Te Paerahi and Porangahau Options Report

Prepared for Central Hawkes Bay District Council
Prepared by Beca Limited
P:C.10

15 October 2020

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Contents

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
0.1	Jolanta Liutkute	Issued for Client's review	11/03/20
1.0	Jolanta Liutkute	Final	16/04/20
2.0	Nicola Marvin	Updated	25/09/20

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Jolanta Liutkute** **Nicola Marvin**		11/03/20 25/09/20
Reviewed by	**John Crawford**		02/10/20
Approved by	**Rachel Shaw**		14/10/20
on behalf of	Beca Limited		

Executive Summary

Central Hawkes Bay District Council (CHBDC) is in the process of preparing for the renewal of resource consents for the Te Paerahi and Porangahau Wastewater Treatment Plants (WWTP). It is likely that as part of the resource consent conditions, an upgrade of the existing plants will be required. The community has been engaged with to express their views on desirable wastewater treatment and discharge method as well as address the concerns or implications on cultural values.

Beca and LEI has been engaged by CHBDC to consider treatment plant upgrade and effluent discharge options that are suitable for the long-term solution, will meet environmental and community drivers.

The long-term solutions for both plants are based on the design horizon to year 2048 with projected population growth of approximately 335 people for Porangahau and 312 permanent residents (up to 624 in peak season) for Te Paerahi.

The wastewater currently undergoes primary treatment in one oxidation pond on each site. Pond effluent is discharged to the Porangahau River at Porangahau WWTP and irrigated to the sand dunes at Te Paerahi WWTP. The current discharge permit is for discharge up to 415 m^3/d and 190 m^3/d for Porangahau and Te Paerahi respectively.

One community engagement meeting was held (16/17 December 2019) for the purpose of understanding perspectives, experiences, benefits, concerns and ideas of the community and stakeholders regarding Porangahau and Te Paerahi WWTPs and for Beca to present some options that will be considered during the options identification process.

The main drivers for community are:

- Te Paerahi WWTP is on a waahi tapu site - there is strong desire to remove the plant
- Discharge to the sand dunes is not acceptable
- A new plant location should be considered
- More advanced technology than stabilization pond is preferred
- Stop discharging to the Porangahau River
- Discharge to land is desirable for the Porangahau site

Through this process several viable discharge and treatment options have been identified, ranging from surface irrigation to effluent reuse and from the upgrade of current ponds through construction of a new WWTP on a new location treating effluent from both plants.

From a cultural and community perspective, it is clear that the existing wastewater scheme servicing Te Paerahi and Porangahau will not be acceptable in the long term as it is. From a resource consent perspective, the two systems are reasonably compliant. For the purposes of discussion and derivation of future scheme options, the following are assumed:

- Do Nothing will not be acceptable
- Continued discharge of treated effluent to the sand dunes at Te Paerahi will not be accepted.
- Continued presence of the oxidation pond treatment system in the sand dune land at Te Paerahi is highly undesirable.
- Removal of the discharge to river is desirable.
- A discharge or discharges to land are preferred by the community
- Treatment for the two communities may be combined or separate. Combined treatment is generally more cost effective, based on economies of scale. However, the more extensive the conveyance system/s, the more this advantage is eroded.

- Discharge for the two communities may be combined or separate. Economies as above

The following are a number of treatment and discharge schemes that could be considered for the future:

- Scheme 1 – Treatment on each site with discharge at Porangahau
- Scheme 2 – Combined treatment at Porangahau discharge at Porangahau or elsewhere
- Scheme 3 – Combined treatment at new site and discharge to land

The long list of treatment and discharge options that could be applied for each of the scheme is:

Treatment option	Treatment Process	Discharge option	Existing discharge
TM1	Pond enhancement: Supplementary aeration to the ponds, artificial aerated media, tertiary filtration and disinfection	DS1	Existing discharge to Porangahau River
TM2	Fixed film process or activated sludge treatment such as SBR, MBR	DS2	Ocean discharge for Te Paerahi only
TM3	Tertiary treatment such as membrane filter, clarification, wetlands, filtration	DS3	Land based irrigation: slow rate irrigation or rapid infiltration beds, conditional irrigation Effluent reuse: Golf course irrigation or nursery irrigation
TM4	Chemical precipitation	DS4	Deep bore injection
TM5	Worm farm	DS5	Drain discharge via Wetland (Porangahau only)
TM6	Disinfection such as UV		

The short-listed options have been developed with staging in mind due to affordability of the upgrades for the community.

Option	Description
Option 1	Te Paerahi WWTP minor improvements, convey to new land treatment site
Option 2	Following Option 1 or stand-alone option Te Paerahi WWTP minor improvements, convey to new land treatment site Porangahau WWTP minor improvements, convey to new land treatment site
Option 3	Following Option 1 and/or Option 2, or stand-alone option Convey untreated wastewater from Te Paerahi and Porangahau to new combined WWTP, convey treated wastewater to new land treatment site

The options will be taken to consultation through the Long Term Plan (2021-24) process, for submissions on community preferences.

1 Introduction

1.1 Purpose of the report

The purpose of this report is to identify a long list of treatment and effluent discharge options for Te Paerahi and Porangahau Wastewater Treatment Plants and associated treated effluent discharge schemes, along with the basis of design for the WWTPs.

1.2 Project objectives

The objective for this project is:

To develop a sustainable long-term solution for treatment and discharge of wastewater for Te Paerahi and Porangahau, which meets the needs of the environment and the community.

2 Background

Central Hawkes Bay District Council (CHBDC) is in the process of preparing for the renewal of resource consents for the Te Paerahi and Porangahau Wastewater Treatment Plants (WWTP). It is likely that as part of the resource consent conditions, an upgrade of the existing plants will be required. A recent community engagement meeting (16th December 2019) identified that there is a concern from the community with regard to wastewater treatment quality and cultural values.

CHBDC has engaged Beca and LEI to develop treatment plant upgrade and effluent discharge options that are suitable for the likely future environmental and community drivers. The outcomes from the communities are detailed below.

2.1 Community outcomes

2.1.1 Te Paerahi

Te Paerahi Community Engagement meeting was held on 16th of December 2019 at Porangahau Community hall. During this meeting members of the community provided the ideas of what changes would be acceptable in the community regarding a new Resource Consent for the treated effluent discharge at Te Paerahi WWTP and what form of treatment is preferable.

The main drivers for the community are:

- WWTP is on a waahi tapu site, so there is a strong desire to move the plant
- Discharge to the sand dunes is not acceptable
- New plant location should be considered
- More advanced technology than stabilization pond is preferred

A more detailed outcomes from the community discussion is presented in Appendix A.

2.1.2 Porangahau

Porangahau Community Engagement meeting was held on 16th of December 2019 at Porangahau Community hall together with the Te Paerahi meeting. During this meeting members of the community also provided ideas of what changes would be acceptable to the community for Porangahau WWTP and preferred treatment processes.

The main drivers for the community are:

- Stop discharging to the river
- Discharge to the land is desirable

More detailed outcomes from the meeting is presented in Appendix A.

2.1.3 Te Paerahi and Porangahau Community Meeting 18 March 2020

The community engagement meeting updated the community on progress to date with optioneering, and introduced the option of combining Te Paerahi discharges with Porangahau, and ceasing of the discharge at Te Paerahi. The three basic options of

1. River discharge
2. Land discharge
3. Combination of land and water

were presented. The subject of affordability was discussed during the meeting, as a total rebuild of a new treatment plant together
with an effluent irrigation

systems for both communities could exceed $10M. The issue of flows during wet weather was also highlighted at the meeting, as in winter months when the land is too wet to irrigate, storage to contain all the flows could be unaffordable, and there would need to be a seasonal land passage or direct river discharge system. There was general appreciation and pragmatism of this i.e. not support but not opposition.

The key aims/objectives for the new systems were discussed, and recorded as:

- Not in river
  - High flow possible
  - Include land passage
- Cease discharge and treatment at Te Paerahi
- Away from river
  - Cockle beds adjacent mouth
- Landscape needs for trees
  - Irrigate
  - Natives
  - Biodiversity
- Need trust
- Community involvement
- Noted that the coastal flat lands with the more irrigable soils are also the areas that contain many waahi tapu and great care will be needed to appropriately avoid these when selecting land for discharge.
- Tour of potential discharge sites is required by local people and the technical team to identify which sites are likely to be acceptable from both a cultural perspective and a technical perspective.
- Maori funding

The need to identify critical areas of significance to Maori was also discussed.

A discussion was also held around possible land areas and farmers who may be interested in irrigation.

The minutes of the meeting can be found in Appendix B.

3 Current Site – Te Paerahi

3.1 Te Paerahi

3.1.1 Site Description

Wastewater from the community is pumped to the Te Paerahi WWTP, which consists of a single clay lined stabilization pond, approximately 0.1 ha in size. There is no incoming flow monitoring or screening facilities, therefore the only form of treatment occurs in the pond and wetland. Part of the solids settles at the bottom of the pond in the sediment layer, where anaerobic conditions prevail, and further treatment occurs. A portion of solids which remains in suspension along with the nutrients and soluble solids are treated by the combination of bacteria and algae in aerobic conditions. The bacteria multiply by using the carbon-based contaminants and some of the nutrients under aerobic conditions. Oxygen for the process is provided by wind, photosynthesising algae and one surface aerator. Following treatment in the pond effluent is passing through the covered area of the pond for the final polishing before discharge to the irrigation system. It was intended to establish a surface wetland on the top of the cover; however the installation was unsuccessful and only weed growth is evident.

Figure 1 Te Paerahi WWTP Stabilization Pond

Figure 2 Pond cover and growth in the Te Paerahi WWTP

The effluent is discharged to the irrigation system via an effluent channel, where the outflow is monitored. A perforated basket is installed in the effluent chamber to catch the eels and debris which didn't settle in the pond. From the effluent channel the treated wastewater is pumped to the sand dunes.

Figure 3 Perforated basket in the effluent chamber

Figure 4 Effluent flow meter transducer

Figure 5 Treated effluent discharge to the sand dunes

3.1.2 Site location

Te Paerahi Wastewater treatment plant is located approximately 500 m north of the Te Paerahi (Porangahau) Freedom Camping grounds at the end of Te Paerahi Road, Porangahau Beach, Central Hawkes Bay District Council (CHBDC).

Figure 6 Te Paerahi WWTP location (aerial picture taken from Google maps)

3.1.3 Consent Requirements

In accordance with the provisions of the Resource Management Act 1991, and subject to its conditions, the Hawke's Bay Regional Council granted the resource consent on the 14th of May 2012 (Consent No:DP030234La) for CHBDC to discharge treated domestic wastewater from the Te Paerahi oxidation pond into or onto the land (via soakage) in circumstances where that contaminant may enter water.

Details of the Resource Consent:

- Effluent to be discharged – Treated municipal sewage
- Rate of discharge – the average daily volume will not exceed 87 m^3/d for more than 50% of the time nor 190 m^3/d for more than 5% of the time over any 12 months period.
- Consent duration – expiring 31 May 2021

Discharge consent outlines the following Conditions:

- General – outlines the physical works to be undertaken on the plant.
- Performance – the following effluent quality parameters over 12 months period:

Table 1 Te Paerahi WWTP discharge consent parameters

Parameter	50th Percentile	90/95th Percentile
Average daily flow	87 m^3/d	190 m^3/d 95th percentile
Carbonaceous Biochemical Oxygen Demand – 5 day ($cBOD_5$)	30 mg/l	60 mg/l 90th percentile
Total suspended solids (TSS)	60 mg/l	140 mg/l 90th percentile
pH	6.5-9	

The standards above are deemed to be breached, if more than 16 samples taken over any 12-month period exceeded the values in the table above, except for pH, which deemed to be breach if any sample taken is outside of the range.

Included in the consent conditions are:

- The requirement for a Stormwater Infiltration Management Plan.
- Monitoring – outlines the incoming and outgoing flow monitoring requirements and piezometers around soakage area.
- Discharge quality sampling – outlines the requirements for sample type, constituents to analyse for, and the frequency.
- Reporting – outlines the Reporting conditions and dates.
- Kaitiaki Liaison – outlines the requirements for liaison.
- Non-Compliance – outlines the steps to be taken in the event of the exceedance of the effluent standards.

3.1.4 Current Performance

Te Paerahi Oxidation Pond Compliance Report Year ending 30 June 2019 was provided to Beca for review, along with the sampling data Te Paerahi DP030234La – Quality Monitoring and Wastewater Outflow Charts. The latter contains flow data since 2008 and Quality Monitoring file contains data since 2009.

Te Paerahi Oxidation Pond Compliance Report Year Ending 30 June 2019 included information about the pond performance for five-day carbonaceous Biological Oxygen Demand ($cBOD_5$) and Total Suspended Solids (TSS) removal. The most recent pond performance is for the period June 2018 – July 2019. The results are summarised in the Figures below.

Daily volumes Year 2018/ 2019 (m3/day) at Te Paerahi oxipond													
	Consent Maximum (m3/day)								87	50% of any 12 month period			
	Consent Maximum (m3/day)								190	5% of any 12 month period			
				Consent Exceeded									
				Upper Limit Consent Exceeded									
				Below Consent Maximum									
Day	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-18	Year
1	124.002	71.622	78.876	114.912	85.878	76.122	141.498	55.17	38.538	52.56	48.42	41.418	
2	130.374	64.818	85.176	111.384	74.358	93.33	133.02	64.764	48.24	59.652	40.518	89.046	
3	116.676	73.494	75.834	102.6	93.564	82.854	102.924	58.608	45	37.044	42.282	43.308	
4	107.262	100.008	237.87	100.818	77.544	79.794	95.364	52.344	40.806	34.704	46.872	32.004	
5	103.014	96.462	181.008	102.492	67.194	64.728	98.82	45.072	29.916	41.688	51.57	38.736	
6	101.88	93.384	192.528	96.678	62.136	66.006	93.456	56.196	28.548	57.276	42.876	51.624	
7	104.418	86.022	177.786	107.604	61.092	65.61	79.884	51.768	32.742	60.426	40.716	30.006	
8	105.894	80.676	192.744	96.498	69.138	63.846	73.71	42.372	36.414	139.554	39.996	31.59	
9	109.494	76.068	161.154	95.292	63.882	65.574	70.092	50.598	46.728	67.896	39.87	31.176	
10	100.044	69.012	156.564	94.824	56.592	67.158	65.25	46.98	91.44	52.632	47.664	27.162	
11	105.156	70.83	161.262	93.978	58.95	59.814	67.842	32.616	42.948	56.556	48.816	26.028	
12	90.252	74.844	148.986	105.804	59.382	81.954	60.156	37.278	33.462	109.008	56.43	28.08	
13	87.372	81.216	152.982	103.68	55.008	62.046	61.29	29.646	38.466	68.832	43.488	223.704	
14	88.992	83.664	153.432	98.91	52.092	59.562	73.026	31.014	31.284	67.356	34.902	127.854	
15	101.466	81.36	167.022	84.672	54.162	54.378	89.388	30.6	30.51	60.732	36.846	96.426	
16	122.22	83.286	151.866	76.86	52.974	54.162	175.284	35.748	37.746	61.002	45.846	96.786	
17	93.114	88.164	143.226	85.104	56.16	54.216	98.874	37.8	48.996	68.922	57.456	88.146	
18	87.066	84.798	135.522	81.558	65.484	55.278	78.3	35.82	37.494	60.786	52.038	82.656	
19	92.016	79.164	132.048	89.316	55.836	55.224	96.912	30.69	28.224	75.492	57.582	77.598	
20	85.662	75.438	130.212	113.364	55.278	86.058	90.666	28.242	25.686	89.802	51.21	74.25	
21	95.868	72.594	124.128	110.61	58.104	58.014	79.236	33.39	33.354	89.244	45.45	77.652	
22	95.508	71.532	123.606	99.18	61.686	72.918	76.212	34.686	34.56	88.29	39.51	76.698	
23	83.358	106.56	114.462	75.582	55.422	74.088	70.128	34.002	37.152	75.276	28.332	103.572	
24	84.51	98.658	114.678	73.836	65.106	96.048	66.834	136.566	35.028	74.898	28.746	163.224	
25	83.16	90.18	115.74	72.666	84.222	162.45	54.774	97.758	29.25	69.714	33.498	91.674	
26	92.034	81.486	120.528	72.846	213.174	135.756	61.02	47.124	27.144	65.952	34.596	81.108	
27	98.172	80.406	117.45	73.872	98.046	104.562	65.124	52.668	34.326	63.198	31.68	82.62	
28	81.612	77.76	119.628	74.574	82.818	115.02	61.308	41.634	33.228	58.392	32.022	79.758	
29	79.614	86.328	128.448	72.612	79.182	120.042	53.298		36.612	51.228	31.32	85.32	
30	76.158	81.324	117.792	82.674	77.112	125.478	49.194		34.65	43.938	30.096	77.958	
31	77.598	87.156		71.892		127.458	51.354		46.188		36.018		
Min	76.158	64.818	75.834	71.892	52.092	54.162	49.194	28.242	25.686	34.704	28.332	26.028	25.686
Mean	96.9	82.2	140.4	91.5	71.7	81.9	81.7	47.5	37.9	66.7	41.8	75.2	76.3
Max	130.374	106.56	237.87	114.912	213.174	162.45	175.284	136.566	91.44	139.554	57.582	223.704	237.87
Days over 50% limit	23	8	27	18	3	9	11	2	1	5	0	9	116
Days over 5% limit	0	0	3	0	1	0	0	0	0	0	0	1	5
Median	96	81	134	95	63	73	74	42	35	62	41	78	73
95%ile	123	99	193	112	96	132	137	86	49	100	57	147	168

Figure 7 Te Paerahi treated wastewater discharge flows[1]

[1]Te Paerahi Oxidation Pond Compliance Report Year Ending 30 June 2019

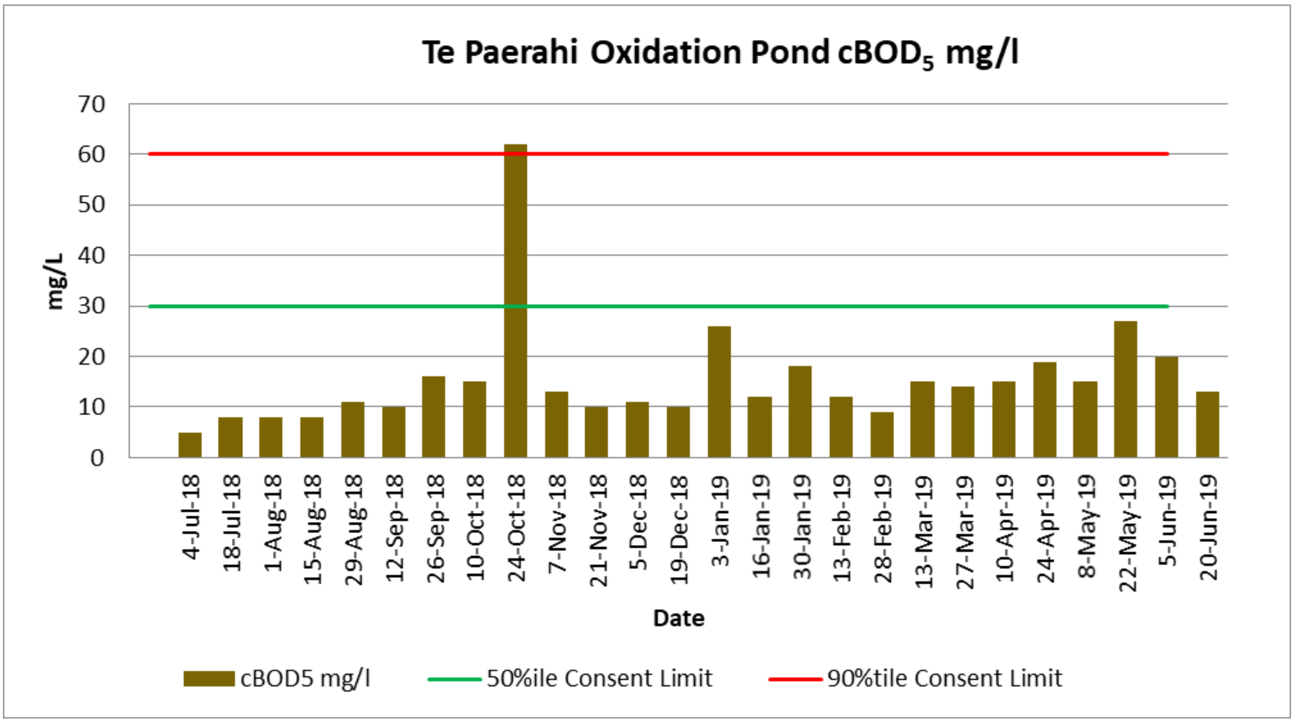

Figure 8 cBOD5 Results 2018-2019[2]

