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Wairoa Wastewater Treatment and Discharge Best Practicable Option

Prepared for

Wairoa District Council

Prepared by

Lowe Environmental Impact

October 2018

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Wairoa District Council

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1 EXECUTIVE SUMMARY

The Wairoa wastewater treatment plant ("WWWTP") discharges treated wastewater into the Wairoa River during out-going tides between 6:00 pm and 6:00 am. The discharge consent authorising this activity expires in May 2019. Consenting of the future discharge will require a thorough analysis of whether the selected discharge method and location is the best practicable option ("BPO") as defined by the Resource Management Act 1991 ("RMA").

A thorough BPO selection process has been followed by WDC using technical advisors, a targeted Stakeholder Group, hui-a-iwi, and public meetings to identify the concerns, design constraints, evaluation criteria, aspirations, and ranking methodology for assessing options. A wide range of potential combinations of changes to each section of the wastewater system provided an overview of the continuum of options. The options were narrowed down by the Stakeholder Group and then refined based around BPO principles to arrive at a concept that can be considered the BPO.

The BPO is considered to be continued discharge to Wairoa River while implementing a package of initiatives involving wastewater irrigation to a series of farms, reductions of reticulation leakage and pump station overflows, installation of filtration and UV treatment at the WWWTP outlet, installation of treated wastewater storage, and support for wider Wairoa River catchment improvement projects.

The discharge initiatives of the BPO include:

- modest flow reductions (which reduce how much needs to be treated and discharged);
- filtration and UV treatment;
- discharges to the river potentially on a continuous 24/7 basis when storage is full and there are high river flows;
- storage (gradually increasing over time); and
- irrigation gradually implemented across more farmland over time.

Having allowed the concept to be developed according to the BPO principles, the following are key factors in coming to the view that the concept is the BPO:

- all components have been selected in order to function effectively as an integrated wastewater management and discharge system;
- the timing of implementation in stages is affordable for the community and matches the timing of future flow reductions being achieved;
- flow reductions are important to minimise pumping requirements, stabilise wastewater treatment processes, minimise storage requirements, and minimise discharge volumes including pump station overflow discharges to the river during storm events;
- the scale of flow reductions proposed is affordable and will be sufficiently effective in the medium to long term to suit the future discharge regimes;
- the existing treatment plant design is acceptable for its loads and it does not need augmentation for performance reasons;
- the addition of filtration and UV disinfection to the outflow from WWWTP is primarily responding to cultural, recreational, and public health values when discharging to the river;
- the addition of filtration and UV disinfection potentially allows the river discharge timing to be changed from overnight out-going tides to continuous 24/7 when storage is full and river flows are high;

- the continuous 24/7 discharge to the river is seen as beneficial for minimising storage requirements, keeping the outfall free of silt, reducing flow rates and surcharging within the discharge pipeline, and avoiding the need to increase the discharge pipe capacity;
- storage is an expensive aspect which is best implemented as irrigation areas are expanded because storage is mostly required for enabling deferred irrigation, not so much for the avoidance of river discharges;
- irrigation is the preferred means of land discharge as an alternative to the river;
- deficit irrigation regimes will improve pasture resilience, improve soil nutrient levels, avoid erosion, prevent drainage, and protect groundwater and surface water quality;
- gradual irrigation implementation is affordable and allows for proving its effectiveness and lack of adverse effects while optimising the application regime;
- gradual irrigation allows for the identification and development of new areas as farmers become interested;
- upstream environmental improvements can clearly improve the river water quality much more than complete removal of WWWTP's discharge; and
- every aspect of the integrated Package is the most effective and efficient use of WDC's limited finances to manage the community's wastewater while protecting and enhancing the environment.

Although this BPO is likely to cost more than the WDC's 2015-25 Long Term Plan (2015-25 LTP) budget of $4.75M, it remains affordable at about $6-7M during 2018-28 as proposed in WDC's 2018-28 LTP and implementation of the remaining aspects of the Package over the following 25 years will ensure that the costs are spread affordably.

The BPO described in this report can form the foundation for refining the details of the design, operation, and implementation timing of each aspect of the reticulation, treatment, storage, and discharge systems. Many of these details are intended to be developed and described in the Conceptual Design (LEI, 2018:C1.0) report. The BPO needed to be developed and confirmed to provide certainty of the key aspects of the future systems before such a conceptual design process could commence.

The future resource consent application documents will rely upon the conceptual design details for assessing its likely effects on the environment and developing appropriate resource consent conditions. The consent application will also rely upon this BPO report to satisfy the RMA requirement that a nominated discharge is the BPO for the system and its locality.

2 INTRODUCTION

2.1 Background

WWWTP was constructed in 1981 south of the urban area near a small hill known as Pilot Hill or Rangihoua. It discharges treated wastewater into the Wairoa River during out-going tides between 6:00 pm and 6:00 am. The discharge consent authorising this activity expires in May 2019.

During 2015-18 Wairoa District Council ("WDC") have engaged advisors and consulted with the community to assist with understanding the existing wastewater system's constraints and design criteria, assessing options for changes, and determining how and where the future discharges should occur, in order to seek the appropriate resource consents from Hawke's Bay Regional Council ("HBRC") to replace the current discharge consent upon its expiry.

A key aspect of seeking any **discharge** resource consent is that the RMA requires the applicant to demonstrate that its proposal adopts the Best Practicable Option ("BPO") which uses the most appropriate current technologies that provide the most benefits for the least impacts on the selected receiving environment and at an affordable cost for its community.

2.2 Purpose

This report assesses the range of available options, describes the selection process, and identifies the BPO for the Wairoa wastewater treatment and discharge, including changes over the next 35 years which is the term of discharge consent that WDC intend seeking. This report explains how the BPO was identified and justifies its selection for implementation. It is intended that the BPO described in this report can form the foundation for refining the details of the design, operation, and implementation timing of each aspect of the reticulation, treatment, storage, and discharge systems. Many of these details are intended to be developed and described in the Conceptual Design (LEI, 2018:C1.0) report.

The BPO and conceptual design can also be relied upon to develop the future discharge resource consent application documents for WWWTP which will include assessing its likely effects on the environment and developing appropriate resource consent conditions. The consent application will also rely upon this BPO report to satisfy the RMA requirement that a nominated discharge is the BPO for the system and its locality. These key documents will be relied upon by the consenting authorities to determine whether to grant or decline the resource consents being sought by WDC.

2.3 Scope

The scope of this report includes the following:

- A summary description of the existing wastewater system, its discharges and the receiving environment including upstream sources of contaminants to the Wairoa River based on available information;
- Describe the key design parameters, previous investigation outcomes, and concerns driving changes to the future design and operation of the WWTP and its discharges;
- Describe the key criteria and aspirations to be achieved by the treatment and discharge system (to the extent practicable) as expressed by interested parties during consultation;

- Describe the constraints and options for designs and locations of treatment, irrigation systems, river discharges, and storage;
- Describe location, design, and operational options for future modifications to the reticulation, pump stations, WWTP, storage, irrigation, and discharges to the river;
- Briefly describe activities and actions across the Wairoa catchment that could form part of the package adopted by WDC to achieve the BPO;
- Assess the implications for each option on reticulation upgrades, treatment performance, discharge management, and storage management;
- Assess the cultural, social, recreational, financial, and environmental benefits and costs of each option;
- Indicate consenting requirements (rule triggers) and ability to gain consent for each aspect of the options for modifying the reticulation, treatment, storage, and discharge systems;
- Justify the selection of each design and operational element in arriving upon the BPO, including their benefits, effectiveness, costs, and comparisons against the alternative options not selected; and
- Indicate the implementation timing for each element and explain how and why the timing has been developed.

3 BPO DEFINITION AND SELECTION PROCESS

3.1 BPO Definition

BPO, in relation to a discharge of a contaminant, is defined in the Resource Management Act 1991 ("RMA") as meaning:

> *"the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to—*
> *a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and*
> *b) the financial implications, and the effects on the environment, of that option when compared with other options; and*
> *c) the current state of technical knowledge and the likelihood that the option can be successfully applied."*

In simpler terms, the nominated BPO must use the most appropriate current technologies that provide the most benefits for the least impacts on the selected receiving environment and at an affordable cost for its community. Ideally the most effective and affordable treatment and discharge technologies are employed and the least sensitive receiving environment is selected. Typically a BPO is a balance of what at times seems to be competing values.

3.2 Drivers and Guidance for Identifying the BPO

Schedule 4 of the RMA identifies the minimum types of information that an AEE must include, and clause 6 states in part:

> *"(1) An assessment of the activity's effects on the environment must include the following information:*
> *...*
> *(d) if the activity includes the discharge of any contaminant, a description of—*
> *(i) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and*
> *(ii) any possible alternative methods of discharge, including discharge into any other receiving environment"*

Clause 7 states in part:

> *"(1) An assessment of the activity's effects on the environment must address the following matters:*
> *...*
> *(e) any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants"*

In addition to the underlying RMA requirements, Policy A3 of the National Policy Statement for Freshwater Management (NPS-FM) strongly encourages regional councils to make rules requiring the adoption of a BPO for discharges that may affect water:

"By regional councils:

a) imposing conditions on discharge permits to ensure the limits and targets specified pursuant to Policy A1 and Policy A2 can be met; and

b) where permissible, making rules requiring the adoption of the best practicable option to prevent or minimise any actual or likely adverse effect on the environment of any discharge of a contaminant into fresh water, or onto or into land in circumstances that may result in that contaminant (or, as a result of any natural process from the discharge of that contaminant, any other contaminant) entering fresh water."

A number of NPS-FM Objectives and Policies drive the preference for discharges to land over discharges to fresh water for a number of reasons (ecosystem health, recreational contact, and cultural values) which a BPO selection process would be expected to reflect.

The need to consider the BPO concept, is reinforced by the New Zealand Coastal Policy Statement ("NZCPS"), which is also relevant as the coastal environment includes the current river discharge site and is close to the WWWTP site. In particular, Policy 23 reads in part:

"In managing discharge of human sewage, do not allow:
(a) discharge of human sewage directly to water in the coastal environment without treatment; and
(b) the discharge of treated human sewage to water in the coastal environment, unless:
(i) there has been adequate consideration of alternative methods, sites and routes for undertaking the discharge; and
(ii) informed by an understanding of tangata whenua values and the effects on them."

These provisions are given effect to in HBRC's Regional Resource Management Plan ("RRMP") and Regional Coastal Environment Plan ("RCEP"). Policy 16.1 of the RCEP is the most relevant in setting the frameworks for developing and considering sewage discharges and states the following:

"3. Sewage Discharges.
(a) The discharge of sewage from land which does not pass through soil or wetland, directly into water in the coastal marine area is inappropriate, unless:

(i) the disposal of sewage directly into the coastal marine area is the best practicable option and
(ii) significant adverse effects on ecosystems, natural character of the coastal environment and on water quality classified for contact recreation purposes are avoided, or remedied or mitigated where avoidance is not practicable.
(iii) there has been consultation with:
- *tangata whenua in accordance with tikanga Maori and due weight has been given to s6, s7 and s8 of the RMA, and*
- *the affected community in determining the suitability of the treatment and disposal system.*

(b) The location and extent of any mixing zone for discharge of sewage shall ensure that there are no significant adverse effects on:

(i) any Significant Conservation Area or
(ii) the use of receiving waters for recreation or

(iii) the use of receiving waters for collection of seafood for human consumption.

(c) the adverse effects of sewage discharges on the present and reasonably foreseeable use of the receiving waters have been avoided where practicable, remedied or mitigated, particularly in:

(i) areas where there is high recreational use or
(ii) areas of maintenance dredging or
(iii) areas adjacent to commercial or residential development."

Balancing these requirements throughout all of these planning documents is a recognition in other Policies and Objectives that:

1) community infrastructure must be provided for and enabled because it is important and necessary for providing for a community's well-being; and
2) community infrastructure often needs to be located within and/or discharging into fresh water bodies and coastal environments.

3.3 BPO Selection Process

Robust processes need to be followed in developing a BPO so that conclusions are valid. The process itself needs to be transparent and open to considering all possibilities, and to provide for this in this case, a group of the local community, iwi, Council staff and advisors was formed to ensure balanced representation.

Options considered in developing the BPO need to represent all potential options without discounting options unduly early in the selection process. The criteria for assessing the acceptability of each option need to be selected to represent Council and community values. The selection criteria also need to be able to be scored or ranked objectively. Where some values are prioritised over others, an appropriate weighting system needs to be transparently developed and applied.

As options are discounted from the list of options and the remaining field of contenders is narrowed, each decision to discount or retain an option needs to be able to be rationally explained and justified. Ideally an objective ranking of selection criteria should be able to reliably support each choice. The decisions should also ideally represent the consensus, or at least the majority, view of the BPO selection group.

