APPENDIX M

Pōrangahau and Te Paerahi Community Wastewater – Discharge Conceptual Design (LEI, 2021:P:C.15)

Porangahau and Te Paerahi Community Wastewater

Discharge Conceptual Design

(LEI, 2021:P:C.15)

Prepared for

Central Hawke's Bay District Council

Prepared by

Lowe Environmental Impact

August 2021

Porangahau and Te Paerahi Community Wastewater – Discharge Conceptual Design

(LEI, 2021:P:C.15)

Central Hawke's Bay District Council

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1 EXECUTIVE SUMMARY

Central Hawke's Bay District Council (CHBDC) are responsible for the management of wastewater from the communities of Porangahau and Te Paerahi. Wastewater for Porangahau is currently collected and conveyed to an oxidation pond treatment system located at the end of Jones Street, Porangahau. Treated wastewater is then discharged to a drain entering the Porangahau River. For Te Paerahi, wastewater is collected and conveyed to an oxidation pond treatment system located off Te Paerahi Road. The treated wastewater from Te Paerahi is discharged to culturally significant coastal sand dunes via sub-surface soakage.

Following engagement with key stakeholder groups, a strong direction to develop a land based application regime for a long term solution was given and Best Practicable Option developed (BPO; LEI, 2021:P:C.12). This report describes the design concept for a staged development of a new wastewater discharge for the communities, which includes discharge to land for agronomic benefit and discharge to a non-deficit irrigation system to manage seasonal high flows of wastewater.

An extensive process including technical reporting and community consultations has been undertaken to identify:

- The available options for a long term discharge;
- Following identification of land discharge as the preferred option, a location for discharge; and
- A suitable discharge regime on the identified land.

The discharge system described reflects the reasonable and appropriate balance between the social, cultural, environmental and economic considerations.

A detailed discussion of the existing treatment systems, and how the wastewater design parameters were determined, is set out in the Beca report (Beca, 2020:P:C.10). The discharge environment has been evaluated to determine key design objectives such as:

- Porangahau River water quality and values (Beca, 2021:P:B.24a); and
- The ability of the soil and plant system to assimilate water and nutrients from wastewater (LEI, 2020:P:B.15).

The development of the discharge system for Porangahau and Te Paerahi's wastewater is proposed to be staged. Land to be used is located on the corner of Beach and Hunter Roads. The proposed system allows for a rapid reduction in the amount of treated wastewater discharged via the existing systems to their respective environments, whilst managing the costs to the Council and the time for procurement and construction to occur.

The staging involves a number of tasks and changes, including reticulation, treatment, storage and discharge. A summary of the proposed stages as they relate specifically to the discharges and new treatment and storage is as follows:

- **Stage 0** allows for the current discharge for both communities to their respective receiving environments to occur for up to four years at Te Paerahi and six years at Porangahau from consent granting while the subsequent stages are enacted;

- **Stage 1** involves provision of 500 m^3 of storage within the Te Paerahi WWTP and development of a minimum 4 ha on the Discharge Property, allowing irrigation to sandy soils (IMU 3) under typical irrigation conditions for approximately 43 % of the **current** Te

Paerahi average annual wastewater discharge volume and 57 % of the annual volume under a non-deficit wet soils regime. This stage **only** includes Te Paerahi flows and applies all to the Discharge Property, while the existing river discharge for Porangahau will continue.

The discharge regime assumes that the currently occurring wastewater flows occur (no allowance for future growth), up to 500 m^3 of storage is available at the Te Paerahi WWTP and discharge under a non-deficit wet soils regime can occur when soils cannot receive wastewater under typical irrigation conditions;

- **Stage 2** involves development of an additional 6 ha of irrigation for sandy soils (IMU 3), allowing for a minimum 10 ha of irrigation at Stage 2. Stage 2 allows for irrigation to IMU 3 (wet and regular irrigation regimes) of between 61 % to 100 % of the **future (2028)** Porangahau and Te Paerahi annual wastewater discharge volumes. This stage includes **both** Porangahau and Te Paerahi flows, but allows for between 0 % to 39 % of all flows to continue to the Porangahau River (when storage is not possible and soil conditions are too wet).

  Stage 2 sees the inclusion of two sub-stages (2a and 2b) which allows assessment of the worst case scenario to occur i.e. 100 % to land or as much to land as practically possible and the balance to the river. In practice for Stage 2, a system which is predominantly to land but includes some contingency discharge to the river is likely.

- **Stage 3** involves development of an additional 10 ha of irrigation for sandy soils (IMU 3) and incorporation of 20 ha of silty/clay soils (IMU 1), allowing for a minimum 40 ha of irrigation at Stage 3. A new combined WWTP and storage pond is to be built at the land application site to receive Porangahau and Te Paerahi flows with a capacity of (up to) 35,000 m^3. This storage allows for irrigation of between 66 % and 100 % of the **future (2057)** average annual wastewater discharge volume to the regular irrigation system (typical irrigation) and between 0 % to 36 % to be applied under a non-deficit wet soil regime.

The management characteristics used for the conceptual design are summarised in Table 1.1.

Table 1.1: Discharge and Management Summary

Parameter	Current Stage 0	Stage 1 (TP)	Stage 2a (P+TP)	Stage 2b (P+TP)	Stage 3a (P+TP)	Stage 3b (P+TP)
Storage volume (m^3)	~1,000	~500	~1,000	~1,000	~10,900	~35,500
Average annual outflow from WWTPs (m^3)	~76,600	~24,600 (~76,600)	~102,000		~183,000	
Discharge to Porangahau River and Te Paerahi Coast						
Volume per year (m^3)	~52,000	~52,000	-	~53,000	0	0
N mass loading from wastewater (kg/y)	1,532	1,076	0	1,050	0	0
P mass loading from wastewater (kg/y)	383	269	0	260	0	0
Deficit/Non-Deficit Irrigation – Regular Irrigation (Dry Soils)						
Irrigation regime	Nil	Deficit	Deferred, non-deficit			
Landform	Nil	Coastal sand dunes			Coastal sand dunes and alluvial plains	
Total area – including non-irrigated (ha)	114.3					

Parameter	Current Stage 0	Stage 1 (TP)	Stage 2a (P+TP)	Stage 2b (P+TP)	Stage 3a (P+TP)	Stage 3b (P+TP)
Wastewater irrigated area (ha)	-	4	10	10	40	40
Irrigation event application (mm/event)	-	Up to 20	Up to 20	Up to 20	Up to 20	Up to 20
Average annual irrigation volume (m^3/y)	-	~10,000	~31,000	~32,000	~121,000	~187,000
Average annual application depth (mm)	-	255	307	370	305	468
Wastewater Nitrogen load (kg N/ha/y)	-	51	61	63	61	91
Wastewater Phosphorus load (kg P/ha/y)	-	13	15	16	15	23
Non-Deficit Irrigation – Wet Soils						
Maximum application rate per event (m^3)	-	20	20	20	20	20
Volume per year (m^3)	-	~14,000	~71,000	~17,000	~66,300	~0
Average annual application depth (mm)	-	350	710	170	663	0
Wastewater Nitrogen load (kg N/ha/y)	-	70	142	34	133	0
Wastewater Phosphorus load (kg P/ha/y)	-	18	35	8	33	0
Sand Dunes (LMU 3/IMU 3)						
Farm Management current/proposed	Pastoral grazing, rotational cropping					
Vegetation current/proposed	Cocksfoot & marram grasses, winter oats				Cocksfoot & marram grasses	
Alluvial Plains (LMU 1 & 2/IMU 1)						
Farm Management current/proposed	Low intensity pastoral grazing/ rotational cropping					
Vegetation current/proposed	Ryegrass pasture; crops (e.g. chicory, raphno, oats, turnips)					

In summary, the discharge system is proposed to consist of the following components:

- 500 m^3 of storage, potentially as freeboard, at the Te Paerahi WWTP for Stage 1. Construction of a pipeline from Te Paerahi to the application site;
- 1,000 m^3 of storage between the Porangahau and Te Paerahi WWTPs for Stage 2. Construction of a pipeline from Porangahau to the application site;
- Construction of a new WWTP servicing Porangahau and Te Paerahi and an (up to) 35,000 m^3 storage pond for Stage 3.
- Irrigation pump station located at discharge Site built for Stage 1;
- A series of fixed and moveable impact sprinklers; and
- Wet well and pumping to:
    - 4 ha at Stage 1;
    - 6 ha (minimum) additional area at Stage 2; and
    - 30 ha (minimum) additional area at Stage 3.

2 INTRODUCTION

2.1 Purpose

This report describes the design concept for a staged development of a new combined wastewater discharge for the Porangahau and Te Paerahi communities which includes discharge to land for agronomic benefit and discharge to a non-deficit irrigation system to manage seasonal wastewater flow highs and wet soils. This report describes the design regime which is the most reasonable and appropriate system after an evaluation of alternatives. This report provides information to support the consenting process, specifically details of the proposed activity and information to support the land and water assessments of environmental effects (LEI, 2021:P:D.10 and Beca, 2021:P:D.25).

2.2 Background

Central Hawke's Bay District Council (CHBDC) are responsible for the management of wastewater from the communities of Porangahau and Te Paerahi. Wastewater for Porangahau is currently collected and conveyed to an oxidation pond treatment system located at the end of Jones Street, Porangahau. Treated wastewater is then discharged to a drain entering the Porangahau River. For Te Paerahi, wastewater is collected and conveyed to an oxidation pond treatment system located off Te Paerahi Road. The treated wastewater from Te Paerahi is discharged to culturally significant coastal sand dunes via sub-surface soakage.

2.3 Scope

This Conceptual Design report contains the following information:

- Section 3 describes the development of the discharge concept;
- Section 4 characterises the wastewater to be discharged;
- Section 5 outlines the key receiving environment properties to be addressed by the system design;
- Section 6 explains the management considerations for the irrigated area;
- Section 7 describes the proposed discharge regime and key inputs and outputs from the system;
- Section 8 summarises the conceptual design and outlines the next step in the design and consenting process for the long term discharge of Porangahau and Te Paerahi treated wastewater;
- Section 9 outlines construction works required; and
- Section 10 presents a summary and conclusions.

This report describes the system concept of the Project. It does not address the potential environmental effects of the Project, except where the design has been informed by a need to avoid or mitigate potential adverse environmental effects.

Data used to determine the discharge regime are as received. It has been assumed that data supplied to LEI is correct and representative. Criteria and parameters adopted in this report are conservative and there may be scope for refinement at the detailed design stage. Detailed design is not able to be completed until resource consents are decided.

3 DEVELOPMENT OF THE CONCEPT

3.1 Existing Reporting

A programme of information gathering, consultation, data processing and evaluation, and scenario development precedes the conceptual design. A range of source material has been used in the development of the discharge conceptual design. Information specific to the Site and relied upon for this report are included within this wider consent package.

Information in the reports included within this consent package are not repeated in full in this report. It is recommended that the reader consults the reports referenced for further information in the first instance.

3.2 Design Aim

The intention of the design concept is to develop a reasonable and appropriate discharge regime which considers and incorporates the social, cultural, environmental and economic needs of the communities. The system needs to be able to be sustainably operated for the foreseeable future, both in terms of the treatment of wastewater, and in terms of ensuring that the integrity of the land and surface water is not compromised by long term, repeated application of wastewater.

3.3 System Concept

The discharge of wastewater could continue to be to surface water (for Porangahau) as it has been historically, or to land, as is increasingly being adopted for small communities. The key drivers to move to a land based discharge system are tangata whenua aspirations, community wellbeing (public health and social acceptability), and potential environmental improvements, in particular to waterway health. The design of a land discharge system is typically based around achieving measurable beneficial environmental outcomes, for instance, a reduction in nitrogen levels in receiving water. Having a quantifiable parameter assists design since changes can be predicted and measured.

3.3.1 Drivers for Change

Beca (2020:P:B.24a) state that total nitrogen, total phosphorus, and dissolved reactive phosphorus concentrations are all above relevant ANZECC guidelines upstream of the discharge point. The discharge is believed to currently be causing minor increases in nutrient and microbiological contaminant concentrations, however no formation of excessive plant, algae and slime growths are noted relative to upstream (Beca, 2020:P:B.24a). During low flow conditions, the discharge is expected to cause moderate increases in nutrient and faecal coliform concentrations in exceedance of relevant guidelines (Beca, 2020:P:B.24a). It is acknowledged that the existing discharge contributes to an overall nutrient and contaminant load to the Porangahau River and the community deems this unacceptable.