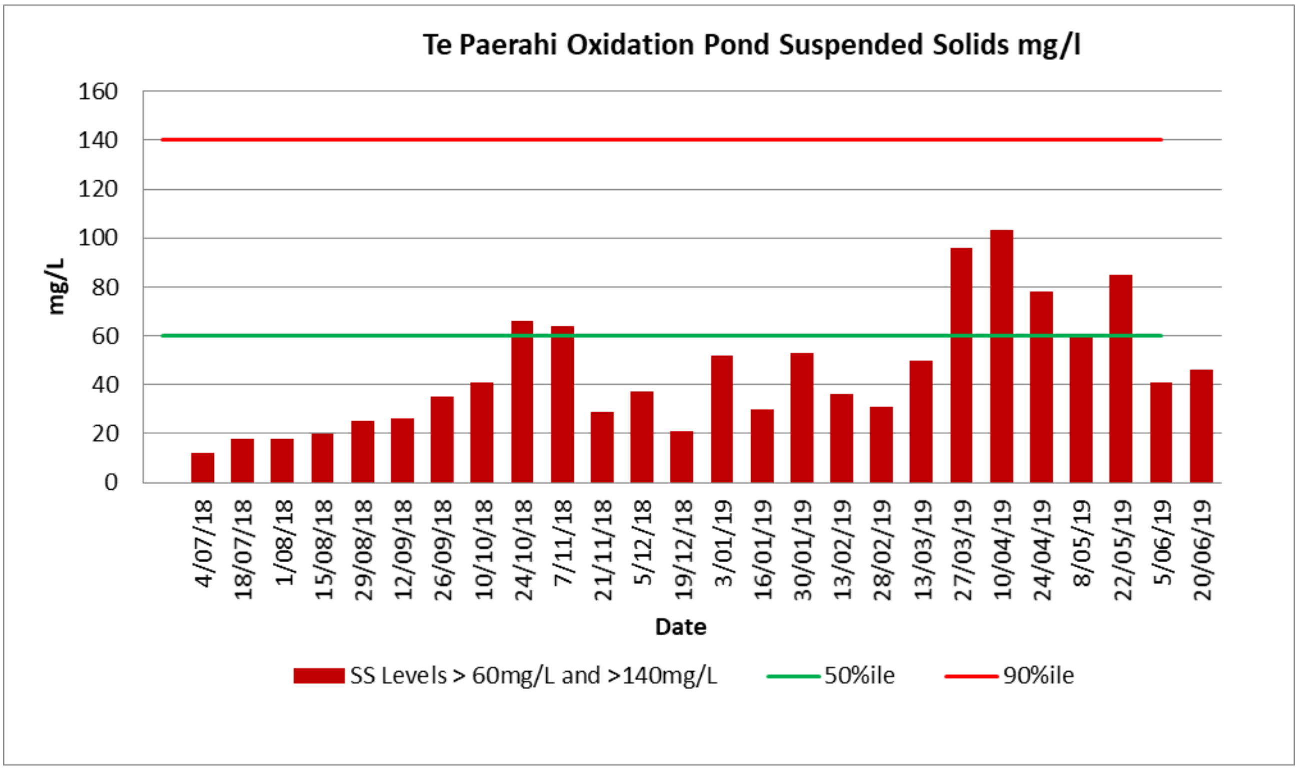

Figure 9 TSS Results 2018-2019[2]

[2] Te Paerahi DP030234La – Quality Monitoring and Wastewater Outflow Charts

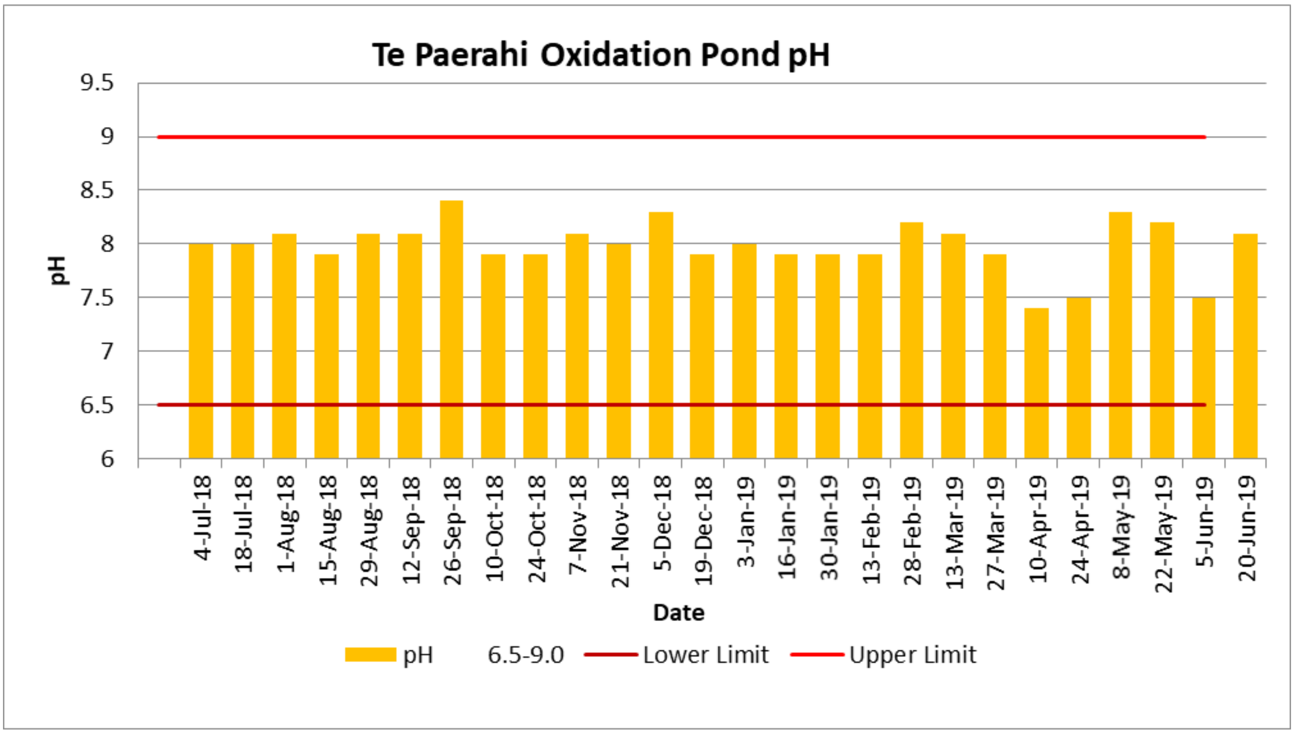

Figure 10 pH Results 2018-2019[3]

The compliance data for 2018-2019 (compliance year) is summarised in the Table 1 below.

Table 2 Te Paerahi discharge consent compliance 2018/19

Parameter	Consent Value	Permitted Exceedance	Actual Exceedance	Numerical Value
ADF, m^3/d 50th percentile 95th percentile	 <87 <190	 <50% time <5% time	 32% 1%	 73 168
Filtered $cBOD_5$, mg/L 50th percentile 90th percentile	 <30 <60	 <16/26 <5/26	 1/26 1/26	 13 23
TSS, mg/l 50th percentile 90th percentile	 <60 <140	 <16/26 <5/26	 6/26 0/26	 39 82
pH	6.5-9	0/26	0/0	7.4-8.4

In the past 12-month period Te Paerahi WWTP met the discharge conditions.

[3] Te Paerahi DP030234La – Quality Monitoring and Wastewater Outflow Charts

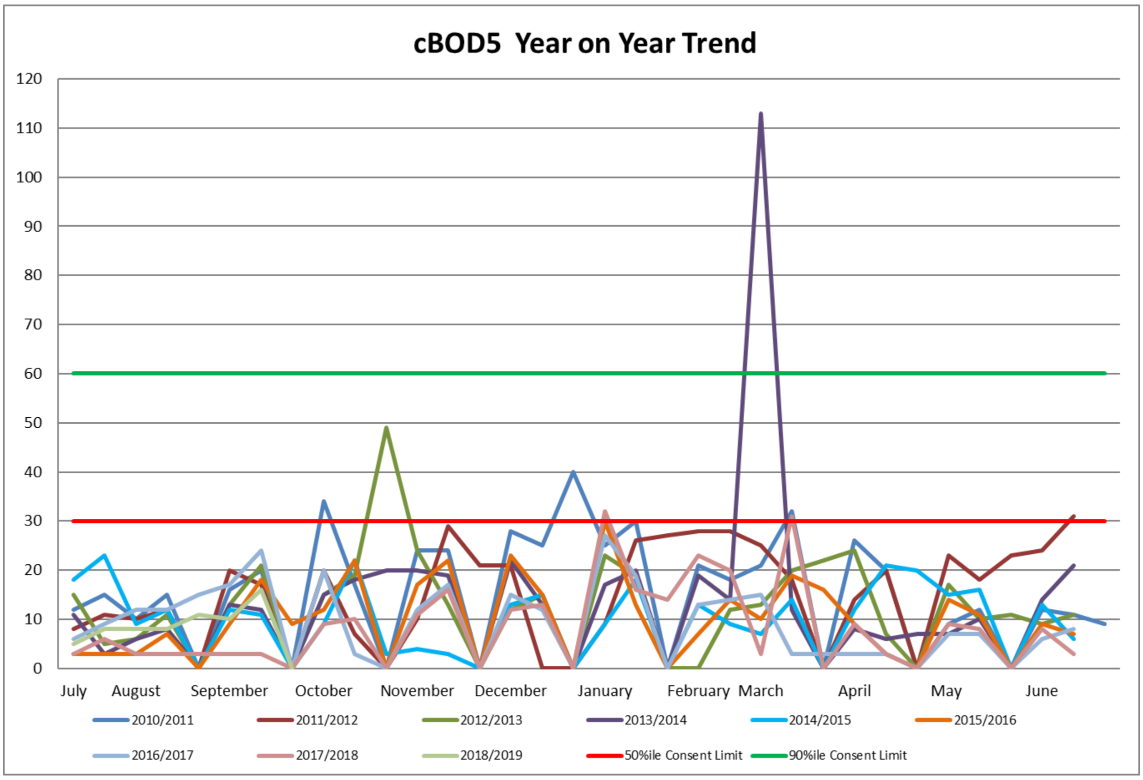

Figure 11 Te Paerahi $cBOD_5$ trend 2010-2019[4]

The minimum $cBOD_5$ for that nine-year period was 3 mg/l and the maximum were 113 mg/l. Averages ranged between 11.6 mg/l and 20.2 mg/l. The results of 2018/2019 year have returned both the lowest maximum and the lowest average for the 9 years as shown in the Figure 11 above.

[4] Te Paerahi DP030234La – Quality Monitoring and Wastewater Outflow Charts

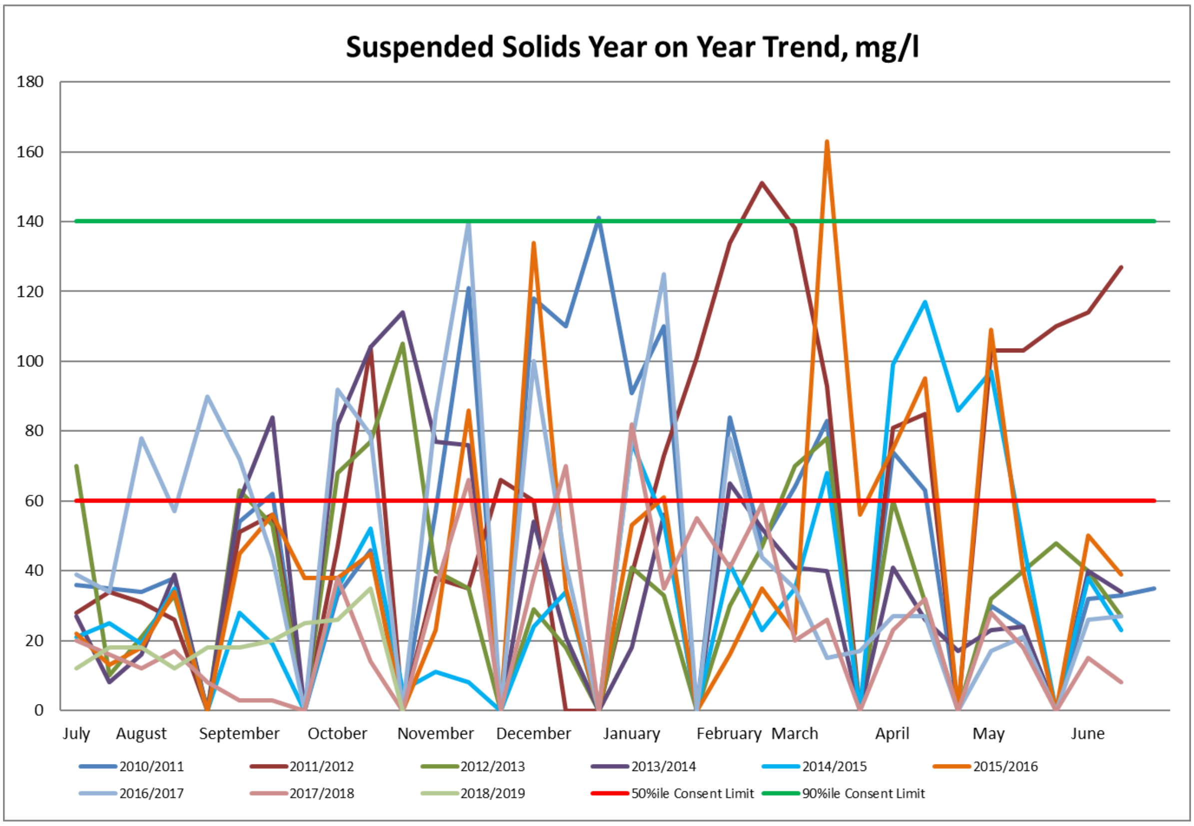

Figure 12 Te Paerahi TSS trend 2010-2019[5]

Total suspended solids have not breached the consent limit during the nine-year period presented in the Figure 12 above. The highest number of exceedances 14/26 for the 50%tile value of 60 mg/l was during 2011-2012 period. The plant stayed within the consent levels for the 90%tile value of 140 mg/l as well, exceeding it only once in each period in 2010-2011, 2011-2012 and 2015-2016.

[5] Te Paerahi DP030234La – Quality Monitoring and Wastewater Outflow Charts

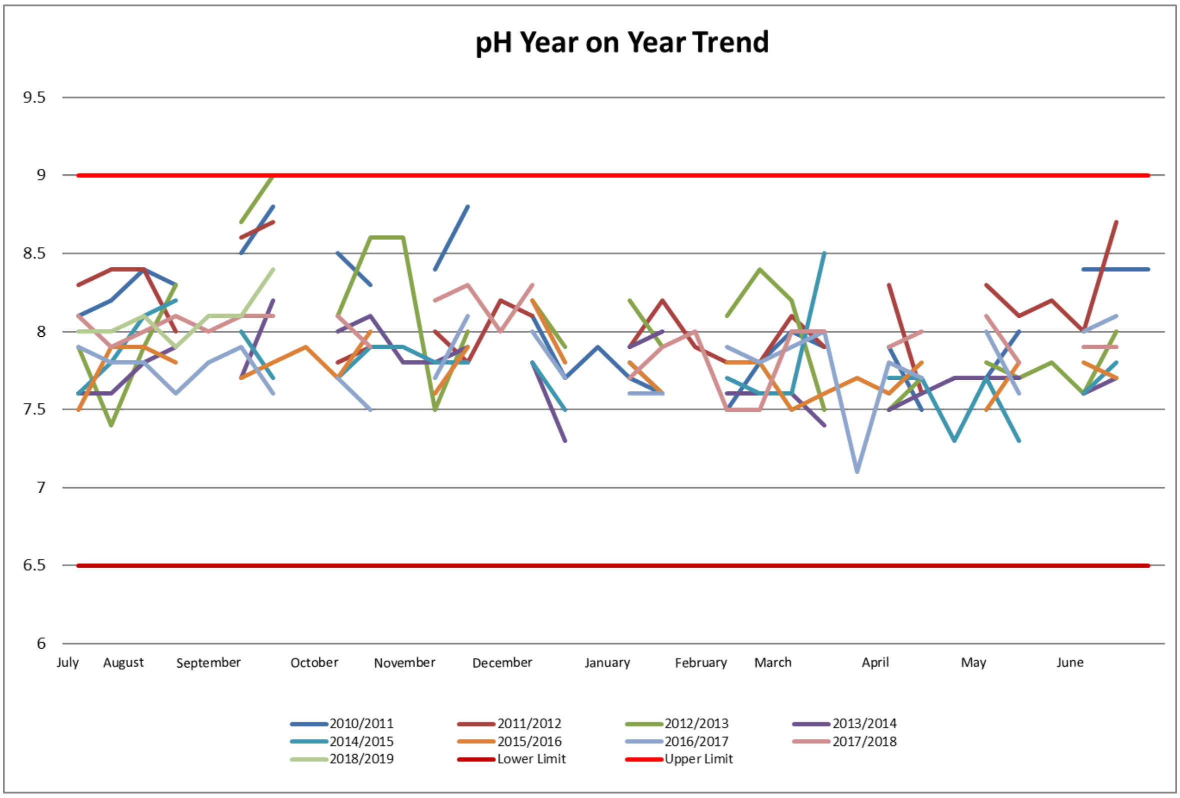

Figure 13 Te Paerahi pH trend 2010-2019[6]

The plant did not exceed the pH consent during the 9 years period. The highest pH value of 9 was in 2012-2013. The lowest pH value of 7.1 was in 2016/2017.

[6] Te Paerahi DP030234La – Quality Monitoring and Wastewater Outflow Charts

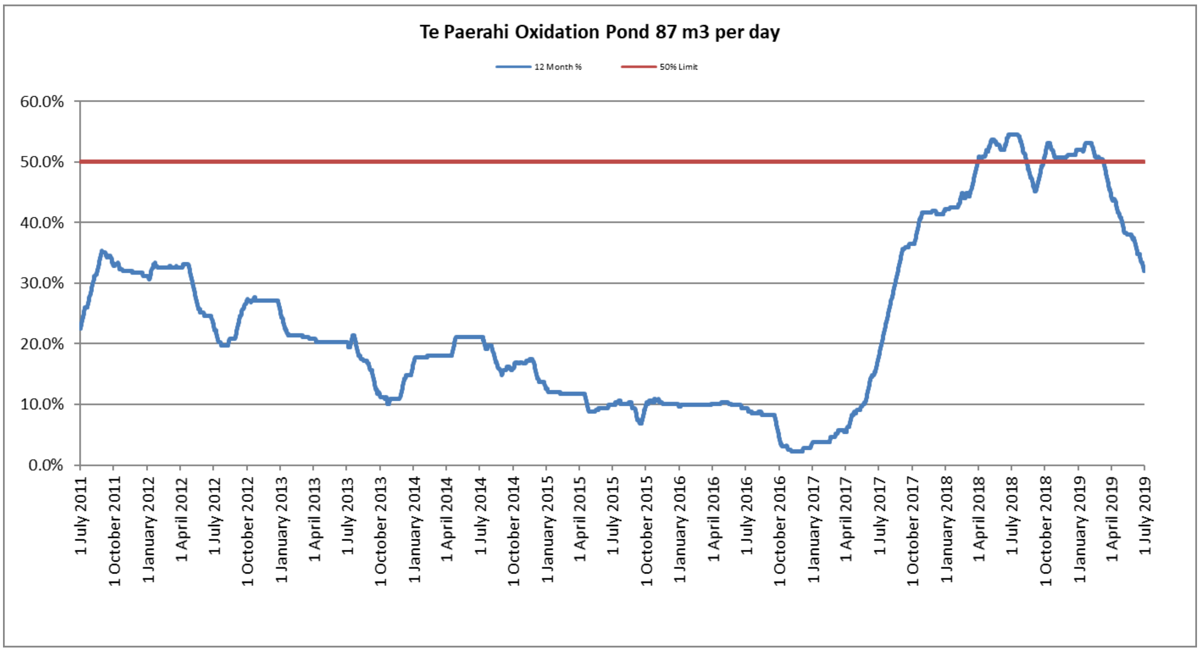

Figure 14 Rolling twelve months discharge percentage for 87 m^3/d[7]

Looking at the discharge flow rate as a percentage of the consented average daily volume, on a rolling twelve-month basis the discharge volume exceeded the 50% for the 87 m^3/d level from 1 July 2018 to 11 August 2018 and from 27 September 2018 to 10 March. The highest percentage was 54.5 % which was from 1 July 2018 to 23 July 2018 as showed in the Figure 14 above.

