment:
    - Zone 1 for BOD removal
    - Zone 2 for nitrification
    - Stainless steel coarse bubble diffuser grids
    - High-density polyethylene media with high specific surface area
- Flocculation tank:
  - Polymer dosing and mixing for solids conditioning
- DAF (Dissolved Air Flotation) system:
  - For removal of total suspended solids (TSS) from MBBR effluent
  - Includes recycle pumps, skimmer, auger, and aeration tube
- UV disinfection via the existing UV reactor.

This configuration allows for a combination of aerobic treatment and solids settling, improving treatment performance while retaining much of the existing infrastructure. Ammonia removal (nitrification) will take place in the post pond MBBR, with the DAF unit removing total suspended solids from the MBBR unit. It is proposed to return the DAF sludge to the treatment ponds.

This option is expected to produce effluent of the quality as shown in Table 6-5.

Table 6-5 Expected effluent quality for Option 3.

Parameter	Units	Value
BOD	mg/l	15
NH3-N	mg/l	<5
TN	mg/l	35
TSS	mg/l	10
TP	mg/l	16
Faecal Coliforms	MPN/100 ml	<100

6.3.2 SCOPE OF UPGRADE

The scope of the proposed upgrades include:

- Desludging both ponds
- An additional blower is required to supply enough air to the treatment process.
- Acid clean and inspection and/or replacement of all plastic airlines
- Pond Cells
  - Pond 1a
    - Floating aeration laterals with HDPE piping and anchoring
    - Fine bubble diffusers with associated anchoring, piping, and retrieval rope
    - One flow diversion baffle
  - Pond 1b
    - Floating aeration laterals with HDPE piping and anchoring
    - Fine bubble diffusers with associated anchoring, piping, and retrieval rope
  - Pond 2a
    - Floating aeration laterals with HDPE piping and anchoring
    - Fine bubble diffusers with associated anchoring, piping, and retrieval rope
    - One flow diversion baffle
  - Pond 2b
    - Settling cell only
- MBBR Zones 1 & 2
  - Reactor tank with media and support hardware
  - Stainless steel aeration grid with coarse bubble diffusers
  - Media retention screens (effluent & drain)
  - Dissolved oxygen sensors with automated cleaning systems

— Aeration pipework (MBBR would utilise the existing blowers)

— DAF Unit

— Chemical mixing system (tank, mixer, access platform)

— DAF unit with:

— Skimmer, auger, recycle pumps (duty/standby)

— PLC/HMI control panel

— Saturation tube and pneumatic control panel

— Geobag sludge storage and dewatering area for pond desludging.

6.3.3 PROPOSED LAYOUT

The proposed layout for this option is shown in Figure 6-5 and the process flow diagram is shown in Figure 6-6.

Figure 6-5 Proposed layout for Option 3.

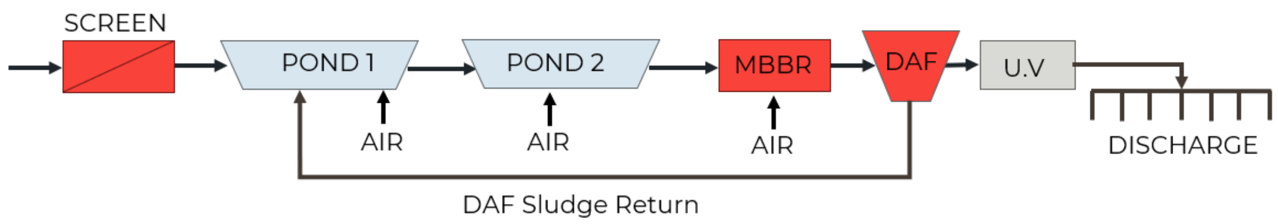


Figure 6-6 Process flow diagram for Option 3.