Figure 3.1 presents a simplified flow chart of the BPO selection process used by WDC, which is explained in more detail below.

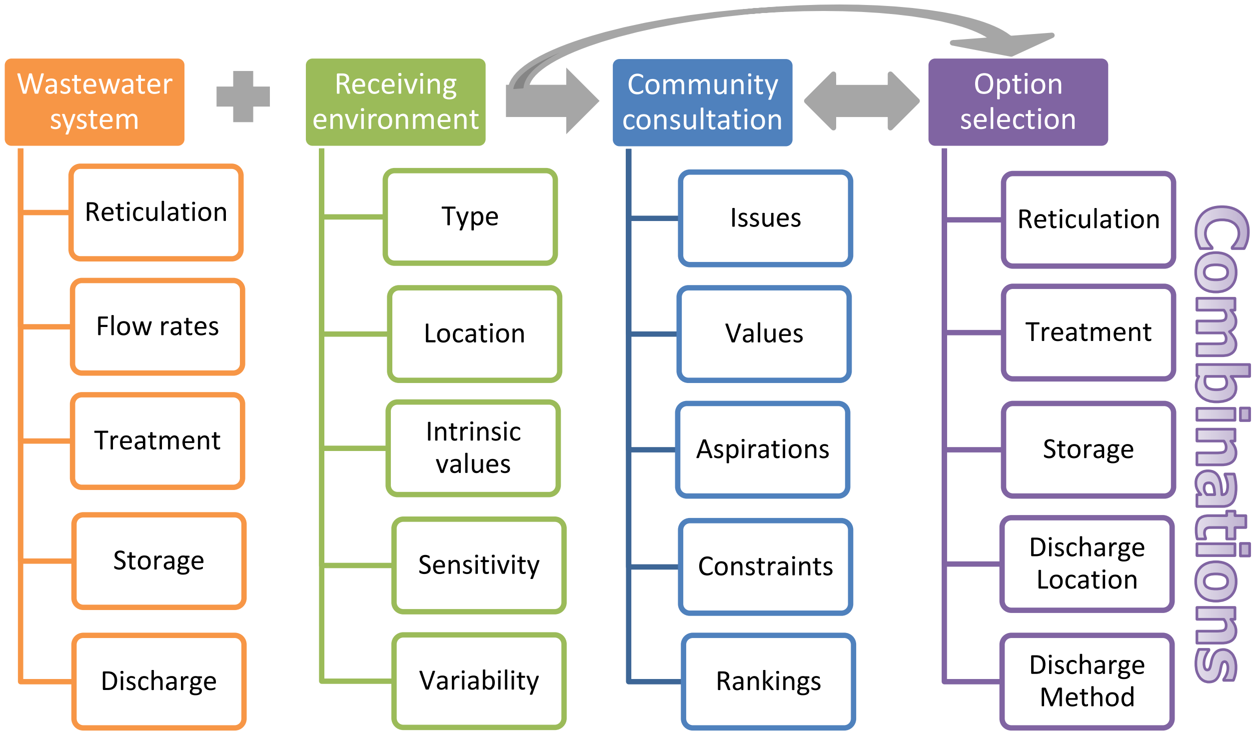

Figure 3.1: BPO Selection Process Overview

3.3.1 Reticulation and Treatment

The volume, quality, and effects of the discharge are all related to and largely controlled by the entire wastewater system upstream of the final discharge point. The sensitivity and assimilative capacity of the receiving environment to absorb or disperse the discharged contaminants while avoiding adverse effects on its ecology is the other primary factor. It is therefore important to understand what can be done with the wastewater system to reduce effects from the discharge as well as understanding the environment's capacity to receive the discharge at various locations and environmental conditions (such as variations in weather, seasons, and ecology).

An initial phase of WDC's consent application preparations was to understand the design and operation of the entire existing wastewater system from the individual properties through the reticulation and pump stations to WWWTP and ultimately its discharge into the Wairoa River. This phase of work defined the key design parameters that any discharge solution must cater for, and it also indicated areas where improvements could be made.

3.3.2 Receiving Environments

Another initial phase was to assess the existing Wairoa River receiving environment for its existing condition upstream of Wairoa and the effects potentially attributable to the treated wastewater discharge. This phase enabled the identification of key contaminants of concern in the environment and enabled the effects of the WWWTP discharge to be put into context with the upstream sources of contaminants and their cumulative effects. The hydrological features of the estuary were important for identifying the timing and controlling conditions for its greatest and least sensitivities to receiving discharges. This information could be used to optimise the timing and volume of discharges to minimise adverse effects on the estuary if this environment was to continue receiving the WWWTP discharge.

The alternative receiving environments in the Wairoa locality were also assessed for their capacity and suitability to receive treated wastewater. The opportunities and constraints of each area to assimilate or improve the wastewater could be used to inform the design and operation of any future discharge system. The distance between a suitable discharge site and WWWTP was also an important factor to help assess the degree of practicability and approximate cost of piping the treated wastewater to the discharge site.

3.3.1 Discharge Regimes and Storage Implications

Discharge regimes can be varied to reflect each receiving environment and the values that the community wants to protect the most. Timing of discharges can be designed to reflect seasonal variations. Discharge systems can also be designed to use more than one discharge site and type of receiving environment; for example, river and land discharges are often complementary.

The discharge regimes also strongly determine the volume requirements for storage to retain flows when the environment is unsuited to receiving the discharge. Varying the discharge criteria can help to optimise the storage volume while managing the scale of effects on the environment within acceptable ranges.

3.3.1 Broad Environmental Factors

In considering potential adverse effects of the discharge on the environment, a broad definition of environment was applied. It factored in ecological, social, cultural, and economic factors, and is consistent with the broad definition of environment in the RMA:

> *"(a) ecosystems and their constituent parts, including people and communities; and*
> *(b) all natural and physical resources; and*
> *(c) amenity values; and*
> *(d) the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) or which are affected by those matters."*

These broad factors were used by WDC's advisors and in consultation with the community to define and rank values of importance which could then be used to evaluate how well each option matched up with the RMA principles and the community's aspirations.

WDC's 2015-25 Long Term Plan (LTP 2015-25) set aside $4.35M over its ten year duration. This was a key factor to be considered in relation to economic conditions as referred to in (d).

3.3.2 Consultation

As the community's values need to be reflected in the selection process and the community are ultimately the ones who pay for the selected systems, community consultation is generally necessary when looking to invest in community infrastructure, and this certainly has an influence on the BPO process. Community consultation is also valuable in order to assure the community and its councils that the selected options have high levels of public support instead of generating unnecessary levels of opposition and concerns during the consenting process.

Community consultation takes many forms and uses various methods of communication which address general public audiences or specific individuals. It involves a continuum of detail and level of expertise as appropriate to the parties involved and their roles in the project. Targeted consultation needs to be undertaken with statutory bodies such as Department of Conservation, the local District Health Board, and NZ Fish and Game. Direct consultation is also often needed with relevant Maori representatives.

The community consultation process used by WDC involved the creation of a Stakeholder Group which included three tangata whenua representatives, one Maori Standing Committee member, two Wairoa District Councillors, one business representative, one AFFCO representative, one youth representative, and one grey power representative. The Stakeholder Group was tasked with identifying preferred options, and the process involved:

- reviewing the existing system including its challenges and key constraints;
- identifying their values and aspirations for the future system;
- assessing a wide range of theoretical options against their agreed criteria in order to refine options; and
- selecting their preferred options.

An iterative feedback process and increasingly detailed technical and community values-based assessments of options were used to select the preferred option.

Upon conclusion of the Stakeholder Group option selection process, WDC consulted directly with iwi through two hui-a-iwi and consulted with the general public on the selected and discarded options through public meetings and newspaper articles seeking their feedback. The public meetings in August and November 2017 were presented with summarised information from the Stakeholder Group process and invited to have their say. In March 2018 WDC's Councillors voted to implement the selected option, and it was then incorporated into the draft 2018-28 Long Term Plan (LTP 2018-28) for further public consultation in May 2018 to inform Councillors' June 2018 decision on whether to approve LTP budgeting for its implementation.

The sections following provide an overview of these concept development/selection processes and cover:

- Description of the existing system;
- Reticulation, treatment and storage options;
- Receiving environment options;
- Discharge methods and considerations;
- Option evaluation and selection; and
- BPO assessment.

4 DESCRIPTION OF EXISTING SYSTEM

4.1 General

In order to assess options for the future, the existing system and its operating parameters and constraints need to be described and understood. Wairoa's urban wastewater system is reticulated to a WWTP which discharges during overnight falling tides to the Wairoa River via a pipeline that crosses the mudflats and terminates near the main river channel at about 150 m from the riverbank opposite Fitzroy Street.

4.2 Wastewater Reticulation

Wairoa's urban wastewater system is reticulated and mainly relies on gravity flow to four pump stations which lift each catchment's wastewater into the next section of gravity mains. The final pump station (Fitzroy Street) receives all of Wairoa's wastewater and pumps it via a rising main to the inlet of the WWTP.

The majority of the reticulation is more than 30 years old and it is known to be prone to excessive volumes of groundwater infiltration and stormwater ingress (I & I) which elevate the base flow and peak wet weather flow volumes. The Kopu Road pump station catchment has been identified by EAM 2011 and LEI, 2015:A1I1 as the most leaky and the main contributor of excessive I & I inflows. WDC have investigated this catchment to identify its main faults and have commenced a more intensive reticulation renewal programme to resolve the issues.

During storm events the pump stations can be overwhelmed with inflows which discharge directly to the river via emergency overflow bypass pipelines. In addition to the reticulation renewal works, WDC has reconfigured their pumps and repaired or replaced some pumps in order to better match the pump capacities to the inflows. These changes have reduced the frequency of storm overflows and in some cases eliminated them since making changes.

Planned changes include the installation of a new main directly from Kopu Road pump station to Fitzroy Street pump station (which will reduce demand on the capacity of the existing main and allow it to be dedicated to the rest of Wairoa's flows) and the installation of a duplicate rising main from Fitzroy Street pump station to WWWTP.

4.3 Wastewater Treatment and Storage

The WWTP design and operation is described in detail in LEI (2017:A2I1). It consists of a step screen at the inlet to an aerated lagoon followed by a large facultative pond. The aeration system used for the aerated lagoon has recently been changed to a sparge. WWWTP's design is a simple but generally effective treatment system that is typical for communities with similar population size across New Zealand.

Fluctuations of operating water levels within a range of 500 mm in the facultative pond provides up to 5,400 m^3 of storage. This is managed by a gate valve at the outlet of the pond and an emergency overflow weir which releases treated wastewater when the pond's water levels exceed the 500 mm surcharging limit.

4.4 Wastewater Flows and Quality

LEI (2017:A2I1) presents details of the wastewater flow variations and treatment performance.

The daily total wastewater flows are strongly influenced by rainfall events and also show seasonal changes that reflect longer term rainfall and soil moisture conditions (averaging about 4,000 m^3/d in winter and about 2,200 m^3/d in summer). The dry weather flows are well above typical flows for communities the size of Wairoa and reflect high groundwater ingress rates. Wet weather and peak storm flows indicate high stormwater inflows across Wairoa. As noted above, the Kopu Road catchment has been identified as the highest contributor of I & I.

Figure 4.1 presents a graph of monthly averages of the daily flows through WWWTP during 2009-14. It should be noted that this is based on historic flow data which have been reduced as a result of recent reticulation works.