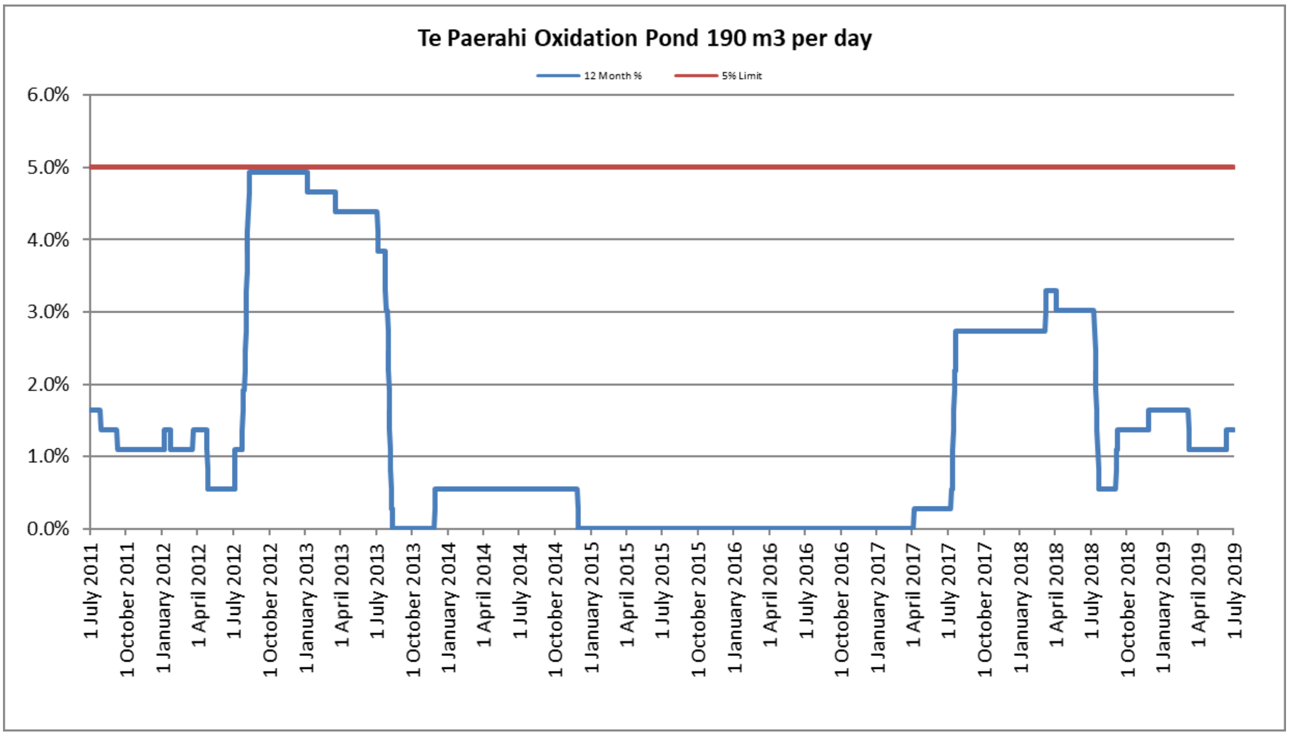

Figure 15 Rolling twelve months discharge percentage for 190 m^3/d[7]

[7] Te Paerahi Oxidation Pond Compliance Report Year Ending 30 June 2019

For the limit above 190m^3/d the highest percentage was 3.0% which was during the period 1 July 2018 to 9 July 2018 as shown in the Figure 16 above.

3.1.5 Current Issues

Beca conducted a site visit on 16th of December 2019 to identify the current issues on site. During this visit the Te Paerahi WWTP operator and CHBDC was present.

There are no major current issues with the plant. However, it is noted that there is no flow meter to measure incoming flow and screening. That said, surprisingly there was no large debris around the pond embankments neither problems in the soakage system in the dunes as it is expected for the plants with no screening.

3.2 Porangahau

3.2.1 Site Description

Wastewater from the community is pumped to the Porangahau wastewater treatment plant (WWTP), which consists of a single, clay lined, stabilization pond approximately 0.3 ha in size. There are no incoming flow monitoring or screening facilities, therefore the only form of treatment occurring is in the pond. Part of the solids settles at the bottom of the pond to the sediment layer, where un-aerobic conditions takes place and further treatment occurs. A portion of solids which remains in suspension along with the nutrients and soluble solids are treated by the combination of bacteria and algae in aerobic conditions. The bacteria multiply by using the carbon-based contaminants and some of the nutrients under aerobic conditions. Oxygen for the process is provided by wind and photosynthesising algae.

Figure 16 Porangahau WWTP Stabilization Pond

The effluent is discharged to the drain via effluent chamber, where the outflow is monitored. A perforated basket is installed in the effluent chamber to catch eels and any debris which didn't settle in the pond.

Figure 17 Effluent discharge chamber and flow meter Transducer

From the effluent chamber the treated wastewater is discharged to the stream, which merges into Porangahau River.

Figure 18 The Stream upstream discharge point

Figure 19 Effluent discharge point to the Stream

Figure 20 The Stream downstream discharge point (on the left) and merge into the Porangahau River (on the right)

3.2.2 Site location

Porangahau WWTP is located off Jones Str. Adjacent to Porangahau River in the Central Hawkes Bay district, approximately 1.5 km South East of the Porangahau village centre.

Figure 21 Porangahau WWTP location (areal picture taken from Google maps)

3.2.3 Consent Requirements

In accordance with the provisions of the Resource Management Act 1991, and subject to its conditions, the Hawke's Bay Regional Council granted the resource consent on the 22th of October 2009 (Consent No:DP030233W) for CHBDC to discharge treated domestic wastewater from the Porangahau oxidation pond into or onto the land (via soakage) in circumstances where that contaminant may enter water.

Details of the Resource Consent:

- Effluent to be discharged – Treated domestic
- Rate of discharge – the average daily volume does not exceed 130 m^3/d for more than 50% of the time nor 415 m^3/d for more than 5% of the time over any 12 months period.
- Consent duration – expiring 31 May 2021

The discharge consent outlines the following Conditions:

- General – outlines the physical works to be undertaken on the plant.
- Performance –the following effluent quality parameters apply over any 12-month period:

Table 3 Porangahau WWTP discharge consent parameters

Parameter	50th Percentile	90/95th Percentile
Average daily flow	130 m^3/d	415 m^3/d 95th percentile
Instantaneous flow	1.5 l/sec	4.8 l/sec 95th percentile
Carbonaceous Biochemical Oxygen Demand – 5 day ($cBOD_5$)	30 mg/l	60 mg/l 90th percentile
Total suspended Solids (TSS)	50 mg/l	90 mg/l 90th percentile
pH	6.5-9	

The standards above are deemed to be breached, if more than 16 samples taken over any 12-month period exceeded the values in the table above, except for pH, which deemed to be breach if any sample taken is outside of the range.

The following are also covered in the consent document:

- A Stormwater Infiltration Management Plan is required.
- Monitoring – outlines the incoming and outgoing flow and quality monitoring requirements. Porangahau River monitoring requirements.
- Discharge quality sampling – outlines the requirements for sample type, constituents to analyse for, and the frequency.
- Reporting – outlines the Reporting conditions and dates.
- Kaitiaki Liaison – outlines the requirements for liaison.
- Non-Compliance – outlines the steps to be taken in the event of the exceedance of the effluent standards.

3.2.4 Current Performance

Porangahau Oxidation Pond Compliance Report Year ending 30 June 2019 was provided to Beca for review along with the sampling data for Porangahau DP030233W – Quality Monitoring and Wastewater Outflow Charts. The latter contains flow data from 2008 onwards and Quality Monitoring file contains data from 2009 onwards.

Porangahau Oxidation Pond Compliance Report for the year ending 30 June 2019 included information about the pond performance for five days carbonaceous Biological Oxygen Demand ($cBOD_5$) and Total Suspended Solids (TSS) removal. The most recent pond performance is for the period June 2018 – July 2019. The results are summarised in the Figures below.

There were 17.500 readings taken at 30 minute increments from 1 July 2018 to 30 June 2019. Of these 5.705 (28.97%) were above 1.5 l/s and 1,212 (1.71%) were above 4.8 l/s. Neither the lower exceedance level, nor the upper level was breached.

The information above is extracted from the Porangahau Oxidation Pond Compliance Report for the year ending 30 June 2019. No data was provided to support this information.

Daily volumes Year 2018/ 2019 (m3/day) at Porangahau oxipond												
Consent Maximum (m3/day)									130	50% of any 12 month period		
Consent Maximum (m3/day)									415	5% of any 12 month period		
				Consent Exceeded								
				Upper Limit Consent Exceeded								
				Below Consent Maximum								
Day	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
1	272.52	83.16	134.1	105.3	106.254	168.966	155.223	52.218	45.018	96.948	44.352	78.156
2	276.84	88.38	130.86	94.86	104.508	161.064	103.671	52.218	44.046	104.94	44.172	94.104
3	271.08	101.88	121.86	88.38	97.524	167.976	69.1236	48.402	43.884	103.14	43.434	87.228
4	236.88	162.72	581.76	88.74	105.696	176.814	54.522	50.598	45.468	99.36	45.882	83.376
5	231.84	250.38	1006.38	82.98	109.512	146.88	53.64	49.338	43.704	92.268	44.784	81.648
6	225.72	303.12	1137.78	93.42	108.108	136.134	53.028	43.452	43.344	94.5	43.02	98.748
7	242.28	352.8	934.74	79.02	111.15	134.262	54.306	45.216	44.856	94.212	42.57	89.892
8	213.84	340.92	894.6	81	114.498	134.532	52.794	46.296	45.702	150.012	41.454	84.564
9	243.36	282.24	644.22	195.66	110.862	134.208	51.966	45.954	49.158	140.688	42.318	81.9
10	244.8	234.18	450	145.8	107.856	130.086	52.02	44.64	55.944	122.22	43.398	81.036
11	210.6	201.42	335.16	140.04	105.768	128.16	51.606	40.122	54.882	117.144	42.984	79.704
12	177.12	190.26	246.06	217.44	103.626	150.48	49.878	42.138	51.84	141.516	41.832	78.948
13	195.84	181.62	198.18	169.506	113.13	143.298	51.21	49.86	49.986	126.252	44.352	176.4
14	203.4	205.92	164.52	98.325	121.842	137.016	51.84	49.788	49.032	114.408	40.698	203.904
15	216.72	187.92	155.7	127.044	114.354	139.068	55.35	48.942	48.6	109.224	43.434	188.424
16	486	145.8	148.68	162.576	111.294	140.688	81.882	46.368	48.384	99.792	42.066	150.804
17	497.88	128.16	136.44	157.1976	106.434	136.422	98.604	42.768	46.494	97.812	43.848	127.26
18	389.16	140.76	142.56	218.628	106.47	124.488	78.444	44.802	46.746	96.552	44.352	115.452
19	327.6	133.56	124.56	214.74	106.254	110.88	67.374	44.1	45.882	95.292	41.436	108.288
20	323.64	132.48	127.08	229.932	104.544	171.558	58.626	37.8	45.792	96.48	39.132	101.772
21	369.36	116.28	124.56	223.956	109.62	193.932	54.792	33.012	52.182	99.468	37.512	103.608
22	329.04	105.48	118.98	228.852	115.074	167.274	54.36	44.658	49.572	98.208	36.864	101.16
23	218.88	192.96	108.9	213.444	123.21	156.852	52.614	45.018	48.348	103.644	37.152	110.664
24	212.76	230.22	117.18	156.636	118.494	168.498	50.382	57.708	47.772	102.96	36.576	179.568
25	198.36	211.86	109.26	110.7	122.886	239.058	50.454	76.68	48.672	105.084	36.252	142.056
26	195.48	168.48	117.36	90	240.156	252.036	47.07	60.966	48.42	101.952	37.224	125.496
27	198	143.1	130.14	87.228	253.35	211.95	49.878	51.768	49.518	98.748	36.882	117.936
28	186.84	131.76	116.28	154.98	196.488	186.408	50.922	47.052	46.152	95.868	38.124	106.416
29	200.16	139.5	141.48	206.82	176.58	168.714	47.16		47.25	94.752	39.168	102.312
30	223.56	133.92	126.36	218.808	176.292	163.242	49.68		46.08	89.856	38.286	105.624
31	194.76	146.52		210.096		166.014	52.362		45.684		40.104	
Min	177	83	109	79	98	111	47	33	43	90	36	78
Mean	259	180	301	151	127	160	61	48	48	106	41	113
Max	498	353	1138	230	253	252	155	77	56	150	46	204
Over 50%	31	25	19	18	5	28	1	0	0	3	0	6
Over 5%	2	0	7	0	0	0	0	0	0	0	0	0
Median	226	163	139	155	111	157	53	46	47	100	42	103
95%ile	438	322	974	226	221	226	101	60	54	141	45	184
Days over annual 130 m3	31	25	19	18	5	28	1	0	0	3	0	6
Rolling 12 months over 130m3	154	159	169	163	168	195	195	195	188	177	160	136
Days over annual 415 m3	2	0	7	0	0	0	0	0	0	0	0	0
Rolling 12 months over 415 m3	22	22	29	25	25	25	25	25	21	20	20	9

Figure 22 Porangahau treated wastewater discharge flows[8]

During the period 1 July 2018 to 30 June 2019 there were 136 days (37.3%) when 130 m^3/d were exceeded and 9 days (2.47%) when the flow exceeded 415 m^3/d. These results are within the consent parameters for the flow.

[8] Porangahau Oxidation Pond Compliance Report Year ending 30 June 2019

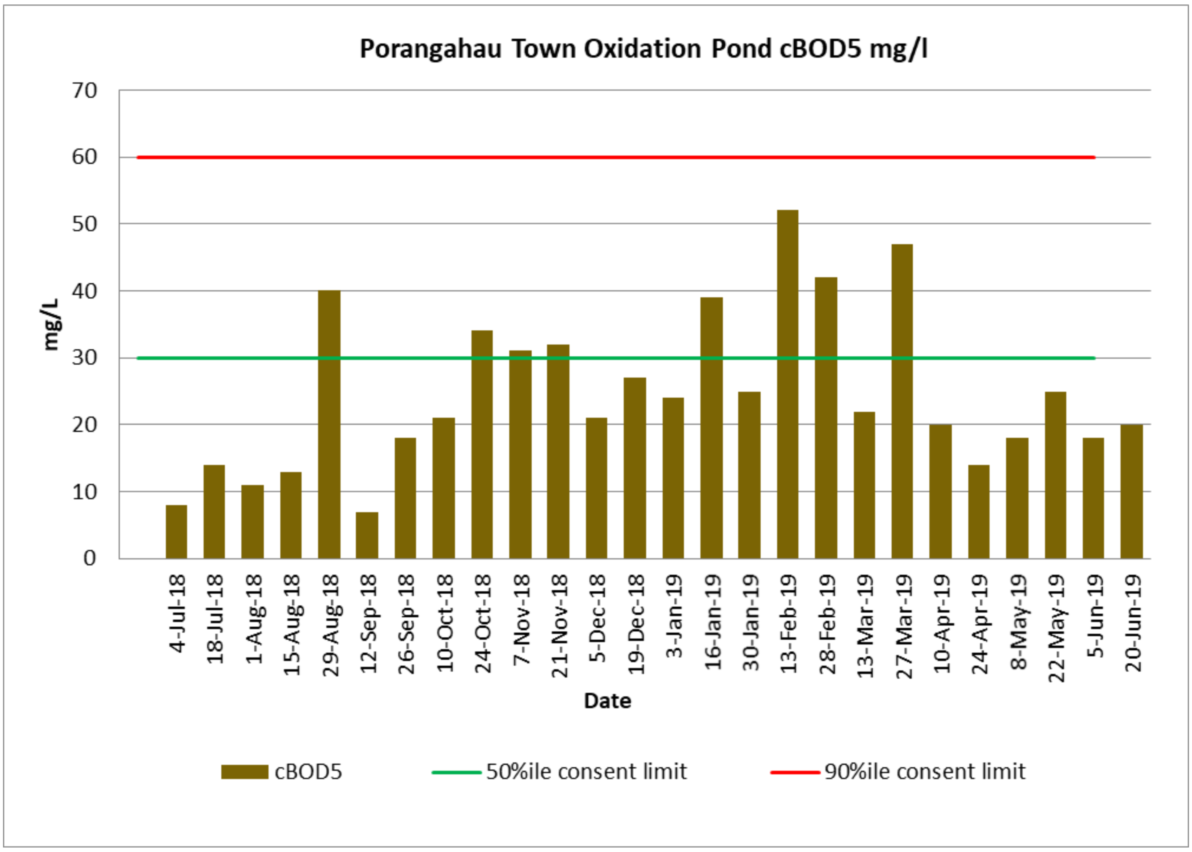

Figure 23 cBOD$_5$ Results 2018-2019[9]

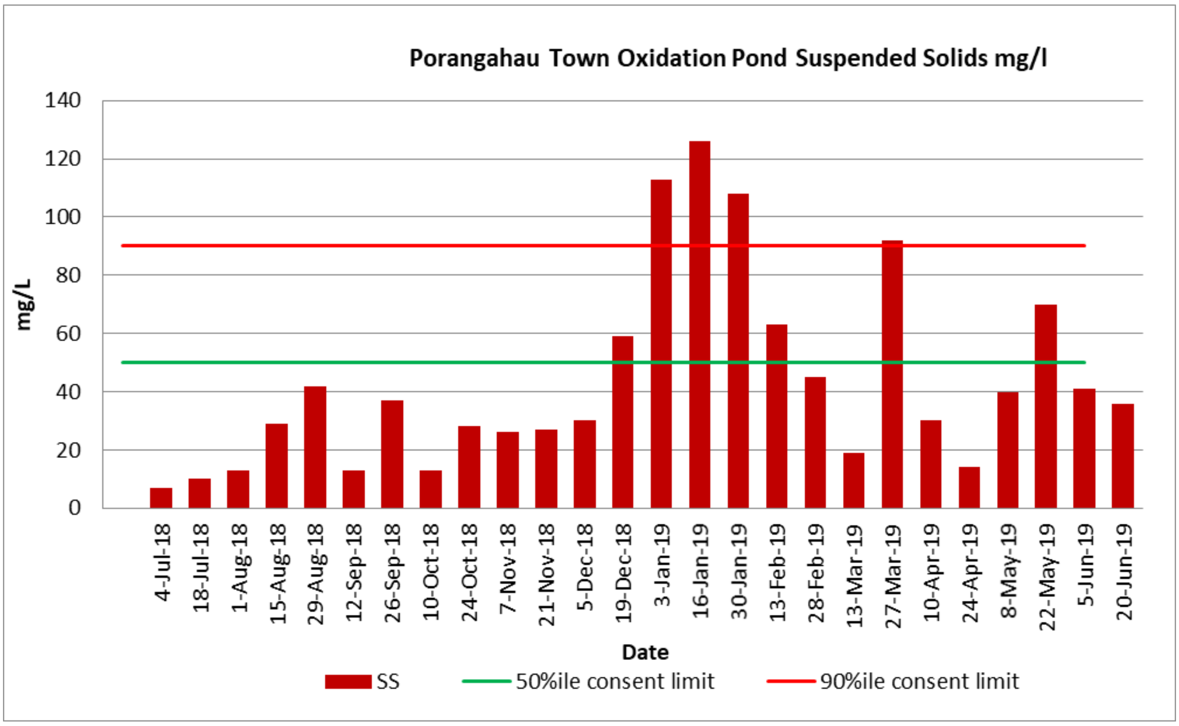

Figure 24 TSS Results 2018/2019[9]

[9] Porangahau DP030233W – Quality Monitoring and Wastewater Outflow Charts.