For the Te Paerahi WWTP, environmental effects of the existing discharge to coastal dunes are expected to be negligible (Beca, 2021:P:D.60). Very low levels of pathogens are noticed within surrounding groundwater monitoring bores with negligible effects anticipated for the marine environment and risk to shellfish gathering (Beca, 2021:P:D.60). Furthermore, residual contaminants in groundwater are highly unlikely to enter surface freshwater or migrate towards the public drinking water supply bore (Beca, 2021:P:D.60). Being discharged to culturally significant dunes, continuation of this existing discharge is not acceptable to the community and must cease, with the preferred receiving environment being to land (LEI, 2021:P:C.12).

This means that decisions around the future discharge of Porangahau and Te Paerahi's wastewater are driven by both water quality factors, as well as factors not easily quantified, being in many cases non-tangible iwi and community preferences.

3.3.1 Identification of the Concept

In developing the conceptual design CHBDC has considered the social, cultural, environmental and economic wellbeing of the district. Engagement and consultation has been undertaken to determine what values the stakeholders, which include community members, iwi representatives, special interest groups and statutory partners, have for the management of the wastewater in the district. This includes dedicated consultation with the Porangahau and Te Paerahi communities and tangata whenua. Details of the consultation are given in the Consultation Summary (LEI, 2021:P:C.34).

During the consultation process new ideas were proposed, some issues were agreed upon and others were unable to be resolved to all parties' agreement. Where possible, points raised through the process have been incorporated into the key design decisions (LEI, 2021:P:C.12). Key design decisions determined through the investigation and consultation process relate to:

1. Options for the discharge;
2. Location of the discharge;
3. Wastewater treatment options; and
4. Location of a new combined WWTP servicing both communities;

An attempt has been made in the development of this conceptual design to develop a reasonable and appropriate balance between the social, cultural, environmental and economic considerations.

In the absence of a quantifiable surface water improvement target (as Porangahau's existing discharge effects cannot be measured), the conceptual design has been based on the ability for land to accept the wastewater. The design has also aimed to address the Porangahau and Te Paerahi communities desire to see ideally 100 % of the discharge being applied to land.

LEI (2021:P:C.12) outlines the process behind the nomination of a land discharge regime as being the best practicable option to receive Porangahau and Te Paerahi's wastewater. A Consultation Summary (LEI, 2021:P:C.34) is appended to this report outlining the community consultation between CHBDC and relevant stakeholders as part of both the existing resource consents, as well as the proposed land discharge regime.

3.4 Tangata Whenua Concerns

Issues for consideration with regard to cultural concerns are being identified and described in a Cultural Impact Assessment (CIA) which is being prepared (Tipene-Matua, 2021:P:D.50 – final not available at the time of writing this report). This CIA report will add to the collective knowledge surrounding the Maori world view on wastewater management, which is described in How (2020:A:B.42).

While commissioned and not yet available at the time of writing this report, specific issues raised in the CIA will be addressed in any subsequent iterations and refinements to the system design.

3.5 Summary of Concept Development

An extensive process that has included technical reporting and community consultation has been undertaken to identify:

- The available options for a long term discharge;
- Following identification of land discharge as the preferred option, a location for discharge; and
- A suitable discharge regime.

The discharge system described in Section 7 in this report reflects the reasonable and appropriate balance between the social, cultural, environmental and economic considerations.

4 DISCHARGE CHARACTERISTICS

4.1 General

A detailed discussion of the current treatment systems, and how the wastewater design parameters were determined for the respective communities, is set out in the Beca report (Beca, 2020:P:C.10). This section lists the key wastewater parameters adopted for the conceptual design and describes how these have influenced the design.

4.2 Wastewater Flows

A reliable flow data set was available for the Porangahau and Te Paerahi WWTPs for the period 01/01/2008-30/11/2019. This data was evaluated, along with predicted changes to wastewater flows in future due to population growth, infiltration and stormwater inflow works and trade waste discharges (Beca, 2021:P.C.16). Population projections indicate a significant increase in population for the Porangahau township with Te Paerahi populated expected to remain constant until 2057 (Beca, 2021: P:C.16). A ten year flow data set was generated based on actual recorded flows and flow predictions for each of the project stages (equivalent outflow at 2019, 2028 and 2057) to account for year-on-year variability in the wastewater flow data.

A summary of flows adopted for 2019, 2028 (late in Stage 2) and 2057 (end of consent term) for Porangahau is given in Table 4.1.

Table 4.1: Daily Outflow Record for Porangahau (2019-2057)

Flow	2019	2028	2057
Median Flow (m^3/d)	94	155	374
Average Daily Flow (m^3/d)	141	205	437
99%ile Flow (m^3/d)	849	953	1,330
Maximum Flow (m^3/d)	2,250	2,354	2,731
Average Annual Flow (m^3)	51,500	75,000	160,000

Table 4.2 shows the projected inflows from the Te Paerahi settlement. Beca (2021:P:C.16) does not project an increase in wastewater flows over the consent term. It is noted that the reported 2019 average daily flow (ADF) is 130 m^3/d compared to the measured ADF from the available data record which is around 67 m^3/d. Wastewater flow data used for the development of a discharge regime is from the measured daily outflow record.

Te Paerahi is a beach settlement with seasonal variation in population corresponds to peak occupancy in summer. A peaking factor of 2 has been adopted (Beca, 2021:P:C.16) to represent the summer peak wastewater flows. This peaking factor is low for a holiday destination but reflects the existing record for Te Paerahi.

Table 4.2: Daily Inflow Record for Te Paerahi (after Beca, 2021:P:C.16)

Flow	Average Inflow (Current - 2019)	Average Inflow (Future - 2057)	Peak Season Inflow (Current - 2019)	Peak Season Inflow (Future - 2057)
Average Dry Flow per capita (l/p/d)	144	144	144	144
Dry Weather Flow (ADWF) (m^3/d)	45	45	90	90
Average Daily Flow (ADF) (m^3/d) **	130	99	260	197***

* Beca, 2021: P:C.16 does not predict that Te Paerahi flows will increase over the term of the consent.
** Beca, 2021: P:C.16 bases Te Paerahi ADF on an inflow and infiltration factor of 2.7 currently and 2.2 in the future (20% reduction in inflow and infiltration).
*** Beca, 2021: P:C.16 states that, this is less than 260 because it is assumed that I&I to existing reticulation will be reduced.

Based on the existing flow record, Figure 4.1 shows the distribution of flows through an average year for both communities and includes projected 2057 flows.

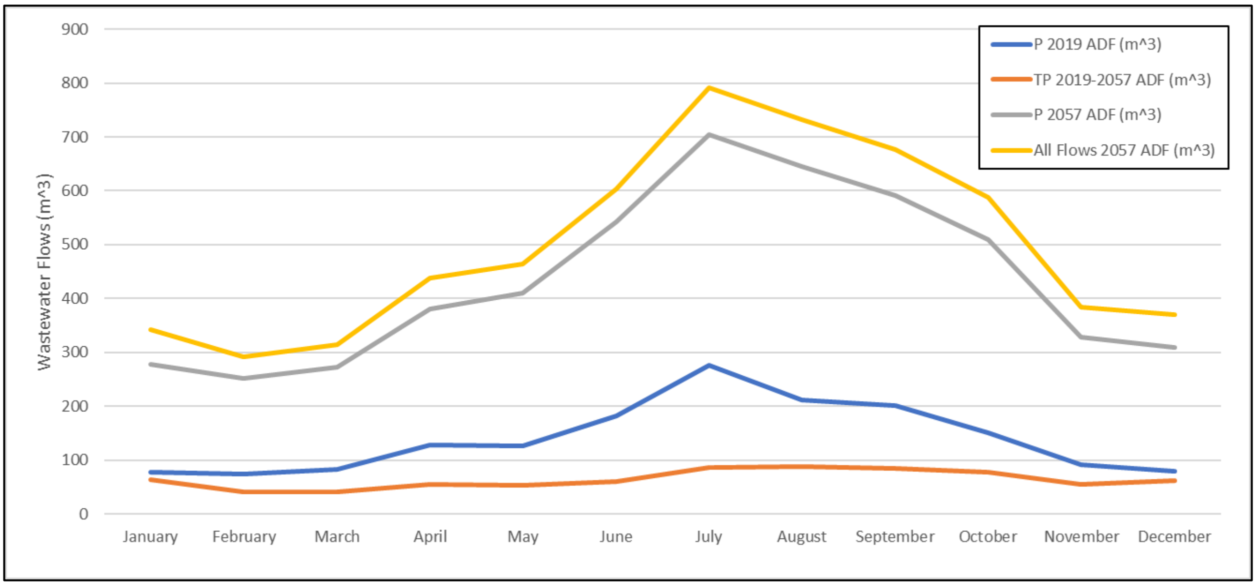


Figure 4.1: Average daily wastewater flows per month for Porangahau/Te Paerahi

Wastewater outflow rates have been used for the determination of the discharge to the irrigated land since these represent the flows that require discharge on any day.

4.3 Wastewater Quality

A detailed analysis of wastewater influent quality and treated wastewater quality for the respective WWTPs is given in the Beca report (Beca, 2020:P:C.10, Sections 3.1 and 4.1 for Te Paerahi, and Sections 3.2 and 4.1 for Porangahau). The performance and suitability of the existing treatment plants to continue to be used until the development of Stage 3 is provided in the treatment plant performance summary (Beca, 2020:P:C.10, Section 3.1 for Te Paerahi and Section 3.2 for Porangahau). This report highlights that no improvements are needed in the performance of the existing wastewater treatment plants if irrigation is to be used. However, it would be of benefit for the irrigation management to incorporate fine filtration (to avoid sprinkler blockage) and disinfection using UV (health and safety) of flows for irrigation.

Constituents of the treated wastewater to be irrigated that are considered in the conceptual design are predominantly due to potential environmental or public health risk. Key parameters taken fortnightly from the oxidation ponds are summarised in Table 4.3 for Porangahau and Table 4.4 for Te Paerahi.

Table 4.3: Treated Wastewater Parameters at Porangahau WWTP Oxidation Pond (November 2009-April 2021)

	Units	n	Min	5%ile	Median	Mean	95%ile	Max
pH		298	7.1	7.4	7.8	7.88	8.6	9.2
E.coli	cfu/100ml	138	4	97	2,700	2244*	72,750	220,000
Enterococci	cfu/100ml	139	4	39.8	660	808*	17,240	191,000
Total P	g/m^3	139	0.92	1.01	1.97	2.14	3.75	4.05
DRP	g/m^3	139	0.28	0.62	1.31	1.45	2.5	3.83
Total N	g/m^3	138	6.7	7.53	13	13.68	20.62	27.6
TKN	g/m^3	139	0.01	0.05	12.1	11.75	20.03	27.6
Total Ammoniacal N	g/m^3	139	0.24	2.1	7.3	7.86	14.7	19.6
Suspended Solids	g/m^3	298	1.5	3	29	34.2	92	126
$cBOD_5$	g/m^3	298	1.5	3	17	17.89	39.15	58
Dissolved Oxygen	ppm	296	0.2	0.45	2.56	3.77	10.52	21.7

**E.coli* and *Enterococci* mean concentrations are presented as geomeans.

Table 4.4: Treated Wastewater Parameters at Te Paerahi WWTP Oxidation Pond (November 2009-February 2021)

	Units	n	Min	5%ile	Median	Mean	95%ile	Max
pH		294	7.1	7.5	7.9	7.9	8.4	9
Faecal Coliforms	cfu/100ml	272	120	2,000	27,150	24,462*	221,400	8×10^6
Total Ammoniacal N	g/m^3	95	0.005	0.1	6.3	10.7	35.3	54.2
Suspended Solids	g/m^3	294	3	8	40.5	49.5	115.1	163
$cBOD_5$	g/m^3	294	1.5	3	13	14.9	30.4	113
Dissolved Oxygen	ppm	293	0.12	0.2	3.7	4.2	9.8	13.9

*Faecal Coliforms mean concentrations are presented as geomeans.
**No nitrogen or phosphorus based parameters outside of Total Ammoniacal N have been measured for Te Paerahi.

This wastewater quality has been assumed for Stage 0, 1 and 2. Following the establishment of a new WWTP at Stage 3, the wastewater quality has been assumed to achieve an **average quality** not exceeding:

- 20 g O/m^3 carbonaceous biochemical oxygen demand;
- 30 g/m^3 total suspended solids;
- 20 g/m^3 total nitrogen;
- 5 g/m^3 total phosphorus;
- 500 MPN/100 mL *E.coli* (following UV disinfection).

Additional detail regarding future wastewater treatment and performance is given in Beca (2021:P:C.16).