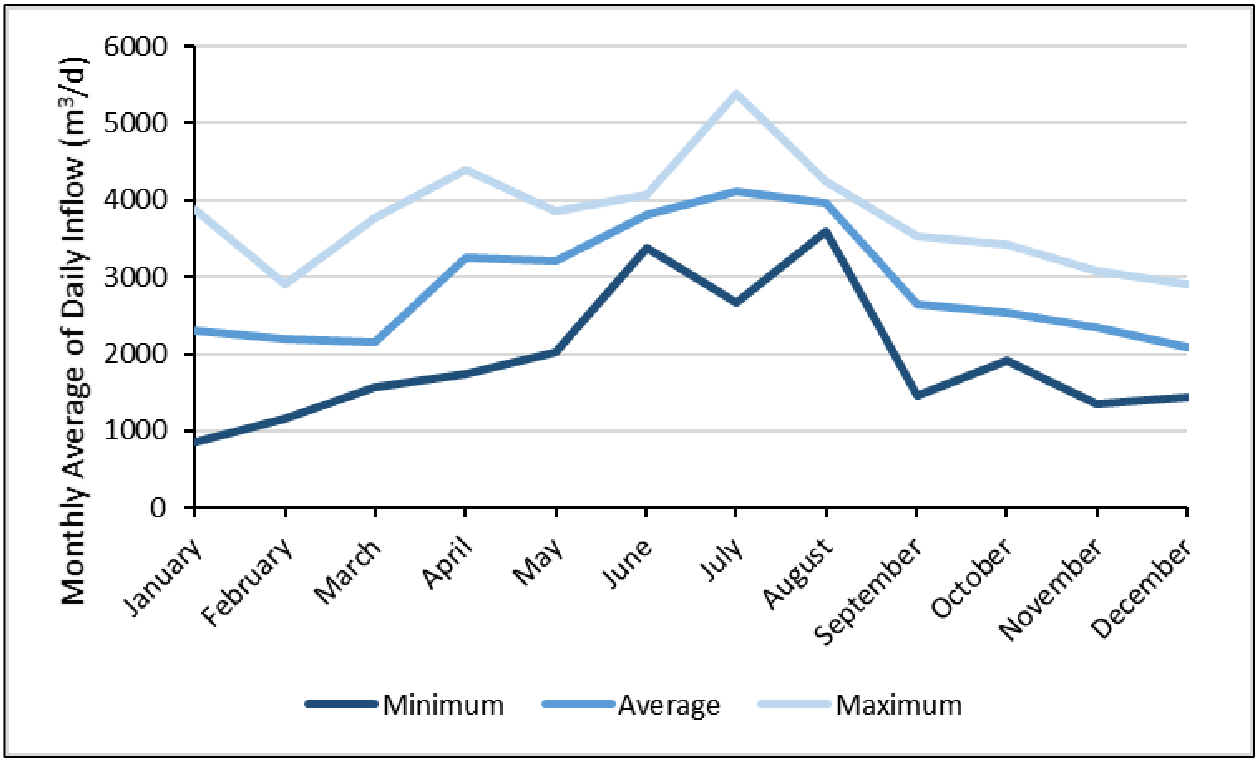

Figure 4.1: Monthly Averages of Daily WWWTP Inflows for 2009-14

Despite elevated I & I volumes increasing the volume of wastewater requiring treatment and high sludge accumulations, WWWTP has generally been achieving treated wastewater quality within the expected ranges for its design. Table 4.1 summarises the daily wastewater flow and treated wastewater quality.

Table 4.1: Wastewater Flow and Quality Statistics for 2008-16

Parameter	Range	Mean	Median
Daily flow (m^3/d)	856 – 9,680	2,682	2,419
pH	6.4 – 9.3	7.6	7.6
COD (g/m^3)	34 – 620	158	126
CBOD (g/m^3)	6 – 190	31	23
NH_3-N (g/m^3)	4.0 – 36	16.1	15.6
TSS (g/m^3)	7 – 290	64	52
E. coli (cfu/100 ml)	8 – 470,000	5,250	5,200

4.5 Treated Wastewater Discharge Regime

WWWTP discharges via a 300 mm ID HDPE pipeline to the Wairoa River that terminates about 150 m off-shore from Fitzroy Street's intersection with Kopu Road as described in LEI (2017:A2I2).

The timing of discharge is restricted by the resource consent conditions which specify that it must only occur during out-going tides between 6:00 pm and 6:00 am (overnight). The total daily volume is restricted to a maximum of 5,400 m^3/d. When the bar is closed across the river mouth, treated wastewater is not allowed to discharge until storage is no longer available at WWWTP; at this point the discharge may resume within the normal timing and volume constraints. In practice, the 5,400 m^3 storage capacity is insufficient to cease discharges for more than 1-3 days during bar closure periods.

During storm events WWWTP has insufficient storage capacity to retain wastewater until the next overnight falling tide and this forces discharges to occur outside of the consented timeframe. On occasions the discharge can be continuous for more than 24 hours. Large storm events have also caused the 5,400 m^3/d limit to be exceeded a few times in some years.

Recent observations and hydraulic studies (Opus, 2017) have indicated that some of the treated wastewater discharge enters the estuary via a small stormwater drain at the riverbank. This is caused by surcharging of the outfall pipeline which exceeds the level of the emergency overflow weir at the final manhole; this enters an adjacent stormwater drain which flows a short distance to the edge of the estuary. The elevation of WWWTP above sea level and outfall pipeline diameter (which control the pressure head and flow capacity) cause the surcharge, and this is particularly apparent during higher than average flow rates (wet weather discharges).

5 RETICULATION, TREATMENT AND STORAGE OPTIONS

5.1 General

Each component of the existing wastewater system has potential for changes to be made. The integrated nature of the existing and future system means that any potential changes to each component must be considered for their reliance and effects upon the design and operation of the rest of the system. Incompatible options need to be avoided. Flow rate is probably the most important parameter to ensure it is correctly factored into every component of the system, and this is mostly controlled by the reticulation design and condition.

It is also important to have a good understanding of the reasons why a change is being considered for each component. This ensures that there is a benchmark or goal against which the potential changes can be assessed to determine how effectively the change can assist with achieving it.

There is no sense in changing something at great expense if there is no need for it, or if it will conflict with another aspect of the integrated system, or if there is no measurable benefit resulting from the change. There may be strong reasons for maintaining the status quo for some aspects or components; these reasons need to be articulated and borne in mind when considering making changes to other parts of the system.

5.2 Wastewater Sources

An aspect of the wastewater system worth considering is what can be done to reduce or avoid the production of wastewater in the first place. It clearly is impracticable to entirely avoid producing wastewater in an urban environment, so reduction of volumes and contaminants is the only feasible option. WDC has a public health duty to collect and treat wastewater for its urban communities, so a treated wastewater stream cannot be avoided and can only be reduced or controlled to a limited extent. The wastewater treatment system also needs to be capable of accommodating future population growth which can easily exceed reductions in volumes that might be generated by any wastewater minimisation measures.

WDC has a trade waste bylaw which requires trade waste producers to limit and preferably pre-treat their wastewater before it enters WDC's reticulation. Trade waste customers are charged fees by WDC based on their monthly volume and strength of wastewater. Part of the rationale for this trade waste scheme is to encourage commercial and industrial businesses to minimise their wastewater burdens on Wairoa's WWTP.

The trade waste scheme also indirectly ensures that such wastes are centralised and controlled through WDC's infrastructure instead of being treated and discharged from multiple treatment plants to on-site systems. AFFCO is an example of this, as they treat and discharge their wastewater separately from Wairoa's municipal system. Multiple on-site discharges of treated trade wastes could create greater adverse effects on the environment than the single centralised and well-treated WWWTP system.

WDC could further restrict trade wastes and enforce more intensive on-site pre-treatment, but there is an economic balance which could affect businesses viability if trade waste limits become too restrictive or expensive. There is also a community benefit which supports a view that WDC's ratepayers should subsidise businesses to some extent because they provide crucial employment and economic prosperity for the district.

5.3 Wastewater Reticulation

The options to consider are:

1. the status quo with on-going renewals already committed in WDC's work programmes;
2. a significant increase in renewal and upgrade activities; and
3. rapid renewal of the majority of the reticulation, potentially including pressure mains.

In this case, the greatest potential in relation to improving the reticulation network lies in reducing I & I flows, so the options considered during the process of developing the concept were represented in terms of approximate percentage reductions in flows to WWWTP:

1. 0 % (status quo with existing programmed renewals);
2. 25 % (significant improvements); and
3. 50 % (major improvements).

The additional cost of each option is a key factor to be considered when determining whether a reticulation option should be part of the integrated BPO solution. The capital and maintenance costs generally increase exponentially for more effective measures and can reach a point where there is little additional benefit from increased expenditure.

Selection of a reticulation improvement option needs to consider the downstream effects on the treatment requirements, treatment performance, storage requirements, and discharge volume limits. If the treatment performance does not need improvement and storage volume is believed to be minimal for the selected discharge regime, then there may be less reason for investment in major reticulation improvements. In some scenarios it might even be considered to be more economic to build larger storage or discharge higher volumes than to invest in reticulation.

On the other hand, fixing leaky reticulation:

- reduces the costs of pumping, treatment, and storage;
- protects pumps from silt and grit damage;
- reduces the rate of sludge and silt accumulation in treatment ponds;
- assists with treatment performance; and
- reduces storage volumes.

5.4 Wastewater Treatment

The general treatment options to consider are:

1. the status quo;
2. improvements to the existing WWTP;
3. additional tertiary treatments; and
4. an entirely new replacement WWTP.

The design options need to be suited to the current and future wastewater flow rates and quality. Treatment technologies need to factor in the degree to which any reticulation improvements will reduce flows, increase raw wastewater concentrations, and affect treatment performance. It is possible, even likely, that the anticipated reductions in I & I will improve treatment performance on their own, and such improvements in effluent quality may be acceptable for the discharge regime that is ultimately implemented.

The sensitivity of the receiving environment and the regime used to discharge the treated wastewater will be the key drivers for determining which parameters, if any, require improvement to manage effects on the environment. For example, land treatment prefers more nutrients (preferably as ammoniacal-nitrogen rather than nitrate- or nitrite-nitrogen) remaining available for plants. More effective treatment is more crucial for discharges to water environments, as they are more sensitive to adverse effects on clarity, nutrients, pathogens, and toxicity from wastewater contaminants.

In order to justify the expense of modifying the treatment processes, there needs to be an adverse effect resulting from its discharge which cannot be rectified by some other means. The most dramatic upgrade would be abandonment of the existing WWTP and construction of an entirely new WWTP within the existing site or elsewhere, but this would need to have extremely strong reasons for its implementation.

The huge variety of available treatment technologies achieves differing degrees of improvements in wastewater quality, and often treatment methods will achieve improvements in only a few parameters which may be different from the parameters improved by other treatments. Regardless of the type of treatment technology used, there is a limit to treatment effectiveness at removing contaminants. More effective treatment technologies are increasingly more expensive for smaller marginal gains in effluent quality. So it is important to identify which treated wastewater quality parameters require improvement, the scale of improvement needed, and why it is needed before researching which technology might be best suited to be added into the existing WWTP to achieve that improvement. Further, there is the scope that treatment might involve options; being alternatives (one or another), successors over time (one then another) or complementary (both together).

Some technologies are compact or can be located within the existing ponds, while others require large land areas or complex construction and operation. The capital costs and power consumption and on-going maintenance costs of treatment generally increase with increasing technological complexity.

Most treatment upgrade options are best suited at a particular point in the sequence of treatment processes (up front, in the middle, or at the end), and often require or prefer combinations with other pre-treatments to work optimally. For example, UV treatment is best as a final polishing treatment to kill pathogens but it usually requires a filter between the WWTP outlet and the UV chamber inlet to ensure that the wastewater is clear enough to allow good UV light penetration.

5.5 Wastewater Storage

The existing WWWTP has available storage capacity of 5,400 m^3 within the main facultative pond which is achieved by managing its water level within a 500 mm operating range. A series of representative options considered for storage were:

1. status quo (1-3 days);
2. modest (14 days) additional storage;
3. large (90 days) additional storage; and
4. very large (120 days) additional storage.

The volume of storage is dependent upon the daily flows of wastewater (and rainfall directly into the WWWTP ponds) and the criteria used to cease discharges to all environments. Consequently, the degree of flow reductions achieved by reticulation improvements is crucial to determining the required storage volume. Decisions regarding the discharge regime controls are also important, as tighter restrictions on discharge events generally mean increased storage volumes are needed for coping with longer periods when discharges are forbidden. In order to determine the optimum storage volume, numerical modelling of the daily wastewater inflows, weather conditions, and discharge regimes is usually undertaken to refine the discharge controls and worst case storage volume.

Smaller storage volumes (less than about 8,000 m^3) can be accommodated in tanks, but larger volumes need to use lined ponds or dams. It is feasible for storage to be located in a number of different locations that are close to each of the discharge sites, but this might lose some of the financial efficiency of constructing a single centralised pond. It also adds complexity to allocating daily wastewater flows to the most appropriate storage location. Suitably large areas of land need to be found for each storage pond that are geotechnically stable and do not affect existing land uses or neighbours.

Generally increasing storage volumes incur increasing costs of construction, but the costs per cubic metre can become slightly cheaper for larger ponds due to efficiencies of scale. Regardless, the cost of storage is generally a significant factor in a wastewater treatment system and is often minimised to focus expenditure on treatment and discharge components.

6 RECEIVING ENVIRONMENT OPTIONS

6.1 Current River Receiving Environment

The Wairoa River is the current receiving environment, as has been the case since the original development of Wairoa's reticulated wastewater system in the 1950's. The river is also the receiving environment for all urban and rural stormwater run-off and AFFCO's treated wastewater discharge. Details of the existing river environment including its hydrology and water quality are presented in LEI (2017:A3I2) and LEI (2018:A3I4).

