MWWTP Technical Memorandum.

To	Adam Mattsen (WWL)
From	Louis Ortenzio (Lutra), Meg Sykes (Lutra)
Subject	Martinborough WWTP – Contingency Process Upgrades
Document Ref	310103998 CCU M02
Issue Date	22nd June, 2023
CC	Niall Chapman (Stantec), Robyn Wells (SWDC), Mark Wollina (Stantec)

Quality statement

Rev. no	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
01	14/06/2023	Technical Memorandum	Meg Sykes	Louis Ortenzio	Michelle Chew	Niall Chapman
02	05/07/2023	Incorporated comments	Meg Sykes	Louis Ortenzio	Michelle Chew	Niall Chapman
03	10/07/2023	Incorporated comments	Meg Sykes	Louis Ortenzio	Michelle Chew	Niall Chapman
04	13/07/2023	Incorporated comments	Meg Sykes	Louis Ortenzio	Michelle Chew	Niall Chapman

1 Glossary

Terms	Description
CAPEX	Capital Expenditure Cost
$CBOD_5$	Carbonaceous Biochemical Oxygen Demand
DO	Dissolved Oxygen
DRP	Dissolved Reactive Phosphorus
GWRC	Greater Wellington Regional Council
ID	Infrastructure Data
MWWTP	Martinborough Wastewater Treatment Plant
NO_2-N	Nitrite as N
NO_3-N	Nitrate as N
SWDC	South Wairarapa District Council
TAN	Total Ammoniacal Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WWL	Wellington Water
WWTP	Wastewater Treatment Plant

2 Introduction

The Martinborough wastewater treatment plant (WWTP) is owned by South Wairarapa District Council (SWDC). The assets and operations for the Martinborough WWTP (MWWTP) are managed by Wellington Water (WWL). WWL have engaged Stantec and Lutra to plan, design, and oversee the implementation of a compliance upgrades programme for the treatment to improve compliance, resilience, accommodate future growth, and improve aspects of health and safety.

In August 2022, Greater Wellington Regional Council (GWRC) issued SWDC with an abatement notice for MWWTP's resource consent non-compliances pertaining to hydraulic load constraints when discharging to land and river, and exceedances in *E. coli* and nutrient limits when discharging to river (Johnston, 2022). GWRC requested a plan of corrective actions to address these issues by 31st May 2023. This plan of corrective actions was submitted to GWRC on 30th May 2023.

The compliance upgrades programme of works for MWWTP is extensive and includes a wide range of improvements to improve treatment performance and accommodate future growth. Most of these upgrades are long term projects as they require background investigations to produce design envelopes, evaluate risk, estimate cost, etc. Lutra and Stantec therefore prepared a technical memorandum (310103998 CCU M01) outlining immediate works to be undertaken for the 23/24 financial year. These works included the following:

- Desludging of the oxidation (facultative) and maturation ponds to restore treatment capacity;
- Plant influent flow measurement and quality sampling programme to allow for preparation of a plant influent design envelope for remaining plant design work;
- Investigation and optimisation of the existing UV disinfection system.

2.1 Objectives

The objective of this memo is to outline potential contingency upgrades to expediently implement to address the non-compliances; in the event the Compliance Delivery Plan doesn't achieve the entire expected outcomes to address the abatement notice. The upgrades outlined in this memo have been identified as part of the long-term compliance upgrades therefore are low risk of interfering with the future upgrades programme. The proposed contingency upgrades are anticipated to provide additional improvements to the plant treatment of effluent and operations by way of:

1. New head works and inlet screens – Prevent unwanted rag and inorganic materials from entering the plant and oxidation pond, increases plant efficiency, lower retained sludge and meets resource consent condition 3.
2. Biocord or Bioshell type installation this will increase nitrification process capacity and reduce ammonia levels in the main oxidation pond.

Both proposed items are long term upgrades and will form part of the plant future operations.

2.1.1 Additional Considerations

SWDC and WWL will be undertaking a growth projection plan during the 2023/24 financial year, in parallel with the scope of work outlined in this memorandum. The growth projection plan is not within this project's scope of work; however, the outcomes of this plan will be relied upon for design and planning purposes for the compliance upgrades programme of works.

