[LEI, 2017:A2I1]

WWTP System Data and Compliance Summary

(LEI, 2017:A2I1)

Prepared for

Wairoa District Council

Prepared by

LWE Environmental Impact

October 2017

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Wairoa District Council

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Ref: RE-10292-A2I1-System_Data_Compliance_Summary-Final-171020.docx

Job No.: 10292

Date: October 2017

Revision Status			
Version	Date	Author	What Changed and Why
2	20/10/2017	PL	Revised to incorporate new information and client feedback on client draft
1	24/05/2017	PL	Client draft

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1 EXECUTIVE SUMMARY

1.1 Introduction

The Wairoa District Council (WDC) owns and operates the Wastewater Treatment Plant (WWTP) for Wairoa, the largest town of the district. The Wairoa township area is very flat and low-lying, and is predominantly encompassed within a large meander of the Wairoa River. The population of Wairoa is slowly declining, and is currently about 4,000 (the population was about 4,400 in 2001 and 5,000 in 1995) according to official New Zealand census data (Statistics New Zealand, 2013).

A large meat processing plant (AFFCO Wairoa), timber processing plant, and some other industrial properties are mainly located in North Clyde. They only contribute domestic wastewater. AFFCO manage their own process wastewater discharge separately from WDC's wastewater system.

WDC holds a resource consent to discharge up to 5,400 m^3/d of treated municipal wastewater into the lower reaches of the Wairoa River during out-going tides at night time (6 pm to 6 am). The consent was granted on 23 August 1999 by Hawke's Bay Regional Council (HBRC) for a term expiring on 31 May 2019. The WWTP discharge requires a replacement consent in 2019 and possible treatment system and discharge modifications.

The future discharge consent will need to provide for either the status quo or for a modified discharge regime. Consenting for any future discharge system will require reliable information on the WWTP design and capabilities, and the quality, quantity, timing, and environmental effects of the present discharge from the WWTP.

This report reviews the current WWTP design and performance, presenting a summary of the current WWTP design parameters including historical flow and treatment performance data that will be relied upon for design reviews and resource consent applications. Unless significant changes to the sewer reticulation, wastewater flows, trade wastes or the population of Wairoa are to be accounted for, the values presented in this report will continue to be valid and suitable for future design and system scenarios.

1.2 Reticulation

The community reticulation system (pipes in the ground) is approximately 40 km and has five pump stations. It is of varying age with about 70% installed more than 60 years ago. About 60% of the pipes by length are earthenware.

Reticulation currently allows significant stormwater inflow and groundwater ingress (I & I), with some catchments experiencing greater inflow than others. High flows can lead to pump station and WWTP storage overflows and can reduce the effectiveness of wastewater treatment (in terms of percentage reductions in pathogen numbers and nitrogen concentrations prior to discharge) while also diluting the incoming wastewater. WDC's sewer reticulation renewal programme is addressing I & I sources and removing stormwater connections through an on-going programme. The pump stations have also been serviced and some of their capacities have been upgraded.

Historically, flooded river water has been able to surcharge back through the reticulation's emergency overflow outlet pipes into the pump stations and reticulation system. Recently (2016) added outlet flap valves have stopped this backflow, and the likely resulting effects of this on the highest wastewater flows is more recent than the flow data used in this report.

1.3 WWTP Design and Performance

The Wairoa WWTP ponds have a total volume of about 23,000 m^3 (mainly in the maturation pond which is about 5 times the size of the aerated lagoon). The aerated lagoon is about 3.4 m deep, while the maturation pond is about 2.0 m deep. Two aerators are operated on the aerated lagoon, while the maturation pond is not mechanically aerated.

An emergency overflow system is built into the WWTP design with overflow weirs located at the WWTP inlet (prior to the screen), in the pipeline connecting the two ponds, and at the outlet of the maturation pond adjacent to the outlet valve. All of these overflows bypass the outlet meter and connect into the discharge pipeline downstream of the WWTP's outflow meter.

Daily wastewater flow averaged about 2,700 m^3/d during 2009-14, with average summer flow of about 2,200 m^3/d and winter average flow of about 4,000 m^3/d. These flows are well above typical expected flows for communities the size of Wairoa, and an increase of about 1,500 m^3/d from flows recorded for Wairoa during 1992-95. Table 1.1 summarises dry weather flows (DWF) and wet weather flows (WWF) through Wairoa's WWTP during 2009-14. The theoretical DWF for Wairoa's current population is about 800 m^3/d, based on an average flow of 200 l/d for each person.

Table 1.1: Dry Weather and Wet Weather Flow Statistics During 2009-14

Flow Statistic (m^3/d)	WWTP Inflow		WWTP Outflow (2009-14)
	Fitzroy Street (2013-14)	Prosol[1] Telemetry (2009-14)	
Actual 5th Percentile Flow	959	1,211	856
Mean DWF	2,379	2,205	2,243
Mean Total Daily Flow	2,419	2,848	2,682
Mean WWF	2,910	3,134	2,836
95th Percentile WWF	6,390	6,639	6,287

There is often a mismatch between the inflow and outflow, with the inflow generally being higher than the outflow. It is not clear whether this relates to erroneous data, larger gaps in outflow records, surcharging of the ponds, pond overflows bypassing the outlet meter, or pond leakage. The inflow data has been seen by WDC as more reliable than the outflow data, as the inflows measured by two separate metering systems closely agreed. The outflows needed to be re-calculated in order to tally with inflows and pond water level fluctuations, and to account for storm overflows that bypassed the outflow meter. The outflow data used in Table 1.1 and throughout this report was the calculated dataset. WDC is aiming to resolve data concerns in the near future and expect that by the time consent applications are prepared a reasonable duration of reliable discharge flow data will be available.

The original WWTP design relied on a hydraulic residence time (HRT) of 18 days, based on an average daily inflow of approximately 1,300 m^3/d (which allowed for long-term population growth in Wairoa with minimal I & I). Based on the actual daily average flow of 2,700 m^3/d, which is significantly higher than the original design flow and the 1992-95 flows due to I & I volumes, the average HRT is less than 8.5 days. This lower HRT is likely a result of stormwater entering the system. The recent (2016) installation of flap valves on the pump station outlets is likely to have reduced the highest flows during storms and flood events, thus potentially increasing the HRT.

Accumulation of sludge in the WWTP ponds further reduces the HRT, as the wastewater can only reside in the volume remaining above the settled sludge. Short HRT's reduce the opportunities

[1] Prosol is a manufacturer's brand name of the telemetry and metering systems that WDC have installed.

for effective treatment and pathogen deactivation, and can at many treatment plants also increase the risk of offensive odours being released from the WWTP. The HBRC compliance reports reviewed for this report indicate that there are no records (at WDC or HBRC) of air quality complaints or problems from the Wairoa WWTP.

Despite the short HRT's, high I & I, high BOD load, and, at times, large accumulations of sludge which can all adversely affect treatment performance, the Wairoa WWTP is generally treating the wastewater to achieve an effluent quality that is similar to, or better than, expected median values for such pond systems, as summarised in Table 1.2 below.

Table 1.2: Comparison of Wairoa's Treated Wastewater Quality with NZ Oxidation Pond Guidelines 2005

Parameter	NZ Oxidation Pond Guideline 2005 Median Value	Wairoa WWTP Effluent Median (2008-16)	Wairoa WWTP Performance (Reduction)
BOD (g/m^3)	30	23 (CBOD)	84 %
NH_3-N (g/m^3)	13	15.6	8 %
TN (g/m^3)	35	-	-
TP (g/m^3)	8	(Influent = 3.3)	-
TSS (g/m^3)	40	52	-
E. coli (cfu/100 ml)	5,000	5,200	99.56 % (2 log)

Sludge appears to require regular removal from the WWTP ponds (every 6-8 years), as it appears to be accumulating rapidly (900 – 2,100 m^3/y). The sludge in the aerated lagoon is more difficult to remove due to its high sand content (reflective of the high stormwater and I & I content of the wastewater which is likely to contribute sediment to the wastewater flows), the pond's small size, and obstacles of aerators and outlet structure. It seems likely that the recent (2016) installation of flap valves on the pump station outlets will have helped to prevent sand and silt from the flooded river entering the reticulation, which in turn should have improved the sludge characteristics and slowed its rate of accumulation. Future sludge removal programmes should assess these aspects of sludge accumulations, but the installation of a grit arrestor at the WWTP inlet would prevent most sand and silt entering the aerated lagoon.

1.4 Resource Consent Compliance

The discharge resource consent conditions limit the daily discharge volume to a maximum of 5,400 m^3/d. It also restricts the timing of discharges to periods of ebb tide 30 minutes after high tide to 6 hours after high tide and only when these tidal phases occur between 6:00 pm and 6:00 am.

When the bar across the mouth of the Wairoa estuary to Hawke Bay is closed, no discharge is allowed and all wastewater is required to be stored at the WWTP until the WWTP's storage capacity has or is about to run out, at which point the discharge may re-commence under the same restricted daily volume, hours and tidal phases as prevails when the bar is open. There are no conditions that specifically allow for discharge volumes or times to exceed these restrictions when storm flows or emergency events occur. When discharges occur while the bar is closed, the consent conditions also require WDC to use public warning signs and public notices in local media to warn the public of the potential health risk.

The discharge of treated wastewater to the Wairoa River has generally complied with the resource consent conditions. There have however, been occasions when storm-induced flows have overwhelmed the available storage volume in the WWTP ponds. Under these conditions a required discharge exceeds the daily discharge limit of 5,400 m^3/d, and/or may occur outside of the falling tide during night hours (6 pm to 6 am). The high I & I flows and perhaps sub-optimal

management of the WWTP's available 5,400 m^3 storage capacity may have caused consent breaches during large storm events. Reductions in I & I and active storage management at the WWTP may reduce the frequency and scale of consent breaches to rare events. Additionally, the restrictions on discharges to the Wairoa River when the bar closes the estuary's mouth to Hawke Bay create a further burden on WDC, which is completely outside of their control, as the closure and opening of the bar is a combination of natural events and remedial works required by the HBRC to open the river mouth.

Pump station and manhole overflows into the Wairoa River caused by storm events occur without consent approval. WDC have been investigating the causes of these overflows, implementing changes to prevent or reduce future overflows, and addressing sources of I & I entering the reticulation. Should overflows continue in the future, WDC will need to obtain appropriate consents for future storm-induced discharges and continue to reduce the volume and frequency of such overflows.

Any reductions of I & I will reduce or eliminate overflows of the pump stations and manholes. A mitigating factor in these overflows is that the discharges are dominated by stormwater rather than wastewater and given the increase in flow essentially the wastewater system is conveying stormwater which has wastewater contamination. Additionally, at these times the Wairoa River is in flood and already carrying higher loads of contaminants than would be contributed by the wastewater overflows. It seems likely that the recent (2016) installation of flap valves on the pump station outlets will have helped to prevent flows entering the reticulation and WWTP that have previously exceeded the daily discharge limit of 5,400 m^3/d and the available storage capacity at the WWTP, but the flow data relied on for this report ended in December 2014, so any recent flow changes could not be assessed for this report.

1.5 Future Consenting Considerations

The current discharge consent was granted by HBRC on the basis that WDC would use the 20-year term to investigate potential upgrades to the WWTP to better address cultural concerns and improve treatment levels, and to reassess the feasibility and affordability of possible alternatives to the river discharge. The reporting planner's recommendation to the hearing panel and the subsequent consent decision noted these expectations.

Cultural values, national environmental standards and policy statements, and various Regional Plan requirements provide strong drivers for ceasing (or at least reducing) discharges to the river and coastal marine environments, and instead implementing discharges to or through land. These drivers are described in more detail in the Planning Considerations report (LEI, 2017:A7I1). Community aspirations for public health, recreation, fishing, and other social values also drive the need to consider discharges to land or perhaps a discharge location further offshore in the marine environment (within Hawke Bay instead of the river).