The Wairoa River is the largest river in the Hawke Bay region and has a catchment area of 3,563 square kilometres. The land uses in the catchment are mostly farming (dominated by hill country sheep and beef farming) and forestry.

The annual median flow of the river as it flows past urban Wairoa is 60 m^3/s while its mean annual low flow (MALF) is about 20 m^3/s. Incoming tides push seawater beneath the fresh water well upstream of urban Wairoa and the river levels are tidal as far as 11 km inland of Wairoa. The bar across the estuarine lagoons and river mouth is highly mobile due to the active coastal erosion processes. The location of the river mouth migrates along the length of the bar and there are periods of time when the bar completely seals off the river mouth.

Rural losses of sediment (from widespread erosion of soft sedimentary hill country) and nutrients provide the dominant contributions of contaminants to the poor water quality of the Wairoa River upstream of the urban Wairoa area. The urban contributions of contaminants are mainly focussed in a short estuarine section of the river and generally involve point sources (pipe outlets) rather than diffuse sources or landslides.

The river water quality as it passes through Wairoa contains high sediment loads and its frequency of elevated *E. coli* results make it unacceptable for primary recreational contact more often than is desired by the NPS-FM and RRMP. Rural runoff, natural sources, flood events, and closure of the bar across the river mouth cause and exacerbate these unfavourable water quality results. Table 6.1 summarises the key water quality parameters against the RRMP and previous NPS-FM standards.

Table 6.1: A summary of water quality guidelines and observed quality in the Wairoa River Upstream of Wairoa (2004 – 2013) (Source: Ausseil, et al, 2016)

Parameter	Min	Median	Max	Guideline/Limit	Source
Clarity – black disc (m)	0.0	0.6	2.1	1.6 m minimum for contact recreation	ANZECC (2000); HBRC RRMP (2006)
Suspended solids (mg/l)	1.5	13.5	2,900	25 mg/l maximum	HBRC RRMP (2006)
E. coli (cfu/100 ml)	1	46	14,000	540 cfu/100 ml maximum for contact recreation (health) Red alert/Action level	MfE/MoH (2003)
E. coli (cfu/100 ml)	1	46	14,000	260 cfu/100ml maximum for contact recreation (health) Amber alert	MfE/MoH (2003)

The 2017 changes to NPS-FM included changes to the recreational water quality standards that introduced a range of statistical thresholds (as summarised in Table 6.2 below) instead of the previous single maximum limit for each alert level. When assessed against the new NPS-FM standards the river upstream of Wairoa is Attribute State C, D or E (depending on which years of monitoring data are assessed) because of its frequency of elevated results varying the 95th percentile value and other rates of exceedance of limits despite its low median always meeting Attribute A criteria. Attributes are required to be determined by compliance with all of the criteria, and the National Target for Regional Councils to achieve by 2040 is for 90 % of all waterways to be Attribute States A-C.

Table 6.2: Recreational Contact Standards for *E. coli* Set by NPS-FM (2017)

Attribute State	% Exceedances of 540 cfu/100 ml	% Exceedances of 260 cfu/100 ml	Median (cfu/100 ml)	95th Percentile (cfu/100 ml)
A	<5%	<20%	≤130	≤540
B	5-10%	20-30%	≤130	≤1000
C	10-20%	20-34%	≤130	≤1200
D	20-30%	>34%	>130	>1200
E	>30%	>50%	>260	>1200

A series of estuarine benthic ecological surveys (Bioresearches 1996, EAM 2007 & 2011, Triplefin 2018:A3I1b, and eCoast 2018:A3D3) have occurred in the vicinity (generally 100 m to 500 m) of the outfall. The conclusions of each of these surveys have included the following statements:

> *"The discharge has had no obvious effects on benthic biology or sediment quality of the habitats of the outfall area." (Bioresearches 1996).*
>
> *"Although the sites surrounding the outfall are higher in the proportion of fines, TVS (organic matter) and phosphorus than the control and 1996 results, contaminant levels were below ANZECC ISQG-low guidelines and low compared to New Zealand reference estuary sites.*
>
> *Benthic infaunal communities surrounding the outfall and the reference site are becoming more similar over time, dominated by surface scavenging and deposit feeding species that are frequently found around outfall sites. However, sensitive bivalve species were present in the downstream, impacted site." (EAM, 2007).*
>
> *"Scores of infaunal diversity, richness and evenness indices for 'impact' sites were not significantly different to the reference site and all were low indicating low a low diversity community.*
>
> *Significant spatial and temporal variability among infaunal communities over time, but not consistent between either years or sites." (EAM, 2011)*
>
> *"There is a persistent adverse effect on sediment quality from organic loading in the area 100m downstream of the outfall that results in an infaunal community that despite being subject to higher stress than upstream sites remains similar in terms of biological 'health' indices. The discharge therefore appears to be enriching the downstream area adjacent to the outfall in a manner in which adverse effects are minor. The contribution of this effect to deterioration of whole estuary health is therefore less than minor in circumstances where the wastewater is able to exit the estuary basin rapidly." (Triplefin, 2018:A3I1b)*
>
> *"Sediment geochemistry characteristics were found to be highly variable across sampling sites in 2018, including across surveys (1996-2018). … There was also a lack of a clear trend for both silt and organic content in relation to increasing or decreasing distance away from the outfall and thus no strong evidence that the outfall is impacting the immediate benthos.*

Numerically dominant species recorded at sites A, B, and C are typically considered to be synonymous with degraded/impacted environments (local nutrification). This was also true for the additional new sites, although abundances are lower than at Sites A-C and pipi were found to occur at much greater densities at sites further away from the outfall.

Evaluating impacts of the outfall on benthic effects is generally difficult given the low species diversity and wider degraded nature of the lower Wairoa Estuary…" (eCoast, 2018:A3D3)

6.2 Alternative Receiving Environments

There are several alternative receiving environments to the existing river receiving environment which WDC needs to consider as part of any concept development process involving BPO principles. These alternative environments would include the ocean, land and groundwater. For completeness however, we also note:

- Discharge by evaporation into the atmosphere is not feasible or practicable for any wastewater system except perhaps in arid regions of the world (which New Zealand and Wairoa are not). Wairoa's WWTP is open to the atmosphere and allows natural rates of evaporation to occur, yet the volume of treated wastewater requiring discharge is still about 1,000 m^3/d during summer when the evaporation rate is highest. It is not an affordable option to heat the treated wastewater so that it evaporates and thus avoids or reduces the need to discharge the residual volume to another receiving environment.

- The recent development of Rocket Lab at Mahia Peninsula provides transport access to the space environment, but clearly it would be impracticable to send rocket loads of wastewater into space or the upper atmosphere on a regular basis, it would be unacceptable to the local and global community, and its costs would be astronomical.

- Shipping bulk volumes of wastewater that has been treated to potable quality to countries that have scarce drinking water sources would recycle the water, assist arid nations, and gain some revenue for WDC. However, this requires suitable port facilities (which Wairoa lacks) and the costs of treatment and shipping would far outweigh the income gained and would not be economically competitive with existing exports of pure water that needs little treatment to reach potable standards. It would be more feasible and economically viable for this potable water to be reticulated back to urban Wairoa, but this is unlikely to be acceptable to the community as an alternative to the existing river-sourced water supply. There would still also be a residual wastewater (and sludge) volume, probably more highly concentrated, that WDC would still need to discharge somewhere locally.

While these options may seem fanciful, they have been raised during community engagement and need to be addressed.

The potentially available and practicable alternative receiving environments for Wairoa are the ocean (Hawke Bay), land, and groundwater. Any preferred discharge site needs to be within a reasonable distance of WWWTP in order to keep the cost of the pipeline from WWWTP to the discharge site within affordable limits. A distance of 10 km is considered to be the likely limit for Wairoa, and somewhere less than 5 km away is likely to be preferred.

The feasibility of each for receiving discharges are briefly described below. It is noted however that an integrated discharge system could develop and use more than one discharge site and more than one type of receiving environment. This would provide greater flexibility of management and the ability to match discharge events to the most appropriate environmental conditions, times and seasons for each discharge site. Such systems can provide complementary discharge options where one environment can accommodate the discharge during some or all of the time that another environment can't receive it. Storage capacity and discharge criteria would need to be balanced and optimised for such integrated multi-discharge systems.

6.2.1 Ocean

The ocean is not always an available option for communities (they are often too far inland), but Wairoa is a semi-coastal community and its current discharge is located less than 1 km from the ocean. Extending or replacing the pipeline to terminate in the ocean is therefore an option worth considering and might be feasible. It was considered as an option in the 1970's when deciding on the design and location of Wairoa's centralised WWTP and discharge system.

The coastal currents and prevailing winds readily erode the soft sedimentary coastal cliffs and flats, and transport coarse gravel along the coast to form the bar that confines the Wairoa estuary and its lagoons. The river mouth opening through the bar migrates and is sometimes closed off by movement of the gravel bar.

The Hawke Bay seafloor gently slopes southwards from the Wairoa shoreline and has a gravelly through to silty surface layer. The RCEP classifies the seabed out to 1 nautical mile from the coastal dune enclosing Whakamahi Lagoon as a Significant Conservation Area with a range of protective provisions, but the Wairoa WWTP discharge has the benefit of some provisions that allow for its location and discharge to continue.

A 303 km^2 area of Hawke Bay seabed up to 18 km wide south of Wairoa, known as the Wairoa Hard, is comprised of boulders, cobbles, and a smooth rock surface with some sandy through to silty areas. It forms an important marine habitat that supports fish life (particularly snapper nursery) and is different from the seabed elsewhere in the region. The RCEP classifies it as a Significant Conservation Area with a range of protective provisions in addition to fisheries restrictions imposed under the Fisheries Regulations.

Fish and marine life are abundant in Hawke Bay, and the marine water quality is only degraded near the Napier port and urban areas and where rivers discharge their sediment loads into the sea.

6.2.2 Land

In general, land can receive treated wastewater at a continuum of application rates from minimal wetting through to mass soakage. Wastewater passing over the surface of land as it flows through a wetland is also considered to include a component of land discharge as some wastewater drains through the underlying soils and some nutrients are retained.

Urban parks and reserves can receive treated wastewater discharges, but other urban land areas are generally too small and surrounded by sensitive residential or commercial properties. The golf course and airport are surrounded by rural properties on river flats approximately half-way between Wairoa and Frasertown. The land outside of Wairoa's urban area is generally used for pastoral farming (primarily sheep and beef, but also some goats and deer) and plantation forestry.

The land near Wairoa is low-lying alluvial plains or steep and hilly formed from soft sedimentary rock layers that are prone to erosion (mainly landslides and slumping), and with poor to medium soil drainage rates. The coastline generally consists of shingle and coarse sand beaches and some gravel dunes which are excessively free draining and actively transforming due to the coastal erosion processes.

Indigenous scrub and bush exists mainly in steep country along waterways and in the upper hill country through to Te Urewera, but these areas are too far away from WWWTP to be considered feasible.

6.2.3 Groundwater

Groundwater can receive treated wastewater either from drainage (from irrigation or soakage areas) or direct injection via a well. Unconfined groundwater occurs in the top few metres of sediments along the lower Wairoa valley. Two confined aquifers exist (one below the other) in the sedimentary layers about 5-40 m deep below ground level along the lower Wairoa valley. Their water quality is generally good quality apart from its naturally occurring elevated mineral content or hardness (calcium, magnesium, iron, and manganese) and dissolved solids from the local geology. They are fed from the upper Wairoa catchment and flows towards the Hawke Bay coast. Local groundwater users include farmers (small volumes for stock water and some irrigation) and industries in North Clyde.

7 DISCHARGE METHODS AND CONSIDERATIONS

7.1 General

In order to select a discharge method, it is important to describe and understand the features of the practicable discharge methods for the available receiving environments. Each receiving environment has options for suitable discharge regimes, and every potential site and discharge regime has advantages and disadvantages across different values and community interests.

There are many advantages to considering a system that discharges into two different receiving environments, as one environment can accept the discharge when another environment can't. This protects each environment from adverse effects during seasons or conditions when it is more sensitive and allows for greater flexibility of discharge and storage management. It is therefore important to consider combined discharges and avoid focussing on a single discharge method as the sole potential solution.

The implications for other components of the integrated wastewater system also need to be identified and understood. In order for a discharge to be acceptable in a specific environment, there may be target parameters for the treated wastewater to adhere to, which may in turn mean that some changes are required in the reticulation and/or treatment sections of the system. A key implication is often the need to provide storage of treated wastewater when discharges are unable to occur. The proximity of a suitable receiving environment is also important, as this is a key factor in the length and cost of a pipeline from WWWTP to the discharge site.

The complexity of considerations increases with increasing choices, so it is useful to develop a methodology and criteria for excluding options and refining potentially acceptable options early in the BPO selection process. This can streamline and simplify the BPO process so that evaluators are not overloaded and time is not unnecessarily wasted.