4.4 Provision of Storage

To assist with managing the development and operation of a land application system the provision of storage is recommended. Use of storage assists to avoid the need for a direct surface water discharge and to enable a greater volume of water to be beneficially used (i.e. irrigated when plants can best utilise it).

Section 7.2 below gives a summary of the project staging. This is based on an increase in storage capacity between Stages 0-2 and Stage 3. The storage requirements are as follows.

- **Stages 0-2 – Utilisation of existing 500 m^3 storage within each of the respective treatment plants:** Approximately 1,000 m^3 of storage is available in the existing treatment plants (500 m^3 in each) up until the development of Stage 3. Sufficient treatment capacity will be retained in the ponds. Following development of a new storage pond at Stage 3, this extra volume will be lost with the decommissioning of the two WWTPs and made available in the new WWTP constructed at the discharge site.

- **Stage 3 – New storage:** An additional (up to a maximum of) 35,000 m^3 of storage is proposed to be provided in a new pond and WWTP at the commencement of Stage 3. CHBDC intend to purchase land at the discharge site for the construction of a pond. The preferred location is given in Figure 4.2. A final site and design of the pond and WWTP is subject to a landform assessment and geotechnical investigations.

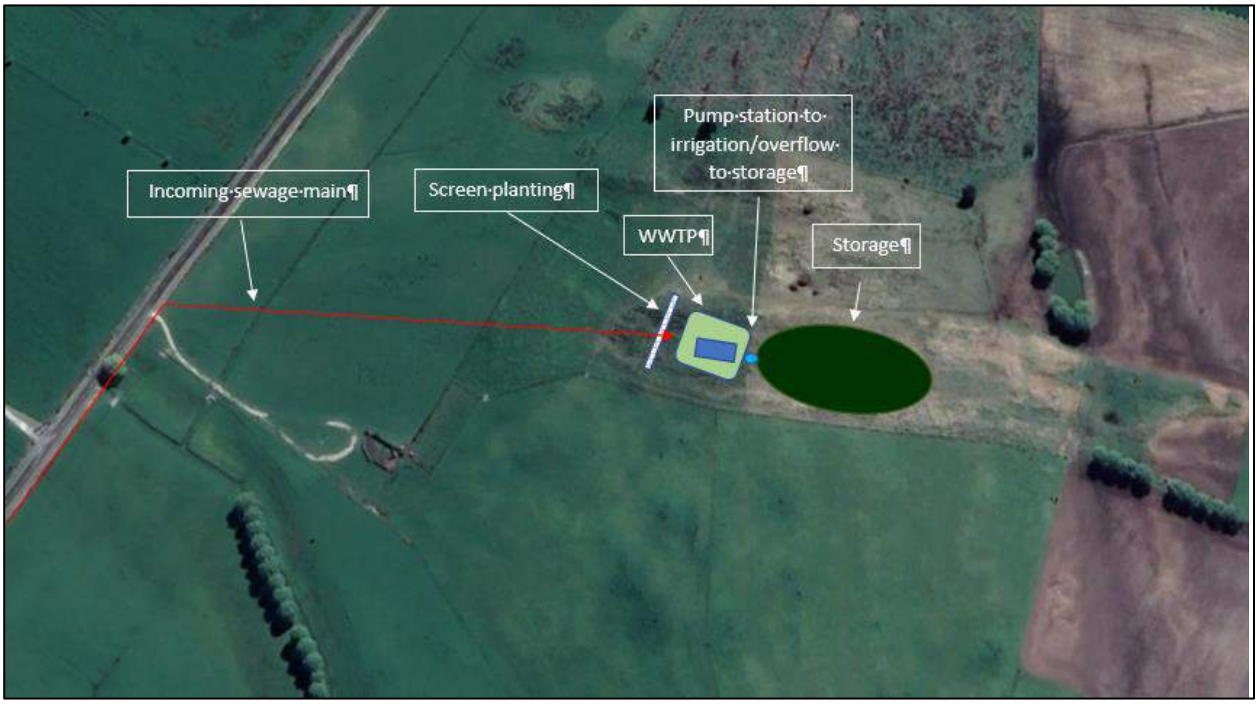


Figure 4.2: Potential Storage Pond and WWTP Location (Beca, 2021:P:C.16)

5 DISCHARGE ENVIRONMENT

5.1 General

At Stage 1 all treated wastewater from Te Paerahi will be discharged to land and all treated wastewater from Porangahau will continue to be discharged to the Porangahau River at the current discharge point. At Stage 2 treated wastewater from Te Paerahi and Porangahau will be discharged to land with some discharge of Porangahau treated wastewater to the current river discharge continuing. At Stage 3 all wastewater from the two communities will be conveyed to a collective treatment facility and discharged to land or stored for later discharge to land.

Section 5 summarises the discharge environment parameters which inform the discharge regime concept. A series of reports details these environments. These reports are included in this consent package and are referenced below.

5.2 Land Environment

Porangahau and its WWTP are located on the alluvial plains of the Porangahau River in the Central Hawke's Bay District. This alluvial plain surrounds the Porangahau River as it emerges from the tertiary to cretaceous aged mudstone and sandstone hill country west of the township and flows east then north-east to the Pacific Ocean, 8 km north-east of Porangahau (GNS, 2021). Shallow groundwater and fine grained soils are noted on this surface.

Te Paerahi, its WWTP and the existing discharge field are located on Holocene aged, windblown sand dune and estuarine deposits, surrounded to the south by Late Cretaceous to Paleogene aged mudstones (GNS, 2021).

Land between the settlements is dominated by the alluvial plain with overlying dunes near to the coast on both sides of the Porangahau River estuary. Evidence of historic movement and occupancy is present all along the coastal dune land form.

The area identified for land application is located over both the Porangahau River alluvial plain and wind-blown coastal sand dunes adjacent to the river. The discharge regime needs to take into account the differing management requirements of the finer grained alluvial soils and sandy dune soils.

Investigations have noted that there are a number of small water paths which drain the hills towards the river and several of these, some as formed drains, run through the target area. At the base of these water ways gravel is noted and it is expected that the fine grained alluvial material overlays river and beach gravels.

Soil hydraulic characteristics and soil chemistry were determined from site investigation (LEI, 2020:P:B.15). This information will assist in combining land areas that are subjected to similar management, which are further described in Section 6.6.

5.3 Surface Water Environment

Available information about the surface water environment has been presented and evaluated in the reports:

- Porangahau Wastewater Treatment Plant Discharge Water Quality Assessment (Beca, 2021:P:B.24a).

Beca (2021:P:B.24a) notes that:

- *Water quality monitoring carried out by Central Hawkes Bay District Council (CHBDC) upstream of the discharge point demonstrate that the Pōrangahau River has generally elevated nutrient concentrations. Water quality parameters with medians above ANZECC physical and chemical (PC) stressor values for warm, dry low-elevation rivers include total phosphorus, dissolved reactive phosphorus, and total nitrogen.*

And that:

- *based on historical monitoring, the discharge does not appear to result in the formation of excessive plant, algae and slime growths in the Pōrangahau River relative to upstream. For faecal coliforms, it is noted that recreational activities occur some distance downstream at the Bridge Rd bridge and that further dilution will occur between the point of discharge and these downstream recreational areas.*

In order to model the river discharge a gauging site with a lengthy and continuous flow record was needed. Beca (2021:P:B.24a) notes that *"flow in the Pōrangahau River is subject to extremes. Very low flows are recorded in summer, with flows of less than 0.1 m^3/s common. The section of the Pōrangahau River around the WWTP discharge is strongly influenced by the tides with a measured difference between high and low tide of approximately 0.5 m. This tidal influence is stronger during late summer when the contributing flows from the river catchment can decrease below 100 L/s. The tidal interchange of water in this section of the river is therefore more significant in the context of the wastewater discharge than the base river flow. The river is considered typically saline at the point of discharge under background, low flow conditions."*

5.4 Estuarine Environment

Available information about the coastal and estuarine environment of the Porangahau River has been presented and evaluated in Beca (2021:P:D.65).

5.5 Summary

Table 5.1 below summarises the main constraints identified in previous reports.

Table 5.1: Key Constraints for Irrigation

Subject	Constraint	Design Solution	Reference
Land assimilative capacity	Free draining nature of the high central sand dunes indicates that nutrient loading is likely to a limiting factor for these dunes.	Apply a limit for irrigation based on an agronomic requirement. Assess discharge to non-deficit system as if no nutrient attenuation occurs.	LEI (2020:P:B.15) Section 7 (LEI, 2021:P:C.15)
Land prioritisation	Available land is predominantly Zoned as A (alluvial plain NE), B (central sand dunes) and D (alluvial plain S) indicating that there are limitations in places for land discharge of wastewater needing to be managed.	Irrigation design optimised to obtain maximum benefit from the wastewater with minimum adverse effects to the land and surface water.	LEI (2020:P:B.11)
Soil description	Soil hydraulic conductivity indicates that water depth of application will be limiting on the soils overlying the alluvial	Apply instantaneous and discharge event limits that are based on measure soil unsaturated hydraulic conductivity.	LEI (2020:P:B.15) Section 7 (LEI, 2021:P:C.15)

Subject	Constraint	Design Solution	Reference
	plain due to their poorer draining nature.		
Flood hazard	The alluvial plain to the south is classified as being a flood risk area with the higher sand dunes and alluvial plain to the north-east being low risk to flooding in a 1 in 100 year flood event by HBRC.	Ability to use non-deficit irrigation on land on the higher elevated sand dunes	LEI (2020:P:B.11)
Existing environmental conditions	The existing discharges have not caused any significant adverse effects to their receiving environments. The proposed environment is well suited to land application.	Discharge to land will enable beneficial use of wastewater.	Beca (2020:P:B.24a) Beca (2021:P:D.60)
Tangata whenua considerations	To be determined based on forthcoming CIA.	-	-
Archaeology	Multiple sites of significance have been located across the Site to date and an unknown number may still be located during the construction phase.	An archaeologist will be on Site during the construction phase and appropriate protocol will be in place for the discharge system.	Pishief (2021:P:B.18)
Landscape and natural character	Farming and irrigation (moveable pods and fixed sprinklers) are the predominant landscape features near the Site.	Land management will be in keeping with the surrounding area. Moveable pods and fixed sprinklers are proposed which fits with the visual amenity of the area.	LEI (2021:P:C.14a) Section 7 (LEI, 2021:P:C.15)
Ecology	The Porangahau River and estuary typically contain great ecological habitat value which should be maintained. The terrestrial habitat is predominantly occupied by farming activities. Riparian margins (adjacent to the Porangahau River may have additional habitat values.	Minimise discharge to the non-deficit system where possible. Retain farming and cropping, and maintain riparian planting along the Porangahau River boundary.	Beca (2021:P:D.66)
Coastal Hazard Zones Regional Coastal Environment Plan (RCEP)	Zone 1 – Land identified as being subject to storm erosion, short-term fluctuations and dune instability and includes river/stream mouth areas susceptible to both erosion and inundation due to additional hydraulic forcing of river or estuary systems. Zone 3 – Land assessed as being at risk to sea water inundation in a 1 in 50 year combined tide and storm surge event, and includes allowance for sea level rise, but doesn't include land within CHZ1 or CHZ2.	CHZ1 extends along the eastern property boundary at no greater than 60 m inland from the boundary fence line. CHZ3 is confined to a small proportion of the alluvial plain to the north-east of the property. No irrigation will occur within CHZ1, with only small moveable pods being used in CHZ3, capable of being shifted, suspended and removed from CHZ3 in the event of coastal inundation.	Beca (2021:P:D.90)

6 LAND MANAGEMENT

6.1 General

To operate a successful discharge regime across the Site, the management of irrigation rates, cropping and/or grazing rotation and protection of landforms and cultural sites is needed. Land management considerations are as follows.

6.2 Land Ownership and Management Responsibility

The land for irrigation is managed by the Stoddart family. A detailed evaluation of the Site is given in the report *Evaluation of Soils to Receive Porangahau and Te Paerahi Wastewater* (LEI, 2020:P:B.15). The landowner of the Site available for irrigation at the time of preparing this conceptual design is given in Table 6.1 and with the property shown in Figure 6.1.

Table 6.1: Land Ownership

Landowner	Stoddart (Southern Parcel)	Stoddart (Northern Parcel)
Site Address	474 Beach Road, Porangahau	474 Beach Road, Porangahau
Legal Description	LOT 2 DP 3877	LOT 3 DP 2741
Map Reference	1910364 E, 5533274 N	1910717 E, 5533843 N
Area (ha)	81.2	33.1

Figure 6.1: 474 Beach Road, Porangahau – Proposed Irrigation Property

It is acknowledged that the diligent management of the land, including the irrigation, is critical to achieve less than minor adverse effects on the environment. It is also noted that use of land not owned by Council comes with the attendant risk of uncertainty of land tenure.

