Beca

CHBDC WWTP Basis of Design 2020

Prepared for Central Hawke's Bay District Council
Prepared by Beca Limited

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Contents

Revision History

Revision Nº	Prepared By	Description	Date
A	Sarah Burgess	Draft issue, withholding conveyance section	25/03/2020
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Document Acceptance

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on behalf of	Beca Limited		

Executive Summary

This report considers available data on Waipawa, Waipukurau and Otane WWTPs and uses that data to make the best possible approximation of the likely flow and load conditions to be considered in conceptual design of the resulting treatment facilities. It also identifies preferred pipeline routes for conveying wastewater between sites for the two design cases under consideration.

The design cases are:

- **Option 1:** Upgrade Waipawa' s WWTP to receive combined Waipawa and Otane wastewater, with discharge to rapid infiltration basins (RIBs) at a site on Walker Road. Separately upgrade Waipukurau' s WWTP with discharge to RIBs at a suitable site (Ford Rd). Otane WWTP to be decommissioned.
- **Option 2:** Flows from all three catchments sent to an upgraded WWTP at Waipawa. Discharge to RIBs at Walker Rd. Otane and Waipukurau WWTPs to be decommissioned.

The projection of likely future flows and loads for the two design cases considered is summarised in the tables below.

Option 1 Influent Design Basis – 2028 and 2048 Design Horizon

Parameter		Waipawa + Otane 2028		Waipukurau 2028		Waipawa + Otane 2048		Waipukurau 2048	
		Average	Peak	Average	Peak	Average	Peak	Average	Peak
Flow (m³/d)		1,343	15,447	2,630	12,402	1,392	16,010	2,785	13,134
TSS	mg/L	482	832	216	247	481	829	214	243
	kg/d	647	1,117	569	649	669	1,154	597	677
$cBOD_5$	mg/L	190	448	325	488	190	426	316	470
	kg/d	255	602	854	1,284	264	592	879	1,309
Total N	mg/L	46	68	51	76	47	64	50	73
	kg/d	62	91	135	200	65	89	139	204
Total P	mg/L	7	12	6	13	7	11	9	13
	kg/d	10	16	16	34	10	16	26	35

Option 2 Influent Design Basis – 2028 and 2048 Design Horizon

Parameter		2028		2048	
		Average	Peak	Average	Peak
Flow (m³/d)		3,973	27,849	4,178	29,144
TSS	mg/L	306	444	303	438
	kg/d	1,216	1,766	1,266	1,831
$cBOD_5$	mg/L	279	475	274	455
	kg/d	1,109	1,886	1,143	1,901
Total N	mg/L	50	73	49	70
	kg/d	198	291	204	293
Total P	mg/L	6	13	9	12
	kg/d	26	50	36	51

The conveyance routes required are:

a. Treated wastewater from Waipawa to Walker Road disposal site for Otane and Waipawa flows (Option 1)

b. Treated wastewater from Waipukarau to Ford Road disposal site (Option 1)

c. Treated wastewater from Waipukurau to Waipawa and to Walker Road disposal site for all three combined flows (Option 2)

d. Raw wastewater from Waipukarau to Waipawa (Option 2).

The selected route alignments are shown in Section 7.6

A full characterisation programme is required that extends the dataset obtained for Waipawa to cover the other two WWTPs to allow for accurate sizing, costing and design of the required facilities.

1 Introduction

1.1 Background

Waipukurau, Waipawa and Otane are towns in the Central Hawke's Bay District. The three towns make up roughly 50% of the district population. Each town has a wastewater treatment plant (WWTP) which treats, and discharges water into the Tukituki River or its tributaries.

Central Hawke's Bay District Council (CHBDC) is developing a wastewater strategy for these three towns which will remove direct wastewater discharges from surface waterways and provides a pathway towards a high-quality treated wastewater which can be used as a resource. In order to achieve these aspirations a step-change in treatment technology will be required, as the current pond-based systems at all three WWTPs cannot be upgraded to meet the agreed treatment targets. Two upgrade options have been identified, with varying levels of consolidation to balance conveyance and treatment costs.

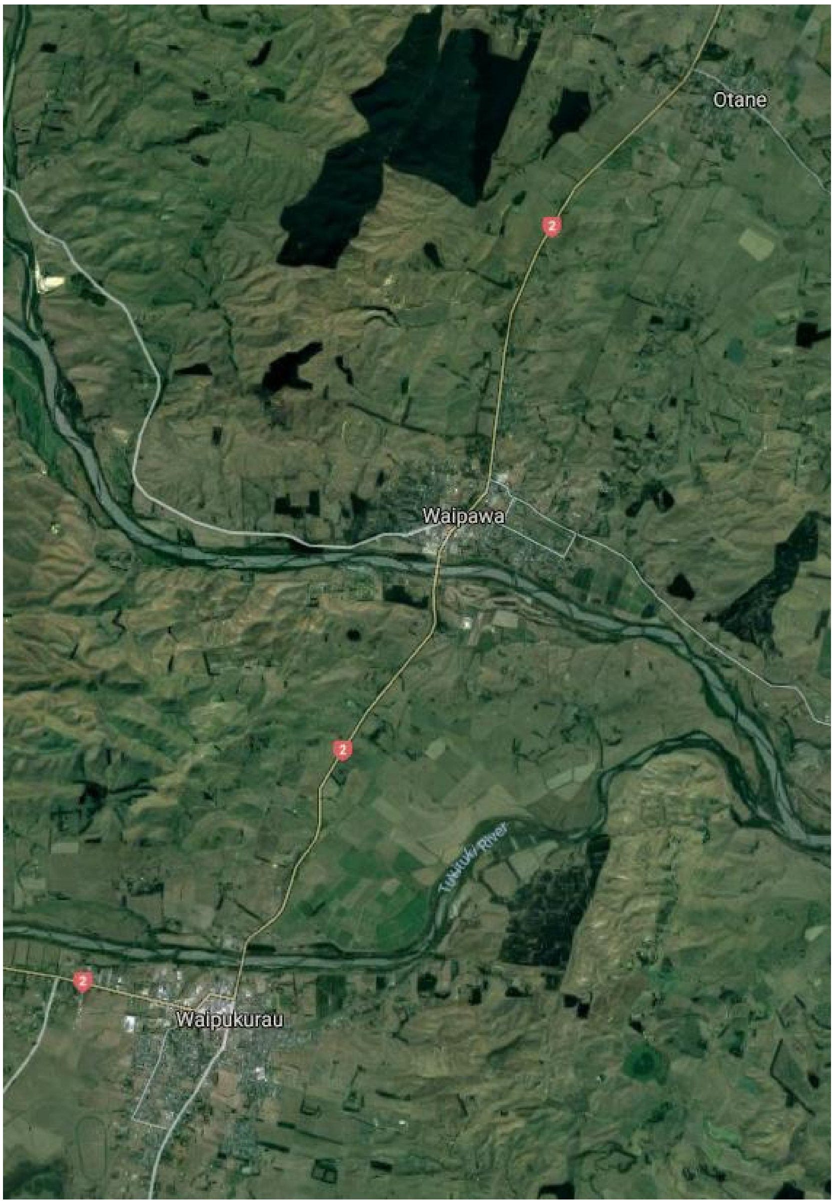

Figure 1-1: Aerial view of Otane, Waipawa and Waipukurau Townships

1.2 Scope

This report determines the basis of design flow rates and contaminant loading for each community, which are then combined to provide the flows and loads for the two potential treatment plant upgrade scenarios. The report also presents the results of an initial route screening exercise to identify suitable pipeline routes for the conveyance requirements of each option.

The flows, loads and pipeline routes set out in this report will form the basis for conceptual-level design of the two proposed options.

1.3 Information Received

The work herein provides an initial assessment of the current and future raw wastewater flows and loads. It is based on incomplete information and will, necessarily, be upgraded as time passes and current operational data and population projections are improved. Plant inflows and influent characterisation data in particular will need to be improved before preliminary design is undertaken.

The data sources use in this report are outlined in Table 1-1.