It therefore is apparent that any application for consents to continue the river discharge will require a very robust reasoning to support such a position. The future discharge replacement consent application will need to thoroughly consider all aspects, including alternative discharge sites, land availability, environmental effects of the existing and proposed discharge, cultural values, recreational/social values, and financial considerations. It will need to demonstrate that all options have been considered, and that the best practicable option (BPO) has been selected for consenting. The process and criteria used to select the BPO, including consultation with the affected community, will need to be clearly described in the consent application documents.

2 INTRODUCTION

2.1 Background

Wairoa District Council (WDC) owns and operates the Wastewater Treatment Plant (WWTP) for Wairoa, the largest town of the district. The WWTP is located near Rangi-houa / Pilot Hill south of Wairoa overlooking the Wairoa River estuary and the Pacific Ocean (Hawke Bay). It is accessed from Whakamahi Road. The treated effluent flows by gravity to discharge via the submerged outfall in the Wairoa River.

WDC holds a resource consent to discharge treated municipal wastewater into the lower Wairoa River during out-going tides at night time (6 pm to 6 am). The consent was granted on 23 August 1999 by Hawke's Bay Regional Council (HBRC) for a term expiring on 31 May 2019. The 20-year term of the consent was intended to allow ample time for WDC to investigate options of upgrades in order to accommodate cultural issues and to provide a better level of treatment prior to discharge, and to reassess the feasibility and affordability of possible alternatives to the river discharge. The reporting planner's recommendation to the hearing panel and the subsequent consent decision noted these expectations.

The Wairoa WWTP discharge requires a replacement consent in 2019 (either for the status quo or for a modified discharge regime). The replacement consents will require reliable information on the WWTP design and capabilities, and the quality, quantity, timing, and environmental effects of the present discharge from the WWTP.

In order to assess any requirement to upgrade the Wairoa WWTP, the capabilities, limitations, and environmental effects of the current system need to be described and assessed.

This report reviews the current WWTP design and performance, presenting a summary of the current WWTP design parameters including historical flow and treatment performance data that will be relied upon for design reviews and resource consent applications. Unless significant changes to the sewer reticulation, wastewater flows, trade wastes or the population of Wairoa are to be accounted for, the values presented in this report will continue to be valid and suitable for future design and system scenarios.

2.2 Purpose

The primary purpose of this report is to provide a description of the existing Wairoa WWTP, and any limitations it may have for effective sewage treatment capability and its suitability for discharge to the available receiving environments. In addition to this, the purpose of this report is to describe and assess the available wastewater monitoring data in order to:

- Identify any instances of erroneous, incomplete, or absent monitoring data;
- Describe the design and operating parameters of the Wairoa WWTP;
- Identify any instances of breaches of resource consent conditions;
- Identify and summarise any trends of parameters over time;
- Assess the treatment performance of the Wairoa WWTP; and
- Assess the limitations on the operation and treatment performance of the Wairoa WWTP.

This report is specific to the wastewater reticulation, treatment, and discharge processes. It does not include environmental data that relates to the quality of the receiving environment or the effects of the discharge on the receiving environment. This additional information is provided in an accompanying report titled Environmental Data Summary (LEI, 2017:A3I2).

2.3 Scope

This report addresses the following aspects of Wairoa's wastewater reticulation and WWTP:

- A description of current treatment methods, including size, depth, design, and hydraulic retention time (HRT) of each component of the plant;
- The dimensions, performance, and capacity of the WWTP;
- Existing data on consent condition compliance;
- A description of flaws and limitations in the current system and its operation;
- A description of the existing discharge structure and its function, operation and condition;
- The identification of drivers for change to the existing system;
- The assessment of relevant inflow and effluent monitoring data relating to the existing WWTP and its discharge receiving environment; and
- The assessment of data for completeness, errors, overall trends, compliance with current consent conditions, overall performance of the treatment plant, and environmental effects resulting from the effluent discharge.

3 INFORMATION

3.1 Sources of Information

The primary source of most of the required information is WDC. The key information included spreadsheets of daily sewage pump station levels and flows, and WWTP treatment performance monitoring data.

Information relating to the WWTP design parameters, pond dimensions, and sludge levels was sourced from various reports and investigations, and these are listed in the References section of this report. Several of HBRC's annual consent compliance reports for recent years were relied upon (in addition to the WDC flow data) for assessing Wairoa WWTP's discharge consent compliance record.

HBRC provided dates that the Wairoa bar was opened by contractors during 2009-14, but this did not identify when the bar had closed nor how long it had been closed before HBRC re-opened the bar.

NIWA's publicly accessible Cliflo weather database was accessed to obtain daily weather data for Wairoa to assist with determining the relevant days of dry and wet weather flows.

3.2 Dataset Descriptions

The individual datasets that LEI relied upon for this report are summarised in Table 3.1 below.

Table 3.1: Summary of Available Datasets

Source	Description	Date Range
WDC	Daily total WWTP inflow and outflow volumes	1 January 2009 – 30 September 2014
WDC	Pump Station daily volume, duration, wet well level, alarm event, and overflow data	1 January 2009 – 30 September 2014
WDC	8-day periods of daily WWTP influent quality at various seasonal (approximately 3, 6, or 12 monthly) intervals (various parameters)	March 2008 – August 2010
WDC	Monthly WWTP influent quality (various parameters)	April 2008 – October 2016
WDC	Monthly WWTP wastewater quality prior to entering maturation pond (various parameters)	January 2009 – October 2016
WDC	Monthly WWTP effluent quality (various parameters)	September 1995 – October 2016
WDC	WWTP Sludge Survey report and drawings by Parklink.	4 May 2016
HBRC	Dates of Wairoa River bar opening works by HBRC	2009 – 2014
NIWA	Daily rainfall, soil moisture deficit, and runoff for NIWA's North Clyde weather station	January 1997 - February 2017

3.3 Dataset Integrity Assessment Methodologies

All datasets were assessed for any gaps or errors, such as extremely high, negative, or very small values. Data gaps were unable to be filled.

Extreme outliers were scrutinised for their likelihood of being errors instead of true outliers. Where typographical errors in data entry were likely to have generated outlier readings, these results were corrected to more realistic values. Where realistic data corrections could not be readily worked out, the outlier data was generally excluded from the dataset.

3.4 Data Processing Methodologies

Statistics were generated for all datasets. Where relevant, monthly and annual statistics were also generated. Graphs of the daily datasets and some of the monthly and/or annual averages were also generated where relevant.

The various datasets were correlated and integrated with each other by matching dates as far as possible.

Wairoa WWTP's daily inflow and outflow data was matched against NIWA's daily rainfall records for Wairoa (NIWA's North Clyde weather station) so that wastewater flows could be categorised into wet weather flow (WWF) when the previous three days received any rainfall, or otherwise as dry weather flow (DWF). Statistics were then generated for the WWF and DWF inflows for the periods that the available data allowed this.

3.5 Dataset Completeness Outcomes

The following gaps were apparent in the datasets:

Raw wastewater quality: Some parameters were missing for June and August 2008, and for January and May 2009.

Primary effluent quality: Some parameters were missing for April, May, and August 2008, and all parameters were missing for June 2008. Occasional lab errors or missing individual results also occurred on other dates.

Final effluent quality: Most parameters were missing for November 2010. Occasional lab errors or missing individual results also occurred on other dates.

WWTP Inflow: The following dates had no inflow records:

Year	Missing Dates of Flow Records
2009	1 March to 30 June, 1-31 August, and 30 November to 9 December
2010	1-30 June
2011	No gaps
2012	1-31 March and 1-30 June
2013	1 July to 30 November
2014	28-30 April

WWTP Outflow: The following dates had no outflow records:

Year	Missing Dates of Flow Records
2009	1 March to 30 June, 1-31 August, 24-25 September, and 30 November to 9 December
2010	1-30 June, 2-4 October, 29 November, and 28-29 December
2011	13 February to 22 March, 1-3 April, and 19-31 December
2012	12-31 January, 2 February to 31 March and 16 April to 30 June
2013	30-31 March and 1 July to 30 November
2014	15-16 February, 19 February, 22-23 February, and 28-30 April

Rainfall: The following dates had no daily rainfall total records:

Year	Missing Dates of Flow Records
2009	4 May to 16 June and 1-29 September
2010	No gaps
2011	No gaps
2012	No gaps
2013	1-19 September
2014	24 April to 12 June

3.6 Data Errors and Outliers Detected

The WWTP outflow datasets were measured inconsistently using several different methods across the available years of data, with the actual outlet valve flow meter data, Prosol[2] telemetry system's original flow data, calculated Prosol telemetry system's flow data, and estimated discharge valve flows combined with estimated pond overflow data being reported over various timeframes and each dataset having different daily readings. It was not readily apparent which dataset was the most reliable, nor the reasons for the different readings or calculated flows. However, graphs of the various datasets and comments in WDC's spreadsheets indicated that the original Prosol and outlet valve meter data were both thought to be inaccurate due to elevated flows bypassing the outlet meter, along with some metering and data transmission errors. The daily inflows, pond level variations, and discharge valve operating data had been found to conflict with the reported outflow volumes, so the Prosol data had been recalculated to incorporate corrections based on the daily inflows and fluctuating WWTP pond levels. The valve opening durations and durations of pond levels above the emergency overflow outlet crest were also used after 1 August 2012 to estimate the actual combined discharge volumes.

The flows based on valve opening durations were generally inconsistent with (significantly higher than) the daily inflows, so they were not used for this report. As noted above, the original outlet meter and Prosol outlet flow data were also inconsistent with the daily inflows and pond level variations. The graphs and statistics of the original and calculated Prosol data against inflow and pond level data demonstrated that the calculated Prosol outflow data was probably the most reliable daily outflow dataset, so the calculated Prosol outflow data has been used in this report as the WWTP outflow data for 2009-14.

The daily inflow data during 2009-12 was recorded only as Prosol telemetry data, while the 2013-14 daily inflow data was recorded by both the Prosol telemetry and the Fitzroy Street pump station's flow meter. A comparison of these duplicate flow datasets during 2013-14 showed overall good agreement on the daily inflows. The pump station data for the upstream reticulation catchments in Wairoa was also tallied for comparison against the actual Fitzroy pump station (which captures all upstream flow) during 2013 and 2014. This demonstrated the reliability of the Fitzroy pump station flow data and identified when storm events caused wastewater overflows between the upstream pump stations and Fitzroy Street. As a consequence of this data comparison, the Prosol telemetry inflow data is used in this report as the WWTP inflow data during 2009-14. WDC is aiming to resolve these data concerns in the near future and expect that by the time consent applications are prepared a reasonable duration of reliable discharge flow data will be available.

In addition to the missing data noted in Section 3.5 above, a large number of errors and outliers or suspected errors were noted in the daily WWTP outflow dataset. These were generally deleted from the data used to generate graphs and statistics for this report. A small number of results

[2] Prosol is a manufacturer's brand name of the telemetry and metering systems that WDC have installed.

were thought to be typographical data entry errors and were manually corrected to more realistic numbers.

A few clearly erroneous outliers in the wastewater quality dataset were corrected or deleted, as summarised in Table 3.2 below.

Table 3.2: Treatment of Identified Outlier Wastewater Quality Data

Parameter	Date (s)	Original Result	Corrective Action
Influent pH	31 May 2011	18.2 (impossibly high)	Changed to 8.2
Influent total nitrogen (TN)	17 September 2008 and 7 December 2011	220 (unrealistically high)	Changed to 22
Influent total Kjeldahl nitrogen (TKN)	17 September 2008 and 7 December 2011	220 (unrealistically high)	Changed to 22
Influent TN	20 November 2012	99 (unrealistically high)	Deleted (unable to estimate true value)
Influent TKN	20 November 2012	99 (unrealistically high)	Deleted (unable to estimate true value)
Influent total phosphorus (TP)	17 September 2008	60 (unrealistically high)	Changed to 6.0
Influent TP	7 December 2011	25 (unrealistically high)	Changed to 2.5
Influent TP	28 March 2012	11.9 (unrealistically high)	Changed to 3.9
Influent TP	20 November 2012	16.2 (unrealistically high)	Changed to 6.2
Primary treated effluent TP	6 January 2009	14 (unrealistically high)	Changed to 5.4
Primary treated effluent TP	29 December 2009	10 (unrealistically high)	Changed to 3.0
Final treated effluent pH	25 November 2010	464 (impossibly high)	Changed to 7.7

Note: It was apparent that the data entries for final effluent pH, temperature, dissolved oxygen and conductivity on 25 November 2010 had all been transposed (the original pH reading of 464 was in fact the conductivity reading).