It is important that the wastewater irrigation fits in with the land management. The day-to-day operation and maintenance of the system will be the responsibility of the landowner. CHBDC as consent holder will monitor to ensure that the irrigation is being managed to comply with conditions of consent.

Formal agreements which define site and system responsibilities are in preparation.

6.3 Current Land Use

Currently the land application site can be described as a low to moderate intensity sheep and beef finishing block, with low intensity rotational cropping, predominantly of crops such as chicory, raphno, hunter and oats occurring. The dominant livestock type across the Site is sheep, with ewes brought onto the property from a partnering farm in spring/summer, kept over the winter period and sent to the works in spring. Seasonal fluctuations influence land management and animal numbers across the Site with fertiliser inputs being relatively low. A summary of the current farming system is provided in LEI (2021:P:B.13).

6.4 Future Land Use

Wastewater irrigation to the Site is expected to increase existing farm productivity through increased pasture yield and year round security of water for irrigation. In terms of management, the existing farming system will remain relatively the same, albeit with greater flexibility and certainty surrounding animal numbers and cropping rotations. The design concept incorporates the current management style into the design of the discharge regime.

A key component to the future farming system will be the inclusion of wastewater irrigation over part of the site and corresponding, increased pasture growth. The area which is likely to receive the largest proportion of irrigation is the central sand dunes which are prone to drying out in summer months due to low water holding capacity. Pasture production is currently low on this landform.

The ability to increase pasture production through irrigation across previously low producing land will enable an increase animal numbers across the Site to manage increased pasture growth. Management of nutrient loss due to increased animals on-site has been incorporated into the design criteria for the discharge regime.

The activities and farm production will ramp up as the development stages advance (Section 7.2). Four farm management scenarios have been evaluated representing the current farming system, prior to irrigation; and the farming system that is likely at each of the stages. A summary of the farming system for each of the stages is provided in LEI, 2021:P:C.14a.

6.5 Management of Cropping and/or Animal Grazing

For future management following wastewater application, existing cropping is to be primarily maintained to land on the alluvial plain to the north-east, adjacent to the river. The location of crops may vary on a seasonal basis, however this location has been indicated by the landowner as being a suitable cropping location, thus is has been incorporated as being predominantly for crops in future. Crops grown under wastewater application, are not to be exported for human consumption. In addition to crop locations, crop types may vary seasonally depending on farm management and may include crops such as chicory, raphno, turnips and oats.

Under a future 'business as usual' approach, stock will largely graze regularly across the entirety of the property. Cropping blocks will likely see break feeding of crops when plants are at maturity over winter periods, with no grazing events prior to this following sowing. Elsewhere, due to much of the Site being in pasture, grazing events will vary in location and duration depending on animal numbers and seasonal variations.

6.6 Land Management Units

For the purposes of modelling and understanding farm management, a series of land management units (LMUs) have been created. The LMU are a combination of landforms and characteristics into practical areas for management. Each LMU should respond in a similar way to the same management approach. The designation of LMUs is mostly based on the landforms and associated soil types outlined in the Site Investigation Report (LEI, 2020:P:B.15). Figure 6.2 shows the distribution of the LMUs.

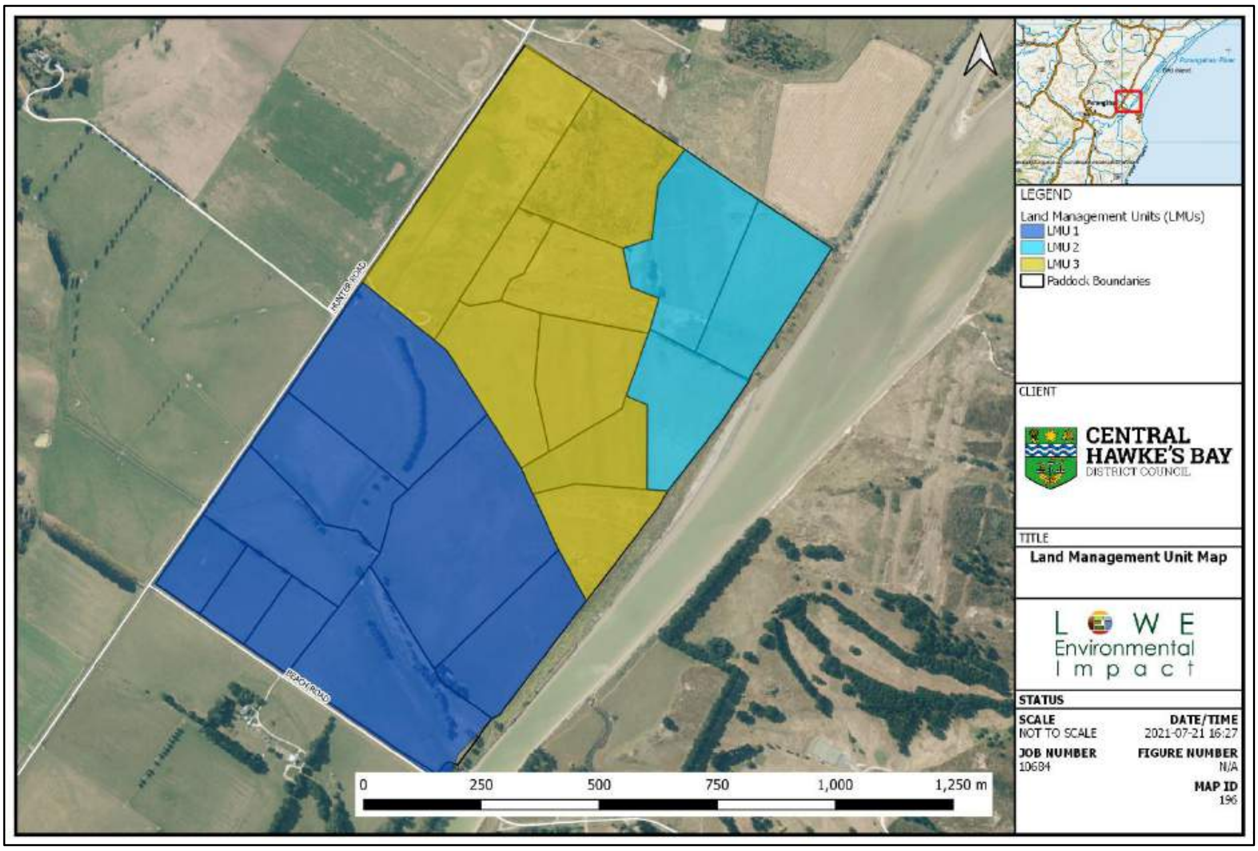


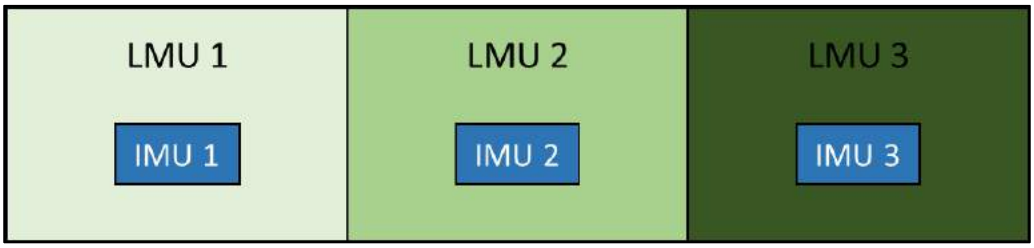
Figure 6.2: Land Management Unit Map

In brief three landforms have been identified:

- LMU 1 dominant landform is poorly drained silty/clayey soils to the south;
- LMU 2 dominant landform is poorly to moderately draining loamy alluvium to the north east; and
- LMU 3 dominant landform is well drained central sand dunes.

6.7 Irrigation Management Units

Not all of the Site will receive wastewater irrigation. Within the LMUs, Irrigation Management Units (IMU), being a subset of LMUs, can be assigned. The relationship between LMUs and IMUs is shown below.



Of the available area within the LMUs:

- Only part of the area is required for the discharge of wastewater, due to the volume of wastewater available for discharge; and
- Only part of the area is available for wastewater discharge following exclusion of buffer zones, sensitive areas or areas which are unsuitable due to a soil management issues such as drainage limitations (Figure 6.3).

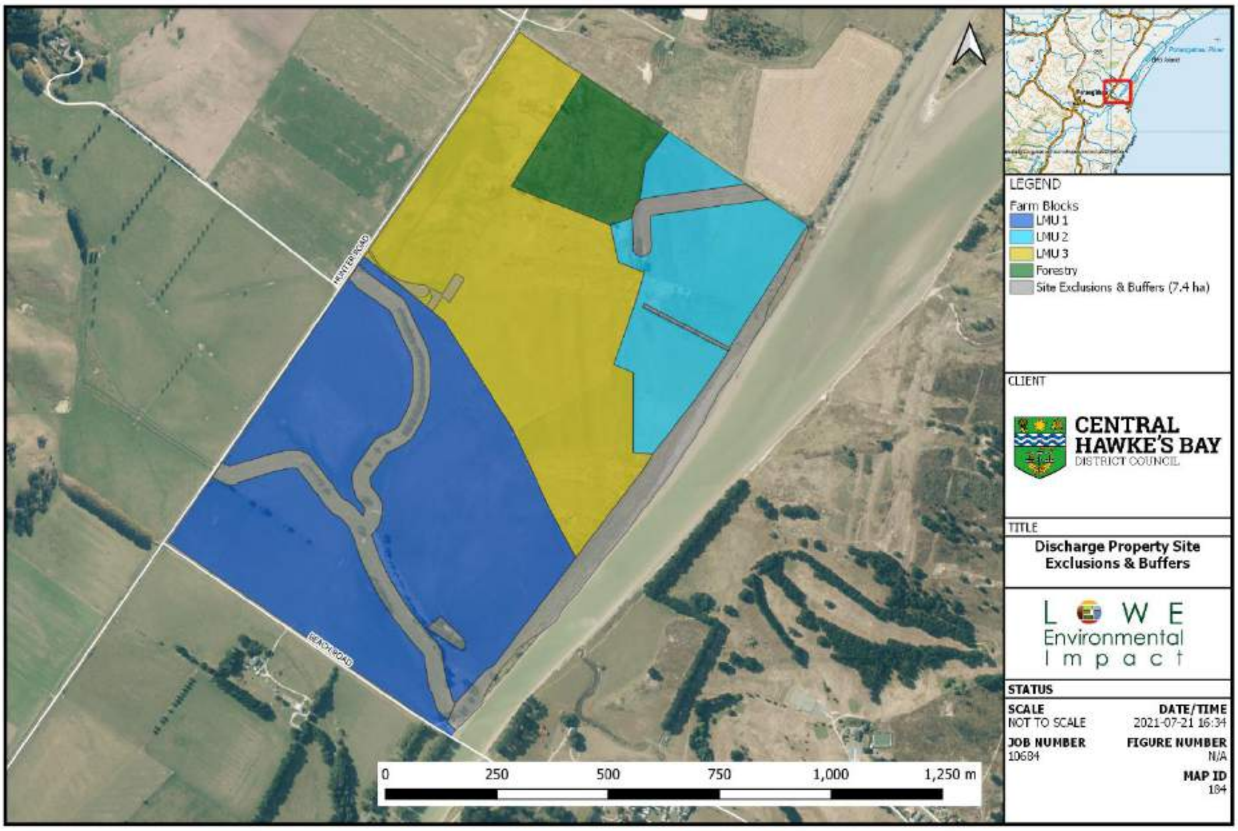


Figure 6.3: Site Exclusions & Buffers

The land area of the Site which is available is significantly greater than what is required to fully irrigate all of Porangahau and Te Paerahi's flows to land. This enables additional management flexibility whereby, the IMU block can rotate within the LMU on any given day depending on landowner preference.

For the purposes of evaluating effects, a scenario which has a fixed area of irrigation will have the biggest impact and so that has been evaluated here.

Table 6.2 represents a summary for each of the LMUs and IMUs at Stage 3 of the project.