Table 1-1 – Data sources used

Data	Date Range	Description
Inflow to Waipawa WWTP	Jan 2014 – Dec 2017	Daily flowrate data, complete .
Inflow to Waipawa WWTP	Jan 2018 – Feb 2020	Daily flows from the Pourerere Rd pump station only
Inflow to Waipawa WWTP	Jan 2017 – Dec 2018	Daily pump run hours from the McGreevy St overflow pump station only
Waipawa WWTP Outflow	Jan 2008 – Dec 2019	Daily flowrate data, complete.
Waipawa Pond Influent Monitoring:	Dec 2013 – Dec 2014	Monthly influent sampling.
Waipawa Pond Influent and Interstage Monitoring: COD, $cBOD_5$, TSS, TKN, NH3-N, NOx-N, TN, TP, alkalinity	Sep 2017 – Apr 2019	Weekly influent sampling.
Waipukurau WWTP Outflow	Jan 2008 – Dec 2019	Daily flowrate data, complete.
Waipukurau Influent Monitoring: DO, Temp, Faecal Coliforms, E.coli, pH, TSS, $cBOD_5$, NH3-N, SRP, TN, TP	Dec 2013 – Dec 2014	Monthly influent sampling.
Otane WWTP Inflow	Oct 2018 – Mar 2019	Daily flowrate data. Missing data from 14/05/19 - 3/06/19 and 22/11/19 - 9/12/19
Otane WWTP Outflow	Jan 2008 – Dec 2019	Daily flowrate data, complete. Found in 'Otane Outflow' tab of spreadsheet.
Otane Influent Monitoring: DO, Temp, Faecal Coliforms, E.coli, pH, VSS, ISS, TSS, COD, $cBOD_5$, TOC, TKN, NH3-N, NOx, SRP, TN, TP.	Aug 2011 – Nov 2012, October & September 2017	Monthly influent sampling.
Central Hawke's Bay District Demographic and Economic Growth Directions	2018 – 2048	Prepared by Economic Solutions Ltd, Napier.

Waipukurau and Waipawa Future Industrial and Domestic Loads	2048	CHBDC Waipukurau and Waipawa Wastewater Treatment Plant Review (The Wastewater Specialists, 2017).
Waipukurau and Waipawa Trade Waste monitoring	2017-2019	Intermittent flow and concentration data for trade waste dischargers including NNNZ, Ovation, Medallion, truck washes, Go Bus and Beach Road holiday park
Waipukurau Septage data	2013 – 2019	Volume and source records for tankered waste discharged into the Waipukurau ponds by Integrity and CHB Tank Cleaners.

2 Glossary

ADF	Average Daily Flow
ADWF	Average Dry Weather Flow
BoD	Basis of Design
$cBOD_5$	Carbonaceous Biological Oxygen Demand
COD	Chemical Oxygen Demand
NH_4-N	Ammoniacal Nitrogen
PWWF	Peak Wet Weather Flow
TKN	Total Kjeldahl Nitrogen
DRP	Dissolved Reactive Phosphorus
TP	Total Phosphorus
TSS	Total Suspended Solids

3 Current Inflows

3.1 Overview

Historical wastewater inflow data is only available for Waipawa (2014-present) and Otane (2018-present). Inlet flow measurement has now been installed on all three WWTPs, but no wastewater inflow data was available for the Waipukurau WWTP.

Waipawa inflow data has been used to estimate current Waipukurau inflows, as daily treatment plant effluent flows are not generally equal to inflow when considering large earthen ponds. Contributing factors include seepage, rainfall, evaporation and hydraulic buffering.

Estimations of flow currently experienced at the plant were made for:

- ADWF (average dry weather flow) for the purpose of calculation the 20^{th} percentile of daily flows has been used as rainfall data is unavailable
- ADF (average daily flow) average of daily inflows
- PWWF (peak wet weather flow) maximum recorded daily flow
- Peak Factor: PWWF / ADWF

3.2 Waipawa

Wastewater from Waipawa's sewer network is pumped to the existing WWTP via two pump stations, at Pourerere Rd and McGreevy St. The Pourerere Rd PS handles the main flow, while the McGreevy St PS typically only operates during high flow periods when the capacity of the main trunk sewer is exceeded. A flowmeter was installed at Pourerere Rd in 2017, but records prior to that, and all data for McGreevy St, are based on pump run hours.

Daily influent flow records from January 2014 to February 2020 were used to determine current daily inflows. An annual breakdown of average inflows and outflows from Waipawa is shown in Table 3-1.

Table 3-1: Historical and Current Outflow from Waipawa WWTP

Year	Average Daily Inflow (m^3/d)	Max Daily Inflow (m^3/d)	Average Daily Outflow (m^3/d)	Max Daily Outflow (m^3/d)
2008			911	4398
2009			964	4397
2010			1276	4395
2011			1065	4396
2012			962	4415
2013			867	5684
2014	1009	5945	916	5186
2015	1057	11516	968	5597
2016	959	4971	870	4780
2017	1401	10509	1214	5569
2018	1208	8184	1146	5208
2019	1035	7538	809	4088

Comparing inflows and outflow shows that, generally, the average daily inflow is approximately 10% higher than the outflow. This is assumed to be due to climatic conditions leading to nett evaporation from the ponds. For the following sections on Waipukurau and Otane, for which only outflow data is available, we have assumed that daily inflow is 10% higher than outflow also, as climate is similar across the three sites.

Figure 3-1 depicts the Waipawa inflow record. At the time of writing, 2019/2020 data from McGreevy St PS was not available, which is reflected in the lack of peak flows shown in the graph.

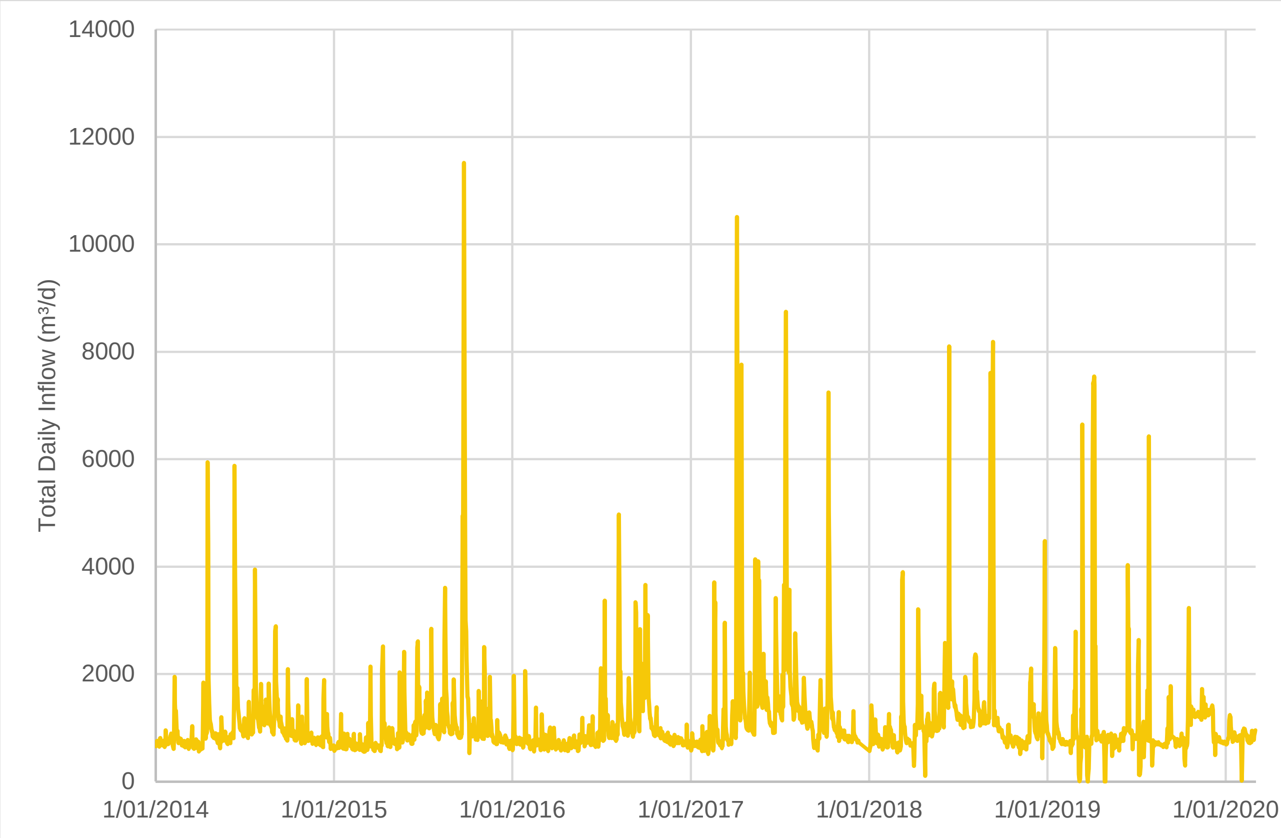

Figure 3-1: Waipawa Daily Inflow Dec. 2013 – Mar. 2020

Flow data from 2019 onwards has therefore been excluded from the analysis. For the period from 2014-2018, the following flows have been established for the basis of design:

- **Average dry weather flow**: taking the 20th percentile of the available data gives an ADWF of 705 m^3/d. This was determined through analysis of the available data, which indicates a baseline daily flow range of between 600 and 800 m^3/d (refer Figure 3-2).