7.2 River Discharges

7.2.1 Discharge Regime

The status quo of discharging only during out-going tides between 6:00 pm and 6:00 am is an option, with or without a variety of modifications to the wastewater system or the discharge structure and location. The existing discharge regime timing to the river was developed in the 1970's and supported by a wide range of parties for subsequent consenting because it was shown to be beneficial for public health protection, contaminant flushing into the sea, and public perception reasons.

Another option is changing the discharge timing to include daytime out-going tides in addition to overnight out-going tides. This change would allow the duration of the discharge events to be doubled from the existing regime, which could assist with discharging wet weather flows and with avoiding the possible need to increase the outfall pipe's capacity. It would also generally result in a smaller discharge volume and greater dilution for each discharge event, which would reduce any adverse environmental and public health effects. This option could be applied only during wet weather and winter seasons when wastewater flows (and generally river flows) are elevated; summertime discharges could remain as the status quo.

A continuous discharge is another potential option regardless of tidal movements, but it is probably unacceptable without disinfection treatment to kill off all or most of the pathogens. A variant would be restricting continuous discharges to wet weather and winter seasons. A change to continuous 24/7 discharges would be beneficial for minimising storage requirements, keeping the outfall free of silt, reducing flow rates and surcharging within the discharge pipeline, improved management of wet weather flows, and avoiding the need to increase the discharge pipe diameter to cope with higher discharge flow rates during shorter discharge durations. A seasonal restriction on this discharge regime would require an alternative discharge regime and perhaps storage for those restricted times.

The discharge could also be limited to river flows above a specific threshold such as median or 20th flow exceedance percentile (20FEP) when the river was high (due to storms and floods) and generally outside of summer and/or recreational periods. Setting low river flow thresholds for discharges protect the aquatic and estuarine environments from increased risks of adverse effects, as dilution and dispersion of the discharge is reduced during low river flows. Generally, the most sensitive conditions occur during summer bathing seasons which would have higher public health risks for recreational and fishing activities. Summer low flows also coincide with warmer water conditions and longer daylight hours which are conducive to algal growth and pathogen survival rates.

7.2.2 Location and Design

WDC can consider discharging at a different location, either closer to the river mouth or further upstream.

A discharge location closer to the bar would reduce the travel distance required for the discharge to reach the sea and therefore would reduce the area of influence within the estuary (although to a lesser extent when the bar is closed off). However, this is more prone to damage from bar and riverbed morphology changes, involves a longer pipeline which could be more difficult and costly to maintain, and is further inside the Whakamahi Lagoon wildlife reserve. It may also be viewed as a more significant navigational and flood flow obstruction hazard.

A discharge further upstream appears to be within a more stable riverbed channel (not so prone to migration or sedimentation) and would be outside the Whakamahi Lagoon wildlife reserve. This would utilise the faster river flow rate and allow more time for the discharge to disperse prior to reaching the sea but could potentially have a more negative aesthetic and perceived public health influence on a larger area of the river and estuary, including a new stretch of the river that is adjacent to the urban area and its riverside parks.

The outfall needs to be placed in the best location for dispersion of the discharge (generally close to the main channel where river flow rates are highest). The depth of discharge is also important, as the deeper water is seawater from the tidal fluctuations and flows faster than the fresh water near the surface, and the discharge tends to bubble up towards the surface.

The design of the outfall structure is important to ensure that it is efficiently dispersing the discharge into the river and is not prone to blockage from sediment deposited by the river. It needs to be well anchored to the riverbed while avoiding causing an obstruction to flood flows.

It may be advantageous for the discharge outfall to be readily dismantled or extended so that it can be relocated to match the riverbed migration patterns. The outfall design would ideally result in the outfall being able to be promptly relocated at short notice in response to changes in the main river channel location. The outfall needs to be as close as possible to the in-shore edge of the main river channel and relatively free from the depositional mudflat environment. Over the last few years it has suffered from siltation and is now some distance from the main river channel. In future the river channel is likely to migrate back towards the shore and the outfall pipeline may then become an obstruction across the channel and at risk of breaking off due to scoured out pipe support foundations.

7.2.3 Values and Relevant Factors

The key concerns with discharges to surface water bodies relate to cultural and public health values. In Wairoa, the tangata whenua feedback via consultation (including hui-a-iwi and Stakeholder Group) and How (2017:A4I2) has sent a strong message that it is culturally unacceptable for treated wastewater to be discharged into a stream or river unless idealistically it is so highly treated that it is potable and it has percolated through soil and plants first. However, the Stakeholder Group meeting on 16 October 2017 agreed that an overland flow or wetland system would not achieve the level of treatment by soil and plant contact required to be culturally acceptable prior to a river discharge, even with disinfection treatment or other WWWTP upgrades to reduce pathogen numbers. Feedback from the Stakeholder Group, iwi, and public meetings during August to December 2017 consistently indicated that the minimum standard of wastewater quality that would be acceptable for future continuation of discharges to the river would need to include additional treatment such as disinfection to reduce pathogen numbers prior to direct river discharge.

Public health concerns mainly centre on pathogens potentially infecting people during recreational contact. The acceptable pathogen standards for recreational contact are set by the NPS-FM, and, as noted in Section 6.1 above, the river quite regularly exceeds these standards due to sources upstream of Wairoa's urban area. The existing discharge would not meet the recreational contact standards for pathogens at and immediately around the outfall, so an option is to improve its treatment so that it meets these standards prior to discharge to the river. Disinfection treatment will generally achieve pathogen concentrations needed to meet the NPS-FM Attribute A recreational contact standards[1]. However, this may be an onerous treatment target for WWWTP to achieve all of the time. This standard also is not necessary for discharges during flood events and is less important outside of the summer bathing season because of the infrequent or rare recreational use of the river during such times.

The RMA assesses compliance and effects of discharges "after reasonable mixing" which, in the case of WWWTP, could mean after dispersion of the discharge plume. The RRMP defines the zone of reasonable mixing based on the width of the receiving waterway and, in WWWTP's case, would probably be 200 m downstream. At a point 200 m from the outfall, Cawthron's 2007 dye dispersion study showed dilution of 100:1 when the bar was unrestricted. A discharge of treated wastewater containing pathogen numbers of 5,200 cfu/100 ml (2008-16 median pathogen content) would therefore be diluted over a 200 m distance to only 52 cfu/100 ml. At a distance of 50 m downstream, the dilution was found to be 25:1, and this would result in pathogen numbers of 108 cfu/100 ml. Discharges of the median pathogen numbers would therefore meet the Attribute A median criteria for recreational contact standards at a distance of 50 m or greater from the outfall.

If elevated (highest 25 % of monthly samples) pathogen numbers were reduced in the treated wastewater, the dispersed plume would meet all Attribute A criteria for contact recreation within a zone located 50-200 m downstream of the discharge if the river already met Attribute A criteria upstream of the discharge. It may be more acceptable to treat the wastewater to a consistently better standard (fewer elevated results) for pathogens which ensures that it would be suitable for contact recreation after reasonable mixing within 50 m of the outfall. The upstream river water quality would then determine the recreational water quality assessments as the discharge would have minimal effects and could often have fewer pathogens than the river.

Public health concerns also consider pathogens potentially infecting people through eating fish or shellfish. Despite the frequently high pathogen numbers in the river from upstream sources (and

[1] Median $\leq$130 cfu/100 ml, <5% exceedances of 540 cfu/100 ml, <20% exceedances of 260 cfu/100 ml, and 95th percentile $\leq$540 cfu/100 ml.

in the vicinity of WWWTP's outfall), DHB and medical records indicate that there is no known evidence of illness (that links to the wastewater discharge) from consumption of kaimoana gathered from the locality of the treated wastewater discharge or nearby areas of the river and estuary.

There is also potential public health concern regarding trace metals near the outfall accumulating in shellfish that are subsequently harvested and consumed. Trace metals may also be an ecological health concern if they are elevated. EAM's 2007 and 2011 benthic surveys at 100 m downstream and upstream and 500 m upstream of the discharge found that trace metal concentrations in the sediments were below ANZECC sediment quality guideline values and "compared to other estuaries in Hawke's Bay and New Zealand the levels of trace metals at all sites are low to very low." EAM 2011 also noted that "the discharge does not have an observable effect on the sediment quality in the lower Wairoa River with respect to trace metals."

EAM 2007 assessed trace metals in flounder caught in the Wairoa River and Mangawhio estuary (Mahia) and found that "trace metal concentrations in Wairoa Flounder are similar to other Hawke's Bay Flounder and fall well below food safety standards (Food Standards Australia and New Zealand (FSANZ) guidelines for fish (standard 1.1.4))." EAM 2007 also found that most trace metal concentrations "were lower in Wairoa flounder compared to other Flounder caught around wastewater outfalls in Hawke's Bay." This study indicates that trace metals in the Wairoa River would be unlikely to trigger public health concerns.

Discharges during in-coming tides was opposed during previous consenting cycles because of the increased potential for wastewater contaminants, particularly, pathogens, being transported up-river past Wairoa where contact recreation is more common. Discharges during daylight hours was also opposed due to the higher likelihood of recreational activities occurring which could elevate the public health risks. Disinfection treatment would address the risks to public health and contact recreation, but it still may not be a sufficient response to resolve the cultural and public perception concerns.

Restricting river discharges during summertime and/or river flow conditions could ensure that risks to public health and recreational contact are reduced from the current risks. Introducing disinfection treatment as well would eliminate these risks. In order to achieve compliance with such discharge restrictions the treated wastewater will need to be stored and probably discharged to another environment. However, this also runs the risk of siltation and complete blockage of the outfall building up during longer periods of time (weeks or months) when discharges to the river are not flushing it out. Specialised engineering design may overcome this siltation issue.

If land discharges form that "other discharge environment" then it will be ideally suited to receiving discharges during summer (and *ipso facto* summer low flow river conditions) and will minimise the volume of any storage required. If no alternative discharge is developed, the volume and cost of storage required to prevent low river flow discharges would be enormous. It would also force subsequent river discharges to occur in larger volumes over shorter durations when the river flows are higher, and this perversely may cause greater adverse effects at those times than the existing discharge regime. The capacity of the discharge pipeline may also need to be increased to enable such large volumes to be rapidly discharged when the river is flowing fast enough to allow the discharge to occur.

In addition, discharges to the Wairoa River may cause potential ecological concerns for the wildlife reserves, and water and sediment quality concerns within the plume dispersion and mixing zone. River mouth closures reduce flows and flushing, which reduce the rates of dispersion and dilution of the discharge. Summer low flows also reduce dispersion and coincide with the bathing season which elevates the public health risks of discharging during these times. This may provide reasons for restricting the discharges to the river during low flows, but there needs to be scientifically demonstrable evidence of unacceptable risks before imposing such restrictions.

The discharge to the river needs to consider the recreational and scenic values, particularly during summer when there is an increase in public use and enjoyment of the river and its banks. The river is used for a variety of recreational activities such as yachting, rowing, water skiing, power boating, and some swimming. The riverbank reserves are popular for walking, running, and cycling. Some picnic and playground areas are also located on the reserve land.

There are financial implications from each of the treatment, storage, and discharge location and management options which WDC and the community need to factor into their decision-making processes.

7.3 Ocean Discharges

7.3.1 Discharge Regime

The ocean volume and its capacity to disperse and assimilate wastewater discharges are so large that generally a wastewater discharge can occur continuously at an unlimited rate (at least for a town the size of Wairoa; cities will need more scrutiny). The discharge quality and daily volume from WWWTP would be suitable for ocean discharge while avoiding adverse effects on marine ecosystems or public health.

7.3.2 Location and Design

The location options are primarily near shore (about 1 km off-shore) or deep sea (5 km or more off-shore). The depth of the ocean floor and its slope (which is steep for a short distance near the coast) will be primary considerations for location. The presence of strong ocean currents, prized fishing or ecologically important habitat, and perhaps elevated seismic risk (active fault lines) would also be important considerations for location. Additionally, the proximity of the outfall and its route from WWWTP (particularly how it traverses the bar and steep coastal section of seabed) will determine the cost and resilience of the pipeline.

The design of the outfall will need to ensure rapid dispersion of wastewater deep below the ocean surface and be adequately anchored to the seafloor.

7.3.3 Values and Relevant Factors

One of the primary concerns with an ocean outfall is the effects on cultural values. How (2017:A4I2) stated "Because of the relationship between Tangaroa and his brother Tane, and the nature of the creation of the seawaters, it is culturally inappropriate to discharge any human waste, and thus wastewater which is not holistically treated, into any body of saltwater…" Constructing a pipeline through the estuary and coastal bars would also require consideration of cultural values, as this may have an effect on a valued kaimoana gathering area and two taniwha who reside within and are represented by the coastal bars.