Table 6.2: Stage 3 LMU and IMU Summary

Land Management Unit	LMU 1	LMU 2	LMU 3
LMU Area (ha)	50.8	16	33.3
Irrigation Management Unit	IMU 1	IMU 2	IMU 3
IMU Area within LMU (ha)	20	-	20
Landform	Alluvial plain (south)	Alluvial plain (north-east)	Sand dunes
Proximity to Features	This unit encompasses the southern portion of the property to which the 20 ha IMU 1 rotates within. This unit features two streams running though its extent and is bounded by Beach & Hunter Roads and the Porangahau River.	This unit comprises the north-eastern alluvial plain, bounded by the Porangahau River, sand dune ridgelines and the drain running along the property's northern boundary. This unit features a small duck pond and a relatively dry drain running through its extent.	This unit includes the higher elevated dune ridgelines running through the property to which the 20 ha IMU 3 block rotates within. This unit runs in a north-south direction, spanning the central to northern extent of the property and is bounded by Hunter Road and the Porangahau River.
Management Type	Low intensity pastoral grazing of sheep and beef.	Low intensity rotational cropping for sheep over winter months. Low intensity pastoral grazing of sheep and beef.	Low intensity pastoral grazing of sheep and beef. Rotating winter oats crop for beef grazing common.
LMU Management Challenges	Poorly draining soils so risk of pugging in winter by beef stock. Risk of flooding in 100 yr flood event.	Low to moderate draining soils so risk of winter pugging by beef stock. Minor risk of flooding in 100 yr flood event.	Well-draining soils so increased risk of nutrient leaching following fertiliser applications. Soil dries out in summer months, reducing pasture growth. Minimal to no soil structure below thin topsoil layer, thus risk from wind erosion if topsoil layer is lost. Careful cultivation and stock grazing management required.
IMU Management Challenges *** (in addition to LMU Management Challenges) ***	Inclusion of wastewater would require appropriate irrigation rates and stock withholding periods to minimise soil pugging and surface water ponding. Appropriate management of beef stock, particularly in winter months (potentially exclude beef from irrigated area altogether in Jul/Aug).	-	Inclusion of wastewater would facilitate substantial increases in pasture growth. Application rates, stock management and land use will need to be carefully managed to minimise nutrient losses. Due to high permeability of soil, high volumes of wastewater will be required to maintain sufficient moisture in soil profile.

7 DISCHARGE REGIME

7.1 General

Section 7 presents the method to determine a discharge regime for the Porangahau and Te Paerahi WWTPs to a designated land application site.

7.2 Proposed Staging of Discharge Development

The development of the discharge system for Porangahau and Te Paerahi's wastewater is proposed to be staged. This allows for a rapid reduction in the amount of treated wastewater discharged via the current discharge systems to the respective receiving environments, while managing the costs to Council and the time for procurement and construction to occur. A summary of the proposed stages is as follows:

- **Stage 0** allows for the current discharge for both communities to their respective receiving environments to occur for up to four years at Te Paerahi and six years at Porangahau from consent granting while the subsequent stages are enacted;

- **Stage 1** involves provision of 500 m^3 of storage within the Te Paerahi WWTP and development of a minimum 4 ha on the Discharge Property, allowing irrigation to sandy soils (IMU 3) under typical irrigation conditions for approximately 43 % of the **current** Te Paerahi average annual wastewater discharge volume and 57 % of the annual volume under a non-deficit wet soils regime. This stage **only** includes Te Paerahi flows and applies all to the Discharge Property, while the existing river discharge for Porangahau will continue.

  The discharge regime assumes that the currently occurring wastewater flows occur (no allowance for future growth), up to 500 m^3 of storage is available at the Te Paerahi WWTP and discharge under a non-deficit wet soils regime can occur when soils cannot receive wastewater under typical irrigation conditions;

- **Stage 2** involves development of an additional 6 ha of irrigation for sandy soils (IMU 3), allowing for a minimum 10 ha of irrigation at Stage 2. Stage 2 allows for irrigation to IMU 3 (wet and regular irrigation regimes) of between 61 % to 100 % of the **future (2028)** Porangahau and Te Paerahi annual wastewater discharge volumes. This stage includes **both** Porangahau and Te Paerahi flows, but allows for between 0 % to 39 % of all flows to continue to the Porangahau River (when storage is not possible and soil conditions are too wet).

- **Stage 3** involves development of an additional 10 ha of irrigation for sandy soils (IMU 3) and incorporation of 20 ha of silty/clay soils (IMU 1), allowing for a minimum 40 ha of irrigation at Stage 3. A new combined WWTP and storage pond is to be built at the land application site to receive Porangahau and Te Paerahi flows with a capacity of (up to) 35,000 m^3. This storage allows for irrigation of between 66 % and 100 % of the **future (2057)** average annual wastewater discharge volume to the regular irrigation system (typical irrigation) and between 0 % to 36 % to be applied under a non-deficit wet soil regime.

Details of the Stage 0 existing discharges for the respective WWTPs are given in the report (Beca, 2020:P:C.10) and are not discussed further here.

An evaluation of treated wastewater flows to be discharged to land at each stage has been made on the basis of the historical record of wastewater flows and climatic conditions. A summary of the discharge regime for each stage is given in the following sections.

7.3 Determination of Design Irrigation Rate

In November 2020 LEI conducted a detailed site investigation of the Site. Key parameters are summarised in the Site Investigation report (LEI, 2020:P:B.15). An appropriate irrigation application depth has been determined from field testing of soil unsaturated hydraulic conductivity ($K_{-40\ mm}$). The most conservative $K_{-40\ mm}$ as determined in the Site Investigation report (LEI, 2020:P:B.15) is 11 mm/h for silty/clay soils and 14 mm/h for sandy soils, corresponding to design irrigation application depths of 79 mm/d and 101 mm/d respectively using the method of Crites and Tchobanoglous (1998). For practical irrigation purposes and to be protective of groundwater this value has been adjusted to up to 20 mm/d. This application depth applies across all IMUs.

Using the **design irrigation application depth of 20 mm/d** will restrict irrigation water movement through the soil to matrix flow, thereby maximising the travel time in the soil and contact with soil particles. This is intended to maximise sorption, filtration and plant removal of applied nutrients and pathogens. An instantaneous irrigation rate not exceeding the lowest K_{-40mm} of 11 mm/h for the Site will be adopted to avoid ponding or run-off of wastewater. A **rate of 10 mm/h is proposed**. Applying at this rate will further reduce risks associated with run-off since in the event of high rainfall events with the potential for overland flow, negligible wastewater and associated contaminants will be at the soil surface.

The design irrigation depths and rates discussed here are the maxima for the Site however, there is potential to reduce the per event application rate to fit in with land management requirements and to optimise the discharged volumes. This is discussed further below.

7.4 Determination of Discharge Regime

In order to determine the proportion of wastewater that can be applied to a land area, and the amount of storage required, a water balance approach has been used to develop a land application regime. This section summarises the methodology used to build the regime.

7.4.1 Water Balance Principle

There are a number of processes to be considered when applying treated wastewater to land. The use of a water balance enables these processes to be quantified and then considered together. This water balance approach is based on an empirical water and nutrient budget for a land discharge system. In the case of the stages presented, actual data (typically daily) is used and so the outputs represent how the system would have operated for the period of the dataset.

7.4.2 Water Balance Key Inputs

Specific input data used includes:

- **Daily wastewater outflow volumes:** Data was available for the period 1 January 2008 to 30 November 2019. Gaps in data sets were populated with estimates based on previous outflow data. As noted in Section 4.2, flows were adjusted for future growth in Porangahau and Te Paerahi;
- **Mean wastewater quality:** While wastewater quality is expected to vary across a year, nutrient data is considered in the context of yearly loads and so mean values for total N and total P are considered to be appropriate for the water balance. Values are summarised in Table 4.3 for Porangahau and Table 4.4 for Te Paerahi;

- **Daily rainfall data** (for additions to the pond surface and for scheduling irrigation): From the nearest climate station with a reliable complete daily data set. In this case data was sourced from the Waipawa EWS Station [31620] for the period 09/06/2009 to 30/11/2019;
- **Daily Priestly-Taylor Potential Evapotranspiration** (for losses from the land application area): From the nearest climate station with a reliable complete daily data set. In this case the Waipawa EWS Station [31620] as for rainfall; and
- **Daily open-pan evaporation** (for losses from the storage pond surface): From the nearest climate station with a reliable complete daily data set, also from the Waipawa EWS Station [31620] as for rainfall and PET.

7.4.3 Variable Inputs to Water Balance

There are many variables for the system which, when manipulated individually, can produce multitudinous outcomes. The variables represent possible day-to-day management decisions such as:

- River flow criteria including flow limits and mass loading limits;
- Irrigation event application depth;
- Area available for irrigation on any day;
- Irrigation limits based on month (% of maximum);
- Irrigation return period;
- Limits to application volumes based on amount of rainfall received over preceding days;
- Soil moisture content triggers to start irrigation;
- Soil permeability and available water holding capacity;
- Inclusion of surface water or rapid infiltration discharge limited by nutrient or hydraulic load;
- Pond dimensions; and
- Minimum volume to be retained in storage.

In order to work with a manageable number of scenarios some decisions have been made as to which variables to fix. These decisions are based on an understanding of the assimilative capacity of the local environment and a need to discharge as much of Porangahau and Te Paerahi's wastewater to land as possible in a sustainable manner, without having a detrimental impact on the land.

The parameters adopted are as determined in the Site Investigation (LEI, 2020:P:B.15) and Water Quality (Beca, 2020:P:B.24) reports.

7.4.4 Processing of Data

The water balance considers the system as a series of separate reservoirs and then as interacting systems. The process can be summarised as follows:

- Determine what volume of wastewater is available for discharge (stored volume and inflow);
- Determine if the soil moisture status criteria are met. This a function of the rainfall and/or irrigation received previously, the evapotranspiration for that day and drainage that may have occurred;
- If sufficient wastewater is available and soil moisture status allows, apply wastewater to land area at the prescribed irrigation rate;
- If insufficient wastewater is available from inflow or in storage then no discharge occurs and inflows are directed to storage;

- If there is not sufficient capacity in the soil to receive wastewater (soil moisture is high) and storage is at capacity, direct Porangahau and Te Paerahi outflows to a non-deficit wet soils irrigation regime.

Where multiple land areas are defined i.e. where they have different criteria to allow discharge to occur, or if there are alternative discharges such as surface water or high rate irrigation then the water balance progressively assesses and discharges the wastewater to each management unit sequentially. The order is determined by the priority for each unit – in the case of Porangahau and Te Paerahi, the order is IMU 3, IMU 1, non-deficit wet soil discharge to IMU 3, then storage.

7.4.5 Outputs

The water balance produces a daily record of discharges to each of the management units. From this data a summary of the discharge regimes can be produced, including:

- Average annual discharge volume to land irrigation and to high rate discharge;
- Average annual land application depth;
- Days of discharge, both the number of days that discharge could occur (due to soil moisture conditions) and the number of days that the discharge did occur (due mostly to stored volume available);
- Nitrogen (N) and phosphorus (P) load received by the land application area; and
- The maximum storage volume needed to operate a full time land treatment system.

These outputs are given below for the Stages described earlier.

7.5 Optimisation of Discharge Scenario

There are three aspects of the discharge system that influence one another; storage, land area and drainage. Each of these aspects can be managed and modified however this comes at a cost which is not always available. Each of these aspects are directly related to one another in that when one is modified (i.e. storage), another is influenced. These modifications to each aspect develop the need for a 'sweet spot' to be identified between each, that is both affordable to Council, but effective for the Project.

Of these components, storage is often modified above others as this is a pre-determined and calculated volume to which modelling is based on. Having a smaller storage volume, increases the land required for irrigation (assuming a 100 % land discharge), as high flow volumes cannot be captured, which in turn influences soil drainage rates. Contrastingly, having a higher storage volume can be expensive and may not be necessary if its full capacity is used infrequently. Therefore, a compromise between storage, land area and drainage is required to manage environmental effects and cost to Council.

Figure 7.1 provides a continuum between these three wastewater system components.