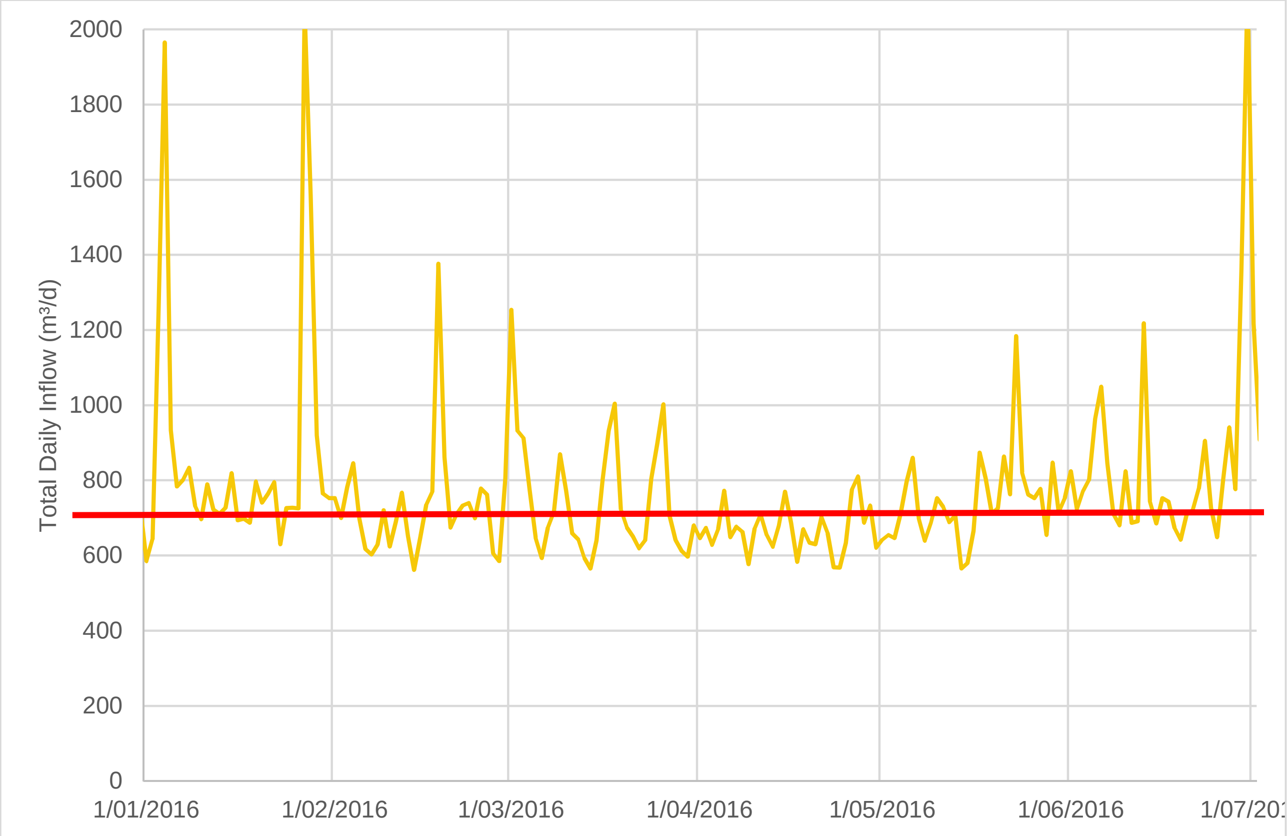

Figure 3-2 - Close-up on Waipawa's baseline daily inflows (Jan-Jun 2016)

- **Average daily flow:** The ADF for the 2014-2018 dataset is 1,127 m³/d. This is an increase on the previous ADF of 990m³/day, as adopted in TWWS (2017). For the purpose of the design basis the higher number has been adopted.
- **Peak wet weather flow:** this analysis has been made over as many years as possible (2014-2019). Based on this record, the maximum daily flow than can reasonably be expected to arrive at the plant is approximately 12,000m³/d.
- **Peak factor:** by taking the PWWF/ADWF both stated above, the peak factor that could currently be expected at the plant is 17. This very high peaking factor is a result of significant inflow and infiltration, and it is expected that this will be reduced as a result of the ongoing I&I reduction programme.

3.3 Waipukurau

Daily outflow data from Waipukurau WWTP is summarised in Table 3-2.

Table 3-2: Historical and Current Outflow from Waipukurau WWTP

Year	Average Daily Outflow (m³/d)	Max flow (m³/d)
2008	2344	7932
2009	2314	8726
2010	2540	8665
2011	2174	8726
2012	2012	8726
2013	1953	8726
2014	2084	6367
2015	2120	6762
2016	1942	7775
2017	2407	10318
2018	2591	11457
2019	1725	5632

Based on this historical outflow data, the following flows can be predicted for current inflow experienced at the Waipukurau plant:

- **Average dry weather flow**: Based on a similar assessment as Waipawa for the 2016-2019 outflow data, the 20th percentile was used to give an estimated current ADWF of 1609 m^3/d.
- **Average daily flow:** Based on a comparison between Waipawa inflows and outflows, we have assumed current ADF is slightly higher (10%) than the average day outflow (average of 2016-2019). Hence a value of 2,545m^3/d has been assessed as the current average day flow. Waipukurau and Waipawa ponds are constructed similarly and so likely exposed to similar flow modifications through the plant.
- **Peak wet weather flow:** This analysis has been made over as many years as possible (2008-2018), hence the maximum daily flow than can reasonably be expected to arrive at the plant is approximately 11,500m^3/d. This peak flow was experienced during a rain event in 2018, we could expect current PWWF to be slightly higher, approximately 12,000 m^3/d.
- **Peak factor:** The current outflow peak factor expected is approximately eight times ADWF.

3.4 Otane

Inlet flow measurements were implemented at Otane in 2018. Daily inflow and outflow data from Otane WWTP is summarised in Table 3-3.

Table 3-3: Historical and Current Outflow from Otane WWTP

Year	Average Daily Inflow (m³/d)	Average Daily Outflow (m³/d)	Max flow (m³/d)
2008		240	1258
2009		215	896
2010		216	836
2011		137	1141
2012		177	2776
2013		137	1947
2014		105	1151
2015		122	2859
2016		96	474
2017		154	2860
2018	190	187	2862
2019	180	129	2146

While limited, the following flow assessment has been made for Otane based on available data.

- **Average dry weather flow**: Based on a similar assessment as Waipawa outflow data, the 20th percentile was used to give an estimated current ADWF of 132m³/d.
- **Average daily flow:** current ADF has been taken as 185 m³/d.
- **Peak wet weather flow:** this analysis has been made using both inflow and outflow data, as outflow data is available over a longer period and so the peak may be more representative of long-term weather patterns. It is estimated that the maximum daily flow that can reasonably be expected to arrive at the plant is approximately 2,860m³/d. This peak flow was experienced during a rain event in 2018, we could therefore expect current PWWF to be slightly higher, approximately 3,000 m³/d.
- **Peak factor:** The peak factor expected is 16.