The necessity of the potential contingency upgrades will be assessed following the delivery of MWWTP's annual report which summarises the WWTP's compliance with consent conditions.

3 Contingency Works

To address the non-compliances set out in GWRC Abatement Notice A1020, an initial scope of work for the 23/24 financial year was outlined in a technical memorandum by Lutra/Stantec in May 2023 (310103998 CCU M01). In addition to this scope of work, the following potential contingency scope could be undertaken to expediently address the compliance issues as detailed in the abatement notice without introducing significant risk, rework, or wastage of materials or equipment, if deemed necessary.

The potential contingency scope of works includes the following:

- Installation of a headworks screening system;
- Installation of an enhanced treatment system in the existing oxidation pond to augment nitrogen removal such as Bioshell, Biocords, etc with nitrate recycle (or equivalent).

An estimated design envelope for the additional potential contingency upgrades outlining the supply of process equipment has been provided in Appendix A to support the potential contingency scope of works.

3.1 Headworks Screening System

Currently the MWWTP has no headworks screening which is a requirement under Stage 1A of the plant's resource consent (Consent Condition 3). Additionally, it is general best practice in municipal wastewater treatment to include primary screening to improve downstream treatment efficiency and improve the overall resiliency of the plant. Installation of a screening system will ensure the removal of a large portion of rags and debris from the influent that can cause premature wear and/or failure of equipment. The screen will also remove a portion of inorganic material that can contribute to build up on the oxidation pond floor. This will decrease the frequency that pond desludging is required and prevent sludge suspension and carryover.

It is suggested that WWL consider the installation of a headworks screening system to address the screening requirement in the resource consent. It is recommended that a duty/standby screening system with a minimum screen aperture of 6 mm is considered (3mm screen aperture could also be considered). The proposed screens will likely be supplied as a vendor package, in a stainless-steel tank and anchor bolted on a concrete pad. The screen operation will be on its own local control panel with HMI.

An example of a type of screening solution is shown in Figure 1 and a summary of preliminary specifications is given in Table 1.

A potential option is a spiral sieve screen package that has two screens operating in a duty/standby arrangement. Rags and debris which are retained on the 6 mm screens will be automatically cleared, and the screenings will be dropped into small bins. The screen cleaning system will consist of a new potable or service water system with solenoids for cleaning.

If the duty screen package blocks or incurs another fault, the standby screen will automatically be brought into service. Additionally, the screen package has a built-in emergency by-pass with a bar screen. If the emergency bar screen also blocks, wastewater will overflow (unscreened) into the screen's downstream chamber and continue to the oxidation pond. Level transmitters will be installed prior to the screen system to indicate to operators of any blockages.

Figure 1 – Potential Headworks Spiral Screen.

Table 1 –Preliminary Headworks Screening Specification.

Parameter	Unit	Value
No. of screens	-	2 (duty / standby)
Type of screen (typical)	-	Spiral screen, perforated plate
Aperture (min recommended)	mm	6
Material (typical)	-	SS316
Installation	-	In vendor supplied tank. Inlet and outlet of tank flanged
Cleaning mechanism	-	Automatic cleaning with an auger and service water spray system

In the next stage of planning for this upgrade, it is suggested that the following actions are undertaken:

- Undertake a hydraulic profile for civil integration into existing inlet infrastructure;
- Obtain a geotechnical survey of the land to determine any required land improvements;
- Investigate any consenting requirements;
- Progress the growth projection plan to determine required capacity of the screen system;
- Investigate electrical and mains power requirements for proposed screen;
- Investigate service water requirements on-site for screen operation.

3.2 Oxidation Pond Treatment Upgrades

The existing pond-based system was built in 1975. The system has not been desludged since its installation and subsequent growth in the Martinborough population has resulted in the plant failing to meet the required ammonia, total nitrogen and *E.coli* limits for a number of years. This is reflected in the data presented in Section 3.2 and 3.4.