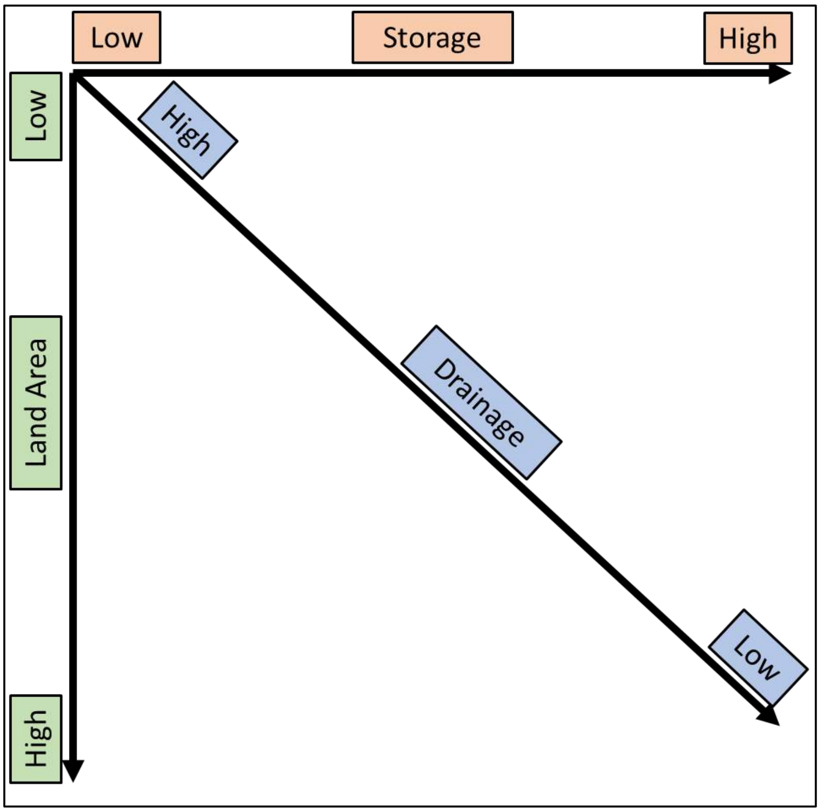


Figure 7.1: Storage, Land Area and Drainage Continuum

7.6 Stage 1 Discharge Regime (Te Paerahi current flows ONLY)

Details of the management of the Porangahau and Te Paerahi WWTP discharges at Stage 1 are as follows.

7.6.1 Wastewater Treatment Plant and Storage

Works to enable Stage 1 to commence will include:

- Minor treatment improvements to existing ponds at Porangahau and Te Paerahi;
- Pipeline from the Te Paerahi WWTP to the irrigation property;
- Establish wet well for inflows and UV treatment at the irrigation property; and
- Establish fixed impact and/or small moveable irrigation infrastructure to at least 4 ha for irrigation of Te Paerahi flows under deficit and non-deficit conditions.

At Stage 1, only land discharge of Te Paerahi's wastewater flows occur. Porangahau's wastewater flows will continue to discharge to the Porangahau River.

7.6.1 Discharge to Surface Water

At Stage 1, the existing discharge from the Porangahau WWTP to the Porangahau River will continue under the same, run-of-pipe, regime that currently occurs. A summary of flows and loads to the Porangahau River under Stage 1 are given in Table 7.1.

7.6.2 Discharge to Irrigation

Following commencement of Stage 1, irrigation will be applied to an area no less than 4 ha within the area identified as LMU 3 and referred to as IMU 3 as described in Section 6.7. To minimise risk of excessive drainage to groundwater and ultimately via groundwater to surface water, the per event discharge maximum is around 25% of the soils available water holding capacity. The proposed per event discharge rate is **up to 20 mm/d**. Discharge will preferentially occur where a sufficient soil moisture deficit exists.

At the proposed discharge rate, the soil is likely to be able to remove all solids and assimilate all BOD applied from the Te Paerahi WWTP. The proposed discharge regime will result in some drainage in excess of what currently occurs since there may be more water in the soil when rainfall occurs. Conversely, more regular water application and keeping the soil at a slightly higher moisture content is expected to reduce overland flow from rainfall compared to the current, unirrigated situation since water from rainfall will be able to more easily enter soil.

To maximise wastewater nutrient removal, wastewater should be retained in contact with the soil for as long as possible. The following decision criteria are recommended to maximise nutrient removal. Under Stage 1, IMU 3 will be operated preferentially as a deficit irrigation system, where criteria determining on any day whether application to land irrigation can occur are as follows:

- **Deficit irrigation - IMU 3:** Represents a regime similar to freshwater irrigation that is common in the wider district. A small amount of nutrient leaching can be expected. A deficit system has been adopted for IMU 3 since no rotation around the block is proposed (no resting period) if only the minimum 4 ha of irrigation is installed. The criteria to discharge are:
    - **Soil moisture status:** Irrigation will not cause the soil moisture to exceed field capacity;
    - **Application rate control:** Vary the application depth to "top-up" a deficit whenever it occurs;
    - **Wind speed and direction:** Irrigation may occur if wind speed is less than 12 m/s, or 4 m/s in the direction of any dwelling within 300 m of the irrigated area;
    - **Previous rainfall:** Irrigation may occur if less than 50 mm rain has fallen in the preceding 3 days; and
    - **Crop condition / harvest schedule / animal rotation:** Harvest or grazing should not occur within 48 h of irrigation ceasing, and irrigation should not be commenced within 24 h of completion of harvest or removal of stock.

There is no alternative discharge or ability to store wastewater for the Te Paerahi flows at Stage 1 and so all flows will be discharged to land. In the event that the criteria above are not able to be met, the discharge can proceed with the same event maximum (20 mm) but will be recorded as a non-deficit (wet soils) discharge. A description of the non-deficit (wet soils) irrigation regime is provided in Section 8.2. For an average year, wet year and dry year, the regime management outcomes are given in Table 7.1.

The regime outcomes assume that currently occurring wastewater flows occur, up to 500 m^3 of storage is available at the Te Paerahi WWTP and discharge under the non-deficit wet soil regime can occur only when soil conditions prevent deficit irrigation.

Table 7.1: Stage 1 – Discharge Management Outcomes (4 ha)

Regime	Average Year	Wet year	Dry Year
DEFICIT IRRIGATION – Regular Irrigation (Dry Soils)			
Annual application depth (mm)	255	354	244
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	10,150 m^3	14,179 m^3	9,750 m^3
N mass loading (from wastewater)	51 kg N/ha/y	70 kg N/ha/y	49 kg N/ha/y
P mass loading (from wastewater)	13 kg P/ha/y	18 kg P/ha/y	12 kg P/ha/y
NON-DEFICIT IRRIGATION – Wet Soils			
Annual application depth (mm)	350	546	147
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	14,460 m^3	21,830 m^3	5,900 m^3
N mass loading (from wastewater)	70 kg N/ha/y	110 kg N/ha/y	29 kg N/ha/y
P mass loading (from wastewater)	18 kg P/ha/y	30 kg P/ha/y	7 kg P/ha/y
CONTINUED DISCHARGE TO PORANGAHAU RIVER			
Volume per year	54,000 m^3	66,215 m^3	30,055 m^3
N mass loading (from wastewater)	1,076 kg N/y	1,324 kg N/y	601 kg N/y
P mass loading (from wastewater)	269 kg P/y	331 kg P/y	150 kg P/y

During a dry year, the discharge to land for deficit irrigation is in the order of 62 % of that year's annual wastewater flows. For a wet year this reduces to 39 % even though the total discharged is higher. All remaining flows from the Te Paerahi WWTP that are not discharged via a deficit irrigation regime will be applied under the non-deficit (wet soils) irrigation regime. This will ensure that 100% of flows from the Te Paerahi WWTP under Stage 1 are discharged to land in one form or another. It should be noted that the non-deficit (wet soils) irrigation regime discharges via the same irrigation infrastructure that the soil moisture controlled deficit irrigation occurs and so water and nutrient loads in Table 7.1 are cumulative. A description of the non-deficit (wet soils) irrigation regime is provided in Section 8.2.

From Table 7.1, nitrogen and phosphorus loads from wastewater are relatively small to the farming system, thus additional fertiliser inputs will be required to increase pasture production.

The evaluation given here assumes that 4 ha of irrigation will be operated, which is a sustainable irrigation regime. In practice it would be desirable to have a larger area of irrigation available (within the areas identified as suitable in Section 6.7, Figure 6.3) to enable some flexibility with the farming system. For the purpose of assessing effects, the scenario presented here is considered the "worst case scenario" which minimises the potential for underestimating effects from the activity.

7.7 Stage 2 Discharge Regime (Porangahau and Te Paerahi future flows)

Details of the management of the Porangahau and Te Paerahi WWTP discharges at Stage 2 are as follows.

7.7.1 Treatment Plant and Storage

Works to enable Stage 2 to commence will include:

- Pipeline from the Porangahau WWTP to the irrigation property; and
- Establish fixed impact and/or small moveable irrigation infrastructure to at least 10 ha (an additional 6 ha from Stage 1) for irrigation of Porangahau and Te Paerahi flows under non-deficit conditions.

Stage 2 is calculated on predicted 2028 flows from the Porangahau and Te Paerahi WWTPs.

7.7.1 Stage 2 Discharge Scenarios

Two discharge scenarios are discussed here. Stage 2a applies 100 % of Porangahau and Te Paerahi's flows to land using a deferred irrigation approach and when wet a non-deficit (wet soils) regime. The deferred irrigation approach is predominately deficit irrigation, but with occasionally applications exceeding field capacity (non-deficit), with the storage used to buffer the need for higher application rates to be used.

Stage 2b sees wastewater flows from both Te Paerahi and Porangahau directed to the irrigation property, however if soil moisture criteria aren't met the Porangahau wastewater is directed to the existing river outfall. This partial river discharge allows for some of the wastewater volumes directed to the wet soils irrigation regime as set out in the Stage 2a example to be diverted to the river. A description of the non-deficit (wet soils) irrigation regime is provided in Section 8.2.

Each of these sub-stages (2a and 2b) allows assessment of the worst case scenario to occur i.e. 100 % to land or as much to land as practically possible and the balance to the river. In practice a system which is predominantly to land but includes some contingency discharge to the river is likely.

7.7.2 Discharge to Irrigation

Following commencement of Stage 2, an additional 6 ha will be available for irrigation totalling an irrigation area of 10 ha over IMU 3. Stage 2 will allow for a mix of deficit and deferred/non-deficit irrigation for both Stages 2a and 2b. As with Stage 1, the per event discharge maximum is around 25% of the soils available water holding capacity. The proposed rate of discharge per event is **up to 20 mm/d**.

In addition to the deficit criteria given in 7.6.2, the following decision criteria are recommended for inclusion in Stage 2:

- **Deferred, non-deficit irrigation – IMU 3:** Represents a regime which maximises the volume of discharge to land while protecting the land from damage by over-watering and avoiding excessive leaching to groundwater or surface water. The application system will see a minimal increase in application depth over field capacity. A portion of applied nitrogen will be transported to groundwater and surface water by leaching but will enter surface water as a diffuse discharge and at a substantially lower mass loading than would occur due to a direct discharge from the Porangahau WWTP. The criteria to discharge under the deferred, non-deficit irrigation regime are:
    - **Soil moisture status:** Irrigation will not cause the soil to exceed field capacity by more than 2 mm per event;
    - **Application rate control:** Vary the discharge rate to match the soil moisture criteria;
    - **Depth to groundwater:** Irrigation should not occur when the groundwater table is less than 1 m from the soil surface;

- **Wind speed and direction:** Irrigation may occur only if wind speed is less than 12 m/s, or 4 m/s in the direction of any dwelling within 300 m of the irrigated area;
- **Previous rainfall:** Irrigation may occur if less than 20 mm rain has fallen in the 24 hours prior to commencement of irrigation; and
- **Crop condition / harvest schedule / animal rotation:** Harvest or grazing should not occur within 48 h of irrigation ceasing, and irrigation should not be commenced within 24 h of completion of harvest or removal of stock. In practice, irrigation is unlikely to occur in the week leading up to harvest and until obvious crop growth is visible however this limit is to manage environmental effects of the irrigation.

Adopting the same decision criteria as described for Stage 1 results in outcomes given in Table 7.2.

Table 7.2: Stage 2a – Discharge Management Outcomes

Regime	Average Year	Wet year	Dry Year
DEFICIT AND NON-DEFICIT (DEFERRED) IRRIGATION – Regular Irrigation (Dry Soils)			
Annual application depth (mm)	307	368	292
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	30,700 m^3	36,900 m^3	29,200 m^3
N mass loading (from wastewater)	61 kg N/ha/y	74 kg N/ha/y	58 kg N/ha/y
P mass loading (from wastewater)	15 kg P/ha/y	18 kg P/ha/y	15 kg P/ha/y
NON-DEFICIT IRRIGATION – Wet Soils			
Annual application depth (mm)	710	937	341
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	71,000 m^3	93,800 m^3	34,100 m^3
N mass loading (from wastewater)	142 kg N/ha/y	187 kg N/ha/y	68 kg N/ha/y
P mass loading (from wastewater)	35 kg P/ha/y	47 kg P/ha/y	17 kg P/ha/y
CONTINUED DISCHARGE TO PORANGAHAU RIVER			
Volume per year	0 m^3	0 m^3	0 m^3
N mass loading (from wastewater)	0 kg N/y	0 kg N/y	0 kg N/y
P mass loading (from wastewater)	0 kg P/y	0 kg P/y	0 kg P/y

Due to high winter/spring wastewater flows from Porangahau, the amount of wastewater discharge that occurs under the non-deficit (wet soils) regime is high. As for Stage 1, the non-deficit (wet soils) regime discharges via the same irrigation infrastructure that the soil moisture controlled irrigation occurs and so water and nutrient loads in Table 7.2 are cumulative. Only the discharge criteria are different. A description of the non-deficit (wet soils) irrigation system is provided in Section 8.2.