3.5 Summary

The estimated current (2019) ADWF, ADF, PWWF and peaking factors for the three WWTPs are summarised in Table 3-4

Table 3-4 Daily Flows Summary

Site	ADWF (m³/d)	ADF (m³/d)	PWWF (m³/d)	Peaking Factor
Waipawa	705	1127	12,000	17
Waipukurau	1,609	2,545	12,000	8
Otane	132	185	2,860	16

4 Current Influent Loads

4.1 Waipawa

Influent quality measurements are based on composite sampling data from September 2017 to April 2019. The average daily flow used for determining the current loads was 1033 m³/d, as discussed in the previous section. The concentrations and estimated current loads are shown in Table 4-1 below.

Table 4-1: Waipawa WASP Characterisation Concentrations (2017 - 19) and Loads

Year	COD	$cBOD_5$	TSS	Total Nitrogen	NH_3-N	TP
Conc. Average (mg/l)	626	187	509	46	29	7.8
Conc. Median (mg/l)	*329*	*82*	*192*	*43*	*28*	*5.8*
Conc. 90th% ile (mg/l)	1170	492	922	71	45	13.0
Load. Average (kg/d)	706	211	574	52	32	9
Load 90th% ile (kg/d)	1,318	554	1,039	80	51	15

For comparison, daily influent loads estimated by TWWS (2017) are provided in Table 4-2. These raw wastewater estimations are based on measured Trade Waste characteristics between August 2016 and July 2017, estimated domestic wastewater contributions, and a long-term average discharge flow rate of 990 m³/d. With the exception of suspended solids, the two methods show reasonable agreement.

Table 4-2: TWWS Estimated Waipawa Loading

Parameter	**Average**		**Peak**	
	Load, kg/d	Concentration* (mg/l)	Load, kg/d	Concentration* (mg/l)
TSS	270	273	430	434
$cBOD_5$	208	210	247	249
Total nitrogen	37	37	56	57
Total phosphorous	9	9	14	14

*At annual average flowrate

Further examination of the influent data shows that the elevated TSS concentrations appear to be due to a number of elevated results beginning from late 2018, as shown in Figure 4-1.

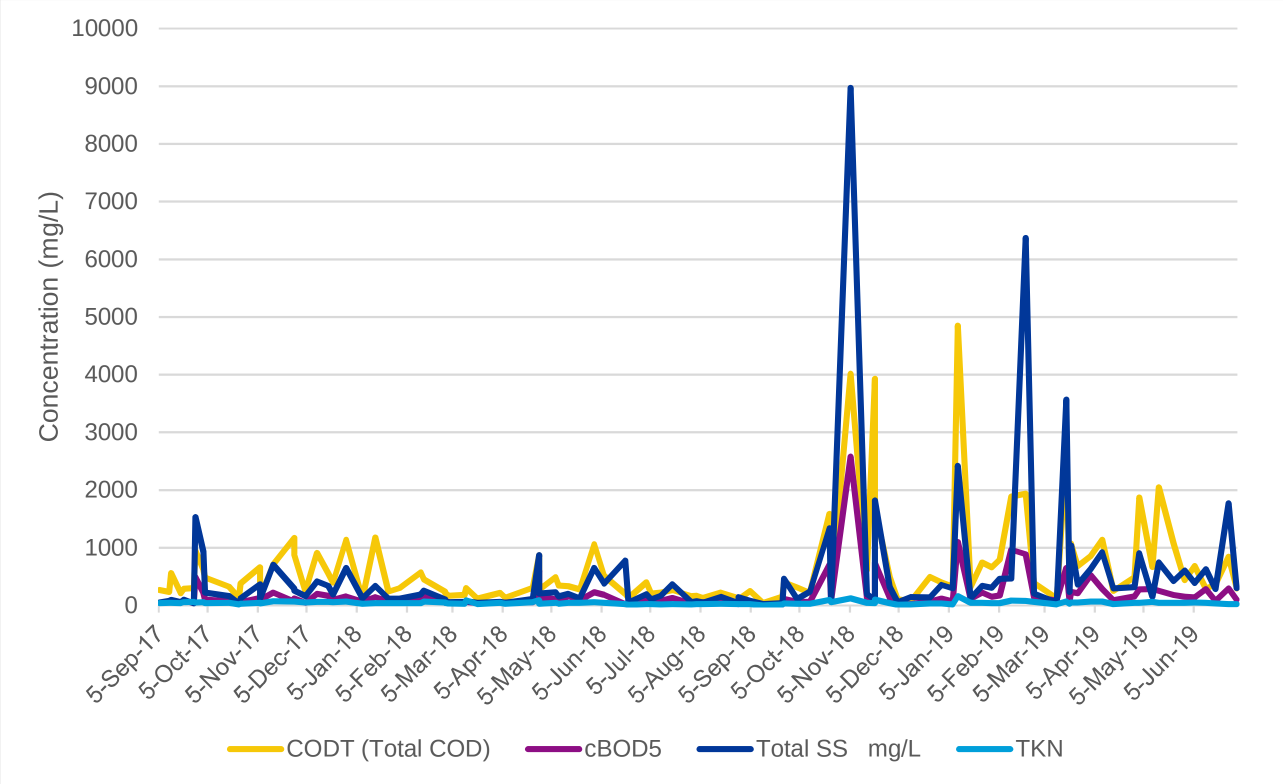

Figure 4-1 - Waipawa WWTP Influent concentrations Sep 2017 - Apr 2019

The source of the peaks is not immediately clear. The most likely sources are trade waste discharges to the sewer network, high strength waste from tankers, or sampling error, each of which are discussed below:

- **Trade Waste:** The elevated TSS concentrations are always accompanied by high COD concentrations, but not always elevated BOD, which could indicate that they are caused by trade waste or septage discharges. The only known major trade waste dischargers to the Waipawa WWTP are Farmers Transport and Stephenson's Transport, which have truck washes that discharge to the sewer. The discharge data available for these two sites currently consists of monthly total discharge volumes and one monthly grab sample of the discharge. Volume and concentration records do not show high discharge volumes or elevated concentrations in either of these discharges in the months where the high concentrations were recorded.
- **Septage Discharges:** At the time of writing, while septage discharge takes place at Waipawa. no septage discharge records were available. These should be located if possible. And detailed septage records should be kept on an ongoing basis. It is understood from previous work that landfill leachate was discharged to the WWTP for a short period in 2017/2018 but these discharges ceased in March 2018, prior to the first peak.
- **Sampling Error:** Sampling collection has been overseen by three different organisations since it commenced in 2017 and full chain of custody documentation and observation records are not available. This means that any errors which might have led to a non-representative sample being taken, for example if the autosampler's collection failed and a grab sample was used as a replacement, cannot be ruled out at this stage.

As there is no clear source for the peaks, future loads of similar magnitude cannot be ruled out at this point, and so the concept design basis will take them into account. However, it is recommended that CHBDC investigate this before developing the design past concept-level.

4.2 Waipukurau

4.2.1 Overview

As there is no direct influent characterisation available for Waipukurau, daily influent loads have been estimated based on trade waste monitoring data from 2017 – present, estimated domestic wastewater contributions, and an average discharge flow rate of 2,130 m³/d.

4.2.2 Domestic Loads

Table 4-3 below shows the estimated domestic loads. These are based on the per-capita contributions previously used by TWWS (2017), and the 2018 population estimate from Economic Solutions Ltd of 5,080 people.

Table 4-3: Estimated Waipukurau Domestic Influent Loads

Parameter	Per Capita Contribution (g/capita/d)	Average Daily Load (kg/d)
TSS	90	457
$cBOD_5$	80	406
Total nitrogen	13	66
Total phosphorous	3	15

*At annual average flowrate

4.2.3 Trade Waste

The meat processing facilities contributing to the trade waste component of the loading have unique wastewater qualities, typically containing higher organic compounds, dissolved proteins and fats, which will tend to increase influent $cBOD_5$ and nitrogen above typical values. These influent loads must be considered during the WWTP design. The available trade waste monitoring data is summarised in Table 4-4.