6.3.4 ADVANTAGES AND DISADVANTAGES

Advantages:

- Compact footprint with intensified treatment — minimal land and civil works
- Improved ammonia removal
- With new DAF will produce a high-quality low solids effluent with a satisfactory level of contaminant removal
- Copes well with fluctuating flows during rain events
- Modular and flexible system using existing lagoons
- Simple, low-maintenance design suitable for smaller communities
- Improved treatment performance through staged aerobic treatment and solids removal
- Modular aeration system with floating laterals allows for flexible installation and maintenance.
- Baffle-driven flow segmentation improves hydraulic performance and treatment efficiency.
- Partial mix and complete mix zones allow tailored treatment intensities

Disadvantages

- Operationally more intensive with MBBR and DAF
- Requires more regular maintenance in terms of MBBR and DAF operation
- Will require chemical addition for the DAF
- Increased energy consumption due to DAF and MBBR.

6.3.5 COST ESTIMATE

A cost estimation for the capital cost was carried out using the Wellington Water Cost Estimation Manual (Water, 2019), this manual is a useful resource, is relevant to the New Zealand Water sector and provides robust cost estimates in line with similar industry cost estimation practices. The cost estimation was a Level Two estimate, which consists of a base estimate that is the sum of all the elements that make up the cost of the project (i.e. scope of the upgrade), it does not include any contingency for unknowns or funding risk. The expected estimate was calculated by adding 20% contingency to the base estimate, the expected estimate is the mean estimated cost, representing the mean of risks and opportunities. A further 30% was added to the expected estimate to arrive at the 95%ile estimate or the "worst case scenario estimate" it represents the difference between the mean and the 95%ile of the risks and opportunities.

The cost estimate summary for Option 3 is shown in Table 6-6.

Table 6-6 Cost estimate summary for Option 3.

Project Estimate	Value*
Base Estimate	**$4,000,000**
20 % Contingency	$800,000
Project Expected Estimate	**$4,800,000**
30% Funding Risk Contingency	$1,200,000
95th percentile Project Estimate	**$6,000,000**

* Numbers are rounded for clarity

6.4 NET PRESENT VALUE

The net present value (NPV) for each of the options was calculated to provide the total cost of each option over 25 years. The NPV comparison allows comparison of the both the initial capital expenditure, and the cumulative costs of each option considering the running cost over 25 years. An internal rate of return (IRR)I of 5% was used for the calculations. The results are shown in Table 6-7.

Table 6-7 Net present value (NPV) of the short list options.

Option	NPV*
Option One	$6,200,000
Option Two	$5,500,000
Option Three	$8,300,000

* Numbers are rounded for clarity

The NPV analysis shows that option 2 will cost the least over 25 years.

6.5 MULTI CRITERIA ANALYSIS (MCA)

Each of the three options were evaluated against 17 criteria each belonging to one of six main categories. The criteria and their weightings are shown in Table 6-8. Each 'secondary criteria' was given a weighting, and within each 'primary criteria' the weighting of the secondary criteria totals to 100.

The MCA intended to identify the best practicable treatment option for the Whatuwhiwhi WWTP, to identify the treatment option that is robust, efficient and affordable to all user parties, and appropriately protect the environment.

A score out of 10 was given to each option against the 'secondary criteria', with a score of one being the best and ten the worst. Each score was first weighted using the 'secondary criteria' weighting then totalled to find the score of each 'primary criteria'. Then the score of each 'primary criteria' was weighted against the 'primary criteria' weighting.

Table 6-8 MCA scoring criteria for the short-listed options

Primary Criteria	Weighting	Secondary Criteria	Notes	Weighting
Financial Criteria	25%	CAPEX	Cost to construct	50%
		OPEX	Ongoing operational costs	50%
Operational Criteria	20%	Future proof / Future regulatory compliance	Related to effluent quality, and potential future regulatory changes	10%
		Robustness	Reliability of process to produce high quality effluent	30%
		Operability	Reflects the need for operator input, training level, and site visits	30%
		Maintainability	Parts can be sourced, frequency of maintenance	30%
Cultural & Community	15%	Suitability for future land disposal	Effluent quality suits future land disposal	50%
		Safeguards Maori Values and Practices		50%
Environmental	15%	Effluent Quality	Level of treatment	50%
		Visual/Noise Odour		30%
		Carbon footprint	Energy	20%
Resilience	15%	Resilience to power outages	Resilience to power cuts without a generator	30%
		Loss of communications	Telemetry goes down	15%
		Wet weather flow events	Impact of peak flow events on process	30%
		Loss of access	Operator cannot access site e.g. weather event	25%
Constructability	10%	Suitability to site layout		70%
		Construction sequencing		30%

6.6 SHORT LIST OPTIONS MCA AND SENSITIVIY ANALYSIS

The MCA scoring of each short-listed option with and without weightings is shown in Table 6-9. The analysis shows that Option 2 is the best option for the W-WWTP upgrade.