An ocean discharge may need to consider risks of adverse effects on marine ecological values, as it is likely to still be within the boundaries of the Whakamahi Lagoon Wildlife Reserve and/or RCA mapped in the RCEP. These designations indicate the significance of this locality's ecology up to 1 nautical mile from the shore and provide some protection for the wildlife including marine life. Some of the seabirds inhabiting the lagoon areas will rely on the coastal marine area for food. The coastal area adjacent to Whakamahi Lagoon and Wairoa River mouth is at least 8 km east of the Wairoa Hard SCA, so any ocean discharge for WWWTP would be distant from Wairoa Hard and should not be seen as likely to have any effects on Wairoa Hard's marine ecological values.

Public health concerns, if any, would only apply to contact recreation and consumption of seabed marine life in the immediate vicinity of the outfall.

The cost of constructing an outfall is likely to be high and its stability in a very active coastal situation may be risky. Its accessibility and associated cost for maintenance or repairs would also be relevant factors. It also potentially forms a navigational hazard for boating and diving.

7.4 Land Discharges

7.4.1 Discharge Regime

There is a continuum of land discharge options:

- land passage, overland flow, or wetland systems;
- soakage fields or border dykes receiving high daily application rates year-round;
- high rate irrigation through most of the year;
- non-deficit irrigation during some or all of spring to autumn each year; and
- deficit irrigation during summer months only.

The discharge regime needs to match the ability for the selected land areas to receive the volume and nutrient application rates without causing unintended land instability, plant cover failure, soil degradation, or groundwater contamination effects.

7.4.2 Location and Design

The location needs to be within reasonable proximity of WWWTP in order to minimise the length and cost of reticulation (and pumping) from WWWTP to the site. Ideally it should also be at a similar elevation to the WWWTP in order to minimise pipeline pressure (and cost) and pumping head requirements. The use of the land for grazing or production forestry needs to be compatible with receiving and managing wastewater discharges. Seasonal changes and harvesting activities will also need to be factored into the integrated management of the land area.

LEI (2017:A5I1) assessed the likely suitability of land around Wairoa for land discharges based on broad-scale mapping of the area for terrain, soil parameters, and waterways. It narrowed the preferred location considerably, as shown in green and yellow in Figure 7.1 below. A large portion of local land is marginally suitable for irrigation as shown in peach shading in Figure 7.1.

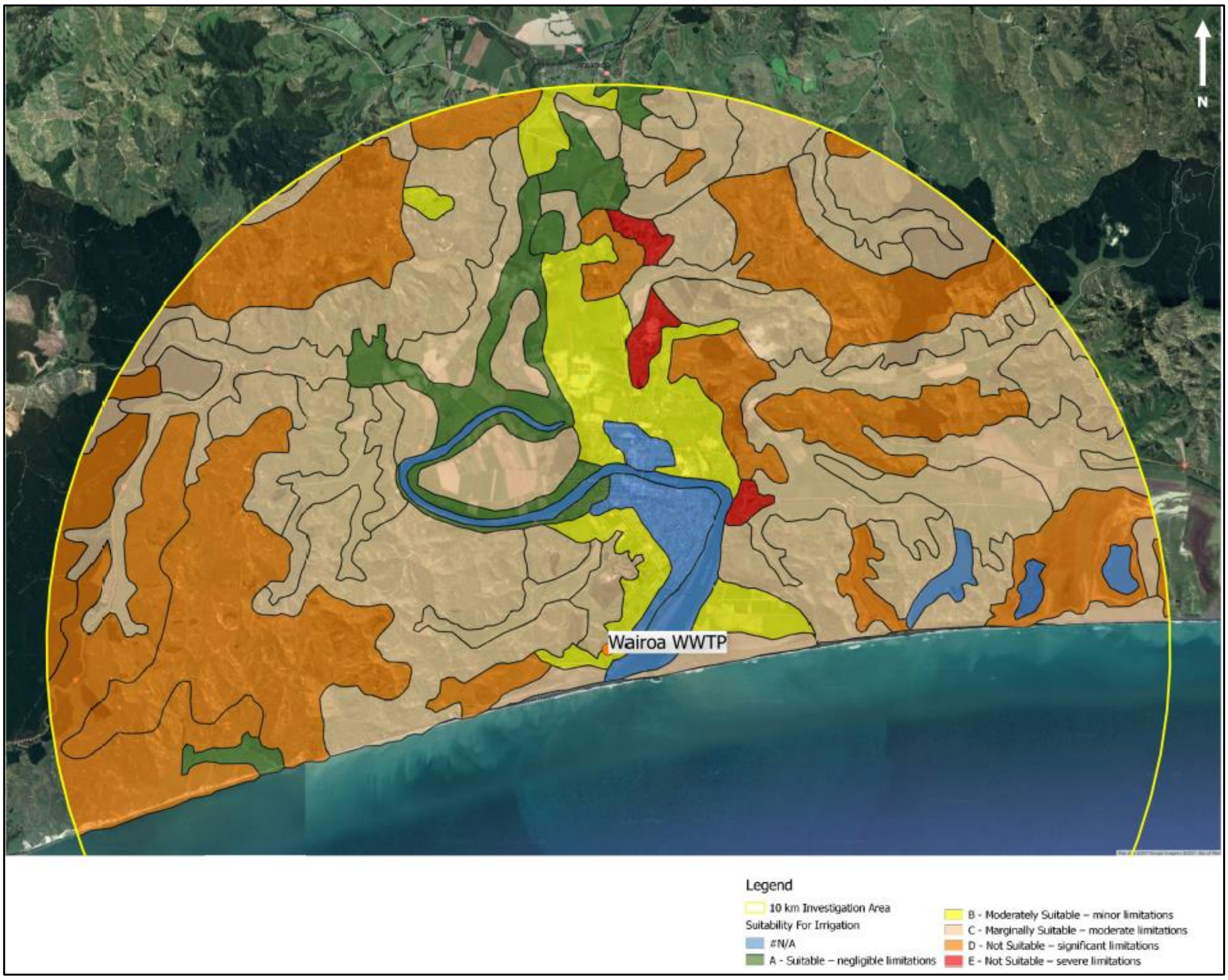

Figure 7.1: Irrigation Suitability (Source: Figure 10, LEI, 2017:A5I1)

Rapid soakage fields can be simple and relatively low pressure systems but they require well-drained soils and generally grow wetland plants or have no plant cover at all. Border dykes and infiltration basins are typical designs for such discharge regimes. The green areas of Figure 7.1 and coastal margins are capable of accommodating such soakage systems.

Irrigation systems can use a variety of reticulation and sprinkler designs. Reticulation can be permanent or temporary (using quick disconnection fittings) and trenched into the land or laid across the surface. Sprinklers can be large pivot irrigators, smaller travelling irrigators, fixed sprinklers on posts, or small pods that are mobile, modular, and temporary. Sub-surface dripper irrigation systems can also be used.

Irrigation controls can be specified to match weather conditions, soil moisture constraints, event durations and timing, and paddock rotations. Monitoring of discharge volumes, locations (fields), event details, and soil moisture will generally be required.

Surface irrigation systems need to allow for buffers from waterways, residences, and any other sensitive environments. The sprinkler design and operating pressure would need to be selected to avoid generating aerosols and odours which could travel some distance downwind. These issues can be further managed by using a smaller radius of wetting and maintaining spray as close to ground level as practicable. Automated high wind speed shut-down may also be an option for managing the potential for adverse effects on more sensitive neighbouring properties.

7.4.3 Values and Relevant Factors

Feedback from the Stakeholder Group, iwi, and public meetings during August to December 2017 consistently indicated that land is the preferred discharge environment for cultural, public health, social/recreational and environmental reasons so long as the discharge does not adversely affect the soils, plants, grazing animals, groundwater, or downstream surface water. The Stakeholder Group, iwi, public meetings, and How (2017:A4I2) consistently advised that discharges to land are the most culturally acceptable discharge and treatment method for human wastewater. This reflects the tikanga that contact with and passage (drainage) through Papatuanuku is the means by which human wastes are transformed and both the earth and residual water increase and rebalance their Mauri. How (2017:A4I2) provides further details and assessments of cultural values associated with land treatment of human wastewater.

The hill slopes readily develop landslides and generally the soils do not drain well, and in these areas it will generally be important to discharge wastewater using relatively small daily amounts in order to protect the land from these concerns.

The coastal areas are prone to erosion and flood/tsunami hazards, so any land discharge system would need to take care to avoid exacerbating these risks and would need to be able to cope with floods where relevant. In the riverside and lagoon areas the protection of wildlife, cultural, and recreational values are important considerations.

Private farm land around Wairoa is not used by members of the public for recreational purposes. However, the scenic value of some of the rural backdrop to Wairoa's urban, ocean, and river valley views is moderate to high, so irrigation structures may need to take some care to remain unobtrusive on these aesthetic values.

Sensitivity to neighbours and waterways requires wastewater irrigation to incorporate some buffer distances (separation) into its design and operation. It is important to reassure neighbours that they will not suffer any adverse effects from wastewater irrigation.

The financial implications of irrigation can be enormous. The costs mainly reflect the lengths of pipeline infrastructure, changes (increases) in elevation of terrain which determine pumping costs, and the size of storage ponds. If farmers do not wish to allow wastewater irrigation on their land, WDC could consider purchasing suitable farms instead of leasing, but this would have greater cost and farm management implications for WDC.

7.5 Groundwater Discharges

7.5.1 Discharge Regime

Drainage of treated wastewater from non-deficit irrigation or soakage systems would occur in pulses following each discharge of wastewater onto land. The volume and duration of drainage will depend on the extent to which wastewater applications exceed soil field capacity and the drainage rate of the soil and underlying geology, and groundwater flow rates.

Treated wastewater could be discharged continuously to groundwater through a bore depending on the assimilative capacity of the groundwater, its flow rate, and the locations, abstraction rates, and sensitivities of its downstream users. There would not be any obvious advantages to limiting the timing of discharges because groundwater generally flows slowly and discharge pulses of treated wastewater would not provide any benefits but could generate more adverse effects such as fluctuations in groundwater quality, depth (mounding), and flow rate.

7.5.2 Location and Design

Section 7.4.2 above addresses the location and design of irrigation or soakage systems generating drainage to groundwater. A soakage or rapid infiltration area would need to be located within the coastal margin where sandy or gravelly soils exist, or possibly on the river terraces if soils are found to be able to drain fast enough. These systems are slightly different to systems discharging directly to groundwater.

Alternatively, a slightly different system could use a groundwater injection bore, which would ideally need to be downstream of any groundwater users. It may need to be some distance from waterways and perhaps the coast. If a location cannot be downstream of all other users or set back far enough from waterways, the discharge should be deep and vertically separated from aquifers being used by downstream abstraction bores. This will ensure that the discharge is well dispersed prior to entering any water body or the ocean and will protect downstream users of the groundwater from contamination.

7.5.3 Values and Relevant Factors

Groundwater generally has value when it recharges streams and rivers or is abstracted for uses such as drinking water (particularly valuable for human drinking water) or irrigation.

Discharges to groundwater can elevate contaminant concentrations and raise groundwater levels (mounding) near the discharge site. Mounding can redirect the natural groundwater flow direction too.

Cultural values may also be compromised if contaminants were found to be entering the groundwater.

There are no recreational values associated with groundwater, but there is a social value of expecting the groundwater resource to be maintained with high purity and available for use wherever people needed to access it.

Financially a soakage system might be attractive, depending on how distant the site might be from WWWTP. The cost of the alternative discharge system of pumping treated wastewater into a groundwater bore may be more expensive than a soakage system.

7.6 Potential Discharge Combinations

As noted in Section 6.2 above, there are advantages to considering an integrated discharge system that uses two or more discharge sites and receiving environments. The range of options is limited to some extent by practicalities and the degree or circumstances under which a site or environment needs protection from discharges.

Ocean discharges are the most readily dispersed and assimilated method, and also generally the most expensive method, so they generally are not combined with discharges to other receiving environments. Despite this, WDC could consider the use of the existing river discharge outfall during winter flows and an ocean outfall during the other months. Alternatively, if the river discharge pipeline was extended and converted into an ocean outfall, land or groundwater discharges could be used during summer while operating the ocean outfall during the other months. However, the costs of developing land or groundwater discharge systems in addition to an expensive ocean outfall are unlikely to be financially acceptable to the community. Storage requirements would most likely be minimal because there would be very few occasions when discharges could not occur.

River discharges can be readily combined with any of the other receiving environments. As noted above, ocean discharges are not usually the alternative combination with river discharges, but combinations of river discharges with land discharges are quite common and practicable. The timing of river discharges can occur during less sensitive seasons such as winter when fewer people use it for recreation and/or when river flows are higher (due to storms at any time of the year) which also coincide with fewer people using it for recreation and food gathering.