The raw influent wastewater quality dataset almost always had identical results for TN and TKN, which is unusual, and this suggests that only one of these parameters was actually analysed but the result was subsequently reported as representing both parameters.

The Fitzroy pump station and Prosol telemetry datasets used for the WWTP inflows and NIWA's meteorological datasets used for total daily rainfall did not appear to contain any erroneous results.

4 WASTEWATER TREATMENT PLANT DESCRIPTION

4.1 General

The Wairoa township area is very flat and low-lying, and is predominantly encompassed within a large meander of the Wairoa River. The population of Wairoa is slowly declining, and is currently about 4,000 (the population was about 4,400 in 2001 and 5,000 in 1995) according to official New Zealand census data (Statistics New Zealand, 2013). A large meatworks plant (AFFCO Wairoa)[3], timber processing plant, and some other industrial properties are mainly located in North Clyde. They only contribute domestic wastewater. AFFCO manage their own process wastewater discharge separately from WDC's wastewater system.

The climate is influenced by dry East Coast weather patterns during summer and frequent rainfall events during winter. The surrounding hill country and ranges of Te Urewera have a large influence on the climate and weather patterns that pass over Wairoa. Further details of Wairoa's climate are presented in the report Environmental Data Summary (LEI, 2017:A3I2).

The Wairoa WWTP is located in a saddle of a spur leading to Rangi-houa, otherwise known as Pilot Hill (latitude 39.05982°, longitude 177.4134°), south of Wairoa and overlooking the Wairoa River estuary and the Pacific Ocean (Hawke Bay). It is accessed from Whakamahi Road. The WWTP is at an altitude of about 20-25 m above mean sea level.

4.2 Reticulation System

Figure 4.1 maps Wairoa's wastewater reticulation, pump stations, and WWTP including its discharge into the Wairoa River.

The originally commissioned reticulation directed sewage to the coastal side of the community where untreated (or perhaps septic tank treated) sewage was discharged into the Wairoa River. An allowance for overflows from pump stations within this reticulation was provided, meaning that there were also points of discharge further up the river and closer to the centre of Wairoa.

In 1980-81 the WWTP was constructed and the wastewater flows from the Wairoa township were directed into a new gravity trunk sewer to the Fitzroy Street pump station which then pumped wastewater up to the WWTP instead of into the Wairoa River. Flows of treated wastewater returned from the WWTP outlet via gravity pipeline to the existing river discharge structure near the river end of Fitzroy Street.

The original pump station discharges to the river were retained as emergency overflow outlets. Until 2016 flooded river water was able to surcharge back through these outlets into the pump stations and reticulation system, adding volume to the wastewater to be treated and discharged. Recently (2016) added outlet flap valves have stopped this backflow, which will have reduced the highest flows during storms and flood events, and this needs to be considered when looking at historical wastewater flow data. During 2014 WDC reconfigured and replaced or serviced several pumps to increase their capacities and reduce overflows. WDC have also been removing stormwater connections and repairing and replacing some of the reticulation.

[3] Contributes domestic wastes but not process wastewater.

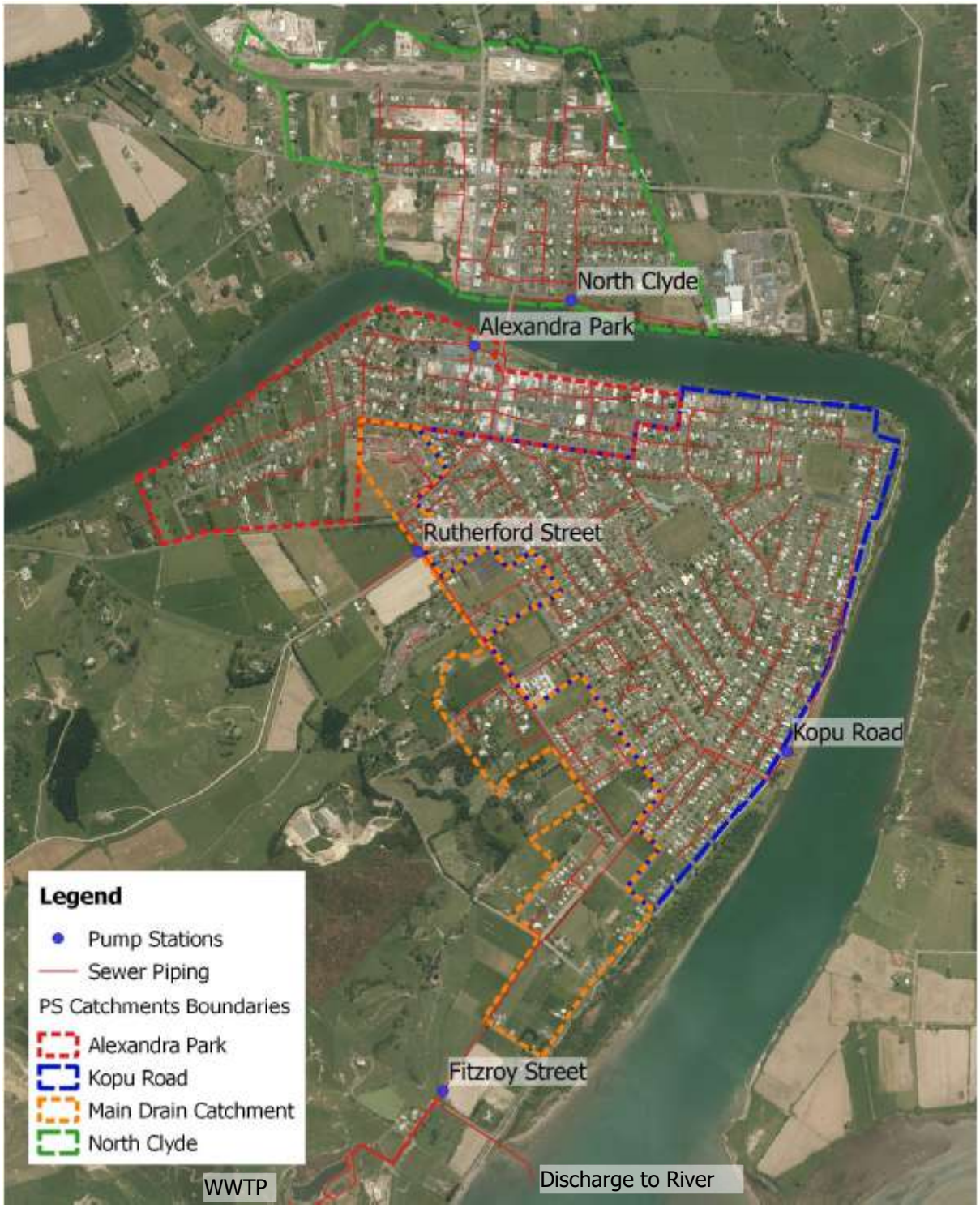

Figure 4.1: Map of Wairoa's Wastewater Reticulation, Pump Stations, and WWTP

A key part of the sewer network is a series of pump stations. These are referred to as:

- Alexandra Park pump station;
- North Clyde pump station;
- Kopu Road pump station;
- Rutherford Street pump station; and
- Fitzroy Street pump station.

Alexandra Park, North Clyde and Kopu Road pump stations are essentially lift stations, pumping the flow from their catchments into a downstream section of the gravity sewer trunk main. Rutherford Street pump station is considered insignificant for reporting on as it services only three properties. Fitzroy Street is a main collector pump station that pumps the combined flows from the other three catchments uphill to the nearby WWTP. Further detail on the pump stations is provided in a report compiled by Opus (2012b).

The wastewater reticulation consists of 745 manholes and 40 km of gravity pipes, with diameters ranging from 100 mm to 450 mm. The original network was built around 1948 with improvements, extensions and replacements occurring periodically since then. Approximately 70% of the reticulation is over 60 years old. About 60% of the pipes by length are earthenware (EW), 15% are asbestos cement (AC) and 10% are sulphide resistant cement concrete (CC-SR) (Opus, 2012a).

4.3 WWTP Pond Design Parameters

The Wairoa WWTP is a two-pond system with a screen at the inlet to the aerated lagoon. The aerated lagoon has two mechanical aerators, while the maturation pond has none. The treated wastewater from Wairoa WWTP flows by gravity back to Fitzroy Street and discharges through an underwater outfall in the tidal Wairoa River roughly opposite the river's mouth to/from Hawke Bay (as shown in figure 4.1 above).

Influent is coarsely screened (<5 mm) before entering a aerated lagoon, which has a surface area of approximately 2,120 m^2 (ParkLink, 2016). The primary treated wastewater flows from the outlet of the aerated lagoon by gravity through an underground pipeline to the maturation pond which has an approximate surface area of 10,970 m^2 (ParkLink, 2016).

The normal operating capacities of the WWTP ponds are about 4,750 m^3 (aerated lagoon) and 18,250 m^3 (maturation). The maximum total capacities of the WWTP ponds when filled to overflowing have been estimated by ParkLink to be 5,350 m^3 (aerated lagoon) and 24,130 m^3 (maturation). The freeboard of the WWTP ponds is about 300 mm for the aerated lagoon and 500 mm for the maturation pond.

The WWTP includes a minimum storage capacity of 5,400 m^3 (mostly provided by the 500 mm operating freeboard of the maturation pond) so that the wastewater can be stored during daytime (6 am to 6 pm) and incoming tide conditions when discharges are not allowed to occur. An automated outlet valve ensures that these discharge conditions are met, and forces wastewater to surcharge within the WWTP ponds up to the 5,400 m^3 capacity.

An emergency overflow system is built into the WWTP design. When water levels exceed the overflow weirs, excess wastewater enters the bypass pipelines. Overflow weirs are located at the WWTP inlet (prior to the screen), in the pipeline connecting the two ponds, and at the outlet of the maturation pond adjacent to the outlet valve. All of these overflows bypass the outlet meter and connect into the discharge pipeline downstream of the meter.

The operating depth of the maturation pond is normally about 2.0 m which is typical for an oxidation pond. The operating depth of the aerated lagoon as surveyed in 2016 by Parklink is about 3.4 m which is slightly deeper than the original 3.0 m design depth.

Figure 4.2 presents an aerial photograph of Wairoa WWTP with its key features. The black lines are the cadastral boundaries of the properties. Areas of floating debris on both ponds indicate where 'dead spots' and greater sludge accumulations are likely to exist. The aerated lagoon also has a vortex generated by the south-western aerator.