Table 4-4 – Waipukurau Trade Waste Data

Parameter	Ovation (2017 – 2019)		NNNZ (2017 – 2019)		Medallion (2014-2019)	
	Average	90th %ile	Average	90th %ile	Average	90th %ile
TSS	60.2	127.9	11.0	21.5	2.9	5.1
$cBOD_5$	231.5	437.9	176.8	393.9	6.3	12.3
Total N	34.0	64.1	28.9	62.3	0.9	2.0
Total P	2.9	6.0	5.2	11.3	0.1	0.1
# samples	152	152	130	30	72	72

The data used for these values is as follows:

- Ovation: Weekly flowmeter reads and samples, January 2017 – November 2019
- NNZ: Weekly flowmeter reads and samples, July 2017 – November 2019
- Medallion: Monthly flowmeter reads and samples, December 2014 – November 2019

Other minor trade waste dischargers include:

- Lowlen Plant Hire (average discharge 135 m³/month 2017-2019)
- Go Bus depot (intermittent discharges, last discharge record June 2018)

To reliably characterise industrial loads for design purposes, ongoing flow weighted composite sampling needs to be continued to adequately cover the range of trade waste discharges and some additional parameters will need to be measured. A full record of septage discharges will also be required.

4.2.4 Septage

The septage data available indicates that between 16 and 25 tanker loads per month are discharged to Waipukurau WWTP. While three months' data is not sufficient to indicate if this is the typical rate of discharge, this information has been used to develop an estimate of the contribution septage makes to the Waipukurau WWTP, which should be confirmed through further investigations.

Determining 'typical' septage characteristics is difficult, as there are a number of contributing factors, including size of household, frequency of tank emptying, ground temperature etc. For the purpose of this assessment the concentrations and loads shown in Table 4-5 were assumed, based on previous studies and an assumed average daily flow of 2.8 m^3/d.

Table 4-5 - Estimated Septage Contribution

Parameter	Typical Concentration (g/m^3)	Average Daily Load (kg/d)
TSS	7,900	22.2
$cBOD_5$	7,000	19.8
Total nitrogen	1,100	3.2
Total phosphorous	260	0.74

4.2.5 WWTP Inlet

Combining the estimated domestic contribution and available trade waste monitoring data gives the estimated WWTP concentration and load data shown in Table 4-6.

Table 4-6: Estimated Waipukurau Loading

Parameter	Average		Peak	
	Load, kg/d	Concentration* (mg/l)	Load, kg/d	Concentration* (mg/l)
TSS	553.5	217.5	633.9	249.1
$cBOD_5$	840.8	330.4	1270.2	499.1
Total nitrogen	133.0	52.3	197.6	77.6
Total phosphorous	24.1	9.5	33.4	13.1

4.3 Otane

4.3.1 Influent Monitoring Data

Two only influent quality measurements from WASP Characterisation Sampling Data were taken in 2017. These data points were averaged to use here. However, there is insufficient data for a 90th percentile analysis. The loads shown in Table 4-7 use the average daily flow of 185 m^3/d.

Table 4-7: Influent Concentrations and Assessed loads at Otane WWTP (2017)

Parameter	$cBOD_5$	TSS	Total Nitrogen	NH_3-N	TP
Conc. Average (mg/l)	239	379	53	25	7
Load. Average (kg/d)	38	61	9	4	1

4.3.2 Population-Based Estimate

As there are only two samples available, from some years ago, the values have been sense-checked against population-based load estimates, which were developed in a similar manner to Waipukurau's domestic loads, using the same per-capita values. These values are shown in Table 4-8.

Table 4-8: Estimated Otane Domestic Influent Loads

Parameter	Per Capita Contribution (g/capita/d)	Average Daily Load (kg/d)
TSS	90	58
$cBOD_5$	80	51
Total nitrogen	13	8
Total phosphorous	3	2

*At annual average flowrate

Comparing these with the measured loads shows similar values for BOD, TN, and TP, but higher measured TSS loads. **Therefore the measured values will be adopted for the design basis**

5 Estimated Future Flow and Loads

5.1 Estimated Future Population

According to population data obtained from Economic Solutions Limited, Waipawa, Waipukurau and Otane are predicted to experience an increase in population, as shown by Figure 5-1.

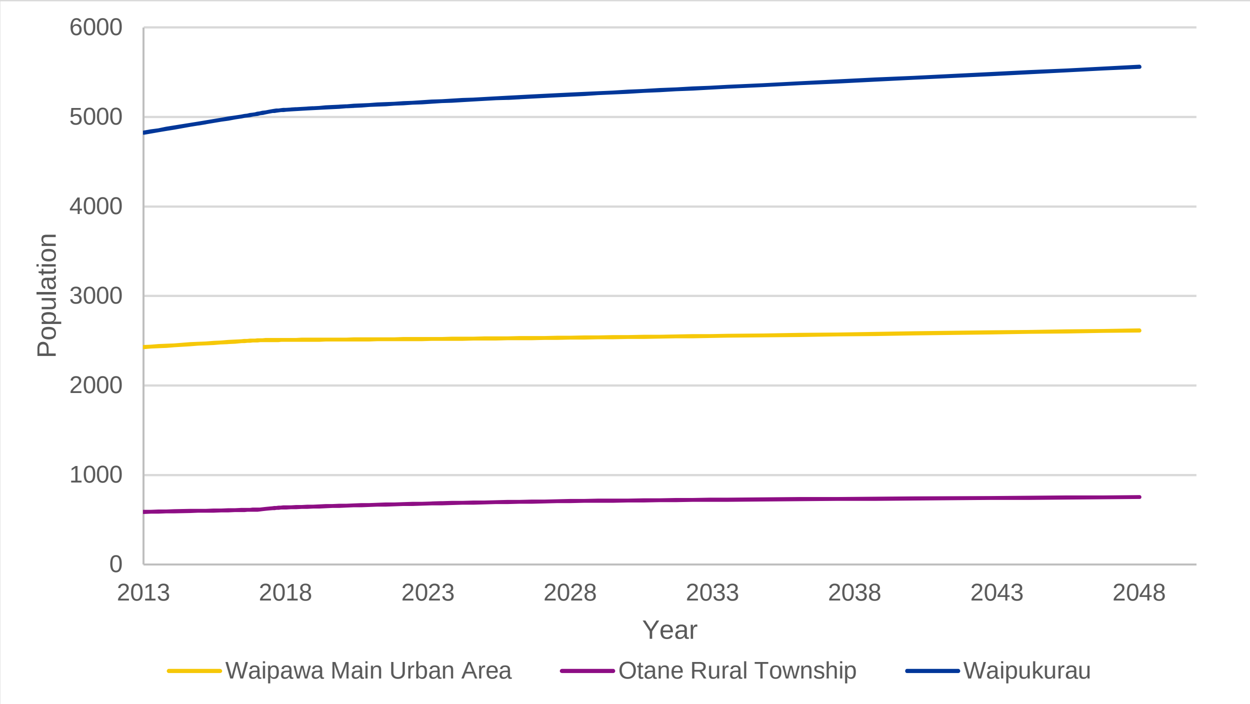

Figure 5-1 Future Population Profile of Waipawa, Otane and Waipukurau region

As shown in Table 5-1, Waipukurau is the largest population centre, encompassing roughly 60% of the total population of the three areas. The growth rate shown for Otane is 0.6% in these projections, but CHBDC have indicated that current subdivision and development activity indicate this rate may be significantly higher.

Table 5-1: Waipawa, Waipukurau and Otane Population Projections to 2048

	2013	2017	2018	2028	2048	30yr growth	% in 30 yrs	% p.a
Waipawa Main Urban Area	2430	2505	2510	2535	2615	105	4%	0.1%
Otane Rural Township	590	615	640	710	755	115	18%	0.6%
Waipukurau	4825	5035	5080	5250	5560	480	9%	0.3%
% Waipawa Main Urban Area	31%	31%	30%	30%	29%			
% Otane Rural Township	8%	8%	8%	8%	8%			
% Waipukurau	62%	62%	62%	62%	62%			

5.2 Estimated Future Inflows

The inflow estimated from the previous section and the population projections above have used to develop future flow estimates as shown in Table 5-2. For the purposes of the concept design it is assumed that wastewater volumes will increase proportionally with population growth. This may not hold true for peak wet weather flows, if inflow and infiltration work is undertaken to reduce the influence wet weather has on wastewater flows.