Table 6-9 MCA scoring for each option

Option	Description	Score	Weighted score
1	Upgrade existing plant with solids removal upgrade	54	3.44
2	Packaged sequencing batch reactor	50	2.97
3	Upgrade existing plant with solids removal and post pond MBBR	62	3.99

The weighting given to each of the criteria influences the overall score of each option. It is therefore important to assess the sensitivity of the MCA to the weightings to ensure that it remains as unbiased as possible. For this assessment, each primary criteria were grouped into one of three categories, as shown in Table 6-10. There are three scenarios presented in Table 6-10, each prioritising one of the three categories to test whether the scores are affected by the category weightings.

Table 6-10 Sensitivity analysis criteria

Category	Primary Criteria	Scenario 1	Scenario 2	Scenario 3
Management	Financial considerations of CAPEX and OPEX.	37	21	20
Non-Technical	Cultural and community considerations, including Maori values	17	8	22
	Environmental considerations	16	8	22
Technical	Operational criteria considering whether the option is future-proof, it's operability and maintainability	10	21	12
	Resilience	10	21	12
	Constructability	10	21	12

The weighting of each of the categories is increased at the expense of others in each scenario. This tests the sensitivity of each category. Based on the results in Table 6-11, Option 2 proves the best option and is not affected by weighting of the categories.

Table 6-11 Sensitivity analysis results

Option	Description	Scenario 1	Scenario 2	Scenario 3
1	Upgrade existing plant with solids removal upgrade	3.97	3.15	3.46
2	Packaged sequencing batch reactor	2.81	2.94	2.61
3	Upgrade existing plant with solids removal and post pond MBBR	4.57	3.79	3.79

7 CONCLUSION

Option Two, the SBR option, was shown through cost of capex, opex, and related net present value to represent the most cost-effective option for the community, it also scored as the best option in the multicriteria analysis and was shown to be robust through the MCA sensitivity analysis.

The SBR option provided the best effluent quality and can produce an effluent that would be suitable for future land disposal options. The SBR option is also very attractive in terms of constructability as the current pond system can stay in place until the SBRs have been constructed

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9 LIMITATIONS

This report (‘Report’) has been prepared by WSP New Zealand Limited (‘WSP’) exclusively for Far North District Council (‘Client’) in relation to Whatuwhiwhi Resource Consent Renewal (‘Purpose’) and in accordance with the Short Form Agreement dated 14 August 2024 (‘Agreement’). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

In preparing this Report, WSP has relied upon data, surveys, analyses, designs, plans and other information (‘Client Data’) provided by or on behalf of the Client. Except as otherwise stated in this Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable for any incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

APPENDIX A

LAYOUT DRAWINGS

REVISION	AMENDMENT	APPROVED	DATE
1	FOR REVIEW	P.S	27/05/2025

Far North District Council

WSP
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES
ORIGINAL SIZE A1

DRAWN F. WU
APPROVED P. SHOEBRIDGE
DRAWING VERIFIED P. SHOEBRIDGE
APPROVED DATE 27/05/2025

FOR REVIEW

PROJECT
FAR NORTH DISTRICT COUNCIL
WHATUWHIWHI RESOURCE CONSENT RENEWAL
OPTION1 - DAF

TITLE
SITE LAYOUT
OVERVIEW

WSP PROJECT NO. (SUB-PROJECT) 1-14657.00
SHEET NO. 1
REVISION 1

Original sheet size A1 (841x594) Plot Date 2025-05-27 at 12:46:05 pm U:\ProjectsNZ\11\1-14642.00 FNDC Programme Support 2023\Home\03_Tech_Docs\02_Tech_Out\01_WIP\03_Sketches\Whatuwhiwhi WWTP\Whatuwhiwhi Layout.dwg OPTION1