Discharges to land are more beneficial and encounter fewer problems during summer, which is when rivers are more sensitive to discharges, so land discharges form the ideal combination with river discharge systems. However, the available land area, soil and terrain constraints, irrigation rate, storage capacity, and raw wastewater inflow rates will determine how much of the wastewater can be diverted from the river discharge, and for how many days each year. Ideally the land discharge can accommodate all of the wastewater volumes generated throughout each summer and the shoulder seasons.

The balance of river discharge constraints and land discharge constraints will determine how much storage is required to be provided so that all discharge constraints are met all the time. The discharge regimes must be capable of discharging an entire year's wastewater even during and following exceptionally wet seasons or years. Sometimes this requires an "exceptional circumstances" out-clause to discharge to land or the river when storage is full despite the receiving environment not meeting the normal constraints for allowing discharges.

Discharges to groundwater could be used as the alternative environment to river discharges during summer seasons to protect the river from direct discharges, but some care in the bore location, depth, and discharge design may be required to ensure that the contaminated groundwater does not subsequently seep into the river or its tributaries during summer.

8 OPTION EVALUATION AND SELECTION

8.1 General

As described above, there are a multitude of options for discharges and for each component of the wastewater system, and some options are not compatible with options for other components of the system. It is important to ensure that the selected option for each component forms an efficient and effective integrated system. All operating parameters and constraints need to work in harmony. The ultimate goal is to develop an integrated system that achieves the best balance of affordable wastewater management and greatest benefits with the least disadvantages.

8.2 Evaluation Criteria for BPO

WDC and their advisors investigated and identified the wastewater system's design parameters. They also developed evaluation criteria for selecting the BPO which were able to be used to define the constraints of any potential system. Ideally the selected BPO needed to cost no more than the budgeted limit of $4.75M set aside in the 2015-25 LTP. It should be noted that an investment of $5 million equates to a rate increase of about $200 per property per year for the next 30 years, and $10 million is a rate increase of about $400 per property per year.

The Stakeholder Group were tasked with developing criteria and then applying those criteria to refining options and guiding selection of a preferred option. The preferred option selection criteria and values established by the Stakeholder Group are summarised in Table 8.1 below, with ranking of 1 being most highly valued and 9 or above being least important (scores are the reverse):

Table 8.1: Aspirations, Scores and Ranking of Option Evaluation Criteria

Pillar	Comment	Score	Rank in Pillar	Rank overall
Recreational	Need an appropriate standard	2	1	10
	Suitable for fishing	2	1	10
	Suitable for boating	2	1	10
	Suitable for swimming	1	4	14
Cultural	Toitu te whenua, Toitu te moana, Toitu te iwi (cultural sustainability)	9	1	1
	Environmental and recreational health	3	2	6
	Unharmed and undamaged water	3	2	6
	Being able to use the water for food gathering	1	4	14
	Having a water management system suitable for Wairoa	1	4	14
Financial	Need to invest in sustainable infrastructure with appropriate capacity	7	1	2
	Spread payment over time	6	2	3
	Need to be aware of who is paying the bills	2	3	10
Environmental	Enhance the quality of water to protect habitat	5	1	4
	Use inherent properties of land to clean water	4	2	5
	Having water free of contamination	3	3	6
	Having a lawful system	3	3	6
	Using technology to improve water quality	1	5	14

The overall rankings were determined by recognising that recreational values were of lesser importance than the other three pillars of values. Overall, the most important values identified by the Stakeholder Group were cultural sustainability, financial affordability, and improved wastewater quality that will protect river water quality.

8.3 Initial Options

The general options for each component of the wastewater system can be combined with the discharge options for initial evaluations of their advantages, disadvantages, and how well each combination matches the Stakeholder Group's values, priorities, and aspirations. Figure 8.1 presents a matrix of the combinations that were initially considered by WDC and the Stakeholder Group.

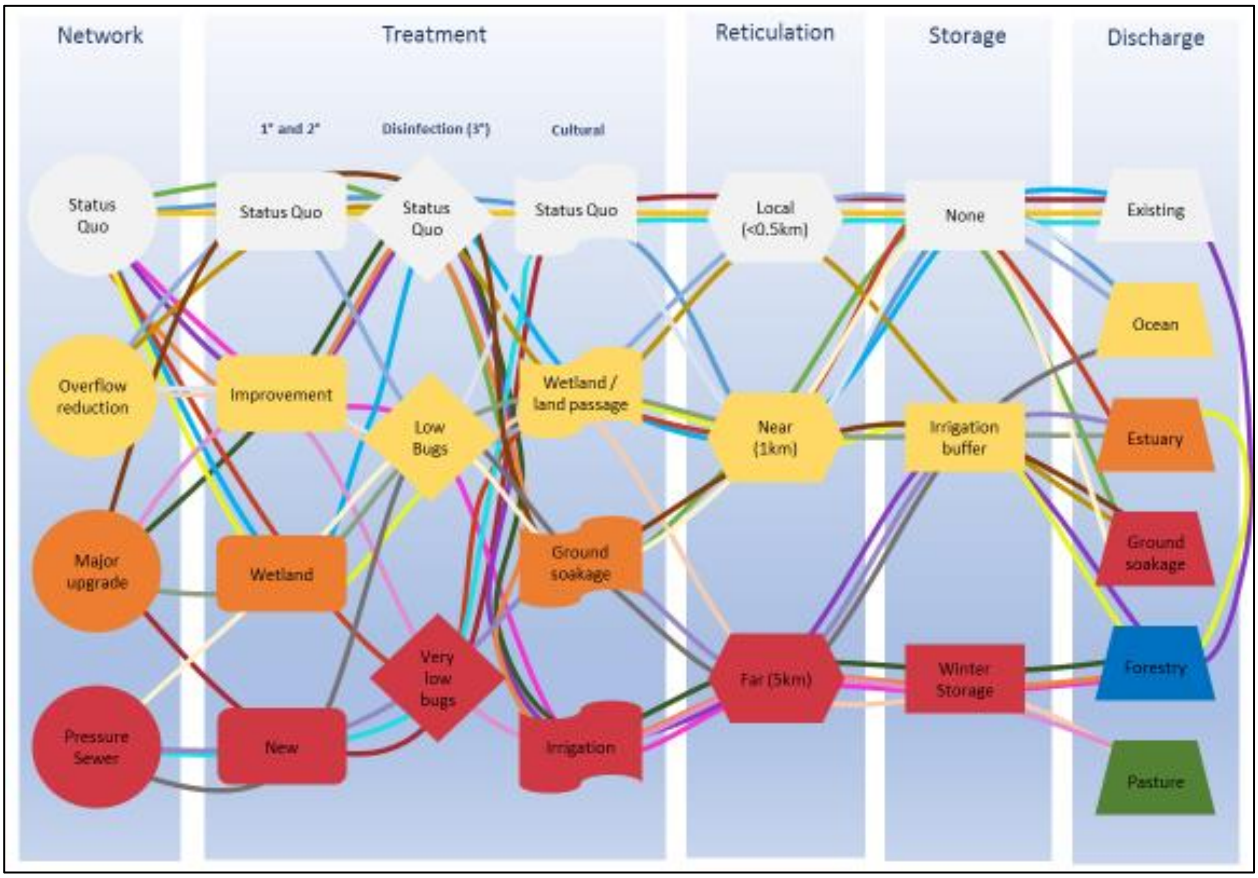

Figure 8.1: Potentially Practicable Combinations of Options

From this multitude of combinations, LEI (2017:A7D1) developed and presented 22 representative options covering the full spectrum of practicable combinations for a high-level assessment by the Stakeholder Group on 4 September 2017. The options selected by LEI for each component of the system and the reasons for their selection are outlined below.

- **Discharge System:**
    1. Status Quo;
    2. River (new outfall);
    3. Ocean;
    4. Land; or
    5. Combination.

These options were selected to cover the full range of available receiving environments and discharge locations.

- **Reticulation:**
  - No changes (current flows - 6,500 m^3/d peak, 4,000 m^3/d winter average, and 2,700 m^3/d mean flow); and
  - 50% of current flow (improved reticulation 50 % reduction in flow - 3,250 m^3/d peak, 2,000 m^3/d winter average, and 1,800 m^3/d mean flow).

  These options were selected to represent the extremes of reticulation improvements that were likely to be practicable for WDC and affordable for the community. The 50% flow reduction is still a very ambitious target and would incur considerable costs that could be unaffordable for the community, particularly in combination with treatment upgrades, large storage, and/or irrigation schemes.

- **Treatment:**
  - No changes;
  - Filtration + UV (low bugs);
  - Filtration only; and
  - High Rate Land Passage – Overland Flow (HRLP-OLF).

  The 'no changes' option was selected because it was noted that the current treatment performance and treated wastewater quality were considered acceptable for a land or ocean receiving environment. The treated wastewater quality was also potentially acceptable for river discharges with some additional treatment to address pathogens, clarity, and cultural values. There seemed to be no other drivers for improving wastewater treatment, so no other technologies were suggested at this stage of the BPO selection process.

  The designs for all additional treatments would need to match the future flow rates and potentially be capable of handling elevated storm flows or incorporate a bypass for storm flows. If reticulation improvements were to be accelerated, the much lower future flow rates would form the basis for design. Reduced flows are likely to assist the treatment performance of the existing WWWTP anyway.

  There are a range of disinfection systems available but for simplicity of option assessments the commonly-applied UV system was included in the suggested options to represent all types of disinfection treatment systems. It also seemed to be appropriate for WWWTP's requirements and flow regimes. UV systems require pre-filtration to ensure that light penetration is adequate for effective pathogen die-off, so this was proposed as a duo treatment. Filtration was suggested as an option on its own because it could potentially be the only additional treatment necessary for acceptance in the ocean or river, and it is usually necessary on its own prior to irrigation to prevent blockages of sprinklers or dripper lines (UV is generally not necessary prior to irrigation).

  HRLP-OLF was suggested as a means of ensuring that treated wastewater had adequate time for contact with and soakage into land (Papatuanuku) which would help revitalise the wastewater's mauri and address cultural values prior to discharge to the river or ocean. This could incorporate a wetland and ground soakage area if the geology and consultation feedback endorsed this. However, the degree of treatment achieved by such a system may not provide a very significant reduction in contaminant concentrations. Discharge volumes to the river or ocean may also be only slightly reduced from the WWWTP outflow volumes if soakage rates into the underlying soils of the HRLP-OLF system are low.

- **Storage:**
  - 2 – 3 days (current);
  - 14 days;
  - 90 days; and
  - 120 days.

  The numbers of days of storage were suggested to reflect the likely storage requirements of the discharge options. All storage volumes would need to reflect the flows resulting from the scale of reticulation improvements, reflect the timing of the reticulation improvements vs timing of storage construction, and reflect winter flows which would be stored (summer flows will generally be lower and could be immediately discharged to land).

  The current 2-3 days' storage could continue to be adequate for some of the discharge options, particularly if additional treatment makes discharges acceptable most of the time. A small increase to 14 days' storage was seen as the minimum necessary for management of a combined land and water discharge system if discharge restrictions were minimal.

  The 90-day and 120-day storage options reflected the likely requirements for more restrictive controls on discharges to the river and/or to irrigation to match their seasonal variations. The 30-day difference was seen to be useful as a means of assessing the benefits and costs of storing varying volumes of the winter and spring flows for deferred irrigation during summer. 120-day storage is unlikely to be needed for combined land and water discharge systems.

  Storage larger than 120 days was believed to be impracticably large and expensive and would impose an onerous burden on the receiving environment when stored volumes would need to be more rapidly discharged during the remaining very short timeframes. A larger discharge pipe to the river may also be required to cope with such increases in flow rates.

- **Discharge:**
  - River – status quo discharge regime;
  - River – 24-hour continuous discharge;
  - Ocean;
  - Irrigation rate 1 – 5 mm application depth per day;
  - Irrigation rate 2 – 0.8 mm application depth per day; and
  - Rapid Infiltration – 200 mm application depth per day.

  The river discharge options could occur using the existing timing controls or potentially changed to 24-hour continuous discharges. The additional treatment options, land discharge combinations, and/or high river flow discharge criteria could support 24/7 discharges, but the frequency and seasonality of continuous river discharges would be determined by these factors and by the level of community acceptance. It was considered possible that continuous discharges to the river could be acceptable as the sole discharge method if the additional treatment was agreed to be adequate to address the community's cultural, recreational, and river water quality values. Large storage on its own might make it practicable to impose river flow restrictions on the continuous river discharge timing such as above median river flows, but it was believed to be more likely that some form of land discharge system would be favoured by the community for enabling this type of river discharge restriction.