It should be noted that the non-deficit (wet soils) discharge is not considered to be a high rate discharge. As with Stage 1, additional fertiliser inputs will be required to increase pasture production.

For Stage 2b, a proportion of this wastewater that would be directed to the wet soils system under Stage 2a, will instead, be discharged to the Porangahau River via the existing outfall. The outcomes of Stage 2b are given in Table 7.3.

Table 7.3: Stage 2b – Discharge Management Outcomes

Regime	Average Year	Wet year	Dry Year
DEFICIT AND NON-DEFICIT (DEFERRED) IRRIGATION – Regular Irrigation (Dry Soils)			
Annual application depth (mm)	320	370	300
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	32,000 m^3	37,000 m^3	30,000 m^3
N mass loading (from wastewater)	63 kg N/ha/y	74 kg N/ha/y	60 kg N/ha/y
P mass loading (from wastewater)	16 kg P/ha/y	18 kg P/ha/y	15 kg P/ha/y
NON-DEFICIT IRRIGATION – Wet Soils			
Annual application depth (mm)	170	220	100
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	17,000 m^3	22,000 m^3	10,000 m^3
N mass loading (from wastewater)	34 kg N/ha/y	45 kg N/ha/y	19 kg N/ha/y
P mass loading (from wastewater)	8 kg P/ha/y	11 kg P/ha/y	5 kg P/ha/y
CONTINUED DISCHARGE TO PORANGAHAU RIVER			
Volume per year	53,000 m^3	71,100 m^3	23,400 m^3
N mass loading (from wastewater)	1,050 kg N/y	1,420 kg N/y	490 kg N/y
P mass loading (from wastewater)	260 kg P/y	350 kg P/y	120 kg P/y

Stage 2b shows a significant reduction in the portion going to the non-deficit (wet soils) discharge compared to Stage 2a. This will result in a lower risk of nutrient loss from the site but is offset by including a river discharge. The increase in total community flows predicted by Stage 2 (Section 4.2) results in the discharge to river being a similar volume to that which currently occurs. However, the distribution of the discharge through the year is different, with no discharge occurring below ½ median flow, and 75 % of the river discharge occurring between May and September inclusive.

7.8 Stage 3 Discharge Regime (future flows)

Details of the management of the WWTP discharge at Stage 3 are as follows.

7.8.1 Treatment Plant and Storage

Works to enable Stage 3 to commence will include:

- Install storage for times irrigation cannot occur;
- Construction of a new combined WWTP at the discharge property servicing both communities;
- Construction of a 10,000 – 35,000 m^3 storage pond; and
- Establish fixed impact or small moveable irrigation infrastructure to at least 40 ha (additional 30 ha) for irrigation of Porangahau and Te Paerahi's future flows under both deficit and non-deficit conditions.

Stage 3 incorporates projected future 2057 population growth and flows from the Porangahau WWTP to the discharge property as outlined in Section 4.2.

7.8.1 Stage 3 Discharge Scenarios

Two Stage 3 scenarios are described. The distribution of the discharge through the year is significantly impacted by the ability to store the wastewater until ideal soil conditions exist.

- **Stage 3a** represents a minimum storage volume to achieve a long term sustainable discharge to land with a low environmental footprint.

- **Stage 3b** represents an optimised storage volume to get maximum productive gain and optimum water and nutrient retention at the Site.

These stages see all flows, with incorporated future 2057 population projections, directed to the discharge property with **no** river discharge occurring.

Table 7.4 and Table 7.5 represents the regime management outcomes for Stage 3a and Stage 3b respectively.

7.8.2 Discharge to Irrigation

Following commencement of Stage 3 a total of 40 ha (20 ha of IMU 1 and 20 ha of IMU 3) will be available for irrigation. For IMU 1, the discharge regime is a deficit system containing the same irrigation conditions as outlined in Stage 1 for IMU 3. For IMU 3, the proposed discharge and management regime is the same as adopted for Stages 2a and 2b. In both scenarios only 10 ha is used for the wet soils discharge. A description of the non-deficit (wet soils) irrigation regime is provided in Section 8.2.

Stage 3 accounts for future 2057 population growth which is not expected to eventuate until the end of the consent term (2050-2057) but have been considered here to ensure the regime can be operated sustainably for at least 35 years. Table 7.4 gives the outcomes for Stage 3a.

Table 7.4: Stage 3a – Discharge Management Outcomes

Regime	Average Year	Wet year	Dry Year
DEFICIT AND NON-DEFICIT (DEFERRED) IRRIGATION – Regular Irrigation (Dry Soils)			
Annual application depth (mm)	305	395	215
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	121,100 m^3	158,100 m^3	85,700 m^3
N mass loading (from wastewater)	61 kg N/ha/y	79 kg N/ha/y	43 kg N/ha/y
P mass loading (from wastewater)	15 kg P/ha/y	20 kg P/ha/y	11 kg P/ha/y
NON-DEFICIT IRRIGATION – Wet Soils			
Annual application depth (mm)	663	765	394
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	66,300 m^3	76,500 m^3	39,400 m^3
N mass loading (from wastewater)	133 kg N/ha/y	153 kg N/ha/y	79 kg N/ha/y
P mass loading (from wastewater)	33 kg P/ha/y	38 kg P/ha/y	20 kg P/ha/y
STORAGE			
Maximum storage (m^3)	10,900		
90^{th} Percentile storage (m^3)	1,000		

As shown in Table 7.4, for an average year the discharge via the non-deficit wet soils system is around 35 % of the total flows. In this scenario the storage volume required seldom exceeds 1,000 m^3 but for some of the time around 11,000 m^3 of storage is required.

The example shown in Table 7.4 represents a worst case scenario for assessment. In practice, the discharge via the non-deficit (wet soils) could be rotated around the site since the discharge is via the existing irrigation system. In this situation around 170 mm would be discharged in an average year (33 kg N/ha, 8 kg P/ha).

Stage 3b summarises a system where the discharge is optimised for maximum plant use of water and nutrients. The trade-off is a high storage requirement and the associated capital cost and maintenance requirements. Table 7.5 gives the Stage 3b outcomes.

Table 7.5: Stage 3b – Discharge Management Outcomes

Regime	Average Year	Wet year	Dry Year
DEFICIT IRRIGATION – Regular Irrigation (Dry Soils)			
Annual application depth (mm)	468	589	307
Maximum application rate per event	20 mm/d	20 mm/d	20 mm/d
Volume per year	187,157 m^3	235,576 m^3	122,887 m^3
N mass loading (from wastewater)	94 kg N/ha/y	118 kg N/ha/y	61 kg N/ha/y
P mass loading (from wastewater)	23 kg P/ha/y	29 kg P/ha/y	15 kg P/ha/y
NON-DEFICIT IRRIGATION – Wet Soils			
Annual application depth (mm)	0	0	0
Maximum application rate per event	0 mm/d	0 mm/d	0 mm/d
Volume per year	0 m^3	0 m^3	0 m^3
N mass loading (from wastewater)	0 kg N/ha/y	0 kg N/ha/y	0 kg N/ha/y
P mass loading (from wastewater)	0 kg P/ha/y	0 kg P/ha/y	0 kg P/ha/y
STORAGE			
Maximum storage (m^3)	35,500		
90^{th} Percentile storage (m^3)	10,300		

Stage 3b sees all wastewater flows directed to the soil moisture controlled deficit and deferred/non-deficit irrigation system, with no use of the non-deficit (wet soils) system. This is achieved by having enough storage to hold wastewater until soil conditions favour soil retention and plant uptake. Here annual application depths increase to the deferred/non-deficit system as compared to Stage 3a due to wastewater previously directed to the non-deficit irrigation (wet soils) system, instead being discharged to the deferred/non-deficit irrigation system. As with Stage 3a, applied nutrient loadings to the existing farming system are relatively small, thus additional nutrients in the form of fertiliser will be required.

7.8.3 Storage of Treated Wastewater

At Stage 3, it is proposed that dedicated storage will be provided for the treated wastewater. The storage will be actively managed to ensure that there is capacity available during periods when no discharge to land can occur due to high soil moisture and/or rainfall.

The provision of storage has a number of advantages for the scheme which include:

- Ensuring the discharge to land is sustainable by directing wastewater to storage during wet periods when discharge to land might cause land damage;
- Minimising the need to discharge wastewater directly to the wet soils system where a higher risk of leaching occurs; and
- Enabling the discharge to land to occur when maximum productive benefit can be achieved i.e. by storing wastewater during wet winter months when highest flows enter the WWTP, it is able to be used during the summer (water short) months when inflow to the WWTP are unable to meet the plant requirements for water.

The amount of storage required is determined from the water balance and is based on daily data as described in Section 7.4.

The maximum storage volume needed varies from year to year as a result of wastewater inflow and climatic variations. The storage will need to be engineered to manage periods with minimal wastewater in storage. If contingency discharge is required, it is possible to irrigate in conditions outside of the criteria given with modification to land management and for short periods. This can be controlled through a contingency provision in the discharge management plan(s).

7.9 Nutrient Impacts of Discharge

While the discharge regime is designed to minimise rapid drainage some drainage and associated nutrient loss is to be expected from the Site; for instance, as a result of a rainfall event. Management of the irrigation and land will be designed to avoid excessive loss. The proposed regime is intended to be sustainable for the lifetime of the land application scheme.

The nutrient losses from the Site are considered here as they relate to the combined operation of both the wastewater discharge (Section 7.6 to 7.8) and the management of the farm (Section 6). A detailed description of the farming system modelled using Overseer™ is given in LEI (2021:P:B.13) and LEI (2021:P:C.14a). It is acknowledged that nutrient inputs from wastewater alone to the farm system are relatively low. Additional nutrients in the form of fertiliser will be required and contribute to the modelled losses summarised in Table 7.6.

Table 7.6: Nutrient Loss Summary

	River and Coast		Farm			
	N (kg/y)	P (kg/y)	N (kg/y)	N (kg/ha/y)	P (kg/y)	P (kg/ha/y)
Current (Stage 0)	1,532	353	2,349	21	71	0.6
Stage 1 – (TP)	1,076	270	2,546	22	94	0.8
Stage 2a – (P+TP)	0	0	3,490	31	155	1.4
Stage 2b – (P+TP)	1,050	260	2,819	25	113	1
Stage 3a – (P+TP)	0	0	3,301	29	205	1.8
Stage 3b – (P+TP)	0	0	3,014	26	201	1.8

The nutrient loss to the river and coast is by the existing discharge i.e. direct river discharge to the Porangahau River and discharge to the existing Te Paerahi dune discharge (Stage 0 only). The farm nutrient loss represents the loss from the soil. There is likely to be additional reduction in nutrients as the leached water travels toward a surface water or other receptor however it has been assumed that no attenuation occurs to examine a worst-case scenario when assessing effects.

7.9.1 Nitrogen Losses

The nitrogen losses via leaching have been predicted using Overseer™ and are detailed in LEI (2021:P:C.14a). Table 7.4 gives nitrogen leaching estimates from the irrigation site under each of the discharge stages given in Sections 7.6 to 7.8. The nitrogen leaching estimates assume that supplementation of nitrogen from wastewater will be needed i.e. nitrogen loading includes both wastewater nitrogen and fertiliser application. Assuming no attenuation of nitrogen in groundwater or the riparian zone, the changes in the nitrogen entering the river and estuary system are:

- Stage 1: 7 % decrease in nitrogen lost to groundwater and surface water
- Stage 2a: 0 % decrease in nitrogen lost to groundwater and surface water
- Stage 2b: 10 % decrease in nitrogen lost to groundwater and surface water
- Stage 3a: 15 % decrease in nitrogen lost to groundwater and surface water

- Stage 3b: 22 % decrease in nitrogen lost to groundwater and surface water

Assuming that all leached nitrogen eventually enters the surface water environment, then the land application results in a reduction of nitrogen currently discharged to surface water from the land management and from the current direct discharge of wastewater to the Porangahau River and dunes. There is likely to be additional attenuation of nitrogen in the groundwater environment prior to reaching surface water and so the reduction in nitrogen reaching surface water is expected to be greater than that described here. Further, it should be remembered that the calculations provided here are under conditions that see greater flow (and nitrogen) as a result of growth within the communities.