REVISION	AMENDMENT	APPROVED	DATE
1	FOR REVIEW	P.S	27/05/2025

Far North District Council

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES
ORIGINAL SIZE A1
DRAWN F. WU
APPROVED P. SHOEBRIDGE
DRAWING VERIFIED P. SHOEBRIDGE
VERIFIER
APPROVED DATE 27/05/2025

FOR REVIEW

PROJECT
FAR NORTH DISTRICT COUNCIL
WHATUWHIWHI RESOURCE CONSENT RENEWAL
OPTION2 - SBR

TITLE
SITE LAYOUT
OVERVIEW

WSP PROJECT NO. (SUB-PROJECT) 1-14657.00
SHEET NO. 1
REVISION 1

Original sheet size A1 (841x594) Plot Date 2025-05-27 at 1:06:11 pm U:\ProjectsNZ\11\1-14642.00 FNDC Programme Support 2023\Home\03_Tech_Docs\02_Tech_Out\01_WIP\03_Sketches\Whatuwhiwhi WWTP\Whatuwhiwhi Layout.dwg OPTION2

REVISION	AMENDMENT	APPROVED	DATE
1	FOR REVIEW	P.S	19/05/2025

Far North District Council

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

WATER

SCALES

ORIGINAL SIZE A1

DRAWN - F. WU

APPROVED - P. SHOEBRIDGE

DRAWING VERIFIED - P. SHOEBRIDGE - VERIFIER

APPROVED DATE 19/05/2025

FOR REVIEW

PROJECT
FAR NORTH DISTRICT COUNCIL
WHATUWHIWHI RESOURCE CONSENT RENEWAL
OPTION3 - NEXOM MBBR

TITLE
SITE LAYOUT
OVERVIEW

WSP PROJECT NO. (SUB-PROJECT) 1-14657.00

SHEET NO. 1

REVISION 1

Original sheet size A1 (841x594) Plot Date 2025-05-27 at 1:12:29 pm U:\ProjectsNZ\11\1-14642.00 FNDC Programme Support 2023\Home\03_Tech_Docs\02_Tech_Out\01_WIP\03_Sketches\Whatuwhiwhi WWTP\Whatuwhiwhi Layout.dwg OPTION3

APPENDIX B

COST ESTIMATES

Project Estimate

Project Name: Whatuwhiwhi WWTP Option One Refurbishment

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
	Construction Phase			
	Implementation Fees			
	- Consultancy Fees (MSQA, Tender Support)	$ 118,714	$ 23,743	$ 35,614
	- Clients Internal Project Management Costs	$ 39,571	$ 7,914	$ 11,871
	- Consenting	$ 13,190	$ 2,638	$ 3,957
	Sub Total Base Implementation Fees	**$ 171,476**	**$ 34,295**	**$ 51,443**
	Physical Works			
1	Contractor's Margin (12%)	$ 274,328	$ 54,866	$ 82,298
2	Contractor's Risk (3%)	$ 66,584	$ 13,317	$ 19,975
3	Preliminary and General	$ 77,700	$ 15,540	$ 23,310
4	Civil Site Works	$ 1,181,080	$ 236,216	$ 354,324
5	Structural	$ 3,000	$ 600	$ 900
6	Dissolved air floatation unit	$ 466,201	$ 93,240	$ 139,860
7	Aeration System	$ 521,200	$ 104,240	$ 156,360
8	Instrumentation and Electrical	$ 48,000	$ 9,600	$ 14,400
	SubTotal Base Physical Works	**$ 2,638,093**	**$ 527,619**	**$ 791,428**
D	**Total for Implementation Phase**	**$ 2,809,569**	**$ 561,914**	**$ 842,871**
E	**Implmentation Base Estimate**	**$ 2,809,569**		
F	**Contingency** (Assessed/Analysed)		**$ 561,914**	
G	**Project Expected Estimate**		**$ 3,371,483**	
H	**Funding Risk Contingency** (Assessed/Analysed)			**$ 842,871**
I	**95th percentile Project Estimate**			**$ 4,214,354**