Table 5-2: Estimated Future Flows

Flows (m^3/d)	2018		2028		2048		Peaking Factor	PWWF
	ADWF	ADF	ADWF	ADF	ADWF	ADF		*2048*
Waipawa	705	1,127	712	1,138	734	1,174	17	12,636
Otane	132	185	146	205	156	218	16	3,374
Waipukurau	1,609	2,545	1,663	2,630	1,761	2,785	8	13,134

Table 5-2 highlights the apparent flow peaking factor for each township. Ideally, these will reduce given inflow and infiltration reduction programmes at the sites. New developments and infrastructure renewals are likely to improve the peaking factors. It may not be feasible to allow for the full peak flow to be accommodated in the new WWTP designs, and where this is the case alternative peak flow attenuation will be allowed for.

5.3 Estimated Future Loads

The estimated future loads for have been developed as follows:

- Waipawa & Otane: extrapolated from influent sampling data using the population projections above.
- Wapukurau: applied per-capita values to the population projections, combined with average loads from trade waste and septage monitoring data. At this point it has been assumed that septage and trade waste loads will be constant for the full 30 years.

The estimated values are set out in Table 5-3.

Table 5-3: Estimated future design loads

	TSS (kg/d)			BOD (kg/d)			TN (kg/d)			TP (kg/d)		
	2018	2028	2048	2018	2028	2048	2018	2028	2048	2018	2028	2048
Waipawa	525	530	547	193	195	201	46.0	46.5	47.9	8.0	8.1	8.3
Otane	61	68	72	38	42	45	9.0	10.0	10.6	1.0	1.1	1.2
Waipukurau	553	569	597	841	854	879	133	135	139	15.2	15.7	16.7

Before the design is developed further it is recommended that the characterisation (currently only available for Waipawa) for each site be fully investigated.

6 Combined Flow and Load Scenarios

6.1 Scheme Options

There are two overall options being considered for combining and treating wastewater from Waipawa, Waipukurau and Otane, as follows:

- **Option 1:** Upgrade Waipawa' s WWTP to receive combined Waipawa and Otane wastewater, with discharge to rapid infiltration basins (RIBs) at a site on Walker Road. Separately upgrade Waipukurau' s WWTP with discharge to RIBs at a suitable site (Ford Rd). Otane WWTP to be decommissioned.

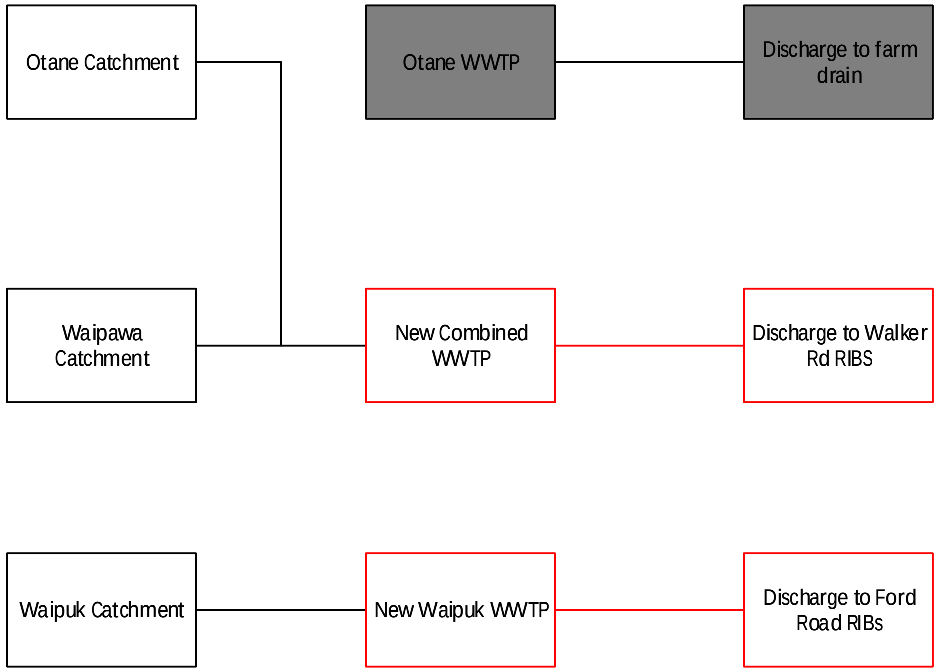

Figure 6-1 - Option 1 System Diagram

- **Option 2:** Flows from all three catchments sent to an upgraded WWTP at Waipawa. Discharge to RIBs at Walker Rd. Otane and Waipukurau WWTPs to be decommissioned.

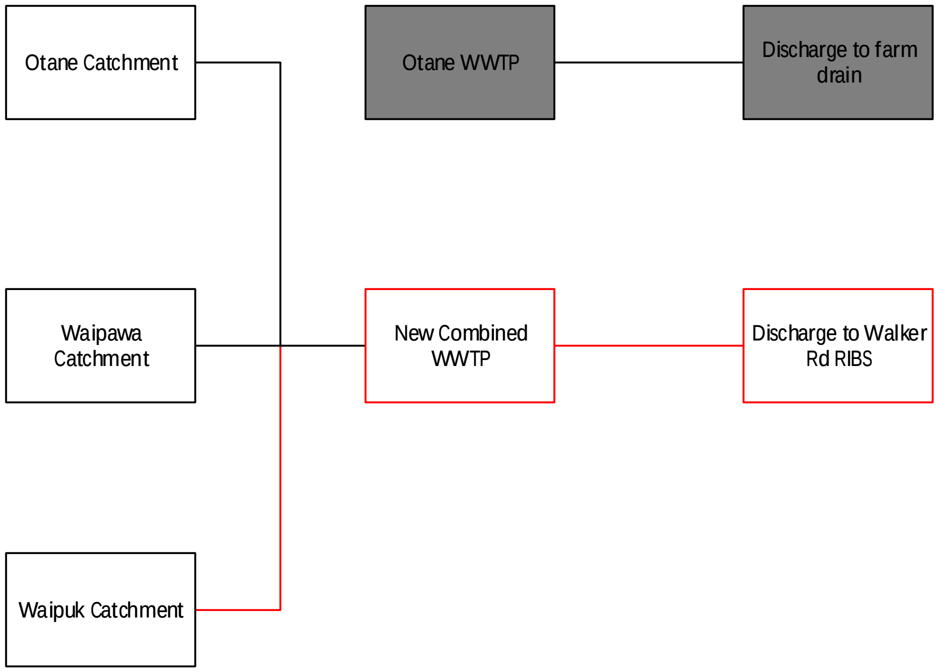

Figure 6-2 - Option 2 System Diagram

6.2 Inflows

The assumed inflows for Options 1 and 2 as described above in the years 2028 and 2048 are set out in Table 6-1 and Table 6-2.

Table 6-1 - Option 1 Influent Design Basis – 2028 and 2048 Design Horizon

Parameter		Waipawa + Otane 2028		Waipukurau 2028		Waipawa + Otane 2048		Waipukurau 2048	
		Average	Peak	Average	Peak	Average	Peak	Average	Peak
Flow (m³/d)		1,343	15,447	2,630	12,402	1,392	16,010	2,785	13,134
TSS	mg/L	482	832	216	247	481	829	214	243
	kg/d	647	1,117	569	649	669	1,154	597	677
$cBOD_5$	mg/L	190	448	325	488	190	426	316	470
	kg/d	255	602	854	1,284	264	592	879	1,309
Total N	mg/L	46	68	51	76	47	64	50	73
	kg/d	62	91	135	200	65	89	139	204
Total P	mg/L	7	12	6	13	7	11	9	13
	kg/d	10	16	16	34	10	16	26	35

Table 6-2 - Option 2 Influent Design Basis – 2028 and 2048 Design Horizon

Parameter		2028		2048	
		Average	Peak	Average	Peak
Flow (m^3/d)		3,973	27,849	4,178	29,144
TSS	mg/L	306	444	303	438
	kg/d	1,216	1,766	1,266	1,831
$cBOD_5$	mg/L	279	475	274	455
	kg/d	1,109	1,886	1,143	1,901
Total N	mg/L	50	73	49	70
	kg/d	198	291	204	293
Total P	mg/L	6	13	9	12
	kg/d	26	50	36	51

6.3 Treatment Standard

The assumed level of treatment for all scenarios is that referred to as "level B" in a memorandum to CHBDC from Beca on 20 June 2019. This level of treatment is described as conventional biological nutrient removal with ammonia reduction to very low levels. The target average effluent quality for level B treatment is summarised in Table 6-3

Table 6-3 - Target average treated effluent quality, all options

Parameter	Unit	Value
$cBOD_5$	mg/L	15
TSS	mg/L	15
NH_4-N	mg/L	2
TN	mg/L	8
SRP	mg/L	0.25
E.coli	cfu/100ml	<100

7 Conveyance Routes

7.1 Design Flows

This section outlines the conveyance requirements for each of the pump routes associated with the treatment options. The design flows are summarised in Section 5.2. It is proposed to use the 2048 flows for the sizing of the conveyance systems.