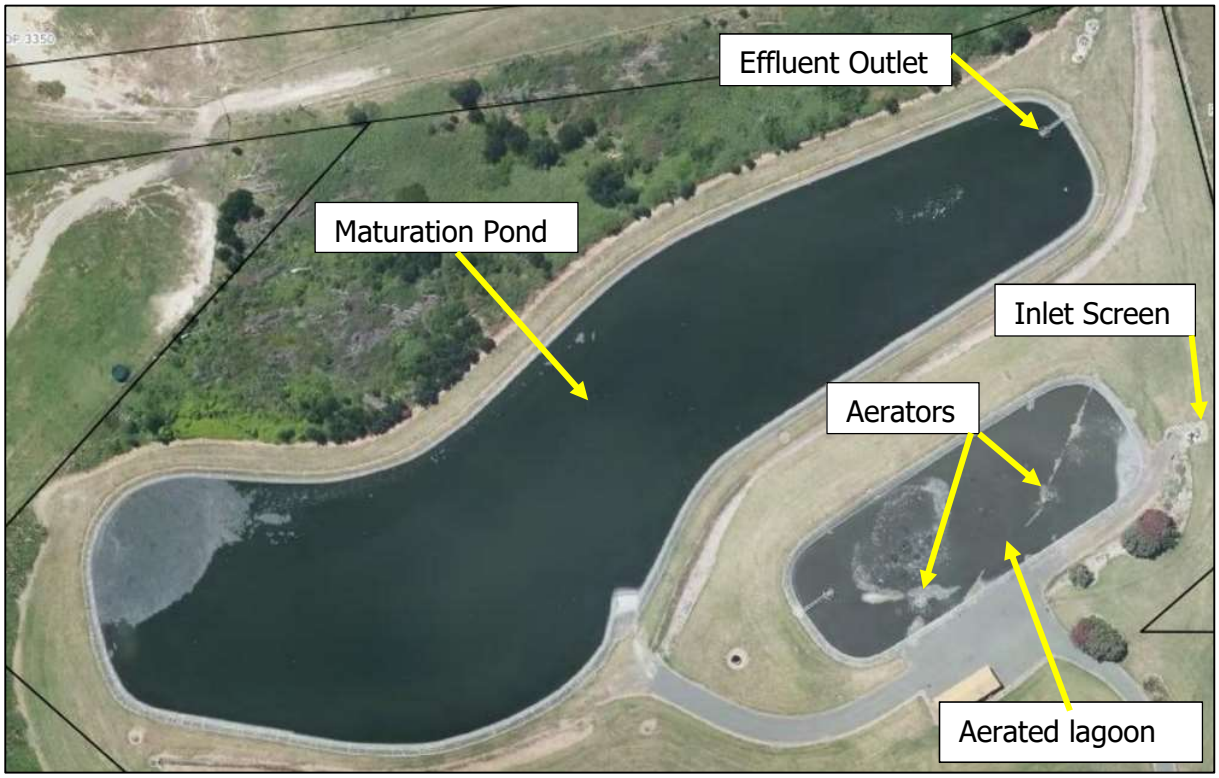

Figure 4.2: Wairoa WWTP Layout and Key Features

Table 4.1 presents Wairoa WWTP's pond dimensions, as surveyed by ParkLink in May 2016.

Table 4.1: Wairoa WWTP Pond Dimensions

Pond Name	Length (m)	Width (m)	Surface Area (m^2)	Average Operating Depth (m)	Operating Capacity (m^3)
Aerated Lagoon	80	27	2,120	3.4	4,750
Maturation Pond	235	30-57	10,970	2.0	18,250
Total WWTP	-	-	13,060	-	23,000

A report by WDC's Utilities Engineer dated October 2010 indicated that the original WWTP design was based on providing about 23,000 m^3 of operating volume for an average wastewater inflow rate of 1,300 m^3/d (which allowed for long-term population growth in Wairoa) and this allowed for an HRT of about 18 days. In 2004 MWH measured the pond volume as 21,640 m^3.

The ParkLink survey in May 2016 showed that the bases of the ponds were not level. This suggests that the original terrain was not levelled perfectly when the ponds were constructed. The original design drawings for the WWTP show that the maturation pond was constructed over the site of an existing dammed pond (which occupied a small gully and may have originally been a smaller natural pond), and an enlarged earthen dam built across the gully at the western side of the maturation pond expanded the pond's area and depth to obtain the required storage capacity.

The nature and characteristics of any pond lining is unclear, but at a minimum given the period of construction it would be expected that *in situ* material would have been compacted. It is unknown whether the base of the original natural pond was lined during the construction of the

maturation pond, but the prior existence of the smaller dammed pond suggests that drainage was already very limited anyway.

4.4 Sludge

An unspecified amount of sludge was removed from the maturation pond in 2001; according to WDC's Utilities Engineer's report in 2010, it was probably no more than 8,000 m^3 or 350 dry tonnes.

The sludge volumes were assessed in 2004 by MWH and estimated to be about 3,911 m^3 in the maturation pond. However, sludge often became readily visible during subsequent years, so WDC engaged EAM surveyed the sludge volume in 2009. EAM estimated that the maturation pond contained 16,500 m^3 (about 700 dry tonnes) of sludge.

During May – September 2010, the maturation pond was de-sludged by Conhur (about 790 dry tonnes were removed from this pond), and a further 83 dry tonnes of sludge was removed from the aerated lagoon. The sludge from the aerated lagoon was found to be denser with a high sand content. The ability to remove sludge from the aerated lagoon was constrained by the sludge properties (more sandy), large de-sludging dredge, and small size of this pond with its outflow chamber and inlet pipe protruding into the pond.

The sludge depths and volumes within both ponds were assessed on 4 May 2016 by Parklink. Their survey reported that the aerated lagoon contained about 2,750 m^3 of sludge, while the maturation pond contained about 5,863 m^3 of sludge. Based on the water level of the day, the percentage of the pond operating volume occupied by sludge was 57.9% and 32.1% respectively.

Sludge samples collected from various locations across both ponds were analysed for their dry solids and volatile solids contents. The aerated lagoon sludge had a higher inorganic material (sand) and lower moisture content than the sludge in the maturation pond. It is likely that the sandy and inorganic content of the sludge is largely caused by the volumes of stormwater that enter the reticulation and contributing sediment to the wastewater flows.

The frequency of sludge assessment and recent removals indicate a de-sludging interval of 6-8 years, however, it should be noted that in some cases either the maturation pond or aerated lagoon only were de-sludged meaning that the actual de-sludging interval may be greater. Based on the historic frequency of sludge removal and the volumes removed from Wairoa WWTP on each occasion, the rate of sludge accumulation appears to be somewhere between 900 m^3/y and 2,100 m^3/y.

It seems likely that the recent (2016) installation of flap valves on the pump station outlets will have helped to prevent sand and silt from the flooded river entering the reticulation, which in turn should have improved the sludge characteristics (at least in the aerated lagoon) and slowed its rate of accumulation. Future sludge removal programmes should assess these aspects of sludge accumulations, but the installation of a grit arrestor at the WWTP inlet would prevent most sand and silt entering the aerated lagoon.

5 WASTEWATER FLOW AND QUALITY

5.1 General

In the report titled Wairoa Wastewater Discharge Re-Consenting Summary of Wastewater and Stormwater Overflow Issues (LEI, 2015:A1I1) LEI assessed the daily flow data for Wairoa's reticulation and pump stations during 2013-14 in order to understand the scale and causes of I & I and reticulation overflow events. The current report assesses the wastewater flow data to describe the current operational parameters of the WWTP and to determine compliance with various discharge resource consent conditions.

Flow data is crucial for determining the HRT of the WWTP which is strongly relevant to the WWTP's treatment capacity and performance. Sludge volumes accumulated within the ponds also reduce the WWTP's hydraulic and treatment capacities, and these changes in capacity can consequently reduce the WWTP's treatment performance. Daily discharge volumes and timing are also required to be monitored in order to assess compliance with the limits set by the discharge consent conditions.

Wastewater quality monitoring data is assessed in this report to describe the treatment performance of the WWTP and to determine compliance with relevant discharge resource consent conditions. This data can also be useful for measuring the effects of de-sludging and other changes to the operation of the WWTP, and can provide guidance as to when de-sludging should occur and/or whether additional treatment processes should be considered for the future.

5.2 Wastewater Flow

The daily outflow data presented and discussed below has been calculated, as noted in Section 3.6 above, and its accuracy is unknown due to the known metering errors and the complexities of estimating the discharge flow volumes from inflows and pond levels. It is likely that the recent (2016) installation of flap valves on the pump station outlets will have reduced flows entering the reticulation and WWTP during storms and flood events, but this report relied on flow data up to December 2014.

Figure 5.1 presents a graph of the daily wastewater inflow and outflow data for the Wairoa WWTP during 2009-14. The erroneous readings noted in Section 3.6 above have been excluded from this graph and the subsequent statistics. The daily total wastewater flows are strongly influenced by rainfall events and also show seasonal changes that reflect longer term rainfall and soil moisture conditions (higher in winter and lower in summer).

Figure 5.2 below presents a graph of the monthly averages of the daily inflow and outflow with monthly total rainfall (where available) for 2009-14, and the relationship between flows and monthly rainfall and seasons is readily apparent in this graph. Both graphs show the flow data gaps and the disparity that has often occurred between the inflows and outflows, with the inflow generally being higher than the outflow.

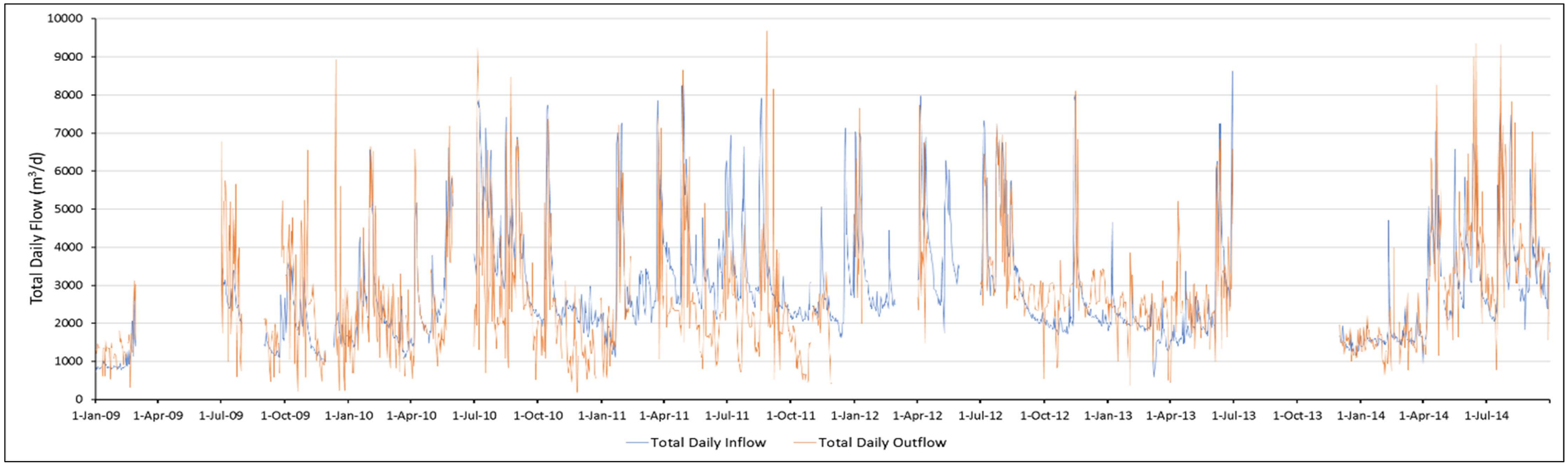

Figure 5.1: Daily Wastewater Inflows and Outflows for Wairoa WWTP for 2009-14

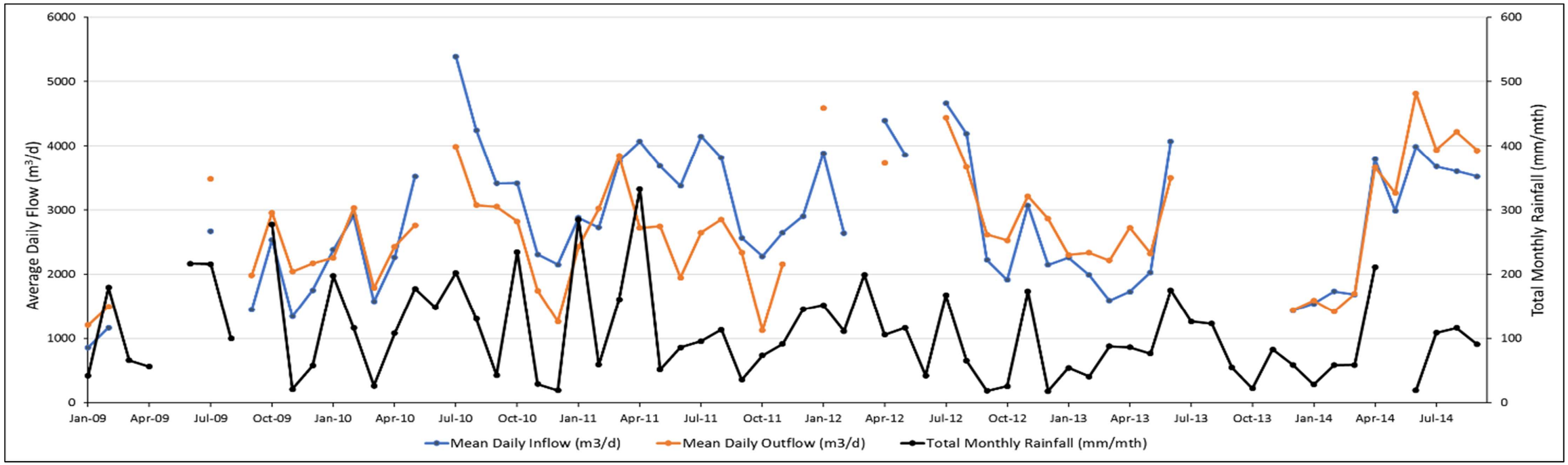

Figure 5.2: Monthly Averages of Daily Inflows and Outflows for Wairoa WWTP for 2009-14