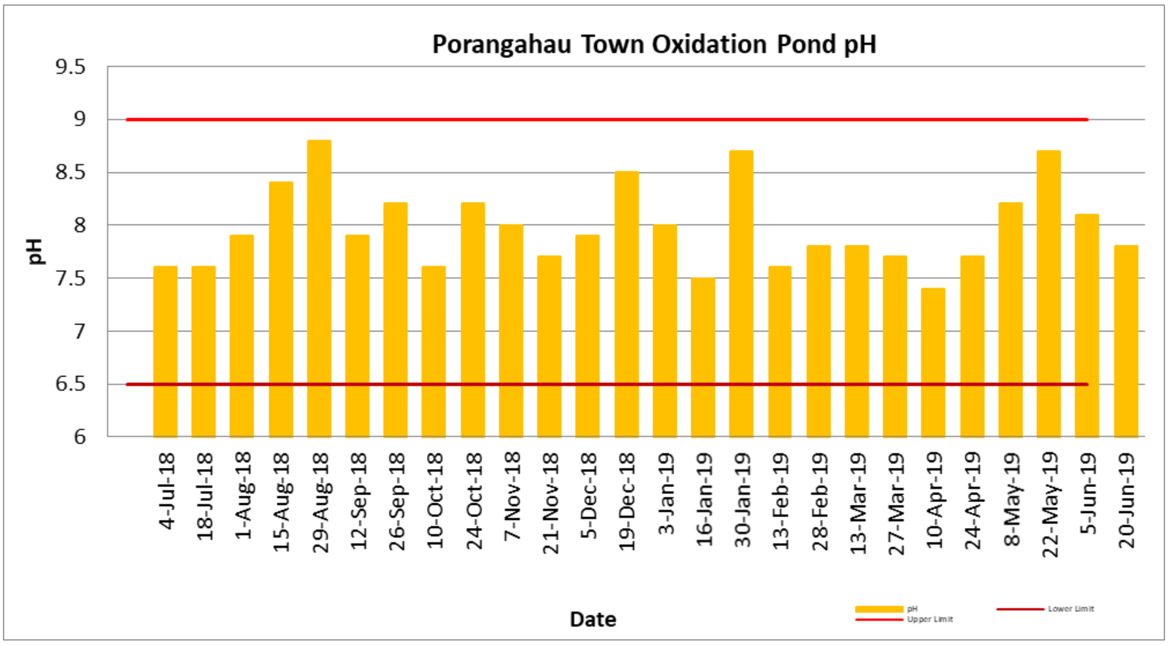

Figure 25 pH Results 2018/2019[10]

The consent compliance data for 2018-2019 (July) is summarised in the Table 4 below:

Table 4 Porangahau Discharge Consent Compliance 2018/19

Parameter	Consent Value	Permitted Exceedance	Actual Exceedance	Maximum Value
Instantaneous flow l/sec 50th percentile 95th percentile	<1.5 <4.8	<50% time <5% time	0 or 28.97% 0 or 1.71%	-
ADF m^3/d 50th percentile 95th percentile	<130 <415	<50% time <5% time	136 d or 37% 9 d or 2.4%	-
Unfiltered $cBOD_5$, mg/l 50th percentile 95th percentile	<30 <60	<16/26 <5/26	8/26 0/26	52
TSS, mg/l 50th percentile 95th percentile	<50 <90	<16/26 <5/26	7/26 4/26	126
pH	6.5-9	0/26	0/0	7.4-8.8

In the past 12-month period Porangahau WWTP met the discharge conditions.

[10] Porangahau DP030233W – Quality Monitoring and Wastewater Outflow Charts.

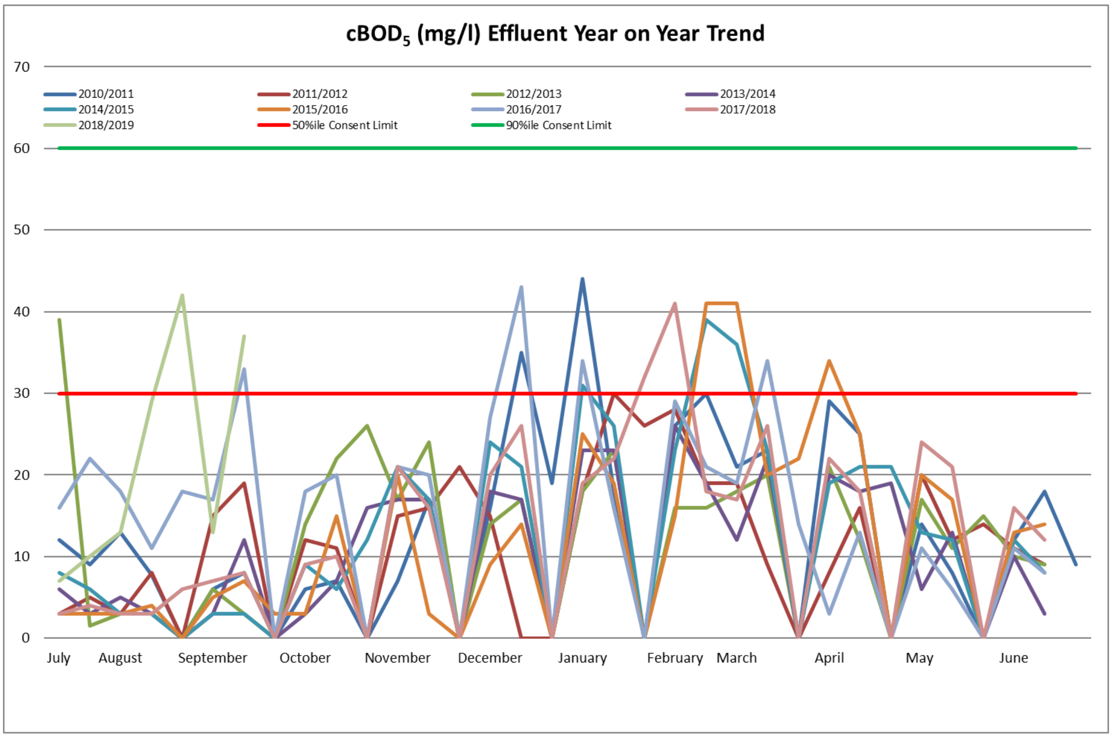

Figure 26 cBOD5 trend 2010-2019[11]

Over the nine-year period the plant did not exceed 50%ile consent limit value of 30 mg/l nor it exceeded 90%tile consent limit value of 60mg/l. The plant was compliant for the nine-year period. The minimum $cBOD_5$ for was 1.5 mg/l in 2012-2013 and the maximum was 44 mg/l in 2010-2011. Averages ranged between 13.1 mg/l and 21.6 mg/l. The plant exceeded 30 mg/l on maximum 4 occasions in 2016/2017 consenting period but did not breach the consent limits. The results of the 2018/2019 year have returned both the lowest maximum and the lowest average for the 9 years as shown in the Figure 26 above.

[11] Porangahau DP030233W – Quality Monitoring and Wastewater Outflow Charts

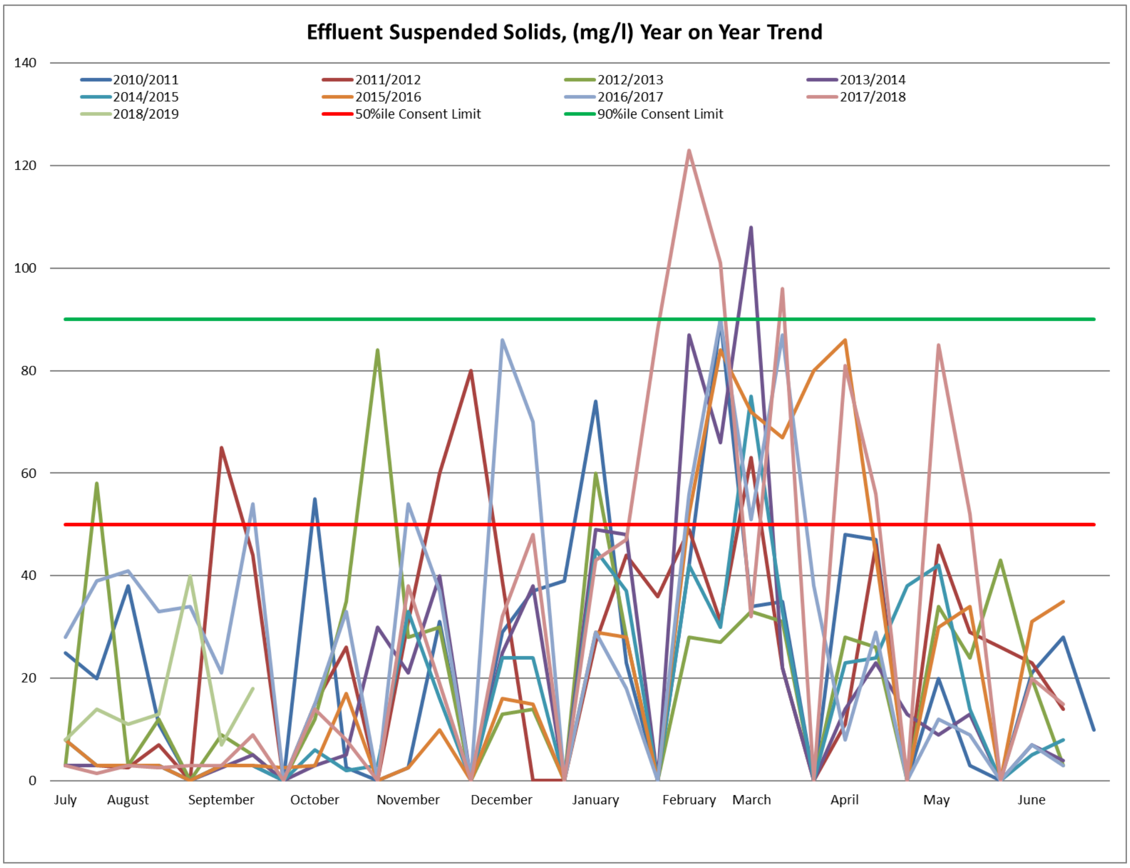

Figure 27 TSS trend 2010-2019[12]

Total suspended solids have not breached the consent limits in the nine-year period presented in the Figure 27 above. The highest number of exceedances (8/26) for the 50 mg/l value (50th percentile) was during 2016-2017 period. The plant stayed within the consent levels for the 90 mg/l (95th percentile) as well, exceeding it only 4 times in the 9-year period - once in 2013-2014 and 3 times in 2017-2018.

[12] Porangahau DP030233W – Quality Monitoring and Wastewater Outflow Charts

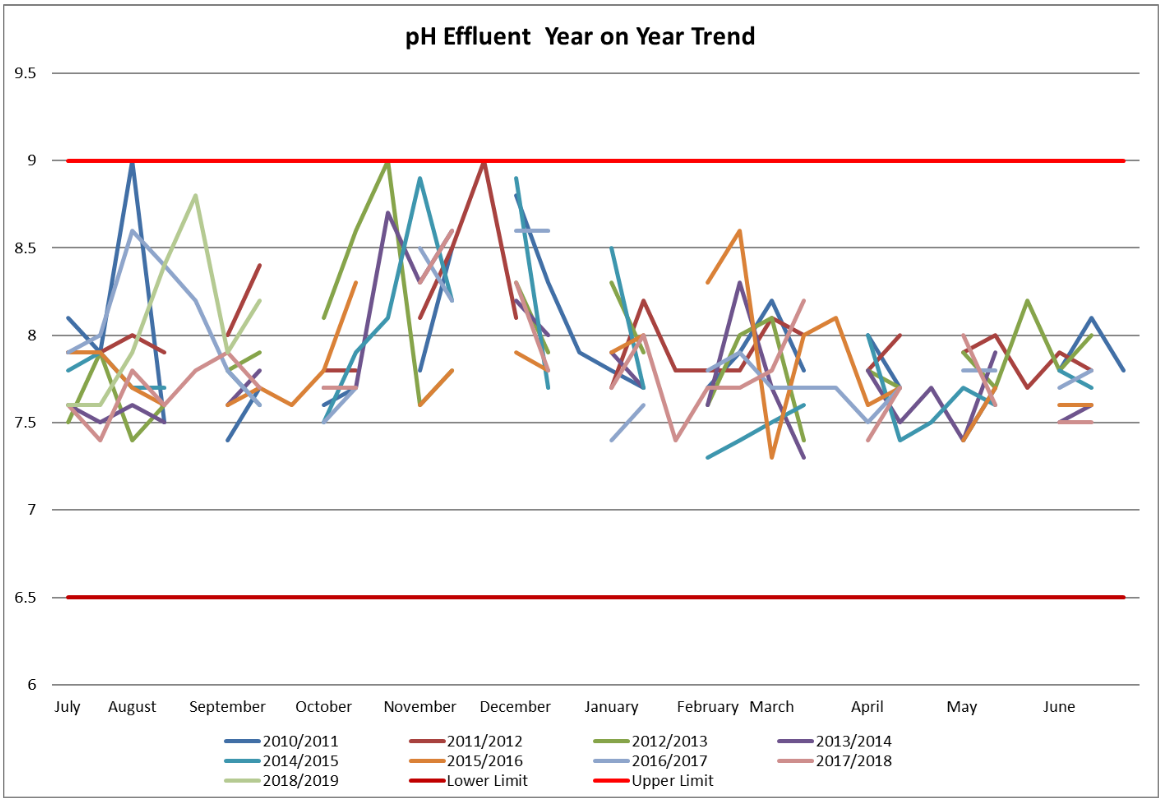

Figure 28 pH trend 2010-2019[13]

The plant did not exceed the pH consent conditions during the 9-year period. The highest pH value of 9 was in 2010-2013. The lowest pH value of 7.3 was in 2013/2014 period.

On the rolling twelve-month period basis, the sum of the exceedances of discharge volume requirement did not exceed 50% at any time, the highest percentage was for 4 days in early January 2019, which was 47.9%. For the limit above 415 m^3/d the plant was non-compliant for almost a year on the rolling twelve-month period basis. The highest percentage of 5% allowance exceedance was 7.4% which occurred during September 2018. This data is shown in Figure 29 and Figure 30 below.

[13] Porangahau DP030233W – Quality Monitoring and Wastewater Outflow Charts

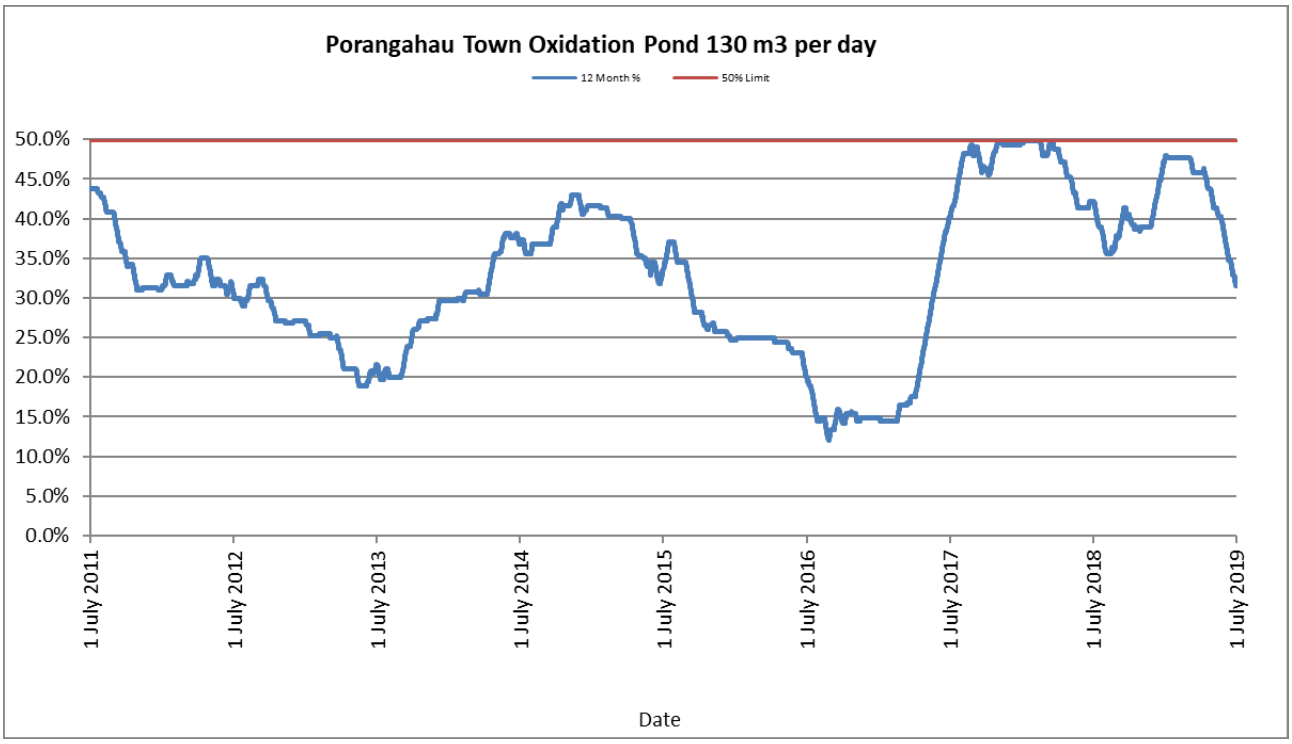

Figure 29 Rolling twelve months discharge exceedance percentages for 130 m^3[14]

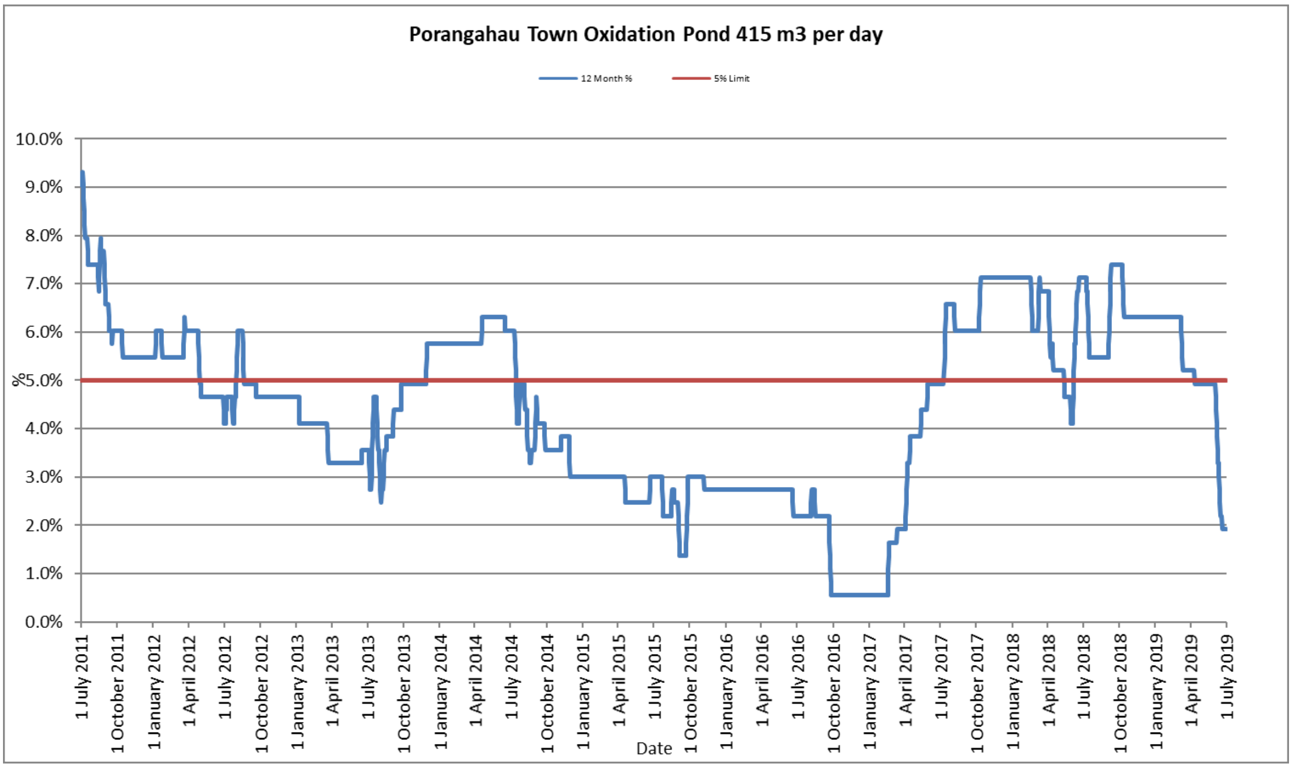

Figure 30 Rolling twelve months discharge exceedance percentages for 415 m^3[14]

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[14] Porangahau Oxidation Pond Compliance Report Year ending 30 June 2019

3.2.5 Current Issues

Beca conducted a site visit on 16th of December 2019 to identify the current issues on site. During this visit Porangahau WWTP operator and CHBDC was present.