The conveyance routes required are:

a. Treated wastewater from Waipawa to Walker Road disposal site for Otane and Waipawa flows (Option 1)

b. Treated wastewater from Waipukarau to Ford Road disposal site (Option 1)

c. Treated wastewater from Waipukurau to Waipawa and to Walker Road disposal site for all three combined flows (Option 2)

d. Raw wastewater from Waipukarau to Waipawa (Option 2)

7.2 Hydraulics

Pumps will be sized to pump the peak daily flow where practical. The effect on residence time in the pumping system will be considered.

Pipework will be sized to achieve a slime shearing velocity in the pipe at the design pumped flow.

7.3 Pumping Arrangement

A single submersible transfer pump station at the respective WWTP is preferred for all options. Initial analysis has shown this should be possible for all pumping systems. However, it is possible that the head required for pumping between the Waipukurau WWTP and the Waipawa WWTP may require the use of an intermediate pump station, progressive cavity pumps or piggy-back pumping. These options will be further considered during the design.

Pump stations will provide a full installed standby pump, and initial screening of available pumps has shown that two pumps in a duty / standby arrangement should be feasible for all options.

7.4 Pipe Materials

Polyethylene pipe (PE) is the preferred material for the rising mains. The key reasons for this are:

- PE is not susceptible to corrosion like concrete lined steel or ductile iron.
- The restrained joints for PE are more seismically resilient compared to rubber ring joints, and do not require thrust restraint at changes of direction.
- PE is more flexible than other materials which helps to mitigate surge effects and accommodate movement.
- PE is more cost effective than ductile iron or steel, and generally there is not a significant difference in installed cost compare to PVC.
- PE is suitable for installation by directional drilling, a technique used successfully for recent pipe installation in Central Hawkes Bay.

Ductile iron or steel pipe is proposed for above ground pipework including bridge crossings.

7.5 Valves

Air valves are proposed at all high points. Elevated vents or carbon filters may need to be considered where odour could be a nuisance. In concept design, additional air valves will be provided every 500m on long downhill or flat sections of pipe. This can be rationalised during detailed design.

Scour valves are proposed at all low points except for crossings under rivers. The scour arrangement will follow that of the Otane rising main design.

Line valves will be considered for longer rising mains to minimise the amount of pipe that needs to be drained for maintenance.

It is expected that all detailed consideration of valve design will take place in the detailed design stage of the project.

7.6 Route Alignment

The purpose of the route selection is to find a realistic but conservative route for each conveyance stream that can be used for the overall wastewater strategy options analysis.

Note that the route alignments only consider conveyance to the RIB site boundary, not within the RIB site.

The routes discussed below were developed at a high-level using GIS provided by CHBDC. This GIS included:

- CHBDCs wastewater network including pipes and nodes
- District Plan zones, designated areas, state highway and rail designation notable trees and natural areas
- 1m and 5m topographical contours
- HAIL contaminated land sites
- LINZ street, roads and land parcels

Note as the WWTPs are designated HAIL sites, all alignments pass through known HAIL sites.

Refer to Figure 7-1, Figure 7-2 and Figure 7-3 below for the main routes considered for each conveyance stream. Note that many of the routes can have sections of the alignment changed to provide further sub-options, but in order to allow a clear comparison of the main overall route options, these sub-options have not been considered at this stage.

The detail of the alignment will be considered at the subsequent design stages.

An online discussion was held regarding the proposed pipe routes for the Wastewater Strategy between Shane Kingston (CHBDC) and Alex Leo and Mike Yarrall (Beca) on 13 March 2020. The routes have been modified and selected based on the discussion. Outcomes of the discussion are included in Table 7-1 to Table 7-3 below.

7.6.1 Conveyance of Treated Wastewater from Waipawa and Waipukurau WWTPs to Separate RIBs

Refer to Figure 7-1 and Figure 7-2 below for pipeline routes from the Waipawa and Waipukurau WWTPs to the respective RIB sites.

Note that the decision to combine wastewater from the Otane and Waipawa WWTPs has already been confirmed[1], and wastewater from Otane can be conveyed directly to the Waipawa WWTP via the recently designed Otane rising main and from the Waipawa WWTP to the Walker Road RIB via the selected route below.

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[1] Otane WW Scheme Tipping Point Assessment – Treatment. Letter from J Crawford to D de Klerk (6 November 2019)

a. Waipawa WWTP to Walker Road RIB

Figure 7-1 shows the route options and Table 7-1 summarises key aspects of the routes and the selection outcome for conveying treated wastewater from the Waipawa WWTP to the Walker Road RIB.

Figure 7-1: Options for conveyance of raw wastewater from Waipawa WWTP to Walker Road RIB

Table 7-1: Conveyance of treated wastewater from Waipawa WWTP to Walker Road RIB

	Route Description	Comments	Outcome
A	• Pourerere and Walker Roads • 3.3 km • Start point 134 mRL • End point 124 mRL	• High point 144m. • Longer route. • More conservative option as no identified land issues as it follows road reserve.	**Selected** as preferred route for wastewater strategy MCA in consultation with CHBDC as land issues are more certain.
B	• Follow Pourerere Road and cut across private land before high point • 2.4 km • Start point 134 mRL • End point 124 mRL	• High point 140m. Could provide operational cost savings. • Shorter route. • Will require landowner negotiations.	Not selected. Could be considered again in design phase if land issues progressed.

b. Waipukurau WWTP to Ford Rd RIB

Figure 7-2 shows the route options and Table 7-2 summarises key aspects of the routes and the selection outcome for conveying treated wastewater from the Waipukurau WWTP to the Ford Rd RIB.

Figure 7-2: Options for conveyance of raw wastewater from Waipukurau WWTP to RIB

Table 7-2: Conveyance of treated wastewater from Waipukurau WWTP to Ford Road RIB

	Route Description	Comments	Outcome
A	• Cross SH2 Tukituki Bridge • 2.5 km • Start point 137 mRL • End point 138 mRL	• High Point is 140 m • Follows public land. • Pier corbel thickness on bridge would mean pipe needs to hang some distance from the underside of the deck. Would require another crossing if bridge was replaced or underwent significant repair.	Not selected as bridge crossings not preferred by CHBDC due to potential structural modifications required. Furthermore, potential future need to demolish bridge would require CHBDC to provide temporary pipe route while the new bridge is built.
B1 **B2**	• River crossing • 0.9 km • Start point 137 mRL • End point 138 mRL	• Follows public land. • Would require work in the riverbed to trench carrier pipe. Drilling may have risk of unsuitable geotechnical conditions at specific locations. • B2 could save a future river crossing if the pipe headed east after the river crossing when sewage is conveyed to Waipawa WWTP.	**Selected** as preferred conveyance route for MCA in consultation with CHBDC. B1 and B2 would be expected to have similar costs and hydraulics to each other.

7.6.2 Conveyance of Treated Wastewater from Waipawa WWTP to Walker Rd RIB and Raw Wastewater from Waipukurau WWTP to Waipawa WWTP

This option consists of two parts; the conveyance of raw wastewater from Waipukarau to Waipawa for treatment and the conveyance of the combined treated effluent to Walker Road Rib.

a. Waipawa WWTP to Walker Rd RIB

This conveyance stream is the same as for the previous option, and the routes are covered in Figure 7-1 and Table 7-1.

b. Waipukurau WWTP to Waipawa WWTP Route

Figure 7-3 shows the route options and Table 7-3 summarises key aspects of the routes and the selection outcome for the Waipukurau to Waipawa WWTP pipeline. Note that this pipeline could be used to convey treated effluent direct to the Walker Road RIB site (either directly or by feeding into the treated effluent line from the Waipawa WWTP) or deliver raw wastewater to the Waipawa WWTP site.