Daily flow averaged about 2,700 m^3/d during 2009-14. This is more than twice the WWTP's original design flow rate and an increase of about 1,500 m^3/d from the flows measured in 1992-95 that were reported in the application documents for the current discharge resource consent. The increase is due to significantly higher I & I volumes, not population growth (which has actually declined about 20 %) or wastewater production increases. The population of about 5,000 in 1995 has reduced to about 4,000 while a large percentage of the original reticulation has not been replaced or upgraded. The age and materials of the oldest reticulation make it more prone to developing faults as the pipes and their connections continue to deteriorate. WDC's reticulation renewal programme is addressing this. Illegal stormwater connections are also being investigated and disconnected. As noted above, it is likely that the highest flows have reduced since the recent (2016) installation of flap valves on the pump station outlets to stop river floodwater entering the reticulation.

The daily average flow during the summer months of 2009-14 was about 2,200 m^3/d (compared with about 800-1,000 m^3/d in 1992-95), and this increased to winter flows of about 4,000 m^3/d (compared with about 1,600 m^3/d in 1992-95). July is the month with the highest average daily flows, while August is the next highest flow month. The months of January and April can also generate high daily average flows. December is consistently the month with the lowest daily average flow.

Figure 5.3 presents a graph of the variations in the monthly averages of daily inflows which clearly shows the seasonal variations in flows. The range of this data needs to be viewed with some caution, as the inflow data was often absent from the dataset for some months each year during 2009-14, and, in any case, it only represents a few years that may not have included extreme dry or wet months compared with long term weather extreme ranges. It also includes some occasions when flooded river water has entered the reticulation through the reticulation's emergency overflow outlet pipes to the river which no longer occurs.

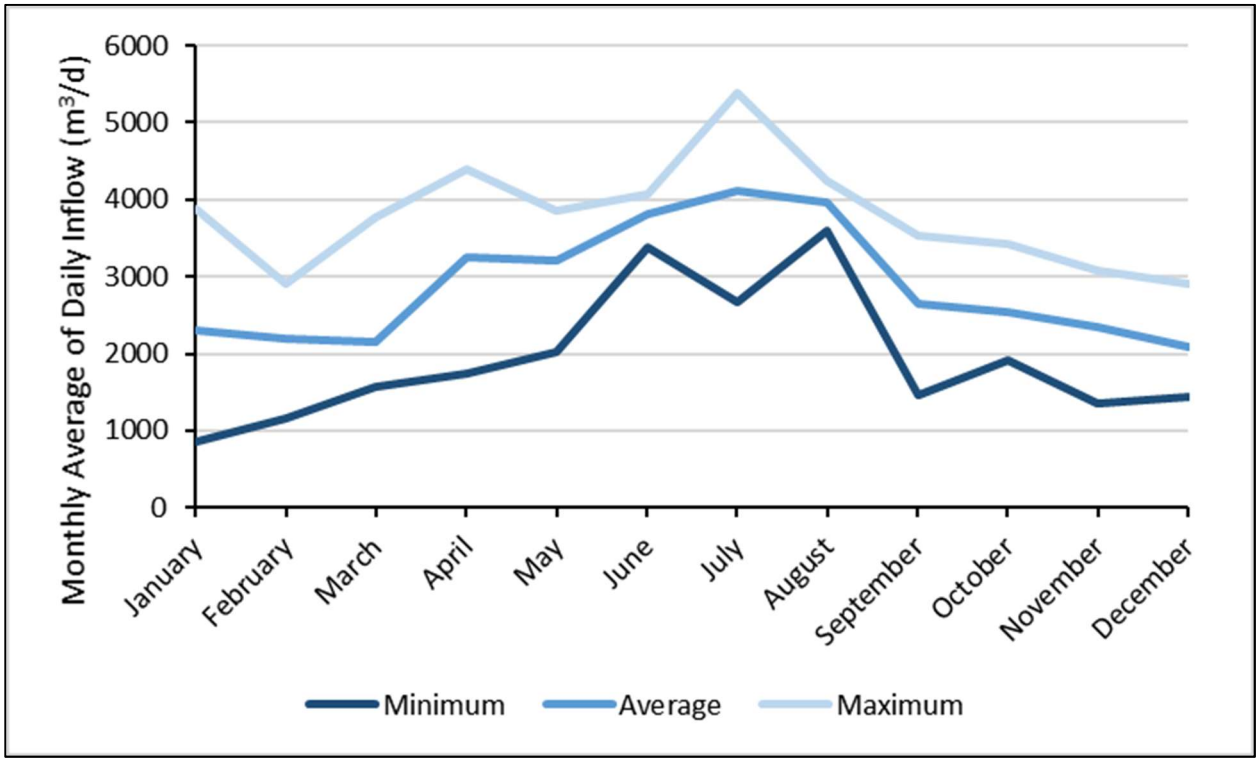

Figure 5.3: Variation Range of Monthly Averages of Daily Inflows for Wairoa WWTP for 2009-14

Annual flow totals during 2009-14 varied between about 900,000 m^3/y and 1,300,000 m^3/y. Annual rainfall during those years varied between about 1,050 mm/y and 1,500 mm/y, but the variations in annual wastewater flows did not always closely follow variations in annual rainfall (partly because of the missing flow data often coinciding with the wetter months). Table 5.1 summarises the daily flows through Wairoa's pump stations and WWTP.

Table 5.1: Dry Weather and Wet Weather Flow Statistics

	2013-14					2009-14
				WWTP Inflow		
Flow Statistic (m^3/d)	North Clyde	Alexandra Park	Kopu Road	Fitzroy Street	Prosol Telemetry	WWTP Outflow
Theoretical DWF[1]	179	139	365	800	800	800
Actual 5th Percentile Flow	210	239	813	959	1,211	856
Mean DWF	433	391	1,589	2,379	2,205	2,243
Mean Total Daily Flow	474	432	1,746	2,419	2,848	2,682
Mean WWF	599	512	2,191	2,910	3,134	2,836
95th Percentile WWF	1,362	1,163	5,511	6,390	6,639	6,287

Note: [1]Theoretical DWF is based on daily average flows of 200 l/pe and a population of 4,000 for Wairoa, which was apportioned on a population basis across the pump station catchments.

There is often a mismatch between the inflow and outflow, with the inflow generally being higher than the outflow. It is not clear whether this relates to erroneous data, larger gaps in outflow records, surcharging of pond levels, pond overflows bypassing the outlet meter, or pond leakage. The inflow data has been seen by WDC as more reliable than the outflow data, as the inflows measured by two separate metering systems closely agreed while the outflows needed to be re-calculated in order to tally with inflows and pond water level fluctuations, and to account for storm overflows that bypassed the outflow meter as noted in Section 3.6 above. WDC is aiming to resolve these data concerns in the near future and expect that by the time consent applications are prepared a reasonable duration of reliable discharge flow data will be available.

Note that the LEI, 2015:A1I1 report flow data statistics for the Fitzroy Street pump station during 2013-14 were similar to the current report's flow statistics for the Prosol inflow data during 2009-14. Overflows upstream of Fitzroy Street (generally between Kopu Road and Fitzroy Street pump stations) were significant at times of heavy rainfall (on average once every 1-2 months during 2012-14). These overflows account for the differences in mean total daily flow and mean and 95th percentile WWF between the Fitzroy Street pump station and the combined totals of the other three upstream pump stations.

Storm-generated overflows of the WWTP ponds via the emergency diversion pipeline around the WWTP ponds bypass the WWTP outflow meter *en route* to the discharge pipeline. The calculated discharge data relied upon for this report aimed to account for these volumes. These pond overflows occur when inflows and rainfall into the WWTP exceed the storage capacity of the WWTP ponds before it is able to discharge into the Wairoa River within the consented time restrictions. These WWTP overflows generally occur outside of the consented time restrictions while the discharge valve is closed, but they can also occur even while it is discharging to the river, as the discharge flow rate can't always keep up with the inflow rate. In order to avoid or minimise WWTP pond overflows, the freeboard storage capacity of the WWTP ponds can be maintained close to its maximum availability of 5,400 m^3 so that any storm inflows can more likely be retained in storage until the next available discharge time. Such management, combined with I & I reductions, could ensure that the discharge would only rarely breach its consent conditions that limit the daily discharge volume to 5,400 m^3/d and/or the timing of discharges to falling tides between 6 pm and 6 am.

5.3 Hydraulic Residence Times

According to WDC's 2010 de-sludging report, the original WWTP design relied on an HRT of 18 days, based on an average daily inflow of approximately 1,300 m^3/d and WWTP operating volume of 23,000 m^3. Based on the average 2009-14 inflow rates, the average HRT for the entire WWTP will be only about 8.0-9.5 days.

Accumulation of sludge in the WWTP ponds further reduces the HRT, as the wastewater can only reside in the volume remaining above the settled sludge. As described in Section 4.4 above, about 16,500 m^3 of sludge had accumulated in the WWTP ponds prior to de-sludging in 2010. This left a total operating volume of 6,500 m^3 within the WWTP ponds, and the resulting HRT would have been only about 2.7 days. In May 2016, Parklink estimated that the accumulated volume of sludge was 8,613 m^3. The remaining operating volume of the WWTP at that time was less than 14,400 m^3, and the HRT was therefore just under 6 days.

Short HRT's reduce the opportunities for effective treatment and pathogen deactivation, but the large dilution of wastewater as a result of the high I & I at Wairoa also reduces the degree of treatment necessary for the wastewater to meet acceptable *concentration* standards prior to discharge. The WWTP's treatment efficiency (in terms of *percentage* reductions in contaminant and pathogen concentrations) is more likely to be reduced (worse) as a consequence of shortened HRT's, as there is less time available for natural processes to reduce the nitrogen concentrations and to deactivate a higher percentage of pathogens.

Short HRT's can at many treatment plants increase the risk of offensive odours being released from the WWTP. The HBRC compliance reports reviewed for this report indicate that there are no records (at WDC or HBRC) of air quality complaints or problems from the Wairoa WWTP. The I & I dilution of Wairoa's wastewater is probably assisting with avoiding odour risks, as odours also tend to be more often generated by more concentrated wastewater streams.

5.4 Wastewater Quality

The monitoring data for raw and treated wastewater quality covers variable timeframes, sampling frequencies, and parameters. In order to directly compare these datasets and obtain appropriate relationships between parameters at each stage of the treatment process, this report only considers the monitoring data for the common period of April 2008 to October 2016. Table 5.2 presents statistics for the raw influent wastewater, the primary treated wastewater (following treatment in the aerated lagoon and before entering the maturation pond), and the final treated wastewater that is discharged from the maturation pond to the Wairoa estuary.