- There are no major current issues with the plant.
- During the site visit there was a noticeable odour in the stream to which the effluent discharges before reaching the River (water level dry until the point of discharge), There was also a small amount of what appeared to be sewage fungus in the base of the drain.
- It is noted that there is no flow meter to measure incoming flow and no influent screening. That said, surprisingly there was no screening debris around the pond embankments as is normally expected for the plants with no screening.

4 Basis of Design

4.1 General

Te Paerahi and Porangahau WWTP are owned and operated by CHBDC. Both plants were constructed in 1990. The complete installation of the plant including additional components such as fencing, baffles and earth bunds was achieved in 2010 and all the consent conditions regarding construction were fulfilled in 2014, followed by Resource consents DP030234La and DP030233W. These consents authorise the discharge of treated wastewater from Te Paerahi and Porangahau WWTPs to the sand dunes and Porangahau river respectively. The consents will expire in May 2021.

Te Paerahi Wastewater treatment plant is located approximately 500 m north from the Te Paerahi (Porangahau) Freedom Camping grounds at the end of Te Paerahi Road. The plant receives the wastewater from the community located around Porangahau freedom camping and Country club. Treated wastewater is irrigated to the adjacent sand dunes.

Porangahau WWTP is located off Jones Str. Adjacent to Porangahau River approximately 1.5 km South East from the Porangahau village centre. The plant treats the wastewater from the township. Treated wastewater is discharged to the Porangahau river though the drain adjacent to the plant.

4.2 Design horizon

The potential upgrades for both plants are to be sized for the design horizon to year 2048 with a population of approximately 150 households in Porangahau with estimated population of 335 contributing to the system.

There are no growth projections for Te Paerahi community, however, in the Environmental Assessment Report prepared by Opus, issued 2007, it was assumed that Te Paerahi is serving approximately 117 connected properties. Porangahau Beach is largely a holiday destination and to there is no reported number of permanent residents. At the time population was estimated at 312 people based on the number of connected properties. As there are no growth projections for Te Paerahi catchment, for the basis of design we have assumed that the maximum population of permanent residents in the future will be approximately the same.

The population growth forecast[15] for the Porangahau township is presented in the tables below.

[15] Central Hawke's Bay District Long Term Planning Demographic and Economic Growth Directions 2018-2048, 28 August 2017, Economic Solutions Ltd.

Table 5 Location of Projected Central Hawke's Bay District Household Growth 2018-2048

Housing Locality/Area	Number of Households						
	Actual		Projected				
	2013	2017	2018	2028	Change 2018-2028	2048	Change 2018-2048
Waipukurau Main Urban Area	1,970	2,040	*2,065*	*2,295*	230	*2,500*	435
Waipawa Main Urban Area	990	1,015	*1,020*	*1,080*	60	*1,175*	155
Otane Rural Township	240	250	*260*	*310*	50	*340*	80
Coastal/Rural Townships	750	770	*775*	*825*	50	*865*	90
Porangahau Rural Township	90	95	*100*	*120*	20	*150*	50
Other Eastern District Rural Areas	65	80	*85*	*150*	65	*160*	75
Takapau Rural Township	215	215	*215*	*220*	5	*245*	30
Western District Rural Townships	810	820	*825*	*850*	25	*925*	100
Other Western District Rural Areas	270	275	*280*	*310*	30	*340*	60
Total	**5,400**	**5,560**	***5,625***	***6,160***	**535**	***6,700***	**1,075**

Table 6 Location of Projected Central Hawke's Bay District Population Growth 2018-2048

Housing Locality/Area	Population						
	Actual		Projected				
	2013	2017	2018	2028	Change 2018-2028	2048	Change 2018-2048
Waipukurau Main Urban Area	4,825	5,035	*5,080*	*5,250*	170	*5,560*	480
Waipawa Main Urban Area	2,430	2,505	*2,510*	*2,535*	25	*2,615*	105
Otane Rural Township	590	615	*640*	*710*	70	*755*	115
Coastal/Rural Townships	1,840	1,900	*1,905*	*1,920*	15	*1,925*	20
Porangahau Rural Township	220	235	*245*	*255*	10	*335*	90
Other Eastern District Rural Areas	160	195	*210*	*250*	40	*355*	145
Takapau Rural Township	530	530	*530*	*535*	5	*545*	15
Western District Rural Townships	1,990	2,025	*2,030*	*2,035*	5	*2,055*	25
Other Western District Rural Areas	665	680	*690*	*710*	20	*755*	65
Total	**13,250**	**13,720**	***13,840***	***14,200***	**360**	***14,900***	**1,060**

4.3 Site Constraints

4.3.1 Te Paerahi

Te Paerahi site is a waahi tapu site located near Porangahau beach. The owner of the land is Puketauhinu Trust.

The plant is constructed on a part of 167 ha parcel block. The agreement between the Trustees and Central Hawke's Bay District Council (CHBDC) was signed in 1981, which authorised WDC to build the oxidation pond on Lot 70. No adjacent land owned by the Council is available.

4.3.2 Porangahau

The site has a shared access with a local farm. The site is owned by Waipukurau District Council. The site is 0.98 ha in total, however the space is limited as 0.3 ha oxidation pond is placed in the middle of the parcel block. No adjacent land owned by the Council is available.

4.1 Flows and loads

4.1.1 Porangahau Flows and loads

Porangahau WWTP doesn't have a flow meter on the inlet pipe only effluent daily volumes and incoming wastewater composition characteristics are monitored at the plant. Therefore, the future flows were calculated from the effluent volume.

The historical effluent flows for the period 2008-2020 May and future flows are summarised in Table 7 below. Future flow is based on flow per capita and future flow actual is based on the actual flow per capita. The actual flow per capita is estimated from the effluent volume at the current population of 245 people. Both future flows are estimated for the future population of 335 people projection provided in the table 2 above.

Table 7 Porangahau WWTP Future (2048) flows

Parameter	Effluent Volume m^3/d	Actual flow per capita l/p/d	Flow per Capita[16] l/p/d	Future flow m^3/d	Future flow Actual m^3/d
Dry weather Flow (m^3/d)	31	127	150	50	45
Average Flow (ADF) (m^3/d)	144	542 (208)*	250	84 (218)*	182
95%ile Flow (m^3/d)	634	-	-	-	928
Max Flow (m^3/d)	2250	9183	300	100	2288^

* Wet weather factor of 2.6 is applied to determine dry weather actual flow per capita, hence the actual dry weather flow per capita is 208 l/p/d

* Wet weather factor of 2.6 is applied to determine average future flow, hence average future flow is 218 m3/d.

^ The Maximum flow is based on the maximum effluent volume for 245 people plus the flow for addition 70 people based on average actual flow per capita 542 l/p/d. (2250 + (542 l/p/d*70/1000) = 2288 m^3/d)

Effluent volumes include water treatment plant softener and backwash waste (24.5 m^3/d total) infiltration and ingress (I&I) in the network and rainfall/ evaporation in the pond. Therefore, it is assumed that the incoming flows includes all the components. There is no information that water treatment plant capacity will be increased in the future, therefore we assume, that total waste from water treatment plant will remain the same in the future.

Wet weather factor of 2.6 is applied for the future average flow to compensate for infiltration. The factor was determined from the effluent volume on the dry and wet days using rainfall data.

The average flow per capita doesn't compare well with the theoretical flow per capita as the later includes wastewater only, without any allowance for I&I.

ADF compares well using dry weather figures. However, average future flow appears to be more conservative than future flow actual, once the wet weather factor is applied. Hence the average flow of 218 m^3/d is used for the contaminant loads to the plant.

[16] Metcalf & Eddy Wastewater Engineering Treatment and Resource Recovery 5th Edition Table 3-7

The maximum daily flows include peak instantaneous flows, which were not determined at this time as a result of insufficient data. Therefore, it is very difficult to compare maximum actual flow and maximum flow per capita. However, given the projected growth of 70 people will include new connections, it is expected to be no to minimum infiltration in the new part of the network. We do not have an information that the infiltration will be reduced in the future, therefore we propose to use the Future Flows Actual for the basis of design to allow for a hydraulic capacity on the wet days.

Incoming wastewater samples were taken from St. Jones Pump station every two months for the period 2011-2019 (May). For the basis of this report only samples from the period 2014-2019 (May) are summarised below as a 5-year period reflects the nature of wastewater as the most recent. Two samples were eliminated from the data set as invalid due to incorrect sampler installation.

Table 8 Porangahau WWTP incoming wastewater characteristics

Parameter	Min	Average	90th %ile	Max	Typical[17]		
					Weak	Ave	High
COD, mg/l	35	297	706	1420	339	508	1016
Unfiltered cBOD5, mg/l	3	103	307	566	133	200	400
TSS, mg/l	2	92	240	551	130	195	389
VSS, mg/l	2	82	218	511	101	152	304
ISS mg/l	0	10	26	42	29	43	96
TKN, mg/l	2	25	42	58	23	35	69
Ammonia, mg/l	1	18	30	34	14	20	41
TP, mg/l	1	4	7	12	3.7	5.6	11
SRP, mg/l	0	3	5	10			
Faecal Coliforms cfu/100ml	680	2.7M	6.8M	15.6M	103-105	104-106	105-108
E.Coli cfu/100ml	669	1.9M	4.8M	8.9M			

The incoming wastewater characteristic average concentrations are very weak for municipal wastewater. Only TKN and Ammonia values are close to the typical municipal weak wastewater concentrations, the rest of characteristics are below these values. This could be due to high levels of infiltration to the collection system or insufficient sampling and poor sampling protocols. The characteristics above would match a diluted wastewater description. However, the quality of sampling program and protocols would have similar effect.

[17] Metcalfe & Eddy Wastewater Engineering Treatment and Resource Recovery 5th Edition Table 3-18

Considering there is uncertainty in wastewater characteristics, the average concentrations of the typical wastewater composition is used for the future treatment plant loads, which is a conservative approach.

The future loads to the treatment plant shown in Table 9 below are based on the average Future Flow 218m^3/d and Typical Average wastewater concentrations provided in Table 8.

Table 9 Future loads to Porangahau WWTP

Parameter	Load per Capita[18] (g/p/day)	Future (2048) Load Theoretical (kg/d)	Future (2048) Load (kg/d)
COD, mg/l	193	65	111
Unfiltered cBOD5, mg/l	76	25	44
TSS, mg/l	74	25	43
VSS, mg/l			33
ISS mg/l			9
TKN, mg/l	13.2	4	8
Ammonia, mg/l	7.7	3	4
TP, mg/l	2.1	0.7	-
SRP, mg/l			-

The projected future load to the Porangahau WWTP appears to be above theoretical load per capita.

For the purpose of this report we assume that Future Load is used as the loading is more conservative than theoretical values. However, it is recommended to undertake incoming wastewater flow monitoring, sampling and characterisation for the concept design of the plant upgrade.

4.1.2 Te Paerahi Flows and Loads

There is no flowmeter on the inlet pipe at the Te Paerahi WWTP, hence effluent daily volumes and incoming wastewater characteristics have been used to calculate future flows and loads. Therefore, the future flows were calculated from the effluent volume.

Population and household estimates were made based on an Environmental Assessment Report prepared by Opus (dated 2007). This states the Te Paerahi WWTP serves approx. 117 households and 312 people and is not expected to experience any population growth over the plant's design horizon. However, the Porangahau Beach is largely a holiday destination and population contributing to the Te Paerahi treatment plant changes significantly during seasons. There is no population peaking factor therefore, for the purpose of this report we assume that the population can be double in summer months. Hence, 624 people is assumed to contribute to the treatment plant in summer months.

The effluent volumes for period 2014-2020 May and future flows are summarised in

[18] Average figures taken from Metcalf & Eddy Wastewater Engineering Treatment and Resource Recovery 5th Edition Table 3-18

Table 10 below. Future flows are estimated from the pond volume which includes seasonal peaks. Future flow peak season is estimated for 624 people and represents the flows for the season only.

Table 10 Te Paerahi Current and Future WWTP Flows

Parameter	Effluent Volume (m^3/d)	Actual Flow per capita (l/p/d)	Flow per Capita[19] (l/p/d)	Future Flow m^3/d	Future Flows peak season m3/d
Dry weather Flow m^3/d	37	118	150	37	74
Average Flow (ADF) m^3/d	74	237 (148)*	250	78 (125)*	156
95%ile Flow m^3/d	136	436	-	136	272
Max Flow, m^3/d	407	1305	300	407	814

* Wet weather factor of 1.6 is applied to determine dry weather actual flow per capita, hence the actual dry weather flow per capita is 148 l/p/d.

* Wet weather factor of 1.6 is applied to determine average future flow, hence average future flow is 125 m^3/d.

Effluent volumes include infiltration in the network and rainfall in the pond and population seasonality. Therefore, it is assumed that the incoming flows includes all the components. There is no information that infiltration will be decreased in the future, therefore we assume, that infiltration portion will remain the same in the future.

Wet weather factor of 1.6 is applied for the future average flow to compensate for infiltration. The factor was determined from the effluent volume on the dry and wet days using rainfall data.

The average flow per capita doesn't compare well with the theoretical flow per capita as the later includes wastewater only, without any allowance for I&I.

The average flow looks very low even for the value including infiltration, therefore average future flow using theoretical flow per capita and wet weather peaking factor value will be used for the plant loading.

The maximum daily flows include peak instantaneous flows and seasonal peak flows, which were not determined at this time as a result of insufficient data. Therefore, it is very difficult to compare maximum actual flow and maximum flow per capita. For the future flows we expect to see similar flows as it is currently as there is no growth projection for this township. However, it is noted that in a peak season the flows can be expected to be double the maximum future flow.

Incoming wastewater samples were taken from Te Paerahi Pump station every two months for the period 2011-2019 (May). For the basis of this report only samples from the period 2014-2019 (May) are summarised below as a 5-year period reflects the nature of wastewater as the most recent. One sample was eliminated from the data set as invalid due to incorrect sampler installation.

Table 11 Te Paerahi WWTP Incoming Wastewater Characteristics

Parameter	Min	Average	90th %ile	Max	Typical[20]		
					Weak	Ave	High
COD, mg/l	15	381	1326	1780	339	508	1016
Unfiltered $cBOD_5$, mg/l	3	137	494	1150	133	200	400

[19] Metcalf & Eddy Wastewater Engineering Treatment and Resource Recovery 5th Edition Table 3-7

[20] Metcalf & Eddy Wastewater Engineering Treatment and Resource Recovery 5th Edition Table 3-18

Parameter	Min	Average	90th %ile	Max	Typical[20]		
					Weak	Ave	High
TSS, mg/l	1.5	136	403	1030	130	195	389
VSS, mg/l	1.5	118	361	834	101	152	304
ISS mg/l	0	19	40	196	29	43	96
TKN, mg/l	5.6	36.2	68.3	112.0	23	35	69
Ammonia, mg/l	3.8	23.2	40.7	63.2	14	20	41
TP, mg/l	0.6	5.7	12.6	26.8	3.7	5.6	11
SRP, mg/l	0.6	3.9	6.1	21.9			
Faecal Coliforms cfu/100ml	7400	0.31M	0.71M	0.85M	10^3-10^5	10^4-10^6	10^5-10^8
E.Coli cfu/100ml	7400	0.26M	0.62M	0.76M			

Overall Te Paerahi incoming wastewater characteristic compares well to typical municipal wastewater. TKN, Ammonia, ISS and TP values are close to typical average wastewater concentrations, the rest of characteristics compares well with typical weak municipal wastewater characteristics.

Given there is no significant infiltration (wet weather factor is 1.6), wastewater falls under typical wastewater characteristics and theoretical values for the plant loading could be used, however typical average concentrations are used for plant loading as more conservative value.

Future loads to the Te Paerahi WWTP have been based on the typical average wastewater concentrations (Table 11) and future average flow (125 m^3/d) estimated entering the plant in 2048. Future load for peak season is based on the future peak season average flow (154 m^3/d) presented in Table 12. The results are provided in Table 12.

Table 12 Future (2048) loads to Te Paerahi WWTP

Parameter	Load per Capita[21] (g/p/d)	Future Load Typical (kg/d)	Future Load Typical peak season (kg/d)	Future Load (kg/d)	Future Load peak season (kg/d)
COD	193	60	120	64	78
Unfiltered cBOD5	76	24	47	25	31
TSS	74	23	46	24	30
VSS				19	23
ISS				5	7
TKN	13.2	4	8	4	5
Ammonia	7.7	2.5	5	2.5	3
TP	2.1	0.7	1.3	1	1
SRP	-	-		-	-

[21] Average figures taken from Metcalf & Eddy Wastewater Engineering Treatment and Resource Recovery 5th Edition Table 3-18

The future load to the Te Paerahi WWTP is very close to typical load per capita this is because the load is majorly based on the theoretical values with a correction of average daily flows to allow for wet weather factor. For the purpose of this report, future loads should be considered as they are more conservative than typical load values.

Future loads typical are estimated using loads per capita and assumed peak season population of 624 people. Typical values for peak seasons appear to be more conservative. Because there is no projection for the future growth, we recommend that Future Load Typical is used in a peak season. This would provide a capacity for some growth in the future. We also recommend undertaking incoming wastewater incoming flow monitoring and sampling for the concept design of the plant upgrade.

4.2 Treated Wastewater Quality Objectives

For the purpose of this report we assume that both ponds will have to achieve the same or higher effluent quality than current consent, depending on the discharge method.

4.3 Geotechnical Investigations

Currently there is no information available and this will need to be investigated during design process. Existing ponds are clay lined. At this stage is unknown what CHB Council's position is regarding the liner. This will have to be investigation.

There are 4 piezometers in the irrigation area at the sand dunes at Te Paerahi WWTP. The water levels of these piezometers for the period 2011-2019 are presented in the table below:

Table 13 Piezometer water levels at Te Paerahi sand dunes

Piezometer	Min water level, m	Max water level, m
Piezometer 1 (Through electric fence gate in the trees to the right at the beginning of the wetland)	450	1700
Piezometer 2 (By the sand dune on the north side of the wetland)	130	2450
Piezometer 3 (By the tree at the end of the wetland)	1000	2460
Piezometer 4 (On the oxidation pond side of the wetland)	850	2470

4.4 Survey

No survey was done for the either site at this stage. It is recommended to undertake survey for each site during design stage.