It is proposed that WWL desludge the pond system in the 23/24 financial year which will improve nitrification and denitrification in the existing pond system. If desludging the ponds does not reduce concentrations to the required ammonia, total nitrogen and *E.coli* limits as stated in the resource consent, WWL could consider installing additional biological treatment to increase the treatment capacity of the pond system.

Technologies such as Biocord, Bioshells or Aquamats could be explored as options to increase the treatment capacity of the pond system. These technologies are all intended to be installed in existing oxidation pond systems and are all relatively low risk in terms of interference with future scoped works.

There are many successful installations of the Bioshell technology in New Zealand and this sort of system could be explored as an option for MWWTP. The Bioshell system is a patented technology and was developed by the University of Utah. The system consists of concentrically nested domes that house media with attached biofilm for nitrification. The domes sit on the floor of a pond and are equipped with aeration diffused at the bottom of the system to provide dissolved oxygen for the nitrifying bacteria. Performance monitoring of other Bioshell systems for more than 1 year of operation has demonstrated that ammonia concentrations have been reduced from typically 50 mg/L to less than 2 mg/L in many applications (Springer, 2022). A diagram of a typical Bioshell system's operation is shown Figure 2.

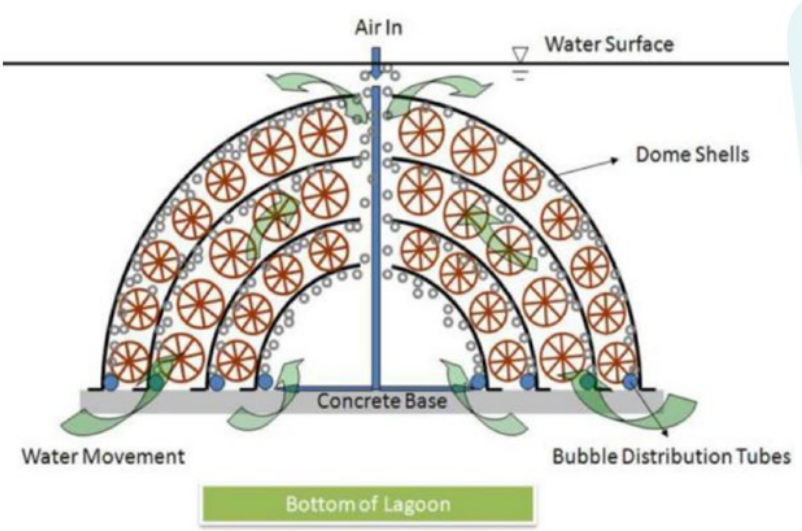

Figure 2 - Diagram of Bioshell Operation.

It is proposed that a Bioshell system would likely be located in the northern end of the facultative pond at MWWTP, near the discharge pump chamber. The system would likely have a floating cover over the system and a recycle pump would pump wastewater from the first maturation pond back to the head of the WWTP with a baffle installed on the upstream section of the facultative pond to facilitate some denitrification under anoxic conditions. An indicative diagram of the potential installation is shown in Figure 3.