Table 5.2: Wastewater Quality Statistics for 2008-16

	Raw Influent Quality			Primary Treated Quality			Final Treated Quality		
Parameter	**Range**	**Mean**	**Median**	**Range**	**Mean**	**Median**	**Range**	**Mean**	**Median**
pH	6.3 – 8.4	7.5	7.5	6.6 – 8.3	7.4	7.4	6.4 – 9.3	7.6	7.6
COD (g/m^3)	59 – 13,800	526	235	36 – 990	173	161	34 – 620	158	126
CBOD (g/m^3)	14 – 6,000	191	78	6 – 220	48	44	6 – 190	31	23
NH_3-N (g/m^3)	3.9 – 37	17.5	16.3	3.9 – 44	17.2	16.7	4.0 – 36	16.1	15.6
TKN (g/m^3)	7.7 – 56	23.7	22.0	7.0 - 50	22.7	21.5	-	-	-
TN (g/m^3)	7.0 – 56	23.8	22.0	-	-	-	-	-	-
TP (g/m^3)	1.0 – 7.4	3.5	3.3	0.9 – 6.1	3.0	2.9	-	-	-
TSS (g/m^3)	-	-	-	-	-	-	7 – 290	64	52
E. coli (cfu/100 ml)	-	-	-	-	-	-	8 – 470,000	5,250	5,200

Parameter	Raw Influent Quality			Primary Treated Quality			Final Treated Quality		
	Range	Mean	Median	Range	Mean	Median	Range	Mean	Median
Enterococci (cfu/100 ml)	3,000 – 4.5 x 10^6	28.3 x 10^4	34.0 x 10^4	-	-	-	30 – 130,000	1,240	1,100

Note: *Enterococci* data for raw influent wastewater was only available for September 1995 to June 2000 so it was used as a likely indicator of influent quality in 2008-16, as the pathogen loads are generally stable.

There were no long-term trends of decreasing or increasing parameter concentrations, and the accumulation of sludge followed by de-sludging did not appear to strongly influence any of the results. Seasonal fluctuations between low and high concentrations were generally apparent for all parameters.

The New Zealand Oxidation Pond Guidelines 2005 (and other generally accepted oxidation pond design guidelines) adopt a treatment load of 84 kg BOD/ha/d as being appropriate for matching the treatment capabilities of a aerated lagoon system. BOD has not been monitored at Wairoa WWTP, but both COD and CBOD have. CBOD is a more appropriate and similar parameter than COD to compare with BOD, as CBOD represents the carbonaceous biologically active components of the wastewater, while COD includes inorganic consumers of oxygen.

Based on the mean influent CBOD concentration of 191 g/m^3 and the mean daily inflow of 2,700 m^3/d, the incoming CBOD load on Wairoa WWTP is 516 kg CBOD/d. If this is applied only to the 2,120 m^2 area of the aerated lagoon, the incoming load is 2,430 kg CBOD/ha/d. If this is applied across the entire 13,090 m^2 area of the Wairoa WWTP ponds, the incoming load is 394 kg CBOD/ha/d. This is about 4.7 times the recommended guideline value of 84 kg BOD/ha/d. However, it is noted that aeration, short HRT's (driven by high I & I), and accumulated sludge in the aerated lagoon assists with increasing the loading rate of the maturation pond above the guideline value.

5.5 Treatment Performance

The New Zealand Oxidation Pond Guidelines 2005 provide guidance on the design and operation of oxidation ponds for treating wastewater, and include expected typical median values for some parameters of the treated wastewater quality. Table 5.3 compares the actual treated wastewater quality (median values) discharged from Wairoa WWTP during 2008-16 with their relevant guideline median values provided by the New Zealand Oxidation Pond Guidelines 2005. The treatment performance of Wairoa WWTP is also presented in terms of its percentage reductions in parameter concentrations from the raw influent wastewater concentrations.

Table 5.3: Comparison of Wairoa's Treated Wastewater Quality With the NZ Oxidation Pond Guidelines 2005

Parameter	NZ Oxidation Pond Guideline 2005 Median Value	Wairoa WWTP Effluent Median (2008-16)	Wairoa WWTP Performance (% Reduction)
BOD (g/m^3)	30	23 (CBOD)	84 %
NH_3-N (g/m^3)	13	15.6	8 %
TN (g/m^3)	35	-	-
TP (g/m^3)	8	(Influent = 3.3)	-
TSS (g/m^3)	40	52	-
E. coli (cfu/100 ml)	5,000	5,200	99.56 % (2 log)[1]

Note: [1] Based on influent and effluent enterococci results for 1995-2000 as an indicator.

Unfortunately, not all parameters in the NZ Pond Guidelines have been monitored for the Wairoa WWTP's treated wastewater, but TN and TP can be assessed based on the effluent NH_3-N and the influent TP, both of which are well below their respective NZ Pond Guideline median values. The raw influent wastewater also has not been monitored for the same parameters as the final

treated wastewater, which has made it difficult to assess the level of treatment performance (reductions in concentrations) being achieved by the Wairoa WWTP across a range of parameters.

Overall, the Wairoa WWTP appears to be treating the wastewater to achieve an effluent quality that is similar to or better than the expected median values, except for TSS which is 30 % higher (worse) and NH_3-N which is slightly higher (worse) and is only a small (8 %) reduction from the influent wastewater's NH_3-N concentration. However, if NH_3-N is the dominant form of nitrogen in the treated wastewater, the WWTP is achieving a total nitrogen removal rate of about 29 %. This treatment performance assessment indicates that the Wairoa WWTP is generally performing to an acceptable standard despite the short HRT's, high I & I, high BOD load, and, at times, large accumulations of sludge which can all adversely affect treatment performance. However, the dilution provided by I & I is assisting with achieving acceptable discharge concentrations, and the small percentage reduction in NH_3-N suggests that nitrification and denitrification processes are less effective than would be typically expected. The pathogen percentage reductions are also usually 99.9% (3 log) or better.

6 WASTEWATER DISCHARGE STRUCTURE

6.1 General

The treated wastewater pipeline from the WWTP outlet runs along Fitzroy Street and is accessible via three manholes along the road before it reaches the edge of the Wairoa River estuary. It discharges by gravity, and flow is controlled by a valve at the WWTP that is automatically timed to open only during falling tides during 6:00 pm to 6:00 am, as required by the resource consent conditions. It can be manually overridden to discharge flows outside of these hours, despite breaching the consent conditions.

6.2 Description and Condition of Discharge Structure

The WWTP discharge structure was constructed in 1981 as an extension of the earlier untreated wastewater discharge pipeline from Fitzroy Street and the southern section of Kopu Road. The discharge port is located sub-tidally, approximately 150m from the nearest shoreline of the Wairoa River estuary and at a depth of about 1.6 m below the mean low water spring tide level of the estuary.

The outfall is constructed of High Density Polyethylene (HDPE) pipe with an internal diameter of 300mm. Over time this has become buried under up to 3 m of sediment. The outcome of a site investigation by Greenfield Diving Services in April and May 2016 resulted in the removal of the sediment from the outlet and the addition of a diffuser attached to the end of the discharge pipe (LEI, 2017:A2I2).

6.3 Function and Operation of Discharge Structure

Greenfield Diving Services were engaged to investigate the problems associated with a restricted discharge, and a surge chamber over flow that occurred in April and May 2016. It was discovered that the shifting river channel had resulted in high riverbed sediment accumulation (about 3 m deep) over the pipe outlet. The outfall was uncovered with dredging and debris removal, but this was seen as a short-term solution with recommendations to install a stand pipe with a T junction to the current riverbed level or to extend the pipeline into a deeper area of the river.

A diffuser was installed on the end of the discharge pipe in March 2017. This is expected to improve the discharge flow out to the Wairoa River and minimise the effects of any further discharges that exceed the consented daily limit of 5,400 m^3/d and/or occur outside of falling tide conditions between 6:00 pm and 6:00 am.

The flow of the Wairoa River into Hawke Bay is restricted by the width and depth of the channel opening through the gravel bar across the estuary. This channel opening is subject to periodic closure from sediment accretion due to wave action and is re-opened through flood events or via mechanical removal of sediments (using a digger or dredge). The maintenance of the channel opening is a HBRC flood management function, and is presumably undertaken in accordance with a resource consent authorisation. This activity is completely outside of WDC's control.

The location of the bar channel tends to vary, but it is generally located either south or slightly southwest of the outfall. HBRC's river monitoring records relied upon for this report indicate that HBRC has reopened the channel through the bar at least once per year during 2009-16 but WDC staff and their community have noted that HBRC do not appear to have acted promptly after the bar closed on each occasion.

LEI, 2017:A3I2 noted that closure of the bar clearly causes water levels in the lower reaches of Wairoa River to rise and maintain higher levels, even at low tide, as its flow into Hawke Bay is impeded. Once the bar channel is reopened, the river water levels drop significantly, particularly at low tide, and tidal variations in water levels become more pronounced as the incoming marine waters are freely able to flow up the estuary.

7 CONSENT CONDITION COMPLIANCE

7.1 General

This section of this report summarises the discharge resource consent condition compliance by the Wairoa WWTP discharge, as assessed by HBRC's consent compliance reviews of WDC's annual consent compliance reports and supporting data.

Pump station and manhole overflows onto land and into the Wairoa River caused by storm events occur without consent, and HBRC's compliance staff have raised their concerns about this when reviewing WDC's annual compliance reports, even though it is an entirely separate suite of discharges from that authorised by the WWTP discharge consent. WDC have been investigating the causes of these overflows, implementing changes to prevent or reduce future overflows, and rectifying I & I sources entering the reticulation. A mitigating factor in these overflows is that the discharges are dominated by stormwater rather than wastewater (ie, they are essentially stormwater contaminated by wastewater), and the Wairoa River is flooding and already carrying higher loads of contaminants than would be contributed by the wastewater overflows. HBRC's compliance staff have acknowledged that the adverse effects from these overflow discharges would be less than minor and difficult to detect downstream.

7.2 Existing Discharge Consent

The existing discharge is authorised by consent number CD940404W, which was granted by HBRC on 23 August 1999, for a 20-year term expiring on 31 May 2019. The consent authorises *"the discharge (of) treated sewage effluent from the Wairoa sewage treatment plant into the Wairoa River estuary."*

The consent has 17 conditions, addressing issues in the following categories:

- Daily volume limit (5,400 m^3/d);
- Time and tide restrictions on the discharge timing;
- Discharge restrictions during river mouth closures;
- Public warnings of discharges during river mouth closures;
- Requirement to use existing discharge structure;
- General limitation on effects from discharge;
- Keeping and making available discharge records;
- Effluent standards and analysis;
- Air discharge;
- Complaints log; and
- Non-compliance responses.

The discharge resource consent conditions limit the daily discharge volume to a maximum of 5,400 m^3/d. It also restricts the timing of discharges to periods of ebb tide 30 minutes after high tide to 6 hours after high tide and only when these tidal phases occur between 6:00 pm and 6:00 am. When the bar across the mouth of the Wairoa estuary to Hawke Bay is closed, no discharge is allowed and all wastewater is required to be stored at the WWTP until the WWTP's storage capacity has or is about to run out, at which point the discharge may re-commence under the same restricted daily volume, hours and tidal phases as prevails when the bar is open. There are no conditions that specifically allow for discharge volumes or times to exceed these restrictions when storm flows or emergency events occur. When discharges occur while the bar is closed, the consent conditions also require WDC to use public warning signs and public notices in local media to warn the public of the potential health risk.

The reasons given in HBRC's decision to grant this resource consent included the following key points:

- The existing treatment and discharge had "not been shown to be creating any actual significant adverse effects to … the Wairoa River estuary";
- The discharge standards will protect and maintain the river water quality;
- The discharge to the river "better meets the purposes of the Resource Management Act than discharge onto land because the establishment of a land discharge option will create significant adverse effects [on] the Wairoa community's economic and social wellbeing, while not necessarily being able to provide for their health and safety better than the current system"; and
- "There are low cost, low technology upgrades that would accommodate cultural concerns as well as providing a better level of treatment prior to discharge to the estuary. A consent duration of 20 years provides sufficient time for these options to be investigated for a future upgrade, while not burdening the community of Wairoa with short term repeat costs associated to consent renewal."