5 Possible Future Wastewater Scheme Architecture

5.1 Preamble

From a cultural and community perspective, it is clear that the existing wastewater scheme servicing Te Paerahi and Porangahau will not be acceptable in the long term. From a resource consent perspective, the two systems are reasonably compliant with the existing consents. The scheme consists of two single pond oxidation pond systems, one discharge to a tidal river and one discharge via soakage in sand dunes.

For the purposes of the following discussion and derivation of future scheme options, the following are assumed:

- Do Nothing will not be acceptable
- Continued discharge of treated effluent to the sand dunes at Te Paerahi will not be accepted.
- Continued presence of the oxidation pond treatment system in the sand dune land at Te Paerahi is highly undesirable.
- Removal of the direct discharge to the river is desirable.
- A discharge or discharges to land are preferred by the community
- Treatment for the two communities may be combined or separate. Combined treatment is generally more cost effective, based on economies of scale. However, the more extensive the conveyance system/s, the more this advantage is eroded.
- Discharge for the two communities may be combined or separate. Economies as above

5.2 Historical Preferred Options

During the 2009 hearing for the current resource consents, concerns were expressed by tangata whenua about wastewater treatment plants. As part of the resource consent hearing process a hui was held at Rongomaraeroa Marae to discuss these concerns.

The outcome of the hui was an agreement between CHBDC and Porangahau Tangata Whenua to work together as the Porangahau Environmental Management Team (PEMT) to investigate solutions for the long term wastewater and disposal for the Porangahau and Te Paerahi townships. A strategy report[22] was issued in 2012 summarising options and the preferred solution for the plant upgrade.

The preferred solution outlined by the PEMT in their Strategy Report issued June 2012 report as follows:

5.2.1 "Porangahau

Build a worm farm and irrigate the effluent from this plant on to farm land or on to forests in the area.

In detail:

- *The existing oxidation pond would be used to balance flow fluctuations due to stormwater inflow and infiltration.*
- *Sewage would be pumped from the existing oxidation pond to the worm farm.*
- *The worm farm would be built on high ground away from the river in order to minimise the risk of inundation in flood events. Possible sites are being investigated with the Porangahau community.*
- *The worm farm includes ultraviolet disinfection to remove all pathogens in the effluent. The remaining nitrogen and phosphorus content of the effluent is beneficial to vegetative growth.*

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[22] Central Hawke's Bay District Council Long Term Wastewater Treatment Strategy for Porangahau and Te Paerahi. A report compiled by the Porangahau Environmental Management Team.

- *Suitable disposal areas are being discussed with the Porangahau community.*

5.2.2 Te Paerahi

Build a worm farm and irrigate the effluent from this plant on to land in the area. Irrigation to the Porangahau Golf Course was a possibility which was investigated at the time. The existing oxidation pond in the sand dunes would be removed and the area returned to its natural state.

In detail:

- *Sewage would be pumped from the pumping station at the end of Te Paerahi Street to the worm farm.*
- *The worm farm would be built on land that Council owns in this vicinity, or possibly on Golf Course land.*
- *Some buffer storage would be provided by large tanks, both before and after the worm farm. Storage before the worm farm would allow sewage distribution on to the beds to be controlled for optimum performance of the worm farm. Storage after the worm farm would allow irrigation to be controlled for effective soakage, thereby avoiding run off. If irrigation to the Golf Course, storage would allow the irrigation to be operated overnight when there are no people on the fairways.*
- *The worm farm would include ultraviolet disinfection to remove all pathogens in the effluent. The remaining nitrogen and phosphorus content of the effluent was considered beneficial to grass growth.*
- *If the Golf Course possibility is pursued, the fairways would be irrigated all year round. Discussions with the green keeper indicated that the sand substrata was considered capable of accepting irrigation at all times of the year. The largest effluent flows are created in the height of Summer when the ground is at its driest. At other times of the year there are very low flows of effluent, and this coincides with times when the ground is likely to have a higher moisture content. However, the fairways are observed to be short of moisture for optimum grass growth at all times of the year.*
- *In considering irrigation to the golf course there is a need to undertake a detailed assessment to confirm whether the discharge will have an effect on water supplies in the area, both from the public health and cultural perspectives. The public water supply for Porangahau and Te Paerahi comes from a bore on the western edge of the Golf Course land.*

The worm farm option was considered by the Porangahau Tangata Whenua to provide the following benefits:

- *Low capital cost*
- *Low operating cost*
- *Simple treatment process*
- *Could be operated by the local community*
- *Can be a stand-alone plant or operate in conjunction with an oxidation pond*
- *Produces compostable material that could be used locally*
- *Produces high quality effluent that can be used for irrigation or further treated through a wetland"*

The long list of options put forward for consideration in the Strategy Report was completed and reported in October 2010 and was appended to the Strategy Report. A summary of the options is presented in the table below. The long list of options for considerations as it was appended to the Strategy Report is available in Appendix B.

Table 14 Treatment options identified for consideration in 2010[22]

TREATMENT OPTION	COMMENTS
1. Oxidation ponds	*Simple, cheap, easy to run and maintain. Limit to quality of effluent possible. Discharge to water usual. Discharge to land possible at extra cost and complexity.*
1a. Oxidation ponds and baffles	*Simple, cheap. Improvement in effluent quality variable depending on effectiveness of pond alone.*
1b. Oxidation ponds and aerators	*Medium cost to build and operate. Improved effluent quality.*
1c. Oxidation ponds and Iogenyx process	*Medium cost to build and operate. Improved effluent quality. Unproven technology.*
1d. Oxidation ponds and dosing for phosphorus	*High cost to build and operate. May need filtering to remove flocculated phosphorus and problems with disposing of the waste sludge.*
1e. Oxidation ponds and floating wetlands	*Medium cost to build, low cost to operate and maintain. Improved effluent quality. Technology still being proved but promising.*
1f. Oxidation ponds followed by wetlands	*High cost to build, medium cost to maintain. Good quality effluent initially, can deteriorate over time. Needs rebuilding in 5-10 year period. Discharge to land (soakage) or water.*
1g. Oxidation ponds followed by rock filters	*Simple, low cost to build and maintain. Limited improvement in effluent quality, depending on size of rock filter.*
1h. Oxidation ponds followed by filters & clarifiers	*High cost to build and operate. High quality effluent produced. Discharge to water usual, but can be discharged to land at extra cost.*
1i. Oxidation ponds followed by UV disinfection	*High cost to build and operate. Eliminates pathogen risk.*
1j. Oxidation ponds followed by ozone disinfection	*High cost to build and operate. Eliminates pathogen risk.*

TREATMENT OPTION	*COMMENTS*
2. Multiple pond systems	*High cost to construct. Simple to complicated to operate depending on the configuration of the ponds and equipment installed. Operating cost reflects pond configuration. Can produce very high-quality effluent. Disposal to water usual, but could discharge to land at extra cost.*
3. Existing treatment	
3a. Treatment plus irrigation to forest	*Can be an add-on to present oxidation pond. Land cost high if purchasing land, possible to lease land. High cost for irrigation set up. Operating costs medium. Possible income from trees.*
3b. Treatment plus irrigation to crops	*Can be an add-on to present oxidation pond. Land cost high if purchasing land, possible to lease land. Medium cost for irrigation set up. Operating costs medium. Income from crops.*
3c. Treatment plus rapid infiltration	*An add-on to present oxidation pond. May need some filtration to stop clogging of disposal area. Needs very porous ground (gravels) to be effective. Low to medium cost addition.*
4. Package plant	*High cost to build and operate. Consistently high quality results should be achieved. Discharge to water or land.*
5. Activated sludge plant	*High cost to build and operate. Consistently high quality results should be achieved. Discharge to water or land.*
6. Membrane technology	*High cost to build and operate. Consistently high quality results should be achieved. Discharge to water or land.*
7. Worm farm	*Medium cost to construct. Low to medium operating costs. Produces wastes that could be used at compost/fertiliser. Effluent could be irrigated to land.*
8. Combined treatment at one site	*High capital cost for pipeline. Problem of septic sewage (smells) with low volumes and long pipeline. Treatment process needed at end of pipeline.*
9. Algae for energy production	*Unproven/uneconomical at this time. Could have potential for income stream from oxidation pond."*

The options long list for the WWTP upgrades appended to the PEMT Strategy report included contemporary novel or well proven technologies available at the time, such as:

- Floating wetlands
- Worm treatment
- Algae production
- Multiple pond system
- E-net[23]

Alongside well-known technologies such as:

- Membranes
- Package treatment plants
- Activated sludge plants
- Constructed wetlands
- Rock filters
- Filters and clarifiers
- UV disinfection
- Phosphorus removal
- Land-based treatment

In 2012 when the preferred option was developed, there was little available information on the contemporary novel technologies and their performance at full scale in New Zealand. Nowadays the technologies are better understood as several studies on installations were done, assessing their performance, including the worm farm.

The performance of tertiary worm treatment at the Kaka Point and Owaka WWTPs in Clutha district was reviewed in the Ratsey (2016) report (appendix C). It concluded poor to moderate to good performance on parameters such as BOD, TSS and Ammonia when the waste stabilization pond (WSP) effluent was applied in a BioFiltro Plant. No data was available for indicator organism performance at the time. A total of 11 BioFiltro worm farms are installed in Clutha District today to improve WSP effluent. Most of the plants struggle to be compliant – it is not clear if this is due to design and/or operational issues. In the Clutha District, the Biofiltro maintenance costs have risen steeply, and CDC staff considered that the maintenance effort was not "value for money". Otago Daily Times published an article "Wastewater problems bring big bill" (by Hamish MacLean) on 13TH March 2020, indicating that around $1mil will be required as an "initial stab" to deal with non-compliant plants.

There may be alternative ways of improving the performance at a reasonable cost, but there are currently no full-scale plants that have been running successfully long-term to date. The proprietary ownership of BioFiltro in NZ is a complicating factor – tailored solutions to individual plant sites are not straight forward. The current owner of BioFiltro in NZ is Intergroup, and they are no longer involved in the Clutha District schemes.

With the evidence on BioFiltro performance and issues mentioned above, other options considered in the past should be re-considered. The application in Clutha district was to improve pond effluent rather than replace treatment as suggested in the Long Term Wastewater Strategy Report.

[23] The application of small electrical currents as suggested in Long Term Wastewater Treatment Strategy Report Appendix Eight. It is unclear if this was referred to Electric coagulation. It was also proposed that the trial of this technology was to be undertaken for Takapau WWTP in 2010, however we have no evidence that it ever was done.

The long list prepared below is generally based on the options considered by PEMT in the past, however only the options that are best suited for the plants are described here. The worm farm process is considered as a tertiary treatment only, but not as a full replacement of the ponds.

The following are a number of treatment and discharge schemes that could be considered for the future.

5.3 Scheme 1 – Treatment on each site with discharge at Porangahau

The scheme would see wastewater treatment on Te Paerahi and Porangahau ponds as it is currently, except there will be no discharge to the sand dunes at Te Paerahi site. Treated effluent will be pumped to the Porangahau site, the two effluent flows blended and discharged to the drain (or a small enhanced wetland), draining into the Porangahau River. Tertiary treatment could be considered for blended effluent before discharge if required to meet discharge consent parameters.

5.1 Scheme 2 – Combined Treatment at Porangahau

The scheme would see a new treatment plant built at the Porangahau WWTP site to treat wastewater from Porangahau and Te Paerahi communities. Raw sewage would be pumped across from a terminal pump station at Te Paerahi. This scheme allows complete removal of the WWTP from the Te Paerahi site. Scheme 2 sub options include:

Table 15 Scheme 2 sub-options

Treatment\Discharge	Porangahau River	Land Elsewhere (Slow rate)	Land elsewhere (RIB)
Pond Based	✓	✓	✓*
High Rate	✓	✓	✓

* Only with tertiary solids removal

A combined, pond-based plant would, at least include flow metering, screening, a facultative pond, maturation pond and, preferably a solids reduction tertiary stage followed by UV disinfection. At this time, it is not clear if such an option would be acceptable, but it should be considered.

5.2 Scheme 3 – Combined Treatment at a new site and application / Discharge to land

The scheme would see a new treatment plant built to treat wastewater from Porangahau and Te Paerahi communities in a new location. This scheme allows to completely remove both wastewater treatment plants from their current locations and stop discharging to the river and sand dunes. The raw wastewater from both communities will be pumped to the new WWTP, treated and pumped off site for the land discharge. As the full nature of available soils and strata are not yet known, both high and low rate application to land can be considered as sub-options.

Table 16 Scheme 3 sub-options

Treatment\Discharge	Land Elsewhere (Slow rate)	Land elsewhere (RIB)
Pond Based	✓	X
High Rate	✓	✓

Site location would need to consider conveyance efficiency, access provisions, waahi tapu, residential buffer zones, power supply, foundations and protection from natural hazards such as fresh-water flooding, sea level rise.

6 Treatment Options

6.1 In-Pond Enhancements

Theoretically, pond enhancement is a comparatively cheap and simple way to upgrade existing pond systems. Even though both existing ponds are meeting their discharge consent requirements, some form of process improvement requirement could realistically be expected in the foreseeable future. The minimum upgrade can be expected to be a UV disinfection system installation, which would most likely result in a requirement for additional removal of TSS to allow for optimum performance of the UV system. The existing ponds could be enhanced by either upgrading the current aeration and mixing capacity or considering a similar process targeting a higher treatment level, particularly for TSS, BOD and ammonia.

6.1.1 Supplementary Aeration

There are many different types of pond aeration systems which range from blower systems through to floating mechanical aerators. “Aquarator” as produced by Aqua Infrastructure, New Zealand, is an example of an advanced pond aeration and mixing system. The system is designed to keep part of the sediment layer in suspension to provide additional treatment by the biomass (bacteria that treat the wastewater). The system is currently installed in Waipukarau WWTP. This technology would be appropriate where additional mixing and aeration is required.

6.1.2 Artificial Aerated Media

“Bio-Shells”, are produced by Wastewater Compliance Systems Inc., Utah, USA (Marshall Projects Ltd in New Zealand). Bio-Shells or Bio-Domes are another form of a retrofit for oxidation pond systems. They take the form of concentric layers of media in the shape of a shell or dome. They are lowered onto the pond floor fixed to a weight. An aeration system beneath each device diffuses air up between the shells and past the biomass growing on the surface of the shells.

One of the objectives of the devices is to provide a secure (against wash out) place (growth surface) for a nitrifying biomass population to grow and remove ammonia.

It is understood that this process has been effective at very low winter temperatures in the mid-west USA but is has not so far been proven in New Zealand. Several NZ sites have or are installing them including Heriot and Kaitangata in Clutha District. These are small systems serving a few hundred people. Unofficial reports to date have suggested mixed performance in the initial two years of operation to date. A larger system has recently been installed in Pahia, Far North, but there are no reports of the system performance published yet.

Hanging curtains, are supplied by Water Clean as part of their Floating Treatment Media (FTM) systems. The vertical curtains provide a medium for biofilm attachment and are spaced 300mm apart with flow between the curtains generated by aeration which also provide extra oxygen for the biomass. At Waipawa and Waipukurau WWTPs, these have failed to do what they promised.

6.2 Post-Pond Enhancements

6.2.1 Additional maturation ponds

Target TSS, BOD and ammonia. Another pond enhancement could be the addition of maturation ponds to the existing system. This technology is widely used in New Zealand. Ammonia removal performance of this system has been variable at North Island pond sites, which illustrates the inherent difficulty in predicting the performance of such systems – refer to Ratsey (2016).

6.2.2 Lamella Clarifier

Target TSS and phosphorus removal. Lamella clarifiers act as a high rate settlement process i.e. small footprint compared to a conventional settlement tank. Inclined media is submerged in a tank, with flows passing upwards through the media. The media attracts the solids particles by providing a large surface area, and this is either washed off during maintenance, or the sludge slides down the plates to a hopper where it is removed during a de-sludge cycle. The surface area in lamella clarifiers are provided either by tubes or plates. Combined with alum dosing on the feed to the unit(s), this is also effective for P removal. Used at Waipawa and Waipukurau, Pahiatua and Woodville WWTPs – these only been in operation for a short time, but are proving to be unreliable. Shortcomings appear to be related to: low specific gravity (SG) of the solids, gas release lifting the flocs, incorrect dosing of coagulant.

6.2.3 Sand or Disc Filters

Target TSS, BOD. The Works Filter System (WFS) at Coromandel WWTP, which was previously used at the Pauanui WWTP is proven to achieve very good performance. However, the installations in Waipawa and Waipukurau WWTPs have a poor performance history. Sand filters require coagulant dosing to the treated effluent prior to the sand filter. Backwash is returned to the inlet of the WWTP. The backwash flow from the sand filters contains TSS, BOD and associated contaminants, which potentially can reduce HRT in the pond and increase the rate of sludge accumulation. Disc filters contain a physical barrier such as a customised cloth or a mesh installed on a number of discs, which filter the flows. Disc filters is proven to achieve a very good performance on the plants which are not pond based, such as Te Puke or Pauanui WWTP (deep pond installation not as much algae). SS above 100 can be an issue. Whitianga and Morrinsville ponds proven a poor algae related disc filter performance. Algae problems for these filters is found across NZ, the main issue being that the filters block up too quickly or the unit is hydraulically de-rated (not able to pass as much flow).

6.2.4 Dissolved Air Flotation

Like Lamellas, these target TSS and phosphorus removal. However, in this case, they are aided, rather than hindered by the low SG of the solids. Polymer is added to the feed and aeration is applied in the unit, which causes the flocculated sludge to rise and form a blanket. Waihi WWTP in Hauraki District has been successfully using a hybrid DAF for this purpose since 2004. If not properly optimised, the operational cost of chemicals can be high.

6.2.5 Actiflo

The Actiflo process uses sand ballasted flocculation to remove TSS from the wastewater, generally after pond systems. The process results in a clear-looking treated wastewater which is simple to disinfect via UV disinfection. Several installations across New Zealand including Gore WWTP, Ngaruawahia WWTP, Rodney DC WWTP provides mixed performance reports. Actiflo can perform well but requires chemical coagulants and very expensive sand replacement (a proprietary product).

6.2.6 Micro-filtration (MF)

Installed on a number of pond systems around New Zealand, most recently at Motueka WWTP. Often considered to provide a higher level of treatment than strictly required for the receiving environment, it does not provide nutrient removal, but will remove pathogens. It can be used for P removal when combined with chemical precipitation. Effluent quality may be suitable for some re-use applications (non-potable uses, not for stock or human consumption).

6.3 Pond alternatives

6.3.1 Flow-through Activated Sludge

Changing the treatment process from wastewater stabilization in the pond to an activated sludge process, will target the TSS, BOD and ammoniacal nitrogen parameters, and achieve a high-quality effluent. Converting the existing pond into activated sludge plant is not feasible, due to insufficient depth in the pond. Construction would be difficult with no redundancy available. A conversion from the pond system to an activated sludge plant could be done in two ways:

- Empty the existing pond, remove sludge and contaminated ground from site. Only then construction of the new system can take place, including under drainage and gas relief system, pond liner, surface-based aeration system and recycle system. A separate clarifier would be required.
- Construction of a purpose built concrete or steel reactor is the preferable long-term solution. Liners have an expected life of 25 years, while concrete or steel have 100 and 50 years respectively. Activated sludge is a more complex solution in terms of operation, with the operating expenditure increasing significantly due to aeration and pumping requirements.

A membrane bioreactor (MBR) is an activated sludge process which uses membranes instead of a clarifier to separate solids from the treated wastewater.

Activated sludge plants are available in package treatment plants which are modular and can be used on a bigger scale. Innoflow package plants were built in Piopio 200 home community, Glendhu Bay Holiday park.