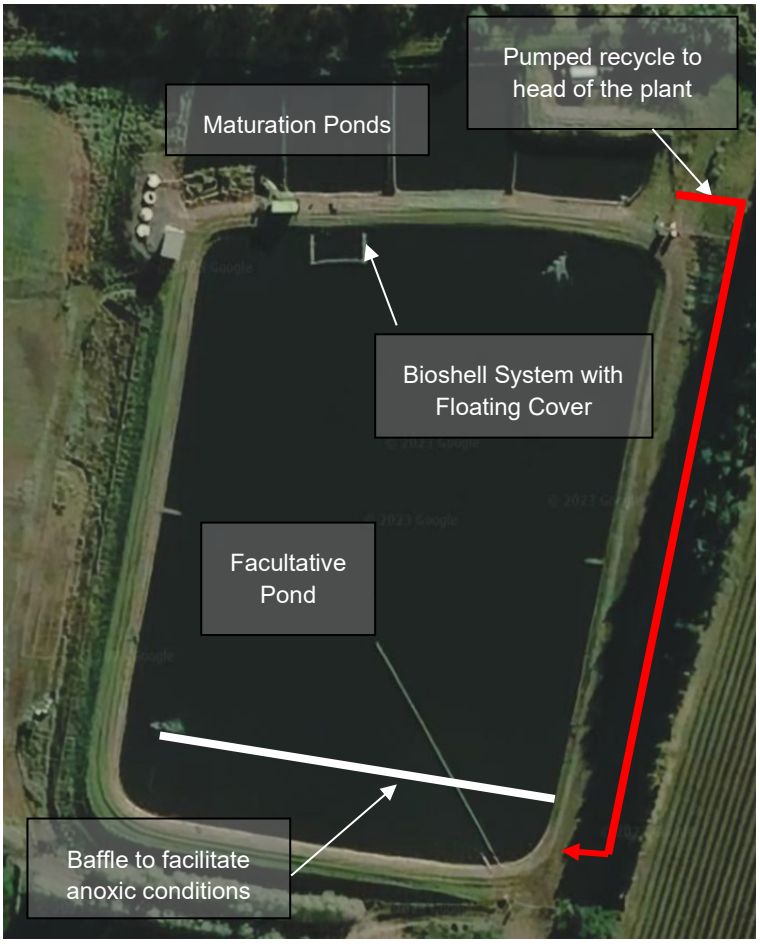

Figure 3 – Potential Bioshell System Installation.

Preliminary sizing suggests that approximately 100 Bioshell units would be required to achieve the target effluent quality of 20 g/m^3. Preliminary sizing was based on the following design parameters:

- 75th percentile post-UV TAN concentration (refer to Table 6 in Appendix A);
- 75th percentile design flow (refer to Table 4 in Appendix A);
- Average temperature of the facultative pond (refer to Table 7 in Appendix A);
- An ammonia removal rate of 0.17 kg/d/unit (at the design temperature of 16.8℃).

Preliminary sizing specifications are summarised in Table 2.

Table 2 – Bioshell System Specification.

Parameter	Unit	Value
TAN Target Effluent Quality	g/m^3	20
Current Post-UV TAN Effluent Quality (75th Percentile)	g/m^3	36.8
Design Flow (75th Percentile)	m^3/d	1,023
Design Temperature (Average)	℃	16.8
TAN Removal Target	kg/d	17.2
TAN Removal Rate (at Design Temperature)	kg/day/unit	0.17
Bioshell Units Required	-	100

4 S127 Application

Part of the Martinborough WWTP compliance upgrades initial long-term plan is to seek a section 127 amendment to the existing consent.

In May 2023, an investigation was undertaken into whether it would be feasible to pursue a s127 application under the Resource Management Act in relation to the hydraulic loading of treated wastewater to land at the MWWTP. This investigation involved the review of the existing consent, recent correspondence between Wellington Water and GWRC, and related technical reports. It also involved a MSTeams meeting with an officer from GWRC. The investigation identified that there is a risk that any s127 application may require more supporting information and be a lengthier process than initially anticipated, Potentially involving notification, more than was anticipated in 2022. However, there is some uncertainty about exactly what will be required. To obtain more direct advice from GWRC a scoping document will be required. This document should include information on the nature of the application, the potential environmental effects of the consent amendments being sought and the alignment of the potential consent amendments with relevant statutory tests under the Resource Management Act. It is expected that this scoping document would require both planning and environmental science inputs.

The more detailed assessment and scoping document are anticipated to be developed during the later part of FY23/24 to progress with GWRC. It is planned this portion of works will commence when consents relating to the desludging activity have been addressed and finalized.

5 Conclusions and Recommendations

MWWTP is currently not achieving consent requirements related to hydraulic load constraints when discharging to land and river, and *E.coli* and nutrient limits when discharging to river. As a result, GWRC have issued SWDC with an abatement notice and require SWDC to have a plan of corrective actions to address these issues.

An existing, long-term programme of works planned for MWWTP has been adjusted for immediate response to the abatement notice and to enable future design works. The details of the planned works for the 23/24 financial year were detailed in a memo (310103998 CCU M01) that included the following works:

- Desludging of the oxidation and maturation ponds to restore treatment capacity;
- Plant influent flow measurement and quality sampling programme to allow for preparation of a plant influent design envelope for remaining plant design work;
- Investigation and optimisation of the existing UV disinfection system.