Date of Estimate	**May-25**
Estimate prepared by	**Signed**
Estimate internal peer review by	**Signed**
Estimate accepted by client project manager	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Project Estimate

Project Name: Whatuwhiwhi WWTP Option two Containerised SBRs

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
	Construction Phase			
	Implementation Fees			
	- Consultancy Fees (MSQA, Tender Support)	$ 89,956	$ 17,991	$ 26,987
	- Clients Internal Project Management Costs	$ 29,985	$ 5,997	$ 8,996
	- Consenting	$ 9,995	$ 1,999	$ 2,999
	Sub Total Base Implementation Fees	**$ 129,936**	**$ 25,987**	**$ 38,981**
	Physical Works			
1	Contractor's Margin (12%)	$ 205,856	$ 41,171	$ 61,757
2	Contractor's Risk (3%)	$ 49,965	$ 9,993	$ 14,990
3	Preliminary and General	$ 77,700	$ 15,540	$ 23,310
4	Civil Site Works	$ 166,500	$ 33,300	$ 49,950
5	SBR Unit	$ 1,318,000	$ 263,600	$ 395,400
6	Structural	$ 30,000	$ 6,000	$ 9,000
7	Instrumentation and Electrical	$ 151,000	$ 30,200	$ 45,300
	SubTotal Base Physical Works	**$ 1,999,021**	**$ 399,804**	**$ 599,706**
D	**Total for Implementation Phase**	**$ 2,128,957**	**$ 425,791**	**$ 638,687**
E	**Implmentation Base Estimate**	**$ 2,128,957**		
F	**Contingency** (Assessed/Analysed)		**$ 425,791**	
G	**Project Expected Estimate**		**$ 2,554,749**	
H	**Funding Risk Contingency** (Assessed/Analysed)			**$ 638,687**
I	**95th percentile Project Estimate**			**$ 3,193,436**

Date of Estimate	**May-25**
Estimate prepared by	**Signed**
Estimate internal peer review by	**Signed**
Estimate accepted by client project manager	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Project Estimate

Project Name: Whatuwhiwhi WWTP Option Three Refurbishment and MBBR

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
	Construction Phase			
	Implementation Fees			
	- Consultancy Fees (MSQA, Tender Support)	$ 168,083	$ 33,617	$ 50,425
	- Clients Internal Project Management Costs	$ 56,028	$ 11,206	$ 16,808
	- Consenting	$ 18,676	$ 3,735	$ 5,603
	Sub Total Base Implementation Fees	**$ 242,786**	**$ 48,557**	**$ 72,836**
	Physical Works			
1	Contractor's Margin (12%)	$ 391,871	$ 78,374	$ 117,561
2	Contractor's Risk (3%)	$ 95,114	$ 19,023	$ 28,534
3	Preliminary and General	$ 77,700	$ 15,540	$ 23,310
4	Civil Site Works	$ 1,181,080	$ 236,216	$ 354,324
5	Aeration System	$ 521,200	$ 104,240	$ 156,360
6	Dissolved air floatation unit	$ 374,001	$ 74,800	$ 112,200
7	MBBR Unit	$ 440,000	$ 88,000	$ 132,000
8	Structural	$ 521,200	$ 104,240	$ 156,360
9	Instrumentation and Electrical	$ 133,000	$ 26,600	$ 39,900
	SubTotal Base Physical Works	**$ 3,735,167**	**$ 747,033**	**$ 1,120,550**
D	**Total for Implementation Phase**	**$ 3,977,953**	**$ 795,591**	**$ 1,193,386**
E	**Implmentation Base Estimate**	**$ 3,977,953**		
F	**Contingency** (Assessed/Analysed)		**$ 795,591**	
G	**Project Expected Estimate**		**$ 4,773,543**	
H	**Funding Risk Contingency** (Assessed/Analysed)			**$ 1,193,386**
I	**95th percentile Project Estimate**			**$ 5,966,929**

Date of Estimate	**May-25**
Estimate prepared by	**Signed**
Estimate internal peer review by	**Signed**
Estimate accepted by client project manager	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.