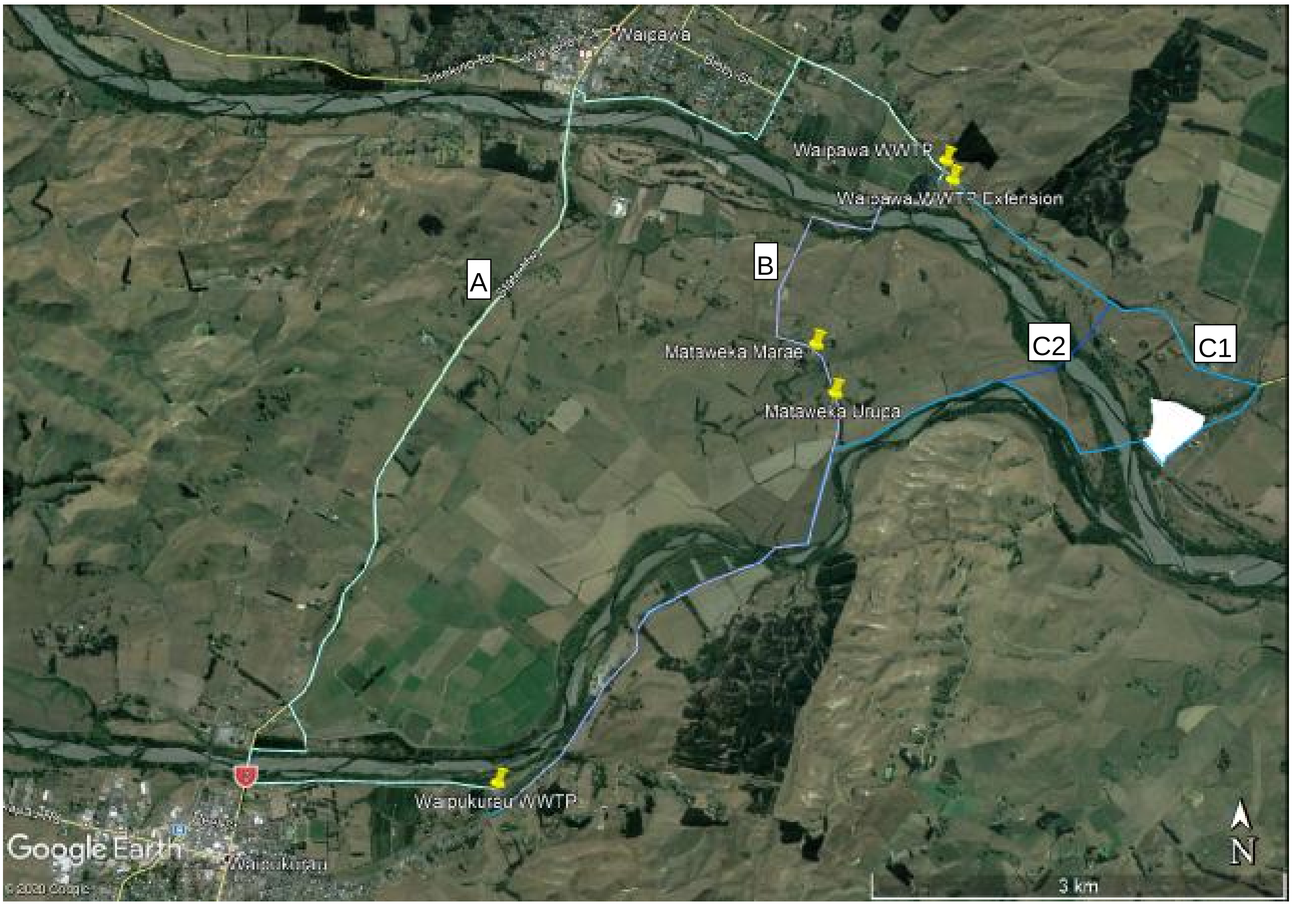

Figure 7-3: Options for conveyance of raw wastewater from Waipukurau WWTP to Waipawa WWTP

Table 7-3: Conveyance of wastewater from Waipukurau WWTP to Waipawa WWTP

	Route Description	Comments	Outcome
A	• Follow SH2 • 11.5 km • Start point 137 mRL • End point 134 mRL	• High Point of 160m. Could cause hydraulic issues as the hydraulic grade line would be below ground level unless the system was specifically designed to address this. • Generally follows public land. • Is the longest of the Waipukurau to Waipawa routes. • Work in cycleway or road would be required. Notably a new cycleway beside SH2 will be installed in the next few years. • Pier corbels on Tukutuki bridge would mean pipe needs to hang some distance from the underside of the deck. Would require other crossings if bridges were replaced or underwent significant repair.	Not selected as bridge crossings not preferred by CHBDC due to potential structural modifications required. Furthermore, potential future need to demolish bridges would require CHBDC to provide temporary pipe routes while the new bridges are built.
B	• Mt Herbert and Tapairu Roads • 7.0 km • Start point 137 mRL • End point 134 mRL	• High point of 163m. Could cause hydraulic issues as the hydraulic grade line would be below ground level unless the system was specifically designed to address this.. • Pipe would be in road reserve that passes by Marae and Urupa site. CHBDC believe this may be acceptable, but this would still require consultation with iwi. • Crossing of private land. • Is the shortest of the Waipukurau to Waipawa routes. • Would require work in the riverbed to trench carrier pipe. Drilling may have risk of unsuitable geotechnical conditions at specific locations.	Not selected due to risks with land owners, cultural sensitivity and potential hydraulic issues. Note that in discussions with CHBDC it was suggested this route could be considered later, but we now consider there to be too many potential issues.
C1	• Waipukurau to Waipawa following Mt Herbert Road • (Southern • 10.7 km • Start point 137 mRL • End point 134 mRL	• High point of 144m. This would provide significant operational cost savings over the life of the pumping system. • Crossing of private land. • Is several km longer than Route B. Could be shortened to 8.0km by further crossing of private land (refer Route C2 below). • Provides shorter route to Walker Road RIB for interim options. • Follows paper road for a long section beside Tukituki river. • Would require work in the riverbed to trench carrier pipe. Drilling may have risk of unsuitable geotechnical conditions at specific locations.	Not selected as Route C2 provides a shorter route.

C2	• Waipukurau to Waipawa following Mt Herbert Road • 8.0 km • Start point 137 mRL • End point 134 mRL	• As per Route C1, except crossing the Waipawa River further upstream. • Shorter route to the WWTP, although longer distance across private land on both sides of the river. • Any interim discharge of treated wastewater from Waipukurau direct to the Walker Road RIB site would need to use the pipe from the Waipawa WWTP to the Walker Road site.	**Selected** as preferred route for wastewater strategy MCA in consultation with CHBDC as it would offer significant operational cost savings, particular compared to Routes A and B. Significantly shorter than Route C1.

8 Conclusions and Recommendations

It has been possible to make estimates of current and future flows and loads to the three treatment plants. Those for Waipawa are the most accurate because both inflow and concentration information are available.

The current data sets are incomplete both with respect to quantity, quality, flows and characterisations. The data sets will need significant improvement in preparation for implementation of the new schemes.

- The characterisation sampling and analysis carried out for Waipawa will need to continue to be collected, on a less frequent basis, but ensuring flow weighted composite sampling.
- Otane and Waipukurau will need comprehensive influent characterisation studies implemented.
- It is recommended that an automatic composite sampler is purchased that is then rotated between the three site influents and the trade waste discharges.
- All plants will require influent flow meters monitored for instantaneous and daily flow, as the flow estimates for current operation in this report are likely to be less conservative that in reality.
- High peaking factors with respect to wet weather flows, suggest the investment is required to address this evident Inflow and Infiltration. These improvements are recommended as a precursor to configuring and designing long new rising mains and high rate plants.