This memo outlines an additional contingency scope of work that could be undertaken to work towards compliance including:

- Install the headworks screening system;
- Install additional biological treatment to increase the treatment capacity of the existing pond system (technologies such as Aquamats, Biocord or Bioshells could be explored as suitable technologies).

To enable the above actions, WWL can proceed with the following actions to support the contingency scope of works, if necessary:

- Support a governance decision making structure to facilitate project change and reallocation of council funds to contingency measures should they be deemed necessary.
- Confirm the estimated design envelope by progressing with sampling of the influent and determination of influent future flows.
- Undertake a hydraulic profile for civil integration of the headworks screen into existing inlet infrastructure.
- Obtain a geotechnical survey of the land to determine any land improvements required for upgrades.
- Investigate electrical and mains power requirements for proposed screen.
- Investigate service water requirements on-site for screen operation.
- Develop a scoping document for submittal to GWRC which includes information on the nature of the application, the potential environmental effects of the consent amendments being sought and the alignment of the potential consent amendments with relevant statutory tests under the Resource Management Act.

6 References

Johnston, A. (2022). *WAR120258.* Masterton: GWRC.

Springer, A. (2022). *Paihia WWTP, Innovatice In Pond Removal of Ammonia Using Bioshells.*

Stats NZ. (2018). National population projections :2022-2073.

WWL. (n.d.). Cost Estimation Manual.

Appendix A Estimated Design Envelope

A.1 Estimated Design Envelope

To expediently address the non-compliances set out in GWRC Abatement Notice A1020, a preliminary design envelope is presented which may be used to aid in planning for implementation of the contingency scope of work.

It should be noted that the design envelope was developed based on limited data available in Infrastructure Data (ID) from June 2021 – June 2023. The following issues have been identified to pose a risk in proceeding with design based on the presented design envelope:

- There are suspected issues with the accuracy of the influent flowmeter and there are many periods over the past two years where the flowmeter was out of operation.
- The influent and post-UV concentrations presented are based on a limited sample set. The resource consent requires Wellington Water to take samples for 3 consecutive days every quarter. As a result, the concentrations and loads in the design envelope were based on a sample set of 24 in most cases.
- The growth projection plan (as detailed in Section 2.1.1) has not yet been conducted which will affect the anticipated flows and loads. For the purpose of this report, growth was projected to 2050 assuming 1.1% annual growth. This was based on the high projection estimate for population growth in the South Wairarapa District (Stats NZ, 2018).

A.1.1 Treatment Plant Arrangement

The MWWTP is an oxidation pond-based treatment system with one main facultative pond, four maturation ponds that operate in series and tertiary treatment (UV disinfection). Treated water is currently discharged to the Ruamahanga River and/or to land, with staged increases planned for land irrigation to minimise river discharge as outlined in the discharge resource consent (No. WAR120258).

The general pond arrangement is shown in Figure 4.. The facultative pond discharge chamber is located in the track between the two sets of ponds, roughly 10 m from the UV container and directs flow through an electrically actuated valve back to the inlet of the maturation ponds. The dissolved oxygen (DO) concentration and temperature of the facultative pond and maturation ponds are routinely measured in the discharge chamber of the facultative pond and at the discharge chamber of the maturation pond. The approximated locations of DO concentration and temperature measurements are also shown in Figure 4.