6.3.2 SBR Activated Sludge as Replacement

Sequencing Batch Reactors (SBR), as opposed to a conventional flow-through activated sludge systems, have treatment and sedimentation of the biomass occurring in the same tank in a timed sequence. This allows SBR systems to be designed with a high degree of flexibility in terms of treating varying flows and concentrations (typically experienced in seasonal population), and to achieve specific treatment quality requirements. Typically, a depth of 4 to 5 m is required, and conversion of an oxidation pond can be difficult and impractical. Each process tends to work more reliably in a reactor configuration that is designed specifically for that process rather than in a retrofit of a sub-optimal space.

A SBR is a cost-effective solution for secondary treatment of wastewater, as it allows for the treatment of variable flows, requires minimum operator intervention, allows anoxic or anaerobic conditions to occur in the same tank, has a reasonably small footprint and very good solids removal efficiency.

SBR’s are installed in multiple locations across New Zealand, including in Kerikeri, Mangawhai, Morrinsville, Waihi Beach, Maketu, Acacia Bay, Kinloch, Motuoapa and Wanaka. Again, SBRs are relatively power-hungry with aeration and pumping requirements.

6.3.3 Fixed Film Processes

Utilising the same bacteria as activated sludge (in a different configuration), a fixed film process (e.g. submerged aerated filter, trickling filter, rotating biological contactor) utilises a biofilm attached to media (typically plastic in various shapes and forms) in a tank to treat the wastewater. A clarification step is also required to separate the solids (biomass) that slough off the media. Fixed film processes could be used in place of the existing plant, in parallel (as side streams) or as tertiary treatment and will target BOD and ammoniacal nitrogen. Use of package fixed film treatment systems are quick common in Europe as part of standardised small community designs and can be relatively simple to operate. Installations for large scale trickling filters in New Zealand are at Gisborne, Greymouth, Levin and Napier WWTPs, and a small-scale plant is installed at Tokanui Hospital. All those plants are targeting BOD and TSS only. Trickling filters in particular can have high capital costs but low operating costs, due to no mechanical aeration requirements.

Fixed film processes are available in a package treatment plant from Veolia, however the biggest plant is sized up to 250 people. Multiple plants could be considered as a package plant.

Rotating biological contactor (RBC) RoadTrain as manufactured by Hydroflux can be used as a package plant, however the system will require primary sedimentation, secondary clarification and a disinfection which makes it more complex than a typical package plant. A single train is sized treat wastewater from up to 1000 people. The installations of RoadTrain is operating since 1970 world-wide, however there is no installation in New Zealand.

6.3.4 Worm farm

The process is a type of packed bed reactor, using timber shavings as a medium. The shavings layer is populated with worms and a micro flora biomass. The effluent is sprinkled on the surface of the bed, to trickle through and be gathered in the drainage layer and discharged. Over a period of time a layer of worm humus is formed at the top of the bed. The worms keep the bed in good condition by moving waste to the top layer and also contribute to the aeration of the bed as they create tunnels through it due to their activity. This process has not been proven to be successful in New Zealand as worms are very sensitive to nutrient and hydraulic shock loads. In the event of killing the worms due to shock loads, a new system has to be established. A worm farm trial was done in Rotoiti for the discharge from households for 6 months, however the decision was made not to go ahead with the real plant installation.

BioFiltro technology was installed in Kaka Point and Owaka plants, which targeted reduction of BOD, TSS, Ammonia and TN. The performance of BioFiltro plants is reported to be unreliable (Ratsey 2016).

6.4 Natural Treatment Systems

6.4.1 Tertiary Wetlands

Constructed wetlands attempt to mimic natural wetlands by directing water flow through flooded beds of emergent aquatic plants. Like natural wetlands they can store, assimilate, and transform contaminants before they reach waterways. They are usually shallow to prevent drowning the aquatic plants, with a typical water depth of 0.3m. In some applications, the inlet of a constructed wetland also contains a deeper section or forebay where there is an absence of aquatic plants before the water flows on to shallower sections. The forebay buffers the flows and protects the wetlands should upstream treatment processes not perform as expected. Wetlands are typically constructed with a high-density polyethylene (HDPE) or compacted clay lining to prevent excessive leakage to groundwater.

Primarily, tertiary wetlands are used to regulate flow as the target parameter. They are typically considered aesthetically pleasing, can be considered culturally acceptable and provide habitat for wildlife. Disadvantages to this option is that new contaminants can be introduced by birds and decomposition of plants, and they require significant maintenance every 5 years or so. Retention times for tertiary wetlands are typically 1-3 days.

6.4.2 High rate algal ponds

High rate algal ponds as trialled in Gisborne, Cambridge and Christchurch have not been considered further due to the large area requirement and the very high peak wet weather flows received at the WWTPs. To date, no local authority to our knowledge has proceed to a full rate implementation of a high rate algal pond system.

6.5 Chemical Phosphorous Precipitation

Phosphorus can be removed from wastewater by reaction with chemicals via coagulation, which can be subsequently removed by a solids separation process (e.g. clarification).

The three major chemicals used for phosphorus removal are aluminium salts (primarily alum), iron salts (primarily ferric chloride) and hydrated lime (calcium hydroxide).

All three chemicals have the potential to meet the final effluent phosphorus requirements. Capital costs for an alum or ferric tertiary removal system are expected to be similar. However, a bulk lime silo and make-up system is likely to be more expensive than bulk alum/ferric PE tanks. Alum is significantly cheaper than Ferric Chloride in terms of operating costs in NZ. Lime reacts with the alkalinity in the water which means the dose rate is independent of the amount of phosphorus to be removed.

The dose rate for lime is therefore uncertain (and hence cost is uncertain) without jar testing, there is potential to be cost competitive with alum. Alum has no significant material handling issues; however ferric chloride is highly corrosive and lime slurry can be difficult to handle. If lime is used, re-acidification may be required post-phosphorus removal to lower the pH in the effluent to <9.

6.6 Disinfection

6.6.1 Ultra-Violet (UV) disinfection

Target pathogens present in the wastewater (measured as e.g. E.Coli). Disinfection could be applied to all the treatment options. Effective UV disinfection relies on light being able to pass through the water to reach and deactivate the microorganisms. There are two main obstacles to the passage of the light through wastewater - light being absorbed by dissolved contaminants, and light being obstructed by TSS. Due to normal algal growth in waste stabilization ponds, the treated effluent is typically high in TSS. The effectiveness off UV disinfection can vary from moderate to very good (Ratsey, 2016, Appendix D). However, to achieve high level of disinfection TSS removal and higher treatment may be required.

6.7 Summary

Table 17 Summary of technologies for the oxidation pond upgrade

Description	Target parameter	Advantages	Disadvantages	Example sites
Supplementary aeration Artificial aerated media Pond Tertiary treatment	TSS, BOD, Ammonia	Treats all parameters except pathogen and phosphorus	Limited technologies available for pond-based upgrades TSS/Algae still an issue	Waipukarau, Whakatane, Matamata, Wairoa, Te Kauwhata
Convert pond to activated sludge (AS) with new clarifier or install new MBR type AS system	TSS, BOD, Ammonia	Reliable performance High level treatment can be achieved Treats all parameters except pathogens, unless membranes are used	High CAPEX and OPEX More complex to operate Sludge to dispose of	Te Kuiti

Description	Target parameter	Advantages	Disadvantages	Example sites
SBR (as replacement for pond system)	TSS, BOD, Ammonia	Can be fully automated Treats all parameters except pathogens Can achieve good quality effluent	Not suitable to retrofit the existing pond Complex control High CAPEX and OPEX costs Sludge to dispose of	Mangawhai, Morrinsville, Waihi Beach, Maketu, Acacia Bay, Kinloch, Motuoapa Russell Kerikeri and others
Fixed film process (parallel or tertiary)	TSS, BOD, Ammonia	Treats all parameters except pathogens Reliable performance	Less CAPEX and OPEX than ASP & SBR Less complex to operate than ASP & SBR Sludge to dispose of	Gisborne Napier Tokanui Hospital Hastings Levin Greymouth
Tertiary membrane	TSS, pathogens	Utilising existing WWTP Small footprint Pathogen removal Colour removal	Moderate CAPEX and OPEX Low nutrient removal Membrane cleaning required (chemicals)	Maungatoroto, Matamata, Dannevirke, Motueka, Taihape, Kaitangata, Heriot
Solids removal via Lamella clarifier, Actiflo	TSS	Utilising existing WWTP Small footprint	Low nitrogen removal Variable performance on pond algal solids in NZ	Ngaruawahia Waipawa, Waipukurau, Taihape, Gore
DAF	TSS, BOD, P	Utilising existing WWTP Small footprint	Low nitrogen removal Variable performance on pond algal solids in NZ	Waihi
Tertiary wetlands	Soluble BOD (solids, nutrients and pathogens can increase)	Aesthetically pleasing. Potentially culturally acceptable Provides wildlife habitat	Where would the compliance point be? Can introduce other contaminants e.g. bird droppings History of lack of maintenance. Performance varies due to seasonal growth cycle	Huntly, Otorohanga
Chemical P precipitation	P	Can load-strip if used on raw sewage Simple chemical reaction	P removal only Have to find a discharge route for sludge Sludge accumulation in process	Dannevirke, Pauanui, Whitianga, Waipawa, Waipukurau
Worm farm	BOD, N, P	Utilising existing WWTP Small footprint Potentially culturally acceptable Treats most parameters	Tertiary treatment only, won’t replace the pond Worms struggle with shock loads and hydraulic loading.	Kaka point Owaka

7 Discharge Options

7.1 Wastewater Discharge in New Zealand

Treated wastewater may be disposed through direct point discharge to a water body such as a river, lake or wetland (surface water), or to an estuary, harbour or the sea (ocean discharge). A highly treated wastewater is generally required for surface water discharges. Alternatively, the treated wastewater may be returned to land by various methods, where the treated wastewater quality requirements are generally not as high as for water-based discharge pathways (See Table 18). The level of treatment required for each is difficult to quantify without further investigation as to the assimilative capacity of the environment and is very site specific.

The other waste produced from a treatment plant is the sludge (biosolids). This may be disposed of to landfill, spread onto land, composted, dried and pelletised, digested or treated for use as a soil conditioner.

Options for returning the treated wastewater to the ecosystem within the site boundaries (often referred to as on-site discharge) depend very much on the site's characteristics such as soil types, area and slope of land available, location of groundwater, and the local climate. Options include seepage into the soil subsurface, irrigation (surface or sub-surface) and evapo-transpiration.

Land application of treated wastewater (either all flows or during dry weather), including to wetlands, has been implemented at several WWTP's in New Zealand (e.g. Taupo, Mangawhai, Paihia, Whangamata, Shannon, Te Paerahi, Ashburton, Tekapo, Twizel and Queenstown). These discharge methods range from fully productive beneficial reuse irrigation, through to wetlands and rapid infiltration to sub-surface strata. Whilst land application is often preferred, geotechnical, soil, hydrogeological, land ownership and economic considerations are all key factors which inform the assessment of discharge pathways.

Table 18 Treated effluent quality indicative requirements based on receiving environment

Receiving Environment	Likely requirements
Freshwater	High quality effluent with regards to: $cBOD_5$, TSS, nutrients, potentially pathogens
Ocean	Existing – medium quality effluent with regards to: $cBOD_5$, TSS, pathogens Unlikely to require nutrient removal
Land	Medium quality effluent with regards to: $cBOD_5$, TSS, potentially pathogens (worker contact/proximity to groundwater bores), nutrients depending on soil characteristics

7.2 Existing Discharge into the Porangahau River (Porangahau WWTP)

Currently, the Porangahau WWTP discharges its treated wastewater into the Porangahau River via a drain. This discharge is consented for up to 415 m^3 of treated wastewater per day to Porangahau River via the drain adjacent to the oxidation pond.

This discharge pathway would be able to use the existing infrastructure. With the projected average future flows of 181 m^3/d, it is unlikely to breach the current 415 m^3/day discharge consent. However, a direct river discharge has cultural and social implications as it does not align with Maori or community values. For example, it may have an adverse impact on the local shellfish beds and fish which are culturally significant.

The current discharge complies with the current consent conditions, however it is considered likely that any renewed discharge consent in this location would require a greater level of treatment than what the pond current achieves and would likely require some form of cultural mitigation.

7.3 Existing discharge to the sand dunes (Te Paerahi WWTP)

Currently, Te Paerahi WWTP discharges its treated wastewater into the sand dunes adjacent to the oxidation pond. This discharge is consented for up to 195 m^3 of treated wastewater per day to the sand dunes.

This discharge pathway would be able to use the existing infrastructure. With the projected average future flows of 76 m^3/d, it is unlikely to breach its current 190 m^3/day discharge consent. However, it is based on no population growth projected for the Te Paerahi catchment. The current discharge generally complies with the current discharge consent conditions. It is considered additional treatment to allow continued land application to dunes is not necessary from an environmental perspective. However, the current irrigation site is a waahi tapu area. Continued irrigation to this site does not align with Maori and community values and is expected to be difficult to consent.

7.4 Ocean outfall

A coastal discharge is a possible option for Te Paerahi treated effluent. This would require the construction of an overland pipeline and associated transfer pump station, and an ocean outfall structure. The length of the outfall would depend on an Environmental Effects Assessment and considerations around the extent of the surf zone and coastal currents. The Te Paerahi WWTP is approximately 200 m from the coast, therefore, it is unlikely to be very costly to engineer a pipe to the high tide mark, however, to engineer an outfall can be very expensive. Due to the high cost of outfalls, they are typically installed for much larger communities, i.e. large towns or cities (Picton, Napier, etc). Hence, given the size of community, the affordability of the ocean outfall is unlikely to be viable. Coastal discharge may not be supported by Iwi.

Te Paerahi / Porangahau beach is a very popular camping area, so this option would likely not be favoured by the community – it would however remove the discharge from the waahi tapu area it currently occupies and is not likely to require any additional treatment. New consents would be required for the discharge to water and for building a structure in the coastal marine environment.

7.5 Land Based Slow Rate Irrigation

Slow-rate irrigation is a land-treatment and discharge system that involves total effluent absorption via soakage and evapo-transpiration through planted crop or vegetation ground cover. Large land areas are required due to application rates being only a few centimetres per week. The higher the level of pre-treatment (secondary treatment being a minimum), the more effective the long-term performance of the irrigated area in coping with the treated wastewater load (Ministry for the Environment, 2019).

Land based discharge would remove treated wastewater flows out of the Te Paerahi waahi tapu area. Two possible slow-rate irrigation options include year-round irrigation or part-year irrigation with discharge to the sand dunes or Porangahau River when conditions are not suitable for irrigation (soil moisture content too high).

Year Round Slow-rate Irrigation: requires a deficit irrigation scheme with additional storage, preferably within 5km of the treatment plant. Storage is required to hold treated effluent during wet weather and when the soil moisture is too high for irrigation. This discharge method is generally considered to be culturally acceptable and supported by the community (due to discharge to land as opposed to water) and has potential for beneficial reuse. Disadvantages can include the large storage requirement, lack of suitable soil and terrain, potential runoff and establishment timescales. Application of wastewater to land can also limit the economic use of the land.

Part Year Slow-rate Irrigation: assumes treated wastewater is only irrigated when soil conditions are suitable (i.e. when there is a soil moisture deficit) and at other times the treated wastewater discharges to the sand dunes or the Porangahau River at the current discharge locations. Less land area and storage volume is required compared to the year-round option. It may not be as culturally acceptable. Disadvantages include its continuation of flow to sand dunes and the river in the off-period, and the establishment timescales.

The key issue for land-based discharge will be the availability of land for a scheme and whether CHBDC can secure the land in the long-term.

7.6 Rapid Infiltration

Rapid infiltration as a discharge option includes the use of shallow beds to allow the wastewater to soak into the ground. Most of these systems are adjacent to waterways and the treated wastewater eventually discharges to these waterways via shallow groundwater. It is generally considered a culturally and community accepted discharge option. Potential location options for this include nearby sites – however any location choice would need to consider the environmental effects and Iwi cultural aspects. A negative aspect of this option is that the current wastewater may need additional nutrient and pathogen removal prior to discharge.

7.7 Reuse

Reuse of treated wastewater for activities such as a plant nursery or golf course irrigation could be considered as a sub-option but are unlikely to take significant volumes or provide year-round takes. Improved treatment such as the addition of a tertiary membrane plant would be required to reduce public health risks. Reuse treats effluent as a resource, reducing the volume to be discharged elsewhere. Generally, wastewater would not be suitable for stock or human potable uses.

7.8 Deep Bore Reinjection

Deep bore reinjection is a method not commonly understood in NZ. It is advantageous in its year-round discharge capacity and minimal footprint, however it requires an ultrafiltration type pre-treatment prior to discharge and the drilling of very deep wells to find a suitable aquifer to discharge to.

7.9 Drain Discharge Via Wetland

Treated wastewater from Porangahau WWTP is currently discharging to the drain. Habitat-enhancing planting and restoration techniques such as bank rehabilitation, riparian planting for shade and temperature buffering, and re-introduction of key aquatic species could be employed to rejuvenate the stream. This option was already considered in the past, but wetlands were not constructed as the resource consent lapsed.

The project would provide community participation and educational opportunities.

7.10 Summary

Sea level rise and the impact of climate change has not yet been considered for the options below.

Table 19 Summary of treated effluent discharge methods

Description	Detail	Advantages	Disadvantages	Indicative treated wastewater quality required
Existing discharge into the Porangahau River or sand dunes		• Existing infrastructure • Consented structure • Consented discharge • Proximity to WWTP	• Visual impact • Impact on shellfish beds? • Cultural aspect/value • Amenity value • Vulnerability to debris flow	• Improved solids, nutrient (river) and pathogen removal
Ocean outfall for Te Paerahi	Pump treated wastewater to new coastal discharge outfall – potential locations to be confirmed	• Flows removed from waahi tapu site	• High CAPEX • Very difficult coastal conditions (engineering aspects) • Difficult terrain on route • Cultural impacts on shellfish and recreational users	• May require disinfection depend on length of outfall and public health risk assessment
Land based – slow rate irrigation year-round	Deficit irrigation scheme with storage Preferably within 5km from WWTP	• Generally acceptable culturally/community	• High CAPEX and OPEX • Large storage required • Need to secure suitable land (soil and terrain) • Potential runoff • Establishment timescales	• No additional treatment
Land based – slow rate irrigation part year – discharge other flows to the sand dunes or Porangahau river	Discharge to land only when soil conditions suitable, very limited storage.	• Less land required vs year round	• High CAPEX and OPEX • Need to secure suitable soil and terrain • Potential runoff • Retains some flow to the sand dunes and Porangahau river • Establishment timescales	• No further treatment for land discharge, current discharge may require improved solids and pathogen removal
Rapid infiltration beds	Potential sites to be investigated	• Generally acceptable culturally/community	• Difficulty locating suitable strata • Proximity to shellfish and recreation areas	• Additional nutrient/pathogen removal

Description	Detail	Advantages	Disadvantages	Indicative treated wastewater quality required
Re-use	E.g. plant nursery irrigation or golf course	• Treated wastewater is a resource • Reduces volumes to be discharged elsewhere	• Not year-round or full flows • Potential public health risks • Limited opportunities	• Additional treatment for solids and pathogens
Deep bore reinjection		• Year-round discharge • Minimal footprint	• High CAPEX and OPEX • Assessing potential impact difficult • Not commonly understood in NZ and no NZ precedent which introduces consenting complexity and uncertainty	• Would require ultrafiltration-type treatment similar to that needed to produce potable water
Drain discharge via wetland for Porangahau	Discharge to the river via local drain with a wetland	• Opportunity to restore stream	• Proximity to shellfish and recreational areas	• Additional solids, nutrient and pathogen removal

8 Treatment and Discharge Options

8.1 Long List of Options for Assessment

There are several different approaches that can be considered to address wastewater treatment and discharge for the Porangahau and Te Paerahi WWTPs. These upgrades can be combined based on which receiving environment we are discharging to, and the contaminants of concern associated with that receiving environment such as nutrients, pathogens, or cultural or amenity objectives.

We have broadly summarised the long list into six groups, based on the treatment provided. The worm farm option has not been taken forward into the long list, as the long-term operation of this type of process has not been successfully implemented in New Zealand on full-scale domestic WWTPs.