7.3 Consent Compliance Reports

HBRC has provided annual Compliance Reports in most years, reporting on the extent to which the consented activities have met the conditions of the authorising consent. The findings of HBRC's reviews of the four Compliance Reports for 2008-14 are presented in Table 7.1 below. Although HBRC staff have incorporated comments about the pump station overflows into their compliance reviews, these strictly are not associated with the WWTP discharge consent and are therefore not breaches of this discharge consent. Table 7.1 is limited to HBRC's commentary on discharges from the WWTP alone.

Table 7.1: Wairoa Wastewater Discharge Consent Compliance

Condition Number	Requirement	Compliance Report Date			
		2009, 9 Oct	2011, 10 Feb	2013, 17 Jun	2014, 14 Apr
1	Operate in accordance with consent application	Yes	Yes	Yes	Yes
2	Volume to not exceed 5,400 m^3/d	Outfall discharge yes; some storm overflows no.	Outfall discharge yes; some storm overflows no.	Outfall discharge yes; some storm overflows no.	Outfall discharge yes; some storm overflows no.
3	Only on falling tide at night (between 6:00 pm and 6:00 am)	Controlled discharges yes; some storm overflows no.	Controlled discharges yes; some storm overflows no.	Controlled discharges yes; some storm overflows no.	Controlled discharges yes; some storm overflows no.
4	When river mouth closed, only discharge if storage capacity full, and then only on a falling tide at night	Generally yes, but some storm uncontrolled overflows do not adhere to required discharge times; no.	Generally yes, but some storm uncontrolled overflows do not adhere to required discharge times; no.	Generally yes, but some storm uncontrolled overflows do not adhere to required discharge times; no.	No river mouth closures, so not applicable.
5	Use warning signs, local radio and newspaper notices to warn public of health risk when river mouth closed	Discharges occur when warnings are not possible. Unable to assess.	Discharges occur when warnings are not possible. Unable to assess.	Discharges occur when warnings are not possible. Unable to assess.	No river mouth closures, so not applicable.
6	Discharge through existing structure	Pond outflow discharges through this	Pond outflow discharges through this	Pond outflow discharges through this	Pond outflow discharges through this

Condition Number	Requirement	Compliance Report Date			
		2009, 9 Oct	2011, 10 Feb	2013, 17 Jun	2014, 14 Apr
		structure, so yes.	structure, so yes.	structure, so yes.	structure, so yes.
7	Sampling station near WWTP outlet	Yes	Yes	Yes	Yes
8	s107 and coastal marine water quality standard.	Yes	Yes; uncontrolled overflows occur during elevated river flows.	Yes; uncontrolled overflows occur during elevated river flows.	Yes; uncontrolled overflows occur during elevated river flows and contaminants from land use.
9	Daily record of discharge volume, time, and river mouth status	Yes	Yes	Yes	Yes, but with evident flow metering problems.
10	Make monitoring records available	Yes	Yes	Yes	Yes
11	Discharge quality limits for COD (220 mg/l), ammonia (36 mg/l) and suspended solids (87 mg/l).	Generally yes, but SS exceeded limit in Dec '08.	Generally yes, but COD over limit on 3 occasions and SS over limit on 1 occasion.	Generally yes, but COD over limit on 3 occasions and SS over limits on 4 occasions.	Generally yes, but COD and SS over limits on 2 occasions each.
12	Analytical standards	Yes	Yes	Yes	Yes
13	Monthly sampling and analysis of effluent	Yes	Yes	Yes	Yes
14	Analysis results to HBRC	Yes	Yes	No, reporting was late.	No, reporting was late.
15	No offensive and/or objectionable odours beyond WWTP boundaries	Yes	Yes	Yes	Yes
16	Maintain a complaints log	Yes	Yes	Yes	Yes
17	Steps required when condition 11 limits are breached	Yes	No; repeat sampling wasn't done.	No; repeat sampling wasn't done.	No; repeat sampling, reporting and remediation not done.
Overall Comment	-	Generally compliant, but uncontrolled discharges with heavy rain require attention.	Generally compliant, but uncontrolled discharges with heavy rain require attention. Noted that ponds will be de-sludged this year.	Generally compliant, but uncontrolled discharges with heavy rain require attention.	Generally compliant, but uncontrolled discharges with heavy rain require attention.

Discussion

A positive feature of this compliance record is that 9 of the 17 conditions have been consistently complied with on all four of the reporting occasions viewed. Issues that arise from Table 7.1 can be summarised as follows:

- The **managed** discharge from the WWTP to the estuary operates within most consent requirements most of the time;

- Storm-induced flows through the WWTP have caused breaches of conditions on a number of occasions in all of the reporting periods reviewed, generally due to discharges occurring outside of the consented discharge times and occasionally exceeding the daily total volume limit. It is apparent that these conditions would not have been breached if storm-induced inflows were smaller and if there were no overflows of the WWTP's storage

capacity. These storm flows are by their nature usually unmanaged, and until reticulation improvements substantially reduce stormwater entry to the sewer they will continue to occasionally breach the consent conditions during large storm events. Some of these storm discharges have been managed by manually opening the discharge valve outside of the consented hours, but the discharge volumes are not restricted. The WWTP's emergency bypass system allows unmanaged discharges to occur at any time and volume once the available storage has been exceeded. As noted above, active management of the WWTP pond levels to maintain as much available storage as possible prior to storm events assists with avoiding or minimising these discharges;

- Condition 4 applies to discharges to the estuary when the river mouth (bar) is closed, requiring storage to be used until it is full, and then any discharges are to be at night and on a falling tide (the same limitations as would apply when the bar is open); Condition 5 requires public warnings to be issued when discharges occur while the bar is closed. In practice, the limited storage at the WWTP means that the ponds rapidly fill and these discharges commence soon after the bar closes, which is insufficient time for WDC to arrange for public warning of these events. WDC has no control over the river mouth closure or opening, as noted above, so WDC are unable to minimise the duration of restrictions on discharges while the river mouth (bar) remains closed.

- Discharge quality limits for COD and/or SS have been exceeded on 1-4 occasions out of 12 in every compliance report, and either the effluent quality limits are too tight and should be increased upon renewal of the discharge consent or treatment is occasionally poorer than expected. It has been noted by HBRC that sludge accumulations have reduced the WWTP's performance, but high I & I may also contribute. The effluent quality has a wide range despite its median values being well below the consented limits. More recent resource consent conditions for other WWTP discharges, in recognition of the inherently variable effluent quality, often allow the rolling 12-month median to exceed any of the effluent quality limits on 2 out of 12 monthly sampling occasions before they are deemed to be a breach of the effluent quality limit condition. Adopting this approach might have resulted in Wairoa WWTP achieving full compliance most, if not all, of the time;

- Technical reporting of effluent analysis results to HBRC has often been late, but this is an administrative issue rather than an environmental effects concern, and perhaps the time limit set for such reporting is too tight; and

- The requirements in Condition 17 for repeat sampling and reporting when effluent quality standards are breached have generally not been met; either the re-sampling timeframe is unrealistic and should be varied upon renewal of the discharge consent, or the management of reporting needs review and active follow-up for prompt re-sampling when breaches are found to have occurred. Regardless of this, additional monitoring will merely help define how long the discharge is exceeding the effluent quality limits while having no influence on the WWTP's treatment performance or on the scale of adverse effects on the river. WDC have limited ability to influence the treated wastewater quality, but it is appropriate that effort should focus on rectifying any causes of poorer treatment instead of, or in addition to, any further monitoring.

8 CURRENT SYSTEM LIMITATIONS

8.1 WWTP Design and Operation

The freeboard of the WWTP ponds is about 300 mm for the aerated lagoon and 500 mm for the maturation pond. These freeboard levels provide limited (but not unusual) storage capacity for surcharging inflows when outflows would breach consent conditions (i.e. outside of overnight falling tides). The WWTP design incorporates a storage capacity of at least 5,400 m^3, but storm inflows can readily fill the available storage capacity and this causes overflow and discharge management issues for the WWTP during large storm events. As noted above, active management of the WWTP pond levels to continually maintain as much available storage as possible will assist with avoiding or minimising these discharges.

Mechanical aeration is provided for the aerated lagoon. There does not appear to be any need for mechanical aeration of the maturation pond or additional treatment prior to discharge, as the overall treatment performance is generally acceptable.

The wastewater treatment load on Wairoa WWTP is well above the design load of 84 kg BOD/ha/d recommended by the New Zealand Oxidation Pond Guidelines 2005 and other commonly accepted design guidelines. However, it is noted that aeration, short HRT's (driven by high I & I), and accumulated sludge in the aerated lagoon assist with increasing the loading rate of the maturation pond above the guideline value. Despite this high load and other factors which can all adversely affect treatment performance, Wairoa WWTP is generally treating the wastewater to achieve an effluent quality that is similar to or better than the expected median values for its design, but this is partly because the I & I dilutes the raw wastewater.

8.2 Wastewater Flow Rates and Sludge Accumulation

Stormwater and groundwater I & I contributions to inflows dilute the wastewater and significantly increase the daily flow rates entering the WWTP while also reducing the HRT of wastewater in the WWTP. These factors can reduce the treatment performance of the WWTP in terms of percentage reductions in concentrations in raw versus treated wastewater for some key parameters, such as nitrogen and pathogens.

Storm events elevate flows substantially and can cause overflows of the wastewater at the pump stations and manholes within the Wairoa township. These overflows reduce the burden on the WWTP, but are a higher environmental and public health concern as they flow over private and/or public land (reserves and roads) or directly discharge into the Wairoa River. The high stormwater content of the overflowing wastewater reduces the health risk of the wastewater overflows. The surface ponding and flow of direct rainfall and stormwater then helps dilute and disperse the wastewater overflows. Finally, the flooding conditions of the Wairoa River are already heavily contaminated (particularly with silt loading) and therefore are not sensitive to these highly diluted wastewater discharges.

Sludge accumulations in the WWTP ponds and difficulties with de-sludging due to access and pond design limitations have, at times, adversely affected the WWTP's treatment performance. The rate of sludge accumulation seems to be rapid, at about 900-2,100 m^3/y, which requires de-sludging at least once every 6-10 years. The sludge within the aerated lagoon has a high sand content (reflective of the high stormwater and I & I content of the wastewater) which is non-biodegradable and more difficult to remove from the base of the pond. Therefore, improvements in reticulation may not only reduce peaking wet weather flows, but also reduce the accumulation rate and inorganic content of sludge.

The Wairoa WWTP's HRT was originally designed to be 18 days, but the elevated I & I and the accumulation of sludge have reduced the HRT; as at May 2016 it had an HRT of only 6 days. The reduction of I & I and more frequent removal of accumulated sludge would extend the HRT and could help improve or stabilise treatment performance.

The alternative or supplementary means of increasing storage volume and/or HRT is to construct additional WWTP ponds. However, the cost and practicality of constructing any additional ponds (additional land and large-scale earthworks with impermeable lining of the new ponds would be required) are likely to be prohibitive for the small community of Wairoa.

8.3 Existing Discharge Consent

As noted above, WDC do not have a discharge consent for any of the storm-induced overflows of untreated wastewater directly from the pump stations and/or manholes onto land or into the Wairoa River. WDC have been investigating the causes of these overflows, implementing changes to prevent or reduce future overflows, and rectifying I & I sources entering the reticulation. In order to allow for future storm-induced events, which are still likely to occur several times in a wet year, WDC will need to obtain appropriate consent(s) and continue to reduce the volume and frequency of such overflows. HBRC's compliance staff have accepted that the adverse effects are less than minor and difficult to detect downstream, which may assist with HBRC approving appropriate consents. Upgrades of reticulation and pumping capacities will prevent or at least reduce these overflows, but a continuation of existing I & I will in turn increase the flows through the WWTP which still need to be discharged to the environment after treatment.