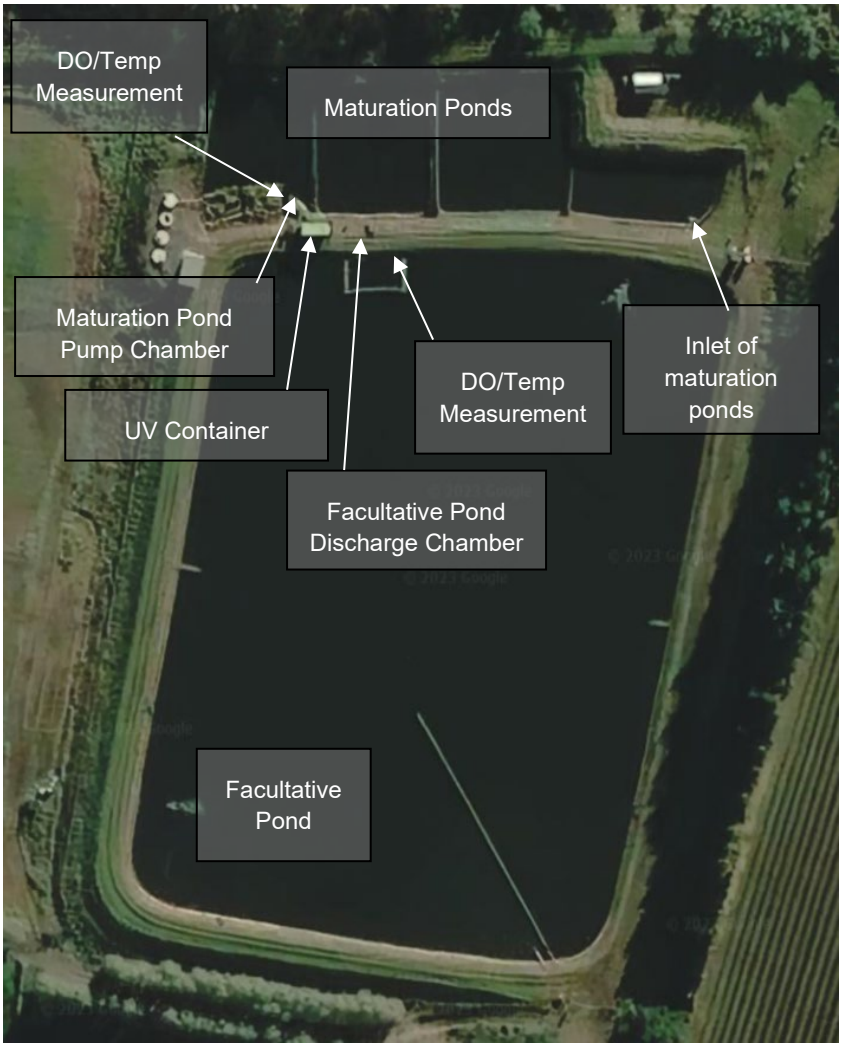

Figure 4 – MWWTP General Arrangement.

A.1.2 Consent Conditions Requirements

Wellington Water currently hold two resource consents for MWWTP. They are as follows:

- Consent WAR120258 [31707]: to discharge treated wastewater to the Ruamahanga River (Primary consent that the plant operates on);
- Consent WAR120258 [32044]: to discharge treated wastewater to land.

A summary of some of the key discharge requirements for discharging to the Ruamahanga River that are to be met are detailed in Table 3 – Martinborough WWTP Key Discharge Consent Conditions to the Ruamahanga River. Note that the consent conditions presented in this design envelope is based on requirements for consent WAR120258 [31707] as this is the primary consent that the plant operates on.

Table 3 – Martinborough WWTP Key Discharge Consent Conditions to the Ruamahanga River

Parameter		
Consent Number		WAR120258 [31707]
Consent Conditions	**Unit**	**Limit**
$CBOD_5$[1]	g/m^3	60
TSS[1]	g/m^3	90
TN[1]	g/m^3	35
DRP [1]	g/m^3	7
TAN[1]	g/m^3	30

A.1.3 Flows

A summary of the plant's influent flows is shown in Table 4. The flow summary was based on 15-minutely SCADA data as recorded by the influent flowmeter from 1 June 2021 – 1 June 2023.

Growth was projected to 2050 assuming 1.1% annual growth, based on the high projection estimate for population growth in the South Wairarapa District (Stats NZ, 2018). It should be noted that it is estimated that the peak instantaneous flow will not increase with population to any significant degree and is therefore assumed to remain constant.

There were many periods where it appeared that the flowmeter was not operating correctly. For periods where this was suspected, the data was omitted.