Nitrogen leaching losses in drainage are predicted to increase, peaking at 49 % higher than the existing land use and farm management (if Stage 2a is pursued) and settling at 28 to 41 % higher than current. It should be noted that, while there is a net increase in nitrogen leached from the Site, there is actually a significant reduction in the nitrogen entering the Porangahau River catchment due to the removal of direct discharge of wastewater to surface water.

7.9.2 Phosphorus Losses

The primary mechanism for phosphorus loss is via overland flow. Projected phosphorus losses are given in Table 7.4 for each of the stages. All wastewater that is applied to the land, whether it be for irrigation or to the non-deficit (wet soils) irrigation system will be up taken by plans, adsorbed to soil or lost via overland flow. Irrespective of the endpoint of added phosphorus, phosphorus losses to the Porangahau River will be reduced dramatically due to the cessation of a discharge river discharge.

Phosphorus loss from the irrigated site will be avoided by the maintenance of suitable buffers from waterways, and by application of wastewater using an instantaneous application rate that is less than the soils unsaturated hydraulic conductivity i.e. so that water on the Site goes into the soil and does not pond or flow across the surface. The predicted change in the phosphorus entering the river and estuary system are:

- Stage 1: 20 % decrease in phosphorus lost to groundwater and surface water
- Stage 2a: 66 % decrease in phosphorus lost to groundwater and surface water
- Stage 2b: 18 % decrease in phosphorus lost to groundwater and surface water
- Stage 3a: 55 % decrease in phosphorus lost to groundwater and surface water
- Stage 3b: 56 % decrease in phosphorus lost to groundwater and surface water

7.10 Summary of Discharge Regime

The key parameters of the discharge regime are given in Table 7.7.

Table 7.7: Land Discharge and Management Summary

Parameter	Current Stage 0	Stage 1 (TP)	Stage 2a (P+TP)	Stage 2b (P+TP)	Stage 3a (P+TP)	Stage 3b (P+TP)
Storage volume (m^3)	~1,000	~500	~1,000	~1,000	~10,900	~35,500
Average annual outflow from WWTPs (m^3)	~76,600	~24,600 (~76,600)	~102,000		~183,000	
Discharge to Porangahau River and Te Paerahi Coast						
Volume per year (m^3)	~52,000	~52,000	-	~53,000	0	0
N mass loading from wastewater (kg/y)	1,532	1,076	0	1,050	0	0
P mass loading from wastewater (kg/y)	353	269	0	260	0	0
Deficit/Non-Deficit Irrigation – Regular Irrigation (Dry Soils)						
Irrigation regime	Nil	Deficit	Deferred, non-deficit			
Landform	Nil	Coastal sand dunes			Coastal sand dunes and alluvial plains	
Total area – including non-irrigated (ha)	114.3					
Wastewater irrigated area (ha)	-	4	10	10	40	40
Irrigation event application (mm/event)	-	Up to 20	Up to 20	Up to 20	Up to 20	Up to 20
Average annual irrigation volume (m^3/y)	-	~10,000	~31,000	~32,000	~121,000	~187,000
Average annual application depth (mm)	-	255	307	370	305	468
Wastewater Nitrogen load (kg N/ha/y)	-	51	61	63	61	91
Wastewater Phosphorus load (kg P/ha/y)	-	13	15	16	15	23
Non-Deficit Irrigation – Wet Soils						
Maximum application rate per event (m^3)	-	20	20	20	20	20
Volume per year (m^3)	-	~14,000	~71,000	~17,000	~66,300	~0
Average annual application depth (mm)	-	350	710	170	663	0
Wastewater Nitrogen load (kg N/ha/y)	-	70	142	34	133	0
Wastewater Phosphorus load (kg P/ha/y)	-	18	35	8	33	0
Sand Dunes (LMU 3/IMU 3)						
Farm Management current/proposed	Pastoral grazing, rotational cropping					
Vegetation current/proposed	Cocksfoot & marram grasses, winter oats				Cocksfoot & marram grasses	
Alluvial Plains (LMU 1 & 2/IMU 1)						
Farm Management current/proposed	Low intensity pastoral grazing/ rotational cropping					
Vegetation current/proposed	Ryegrass pasture; crops (e.g. chicory, raphno, oats, turnips)					

8 DISCHARGE SYSTEM

8.1 System Summary

In summary, the discharge system is proposed to consist of the following components:

- 500 m^3 of storage, potentially as freeboard, at the Te Paerahi WWTP for Stage 1. Construction of a pipeline from Te Paerahi to the application site;
- 1,000 m^3 of storage between the Porangahau and Te Paerahi WWTPs for Stage 2. Construction of a pipeline from Porangahau to the application site;
- Construction of a new WWTP servicing Porangahau and Te Paerahi and an (up to) 35,000 m^3 storage pond for Stage 3.
- Irrigation pump station located at discharge Site built for Stage 1;
- A series of fixed and moveable impact sprinklers; and
- Wet well and pumping to:
    - 4 ha at Stage 1;
    - 6 ha (minimum) additional area at Stage 2; and
    - 30 ha (minimum) additional area at Stage 3.

Further detail is provided below.

8.2 Irrigation System Description

Treated wastewater from storage is to be transferred to a wet-well from which it can be pumped to the irrigation system. This will include irrigation under deficit and/or non-deficit conditions (regular irrigation) depending on the Stage or to the non-deficit (wet soils) irrigation regime (for all stages).

The non-deficit (wet soils) irrigation regime utilises existing infrastructure of the regular irrigation (dry soils) irrigation regime but applies up to 20 mm of wastewater to land when storage is unavailable/at capacity, irrespective of soil moisture conditions (i.e. likely when the soil is already wet). This system will be on the rapid permeability sand dunes and will facilitate drainage.

It is proposed that irrigation mains and hydrants are installed along fence lines enabling moveable pods and fixed sprinkler irrigators to irrigate as much of the Site as financially possible (which may see more than the minimum installed).

Buffer distances of 20 m from sensitive receptors or environments (Porangahau River) and 5 m from property boundaries (and a separate buffer of 150 m from any dwellings) will also be incorporated into the wastewater irrigation layout design. There is potential that fencelines may be moved as part of the site development and as directed by the property owners.

The wastewater irrigation system will utilise a low rate of irrigation system using impact sprinklers delivering between 3 and 9 mm/hr. They are expected to have a low production of aerosols with particle sizes no greater than 200 µm in size.

The infrastructure for the land application system will include the following key components:

- Storage pond and pumping system at the newly constructed Porangahau and Te Paerahi WWTP located at the discharge Site for Stage 3;
- Irrigation system, enabling irrigation of a minimum 40 ha by small moveable pods and fixed sprinklers;
- Conveyance pipelines from the Porangahau and Te Paerahi communities to the new WWTP and storage pond, and then to the irrigation system.

- Conveyance to a non-deficit (wet soils) irrigation system.

The visual impact of these components is in keeping with the rural environment, existing infrastructure and equipment used on neighbouring farms.

9 CONSTRUCTION AND ESTABLISHMENT

9.1 Design Features

Specific design features are proposed to ensure the irrigation system and its operation do not have adverse effects. In particular, attention has been paid to the investigations to date to ensure that a system is fit for purpose and irrigated areas and associated infrastructure avoid areas of significance or higher risk at compromising known values that should be protected.

As stated in Section 7 above, the irrigation will consist of low rate irrigation methods delivering an application rate of less than 10 mm/hr.

9.2 Earthworks

No recontouring (bulk earthworks) for irrigation purposes is proposed. The method of irrigation allows for flexibility to ascend and descend slopes of the central sand dunes.

Irrigation earthworks will involve trenching or directional drilling to install piping. Trenches, where required will be typically 0.6 m wide and up to 1.2 m deep.

While design and dimensions are not yet confirmed, a new storage pond, as well as a new WWTP servicing both communities is to be constructed. The location of these features is outlined in Figure 4.2. Any consenting for these facilities will be completed at the time of design, noting that design may be influenced by the outcome of the discharge consents.

All earthworks will require the preparation of a Construction Management Plan (CMP) and an Erosion and Sedimentation Control Plan (ESCP). These plans will detail construction methodology and how construction related effects will be managed.

9.3 Staging

The development and implementation of the **Project** will be in a series of Stages. These stages are detailed below in Table 8.1 along with an overview of the works involved:

Table 8.1: Implementation of the Porangahau and Te Paerahi WWTP Project

Activity	Description	**Timing** *within date of consent being granted
Resource Consenting	• HBRC consents; and • CHBDC consents as required.	
Detailed Design	• Determine irrigation design; • Determine wet well, pump station and UV design; and • Monitoring and management plans.	6 months
Detailed Design	• Determine storage pond design; • Construction management plans; • Sediment and erosion control plans; and • Design of pipeline from Te Paerahi to Discharge Property.	12 months
WWTP Pumping	• Installation of a pump wet well; • Installation of irrigation pump system and controls; • Installation of UV system at both WWTPs; • Construction of pipeline from Te Paerahi to Discharge Property.	12 months
Tendering and Irrigation Installation	• Preparation of tender documents; • Letting of contracts; • Installation of irrigation rising main; • Installation of irrigation laterals and sprinklers for Stage 1; and • Design of pipeline from Porangahau to Discharge Property.	12 months
Tendering and Irrigation Installation	• Installation of irrigation laterals and sprinklers for Stage 2. • Construction of pipeline from Porangahau to Discharge Property.	24 months
WWTP Storage (Stage 3)	• Preparation of tender documents; • Letting of contracts; • Modify pond wall as needed to create design storage volume; • replace wave bands; • modify metering and telemetry as needed; and • Installation of irrigation laterals and sprinklers for Stage 3.	24 months
WWTP Construction (Stage 3)	• Preparation of tender documents; • Letting of contracts; • Construction of new storage pond; and • Construction of new WWTP.	36 months

10 SUMMARY AND CONCLUSIONS

The intention of the design concept is to develop a reasonable and appropriate discharge regime which considers and incorporates the social, cultural, environmental and economic needs of Porangahau and Te Paerahi, as well as the wider Central Hawke's Bay community. The system needs to be able to be sustainably operated for the foreseeable future, both in terms of the treatment of wastewater, and in terms of ensuring that the integrity of the land is not compromised by long term, repeated application of wastewater.

To address the social, cultural, environmental and economic needs of the community an extensive process of technical reporting and community consultations has been undertaken to identify:

- The available options for a long term discharge;
- Following identification of land discharge as the preferred option, a location for discharge; and
- A suitable discharge regime.

For Porangahau, the existing surface water discharge is believed to cause minor increases in nutrient and microbiological contaminant concentrations during median flow conditions, alongside moderate increases in nutrient and faecal coliform concentrations in exceedance of relevant guidelines during low flow conditions (Beca, 2020:P:B.24a). For Te Paerahi, environmental effects of the current discharge to dunes are expected to be negligible.

Both discharges are deemed to be culturally unacceptable by the communities and an alternative discharge environment needed to be identified with this being land. A land discharge regime and ceasing of the existing discharges is deemed to be acceptable by the communities.

The diligent management of the land, including the irrigation, is critical to achieve no more than minor adverse effects on the environment. The current landowners will manage the Site with a mixed cropping and grazing regime.

The development of the scheme has been divided into stages to enable progressive reduction in the discharge to the respective receiving environments, particularly the Porangahau River. Site investigations have determined that a combination of deferred/non-deficit and deficit irrigation depending on the underlying soil type is well suited to the Site. A summary of the characteristics for the conceptual design for each Stage is given in Section 7.11.

In summary, the discharge system is proposed to consist of the following components:

- 500 m^3 of storage, potentially as freeboard, at the Te Paerahi WWTP for Stage 1. Construction of a pipeline from Te Paerahi to the application site;
- 1,000 m^3 of storage between the Porangahau and Te Paerahi WWTPs for Stage 2. Construction of a pipeline from Porangahau to the application site;
- Construction of a new WWTP servicing Porangahau and Te Paerahi and an (up to) 35,000 m^3 storage pond for Stage 3.
- Irrigation pump station located at discharge Site built for Stage 1;
- A series of fixed and moveable impact sprinklers; and
- Wet well and pumping to:
    - 4 ha at Stage 1;
    - 6 ha (minimum) additional area at Stage 2; and
    - 30 ha (minimum) additional area at Stage 3.

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