These groups are summarised in the tables below:

Table 20 Treatment method long list options

Option Number	Treatment Process
TM1	Pond enhancement: Supplementary aeration to the ponds, artificial aerated media
TM2	Fixed film process or activated sludge treatment such as SBR, or MBR
TM3	Tertiary treatment such as membrane filter, clarification, wetlands, filtration, DAF
TM4	Chemical precipitation
TM5	Disinfection

Table 21 Discharge method long list options

Option Number	Discharge Method
DS1	Existing discharge, stream discharge via Wetland (Porangahau only)
DS2	Ocean Discharge
DS3	Land based irrigation: slow rate irrigation or rapid infiltration (RI) beds, conditional irrigation Effluent reuse: Golf course irrigation or nursery irrigation
DS4	Deep bore injection

The combinations of the treatment methods and discharge options for Porangahau and Te Paerahi are summarised in the tables below. None of the options will be stand-alone.

Table 22 Likely upgrade requirements/options by receiving environment at Porangahau WWTP

	DS1 Existing discharge	DS2 Ocean	DS3 Land	DS4 Deep bore
TM1 Pond enhancements	Yes	Possible	Unlikely	Possible + tertiary
TM2 Fixed film or AS	Yes	Yes	Yes	Yes + tertiary
TM3 Tertiary	Possible	Possible (if UV required)	Possible	Yes
TM4 Chem P	Possible	No	Unlikely (LEI to confirm)	Yes
TM5 Disinfection	Yes	Possible	Possible	Possible

Table 23 Likely upgrade requirements/options by receiving environment for Te Paerahi WWTP

	DS1 Existing discharge	DS2 Ocean	DS3 Land	DS4 Deep bore
TM1 Pond enhancements	Possible	Possible	Unlikely	Possible + tertiary
TM2 Fixed film or AS	Yes	Yes	Yes	Yes + tertiary
TM3 Tertiary	Possible	Possible (if UV required)	Possible	Yes
TM4 Chem P	Possible	No	Unlikely (LEI to confirm)	Yes
TM5 Disinfection	Yes	Possible	Possible	Possible

8.2 Considerations

For all options described below it is important to consider screening of incoming wastewater. This will reduce large debris in the pond which can have an impact on equipment performance. It can also reduce the presence of debris in the treated effluent such as plastic cotton buds which float through processes.

For the long list options, we have assumed that the treated wastewater quality is going to be the same as current discharge consent requirements or improved. All discharge methods, would preferably include disinfection. Rapid infiltration (RI) would preferably include enhanced solids removal for longevity of the RI beds. Any discharge ending up in freshwater would preferably include nutrient removal.

8.3 Option DS1 – Existing Discharge

The “do minimum” option for both Te Paerahi and Porangahau would be to improve treated effluent quality in order to meet current consent compliance and discharge via the existing discharge to river (Porangahau) and sand dunes (Te Paerahi). With the existing resource consents expiring in 2021, it is unlikely that the current quality requirements will stay the same, and with tightening over-arching regulatory requirements for discharges to freshwater across New Zealand, it is likely that nutrient removal (and potentially pathogens depending on findings of any future investigations into public health risk) will be required going forwards for Porangahau. It is difficult to predict if Te Paerahi will require nutrient removal as the ultimate discharge environment is unknown (groundwater or saline environment).

Should a wetland be constructed for Porangahau, the flows will have the same ultimate discharge environment as the existing flows, so the discussion above also applies.

The treatment improvement options are summarised in Table 24 below.

Table 24 - Treatment improvement options by parameter for the existing discharge (current consented parameters shown in blue)

Parameter	TM1 Pond Enh	TM2 Fixed film/ASP	TM3 Tertiary	TM4 Chem P	TM5 Disinfect
TSS	-	Yes	Yes	-	-
BOD/ ammonia	Possible	Yes	Yes	-	-
TN	Modified additional pond	Yes	-	-	-
TP	-	-	-	Yes – if required	-
Pathogens	-	-	-	-	Yes

Minimum treatment likely to be required: tertiary TSS removal and disinfection. If nutrient removal is required, it is unlikely that pond enhancements will be able to achieve total nitrogen levels required for continued surface water discharge (particularly long-term), and additional treatment or a change of treatment process will be required. Chemical dosing for P removal will be required.

8.4 Option DS2 - Ocean Discharge

With a new ocean outfall, a resource consent will be required for the change of discharge location, and the structure itself. Shellfish and recreational use will potentially guide consent requirements and public health risk assessments. Disinfection is a likely requirement, so reduction of the algae in the summer months will be required to make sure the disinfection is effective. Nutrient removal is unlikely to be required.

Table 25 - Treatment upgrade options by parameter for an ocean discharge for Te Paerahi and Porangahau (current consented parameters shown in blue)

Parameter	TM1 Pond Enh	TM2 Fixed film/ASP	TM3 Tertiary	TM4 Chem P	TM5 Disinfect
TSS	-	-	Yes	-	-
BOD/ ammonia	Possible	-	Yes	-	-
TN	-	-	-	-	-
TP	-	-	-	-	-
Pathogens	-	-	-	-	Yes

Minimum treatment likely to be required: tertiary TSS removal, disinfection.

8.5 Option DS3 – Land Treatment

The Te Paerahi discharge is currently to a waahi tapu site, and the community/iwi would like the discharge taken out of this area. If discharging to land for both communities is preferred, there is an opportunity to combine the Te Paerahi and Porangahau discharges at one land treatment site. This would provide for efficiencies and optimisation in the land application operation and storage design but may require overall longer pumping distances depending on the location of the site (5-6 km).

Even if year-round irrigation was able to be adopted, a discharge to the Porangahau River will be required as contingency. This could be in the form of an overflow from the storage on site at the land treatment location, hence needing only one discharge point. With part-year irrigation, a discharge to the river will be required regardless.

Should rapid infiltration be the solution, each of the WWTPs would have their own beds in close proximity to the sites, which in turn means relatively close proximity to the river.

Ultimately, all the land treatment options have the potential for at least some of the flows to end up in the river. With tightening freshwater requirements, recreational use and kai/kaimoana gathering in the area, consent quality parameters are highly likely to tighten.

Table 26 - Treatment improvement options for discharge via land treatment for Te Paerahi and Porangahau (current consented parameters shown in blue)

Parameter	TM1 Pond Enh	TM2 Fixed film/ASP	TM3 Tertiary	TM4 Chem P	TM5 Disinfect
TSS	-	Yes	Yes	-	-
BOD/ ammonia	Possible	Yes	Yes	-	-
TN	Modified additional pond	Yes	-	-	-
TP	-	-	-	Yes – if required	-
Pathogens	-	-	-	-	Yes – if required

Minimum treatment likely to be required: Tertiary TSS removal, disinfection may be required. There is the potential to have any additional treatment at the combined land treatment site to treat the combined flows to higher standards, particularly given the need to store flows at times, and the knock-on effects of that. Flows going to the river could be treated on route to the river for any potential future nutrient removal requirements.

8.6 Option DS4 – Deep Bore Injection

Any discharges being injected into aquafers need to be highly treated, as there is potential for the water to be used in the future for drinking water. There is also the added issue of the long-term effects of unknowns such as emerging contaminants being a risk, and cannot be consented for at this stage. Solids levels will need to be required in order to blockages or bio-fouling in the injection bores.

Table 27 - Treatment upgrade options for discharge to deep bore for Te Paerahi and Porangahau (current consented parameters shown in blue)

Parameter	TM1 Pond Enh	TM2 Fixed film/ASP	TM3 Tertiary	TM4 Chem P	TM5 Disinfect
TSS	-	Yes	-	-	-
BOD/ ammonia	-	Yes	-	-	-
TN	-	Yes	-	-	-
TP	-	-	-	Yes	-

Parameter	TM1 Pond Enh	TM2 Fixed film/ASP	TM3 Tertiary	TM4 Chem P	TM5 Disinfect
Pathogens	-	-	-	-	Yes

Minimum treatment likely to be required: membrane bioreactor (to remove nutrients, not just for solids removal), disinfection, chemical dosing for P removal.

9 Options Assessment

9.1 Methodology

Any upgrades to the treatment processes at both sites will be driven by the receiving environment, and the consequent water quality requirements. The existing ponds treat well, although algae causes seasonal issues (typical for pond-based systems).

As discussed in Section 2, and Appendix E, objectives relevant to the scheme based on knowledge and information gleaned from the community are:

1. Cease discharge at Te Paerahi and ideally cease treatment;
2. Ideally cease, or at a minimum reduce the discharge of wastewater at Porangahau to Porangahau River;
3. Develop a discharge system whereby the wastewater is beneficially reused;
4. Develop a system that utilises land application as far as practically possible;
5. Provide for efficiencies of managing both communities together where possible;
6. Recognise and provide for tangata whenua values;
7. Provide for a system that can be implemented over time and as finances provides for;
8. Provide for community growth; and
9. Provide a system that is environmentally and regulatory robust and enduring.

With community/iwi preferences being for removing the existing discharges from their current locations, and putting them to land, investigations are underway by Lowe Environmental Impact (LEI) with respect to land suitability in the vicinity of the WWTPs.

It is mostly likely that even with a discharge to land solution, some flows will still have to go to the river at times of the year where there have been extended periods of rainfall, and no opportunity to irrigate to land because of soil saturation. At such times, river flows are typically higher than normal and thus potential effects, assessed under dry weather flow conditions are significantly lessened. The general order of discharge operations is as follows:

- Irrigate for as long as possible under the governing application consent conditions
- If applicable, amend application rates under wet weather consent conditions
- Continue to discharge effluent to the storage facility until this is full
- Commence alternative discharge to water
- Recommence irrigation as soon as possible and drawn down storage level to maintain availability for next wet weather period

9.2 Preferred Option

Development of a preferred option has been driven by the objectives listed above, along with the imminent expiry of the existing resource consents. Alternative land for disposal of the treated effluent from Te Paerahi is being investigated by LEI as mentioned above. There is also benefit in treated effluent from Porangahau going to the same land disposal site, providing the efficiencies of having only one land disposal system, and associated infrastructure to manage.

The preferred option has been developed into the Strawman (see Figure 31 and further detail in Appendix E), which is a staged approach to a long-term solution for Te Paerahi and Porangahau. There are options through the staging, and each of the stages also form a stand-alone option. The options are shown in Figure 32, Figure 33, and Figure 34 below. Option 1 is shown in Figure 31 as Stage 1, Option 2 as Stages 1+2, and Option 3 as Stages 1 to 5.

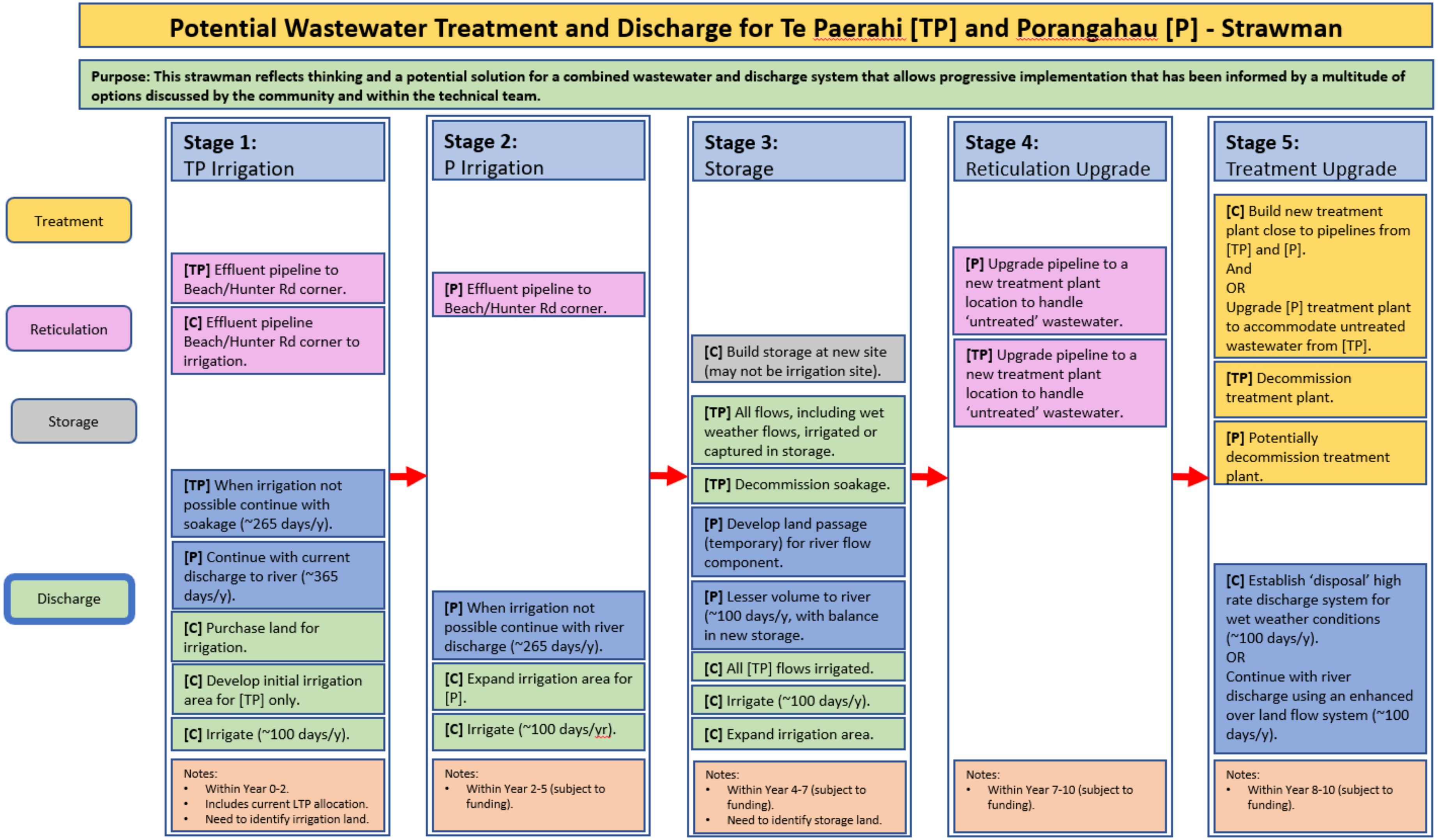

Figure 31 Te Paerahi and Porangahau Strawman

(C = conveyance, TP = Te Paerahi, P = Porangahau)

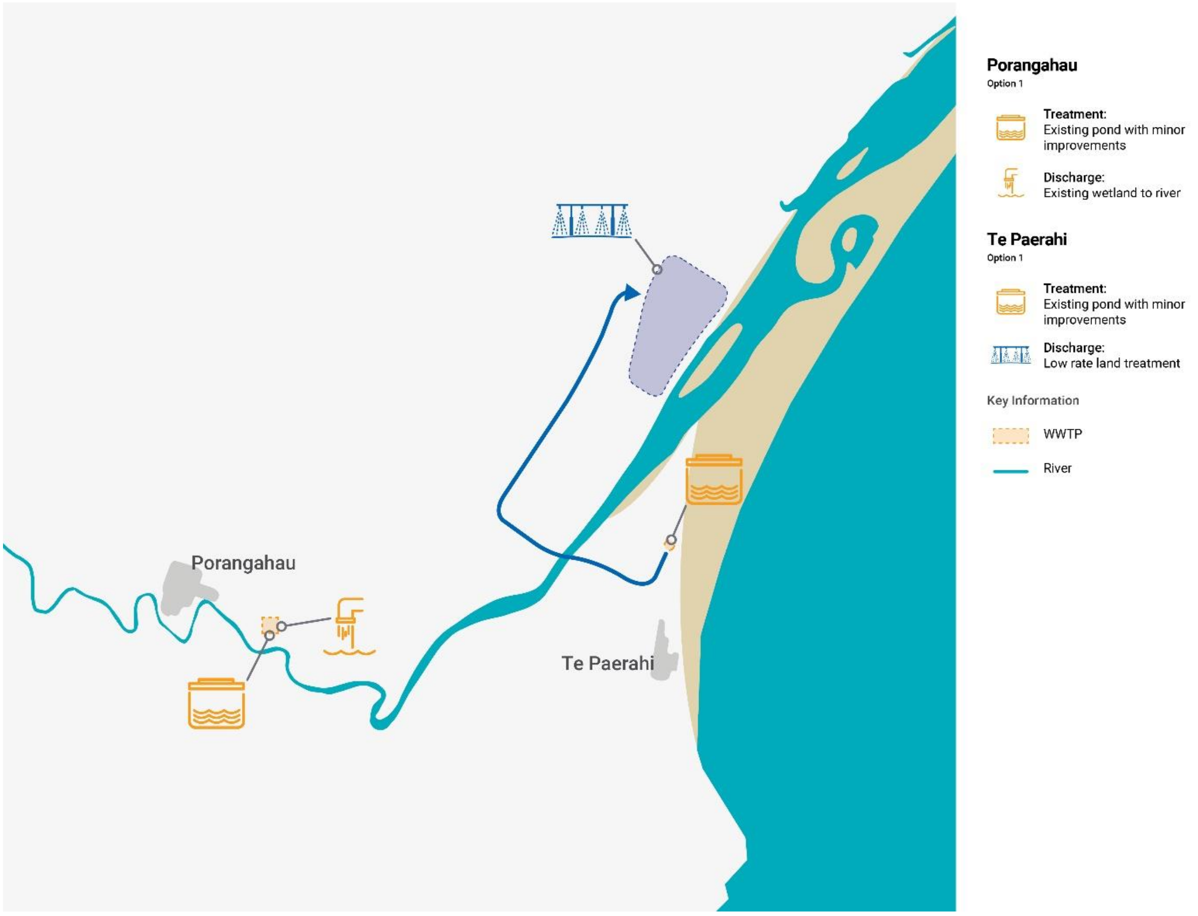

Figure 32 Option 1 - Minor improvements at WWTPs, Te Paerahi discharge to new land disposal site

Option 1 includes minor improvements such as DAF and UV (if required) at the WWTPs, continued discharge to the river for Porangahau WWTP, and discharge to a new land disposal site for treated effluent from Te Paerahi WWTP. The actual irrigation methodology has not yet been developed.

Figure 33 Option 2 - Minor improvements to WWTPs, Te Paerahi and Porangahau to new land disposal site, Porangahau conditional discharge to river

Option 2 can be a stand-alone option, or the stage following Option 1. Te Paerahi treated effluent is to be conveyed to a new land disposal site with minor improvements as per Option 1 at the WWTP. Porangahau WWTP will have minor improvements such as DAF and UV if required, and treated effluent would be conveyed to an expanded version (Option 1) of the land disposal site during dry weather. When weather conditions do not permit discharge to land, a discharge to river via a wetland would be required. Te Paerahi flows will be stored if they cannot be irrigated (location to be confirmed – may be at irrigation site).

Figure 34 Option 3 - Raw sewage from Te Paerahi and Porangahau to new combined WWTP, low-rate land disposal in dry weather, high-rate land disposal in winter, conditional discharge to river

Option 3 can be either a stand-alone option, or the stage following either Option 1 or Option 2. Untreated wastewater from Te Paerahi and Porangahau would be conveyed to a new combined WWTP. Treated effluent from the combined WWTP would be conveyed to a new land treatment site during dry conditions. When the soil is saturated, irrigation is not possible and storage is full, treated effluent would be conveyed to a new high-rate land disposal site, or discharged to the river.

9.3 Next Steps

Engagement and submissions through the Long Term Plan (LTP) process for the 2021-2024 LTP and beyond will steer the selection of the ultimate solution for Te Paerahi and Porangahau.

In the meantime, investigations and discussions with the community, iwi and landowners will continue to find suitable land sites to discharge to and for the new treatment site/s if required.

A

Appendix A – Minutes of Community Engagement Meeting 16 December 2019

B

Appendix B – Minutes of Community Engagement Meeting 18 March 2020

C

Appendix C – Treatment Options 2010

D

Appendix D – H. Ratsey Report 2016

E

Appendix E – Strawman Memo