Table 4 – Raw Influent Design Flows

Parameter	Unit	Flow (2021 – 2023)	Design Flow (2050)
Average Flow	m^3/d	637	855
75th Percentile Flow	m^3/d	762	1023
Peak Instantaneous Flow	L/s	63.6	63.6

A.1.4 Existing WWTP Performance

A summary of the current plant performance is shown in Table 5 and Table 6. The values in Table 5 show sampling conducted of the raw influent, and the values in Table 6 show sampling post-UV disinfection. The concentration values were based on grab samples taken by Wellington Water Operations Staff from June 2021 – May 2023. Design loads for nutrients are also presented which are based on the 75th percentile concentrations and the 75th percentile design flow.

The data presented indicates that the existing treatment for $CBOD_5$, TSS and DRP is likely sufficient, and no additional treatment is required. The TAN and TN averages presented exceed the resource consent concentrations. Plant upgrades are required to provide further treatment for both TAN and TN.

[1] Limit shall not be exceeded for more than 4 out of any 12 consecutive monthly test results.

Table 5 – Martinborough WWTP Influent Concentrations and Loads

Parameter	Unit	No. Samples	Min.	25th Percentile	Average	75th Percentile	Max.	Design Load (kg/d)
$CBOD_5$	g/m^3	24	45.0	84.5	156	215.0	305	**220**
TAN	g/m^3	24	16.7	26.0	37.1	44.4	85.7	**45.5**
TSS	g/m^3	24	24.0	56.0	136.2	212.5	431	**217.4**
TN	g/m^3	24	26.6	34.3	48.3	60.1	111.0	**61.4**
DRP	g/m^3	24	1.79	2.49	3.71	4.69	8.15	**4.8**
NO_3-N	g/m^3	24	0.0	0.0	0.01	0.0	0.2	**0.0**
pH	-	24	6.7	7.1	7.3	7.4	7.8	**N/A**
TP	g/m^3	24	3.3	4.0	37.3	46.4	129.0	**47.5**
Turbidity	NTU	9	40.4	55.6	84.8	109.0	129.0	**N/A**

Table 6 – Martinborough WWTP Post-UV Concentrations and Loads

Parameter	Unit	No. Samples	Min.	25th Percentile	Average	75th Percentile	Max.	Design Load (kg/d)
$CBOD_5$	g/m^3	24	12.0	24.0	35.9	43.3	77.0	**44.3**
TAN	g/m^3	24	8.9	21.5	30.3	36.8	72.0	**37.6**
TSS	g/m^3	24	12.0	35.3	52.8	69.0	89.0	**70.6**
TN	g/m^3	24	15.4	30.3	39.0	46.7	70.8	**47.8**
DRP	g/m^3	24	1.1	2.7	5.0	5.0	13.8	**5.1**
NO_2-N	g/m^3	24	0.0	0.0	0.06	0.01	0.67	**0.01**
NO_3-N	g/m^3	24	0.0	0.0	0.02	0.04	0.09	**0.04**
pH	-	24	7.0	7.3	7.6	8.0	8.1	**N/A**
TP	g/m^3	24	2.3	4.2	6.4	6.7	14.3	**6.8**
Turbidity	NTU	24	14.7	17.1	27.2	37.8	42.2	**N/A**

A.1.5 Temperature and Dissolved Oxygen

The temperature and dissolved oxygen (DO) concentration of the facultative and maturation ponds are shown in Table 7. The estimated locations of where measurements are taken are shown in Section 3.1.

Table 7 – Pond Temperatures and DO

Parameter	Unit	No. Samples	Min.	25th Percentile	Average	75th Percentile	Max.
Facultative Pond Temperature	℃	391	7.5	14.1	16.8	20.8	26.5
Maturation Pond Temperature	℃	391	6.2	12.2	16.1	19.9	26.8

Parameter	Unit	No. Samples	Min.	25th Percentile	Average	75th Percentile	Max.
Facultative Pond DO	mg/L	391	0.05	1.3	5.1	7.5	22
Maturation Pond DO	mg/L	391	0.08	0.8	4.5	7.0	22