The most effective remedy for preventing or reducing these unauthorised and uncontrolled discharges is to rectify the reticulation system to exclude I & I so that such large additional volumes of diluted wastewater are not pumped within the reticulation network and ultimately into the WWTP for treatment and discharge. Maintaining daily wastewater volumes within the pumping capacity and discharge limits will ensure that overflows will not occur anywhere and consent breaches will be avoided. It needs to be noted that the required scale of reticulation improvements is unlikely to achieve these ultimate objectives within the next few years.

The existing consent limits on the timing of discharges of treated wastewater from the WWTP have been difficult to comply with when storm flows pass through the WWTP, as the available storage capacity of the WWTP is sometimes insufficient for retaining flows until the next night's out-going tide. As a result of WWTP design and operational constraints and elevated inflows, the discharges to the Wairoa River estuary have, at times:

- exceeded the daily maximum limit of 5,400 m^3/d; and/or
- been outside of the night-time falling tide periods; and/or
- occurred without public warnings while the bar has closed the estuary mouth; and/or
- been additional to the discharges of un-treated wastewater from the pump stations.

The ideal discharge consent would allow for all daily flows to be continuously discharged to the receiving environment without delays, flow limits, or requiring storage. However, this is perhaps unrealistic, as any land discharge would also require storage and managed discharges, and the limits on the river discharge timing and volumes have been set in order to protect the estuarine environment and ensure that the discharge is rapidly flushed out to sea instead of mixing and staying within the estuary area. Previous river monitoring and environmental assessments have indicated that discharges during low river flow rates, incoming tides, and closed bar conditions are each likely to result in unacceptable risks of adverse effects, which formed the basis for the consent conditions regulating discharges to avoid such river flow conditions. The effects of the actual discharge of treated wastewater to the river (which has mostly complied with the discharge

conditions) have been less than minor or undetectable in terms of water quality and ecosystem changes, as noted in LEI, 2017:A3I2.

8.4 Future Consenting Constraints

The current discharge consent was granted by HBRC on the basis that WDC would use the 20-year term to investigate potential upgrades to the WWTP to better address cultural concerns and improve treatment levels, and to reassess the feasibility and affordability of possible alternatives to the river discharge. The reporting planner's recommendation to the hearing panel and the subsequent consent decision noted these expectations.

Cultural values, national environmental standards and policy statements, and various Regional Plan requirements provide strong drivers for ceasing (or at least reducing) discharges to the river and coastal marine environments, and instead implementing discharges to or through land. These drivers are described in more detail in the Planning Considerations report (LEI, 2017:A7I1). Community aspirations for public health, recreation, fishing, and other social values also drive the need to consider discharges to land or perhaps a discharge location further offshore in the marine environment (within Hawke Bay instead of the river).

It therefore is apparent that any application for consents to continue the river discharge will require a very robust reasoning to support such a position. The future discharge consent renewal application will need to thoroughly consider all aspects, including alternative discharge sites, land availability, environmental effects of the existing and proposed discharge, cultural values, recreational/social values, and financial considerations. It will need to demonstrate that all options have been considered, and that the BPO has been robustly selected for consenting. The process and criteria used to select the BPO, including consultation with the affected community and iwi, will need to be clearly described in the consent application documents.

8.5 Potential Treatment Enhancements

Although the Wairoa WWTP has generally been performing within the treatment standards expected for its design, concerns about its performance have been raised in the past, and WDC have been offered and/or considered some treatment enhancements.

Parklink suggested that using Advanced Microbial Digestion (AMD) induced by seeding the WWTP ponds with specific bacteria could reduce solids accumulation and stimulate important biological functionality (Parklink Ltd, 2016). However, an earlier WDC investigation had indicated that the high stormwater component of Wairoa's wastewater inflows would limit the effectiveness of this.

Any treatment enhancements will be of limited benefit while the wastewater is diluted by I & I. It would therefore be of a much greater financial efficiency to rectify the reticulation system to exclude I & I as a priority over implementing any improvements to the WWTP treatment processes. Regular removal of accumulated sludge from the ponds will probably also assist treatment performance more efficiently than treatment enhancements.

The high inorganic (sand) content of the sludge in the aerated lagoon suggests that the existing inlet screen is not preventing sandy grit entering the WWTP ponds. It is likely that reductions in I & I will reduce the sandy content of the wastewater and settled sludge. In addition, it may be advantageous for WDC to install a grit trap prior to the aerated lagoon inlet (either before or immediately after the inlet screen) to address this issue. A grit trap would require daily cleaning. During storm events it is likely to require more frequent cleaning.

If WDC and the community require greater certainty of low health risks from discharges of pathogens into the river, WDC may wish to consider the installation of UV disinfection of the treated wastewater prior to its discharge. A filtration system would probably also be required to ensure that the UV treatment is effective.

9 CONCLUSIONS

9.1 Reticulation

The community reticulation is approximately 40 km and has five pump stations. It is of varying age with about 70 % installed more than 60 years ago. About 60% of the reticulation by length are earthenware.

Reticulation currently allows significant I & I inflows, with some catchments experiencing greater inflow than others. High flows can lead to pump station and WWTP overflows and can reduce the effectiveness of wastewater treatment (percentage reductions of parameter concentrations) while also diluting the wastewater. WDC have been addressing I & I by removing stormwater connections, upgrading and servicing pump stations, and repairing and replacing some of the reticulation through an on-going programme.

Historically, flooded river water has been able to surcharge back through the reticulation's emergency overflow outlet pipes into the pump stations and reticulation system. Recently added outlet flap valves have stopped this backflow, and the resulting effects of this on the highest wastewater flows is more recent than the flow data used in this report.

9.2 WWTP Design and Performance

The Wairoa WWTP ponds have a total volume of about 23,000 m^3 (mainly in the maturation pond which is about 5 times the size of the aerated lagoon). The aerated lagoon is about 3.4 m deep, while the maturation pond is about 2.0 m deep. Two aerators are operated on the aerated lagoon, while the maturation pond is not mechanically aerated.

An emergency overflow system is built into the WWTP design. Overflow weirs into bypass pipelines are located at the WWTP inlet (prior to the screen), in the pipeline connecting the two ponds, and at the outlet of the maturation pond adjacent to the outlet valve. All of these overflows bypass the outlet meter and connect into the discharge pipeline downstream of the WWTP's outflow meter.

Daily wastewater flow averaged about 2,700 m^3/d during 2009-14, with average summer flow of about 2,200 m^3/d and winter average flow of about 4,000 m^3/d. These flows are well above typical expected flows for communities the size of Wairoa, and about 1,500 m^3/d higher than the 1992-95 flows reported in the application documents for the current resource consent. The theoretical DWF for Wairoa's current population is about 800 m^3/d based on 200 l/d for each person. Table 9.1 summarises the daily flows through Wairoa's WWTP during 2009-14.

Table 9.1: Dry Weather and Wet Weather Flow Statistics During 2009-14

	WWTP Inflow		
Flow Statistic (m^3/d)	Fitzroy Street (2013-14)	Prosol Telemetry (2009-14)	WWTP Outflow (2009-14)
Actual 5th Percentile Flow	959	1,211	856
Mean DWF	2,379	2,205	2,243
Mean Total Daily Flow	2,419	2,848	2,682
Mean WWF	2,910	3,134	2,836
95th Percentile WWF	6,390	6,639	6,287

There is often a mismatch between the inflow and outflow, with the inflow generally being higher than the outflow. It is not clear whether this relates to erroneous data, larger gaps in outflow

records, surcharging of the ponds, pond overflows bypassing the outlet meter, or pond leakage. The inflow data has been seen by WDC as more reliable than the outflow data, as the inflows measured by two separate metering systems closely agreed while the outflows needed to be re-calculated in order to tally with inflows and pond water level fluctuations, and to account for storm overflows that bypassed the outflow meter. The outflow data used in Table 9.1 and throughout this report was the calculated dataset. WDC is aiming to resolve data concerns in the near future and expect that by the time consent applications are prepared a reasonable duration of reliable discharge flow data will be available.

The original WWTP design relied on a hydraulic residence time (HRT) of 18 days, based on an average daily inflow of approximately 1,300 m^3/d. Based on the actual daily average flow of 2,700 m^3/d, which is significantly higher than the original design flow and the 1992-95 flows due to I & I volumes, the average HRT is less than 8.5 days. Accumulation of sludge in the WWTP ponds further reduces the HRT.

Sludge appears to require regular removal from the WWTP ponds (every 6-8 years), as it appears to be accumulating rapidly (900 – 2,100 m^3/y). The sludge in the aerated lagoon is more difficult to remove due to its high sand content (reflective of the high stormwater and I & I content of the wastewater), the pond's small size and obstacles of aerators and outlet structure. It seems likely that the recent (2016) installation of flap valves on the pump station outlets will have helped to prevent sand and silt from the flooded river entering the reticulation, which in turn should have improved the sludge characteristics and slowed its rate of accumulation. Future sludge removal programmes should assess these aspects of sludge accumulations, but the installation of a grit arrestor at the WWTP inlet would prevent most sand and silt entering the aerated lagoon.

Despite the short HRT's, high I & I, high BOD load, and, at times, large accumulations of sludge which can all adversely affect treatment performance, the Wairoa WWTP is generally treating the wastewater to achieve an effluent quality that is similar to or better than expected median values for such pond systems, as summarised in Table 9.2 below.

Table 9.2: Comparison of Wairoa's Treated Wastewater Quality with NZ Oxidation Pond Guidelines 2005

Parameter	NZ Oxidation Pond Guideline 2005 Median Value	Wairoa WWTP Effluent Median (2008-16)	Wairoa WWTP Performance
BOD (g/m^3)	30	23 (CBOD)	84 %
NH_3-N (g/m^3)	13	15.6	8 %
TN (g/m^3)	35	-	-
TP (g/m^3)	8	(Influent = 3.3)	-
TSS (g/m^3)	40	52	-
E. coli (cfu/100 ml)	5,000	5,200	99.56 % (2 log)

9.3 Resource Consents

The discharge of treated wastewater to the Wairoa River has generally complied with the resource consent conditions except when storm-induced flows have overwhelmed the available storage volume in the WWTP ponds and forced the discharge to exceed the daily discharge limit of 5,400 m^3/d and/or to occur outside of the falling tide during night hours (6 pm to 6 am). The high I & I flows and perhaps sub-optimal management of the WWTP's available 5,400 m^3 storage capacity for surcharging inflows have caused consent breaches during large storm events. Reductions in I & I and active storage management at the WWTP may reduce the frequency and scale of consent breaches to rare events. Additionally, as noted above, the restrictions on discharges to the Wairoa River when the bar closes the river mouth opening to Hawke Bay create a further burden on WDC which is completely outside of their control.

Pump station and manhole overflows onto land and into the Wairoa River caused by storm events occur without consent approval. WDC have been investigating the causes of these overflows, implementing changes to prevent or reduce I & I and overflows, and rectifying I & I sources entering the reticulation. Should overflows continue in future, WDC will need to obtain appropriate consents for future storm-induced discharges and continue to reduce the volume and frequency of such overflows. A mitigating factor in these overflows is that the discharges are dominated by stormwater rather than wastewater (ie, they are essentially stormwater contaminated by wastewater), and the Wairoa River is flooding and already carrying higher loads of contaminants than would be contributed by the wastewater overflows.

The current discharge consent was granted by HBRC on the basis that WDC would use the 20-year term to investigate potential upgrades to the WWTP to better address cultural concerns and improve treatment levels, and to reassess the feasibility and affordability of possible alternatives to the river discharge. Cultural values, community aspirations, national environmental standards and policy statements, and various Regional Plan requirements provide strong drivers for ceasing (or at least reducing) discharges to the river and coastal marine environments, and instead implementing discharges to or through land.

The future discharge consent renewal application will need to thoroughly consider all aspects, including alternative discharge sites, land availability, environmental effects of the existing and proposed discharge, cultural values, recreational/social values, and financial considerations. The process and criteria used to select the BPO, including consultation with the affected community and iwi, will need to be clearly described in the consent application documents.

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