For some combined land and river options it may be practicable to impose river flow controls on the discharge timing such as above 20FEP, but the volume of storage and the area and drainage rate of irrigated land would need to match the implications of such river discharge restrictions. Care may be required to avoid overwhelming the river's assimilative capacity when large volumes need to be rapidly discharged to the river in short timeframes. A larger discharge pipe to the river may also be required to cope with such increases in flow rates.

The irrigation rates were selected as practicable and appropriate rates for the soils and terrain in the Wairoa locality. Higher application rates are unlikely to be acceptable or sustainable due to the poor drainage rates of soils and erosion risks of the slopes. The 0.8 mm/d rate was suggested as a minimum for maintaining pasture growth and avoiding drainage to groundwater, but this would require a proportionately much larger land area than a 5 mm/d application rate that would be able to support increased pasture growth rates. Storage volumes will also reflect these irrigation rate options.

The rapid infiltration option was suggested specifically for potential implementation in the coastal dunes. It is a viable option which requires smaller storage, avoids direct discharges to surface water, and ensures that all of the treated wastewater passes through soil.

These components were subsequently combined into practicable options covering the full range of choices and combinations as shown in Table 8.2 below. These options were presented to the Stakeholder Group for their evaluation during their meeting on 4 September 2017.

Table 8.2: Option Combinations

Option Code	Option Description
1.1	Status Quo
1.2	River-low bugs/24-hour continuous discharge
2.1	River-low bugs
2.2	River-low bugs/HRLP-OLF
2.3	River-HRLP-OLF
2.4	River-50% flow/low bugs/HRLP-OLF
2.5	River (new outfall)-low bugs/HRLP-OLF
3.1	Ocean
3.2	Ocean-HRLP-OLF
4.1	Land-90 day storage buffer/irrigation rate 1
4.2	Land-120 day storage buffer/irrigation rate 1
4.3	Land-50% flow/90 day storage buffer/irrigation rate 1
4.4	Land-50% flow/120 day storage buffer/irrigation rate 1
4.5	Land-90 day storage buffer/irrigation rate 2
4.6	Land-120 day storage buffer/irrigation rate 2
4.7	Land-50% flow/90 day storage buffer/irrigation rate 2
4.8	Land-50% flow/120 day storage buffer/irrigation rate 2
4.9	Land-rapid infiltration
5.1	Combo-River/land-HRLP-OLF/14 day storage buffer/irrigation rate 1
5.2	Combo-River/land-HRLP-OLF/90 day storage buffer/irrigation rate 1
5.3	Combo-50% flow/River/land-HRLP-OLF/14 day storage buffer/irrigation rate 1
5.4	Combo-50% flow/River/land-HRLP-OLF/90 day storage buffer/irrigation rate 1

8.4 Refined Options

On 4 September 2017 the Stakeholder Group assessed the pros and cons of these 22 options including their likely scale of costs against the evaluation criteria set for each value pillar (cultural, environmental, financial, and social/recreational).

The Stakeholder Group unanimously agreed that the status quo discharge to the river was unacceptable for the future. There was unanimous preference to consider land application options, but a realisation that they have practical limitations and may not be able to be readily implemented. If surface water discharges were to be used they agreed that it was essential to install additional filtration and UV treatment prior to any discharge that entered the river or sea. On the basis of installing UV treatment and filtration, they agreed that a river discharge could continue to operate if other discharge options were unviable for the community. They also agreed that a change in river discharge location would not gain any benefits over improvements to the existing river discharge system, and it was likely to incur additional costs for a structure that might become redundant in future if all flows are diverted to irrigation or some form of land discharge system.

The Stakeholder Group did not support WDC dramatically increasing the scale or intensity of its reticulation renewal programme to more rapidly reduce wastewater flows, as the costs were seen to become unaffordable in addition to the discharge and potential storage costs. The rate of flow reductions being achieved by the existing programme was seen as being acceptable, pump station overflows were expected to occur less often (during larger storms than currently), and the timing of the discharge regime and storage development was able to be appropriately matched to the rate of flow reductions.

The Stakeholder Group acknowledged that reduced flows in future would help to reduce the required storage volumes and minimise discharge volumes. This was particularly important for minimising land area requirements for irrigation and for maximising the frequency and duration of avoiding discharges to the river. A reliance upon future reductions in flows allows WDC to construct smaller storage than would be necessary for the current flows and ensures that WDC can avoid large investment into unnecessarily large storage that later becomes redundant. In any case, the Stakeholder Group agreed that 120-day storage for irrigation was unaffordable, and even 90-day storage at future reduced flow rates was likely to be unaffordable.

There was mixed reaction to the potential installation of HRLP prior to a river discharge. Some saw it as a practical means of addressing cultural values and providing environmental benefits. Others saw it as a significant investment in a feature that would have limited cultural value (and could be seen to be tokenism). Its effectiveness at improving the treated wastewater quality was queried. There was also some concern that it would become redundant in the long term if land discharges developed enough capacity to cease the river discharge.

There was acknowledgement (and acceptance) by the Stakeholder Group that the health of the Wairoa River was in a poor state, and regardless of the changes made for the wastewater discharge there may be limited improvement in river water quality until all river issues were addressed.

The Stakeholder Group agreed that the degraded state of the Wairoa River water quality needed to be improved, but that community affordability was a critical factor regarding the contribution that was made to changes in wastewater discharges. They indicated that a rates increase of $200-400 per household per year was likely to be the limit of affordability for the community, and that even $200 would be unaffordable for many ratepayers.

This financial limitation meant that their ideal aspiration of irrigation of wastewater and ceasing the discharge to the river was unlikely to be affordable. The ocean discharge options were also likely to be unaffordable. This meant that WWWTP would need to primarily rely on discharges to the river or coastal dunes. However, they were still interested in striving to implement irrigation over time in future, if at all possible, and whenever the opportunities arose. This was seen to be achievable by phasing in irrigation over time to gradually reduce the reliance upon the river or coastal dune rapid infiltration discharge.

The combined treatment and discharge options initially preferred by the Stakeholder Group in September 2017 were:

- 1a – Status Quo System with UV post-treatment prior to existing River Discharge
- 1b – HRLP-OLF System and River Discharge
- 2 - Rapid Infiltration (RI) System and Coastal Dune Discharge

They indicated that the RI system would need additional treatment in order to be acceptable, primarily UV to remove pathogens. They also expressed a preference for the discharge from the coastal dune system to directly enter the sea instead of the lagoon and/or river.

In addition to these wastewater system improvements, the Stakeholder Group were supportive of WDC assisting with rural landowner improvements across the Wairoa River's catchment to help improve the river's water quality before it reached urban Wairoa as this had potential for greater water quality outcomes throughout the catchment compared with focusing too much on the wastewater discharge at the bottom of the catchment. Based on this, a package of actions to address both rural contributions and urban wastewater discharges was proposed, with WDC's funding for its wastewater infrastructure obviously dominating its contributions to management of rural issues.

8.5 Development and Selection of the Preferred Option

On 16 October 2017 the Stakeholder Group met again to consider the implications of the three preferred options that they had identified in September 2017, with a goal of identifying a single option that could then be refined and consented. Some concept plans and descriptions of each preferred option including their effects on the core values and assessments against the evaluation criteria were presented to the Stakeholder Group for the group's members to evaluate.

During the 16 October 2017 meeting the Stakeholder Group repeated their desire to incorporate some irrigation into the long-term solution so that the river discharge could be reduced and perhaps even completely stopped in the future. Despite this aspiration, they acknowledged that irrigation of 100 % of the wastewater was impracticable in the short term and possibly in the long term due to the need for very large areas of land and very large storage facilities. The cost of this was also acknowledged to be unaffordable unless it could be phased in over a long period of time (30 years or more).

Filtration and UV treatment were confirmed by the Stakeholder Group on 16 October 2017 as being essential for the river discharge to be acceptable to the community and to provide assurances that public health and recreational opportunities were protected. The Stakeholder Group rejected the RI option but remained interested in exploring how a HRLP-OLF system could be designed and operated between the UV outlet and a river discharge outfall. A continuous 24/7 river discharge regime was not discounted, especially during high river flows. This stance included an acceptance that a river discharge would continue for the foreseeable future and that it would incorporate some additional storage and increased overall costs, but it was believed to be an affordable solution if irrigation and storage were developed gradually over a long timeframe of 20-30 years.

UV disinfection treatment was highly favoured by the Stakeholder Group on 16 October 2017 because it brought the treated wastewater quality closer to drinking water standards and ensured that public health concerns for the river discharge and any other discharge system were addressed. It also would not become redundant as river discharges were phased out and replaced with the favoured alternative land discharge systems. In order to ensure that UV is effective, filtration of the treated wastewater is necessary between the WWWTP outlet and the UV chamber inlet. This provided a further improvement to the treated wastewater quality at no additional cost to the UV system's requirements.

The irrigation aspect of the preferred discharge option was agreed by the Stakeholder Group on 16 October 2017 to focus initially on land near WWWTP where landowners had already expressed some interest in allowing irrigation, and on WDC's forested areas of the Wairoa landfill property. The practicality of irrigation was accepted as being primarily a summer discharge at deficit rates to avoid concerns with soil quality, erosion, nutrient losses, and runoff, but this also achieved protection of groundwater quality and avoided concerns about potential effects on nearby surface water. The volume and location of storage was left for future implementation discussions to decide.

The October 2017 Stakeholder Group meeting agreed that the preferred option would include the following features:

- Installation of disinfection (probably filtration and UV) at the outlet of the WWWTP;
- Possible installation of HRLP-OLF between the UV system and river discharge outfall;
- Continued use of the river discharge outfall, perhaps without restrictions on timing such as overnight out-going tides; and
- Development of irrigation and storage over the long term (30 years or more) to reduce and perhaps ultimately cease river discharges.

8.6 Refinement of the Preferred Option

The Stakeholder Group developed the details of the wastewater system during their final meeting on 13 November 2017 to address their views of the best balance of improvements which constituted the best overall value. The consideration of factors and works within the entire Wairoa River catchment had also become important features to include in WDC's programme to support the continued river discharge with gradual irrigation development as integral parts of the BPO, provided that WDC's investment primarily went into Wairoa's wastewater infrastructure.

HRLP-OLF systems were rejected by the Stakeholder Group on 13 November 2017 because of their minimal cultural acceptability and less than desired reductions in treated wastewater volumes and quality that were ultimately flowing into the river and/or coastal environment. HRLP was also seen as a large investment in a land passage system that may become redundant in future as irrigation was developed. Consequently, both HRLP and RI systems were abandoned as components of the Stakeholder Group's preferred discharge system.

The key aims of the proposed programme of parallel work streams were to implement changes over a long timeframe in an affordable manner that would maximise irrigation of treated wastewater to farm land and reduce or ideally cease the discharges to the river, at least during summer months if it is found to not be possible all year round. Along with these measures it included WDC support of actions in the upstream rural catchment to improve the river's water quality before it reached Wairoa. It was also noted that if external funding was provided there may be greater adoption of changes quicker, particularly implementation of storage and greater irrigation areas.

The Stakeholder Group agreed during their 13 November 2017 meeting to recommend that WDC adopt the programme of multiple parallel work streams to improve the wastewater discharge and the Wairoa River quality across more of its catchment. Responses from public meetings and hui-a-hapu during August to December 2017 indicated that this approach was widely endorsed by the Wairoa community.

WDC's Engineering Manager presented a report to the Councillors' meeting on 30 January 2018 recommending that WDC adopt the proposal, which the Councillors agreed to adopt. The components adopted by WDC are summarised below:

Wastewater Infrastructure Improvements

- **Extra treatment**
  - Filtration - sand/media to remove algae and particulate
  - Disinfection - Ultra Violet Light Treatment to reduce bugs even further than curent treatment
- **Reticulation upgrades**
  - Sewer pipe replacement
  - Pump station upgrades
- **Discharge management**
  - Ceasing illegal connections
  - Add storage to allow for continuous slower dicharge rate
  - Maintain existing discharge
  - Make upgrades
  - Change to 24/7 discharge
  - Make changes over time

Wastewater Irrigation

- **Irrigate neighbouring land**
  - Adjacent land
  - Potentially council land includng Landfill forestry
  - Other farmers in area as needed
- **Provide some storage to reduce summer river discharge**
- **Develop over time based on willingness and funding**

Catchment Advocacy

- **Contribute to driving catchment improvements**
- **WDC to be part of catchment decisions**
- **Work with HBRC and community to make changes**
- **Work with community to create opportunities**
- **Partial funding of catchment administration**

The aims of the integrated programme are:

- to implement changes over a long timeframe in an affordable and integrated manner;
- to reduce the flows needing pumping and treatment so that pump station overflows cease and treatment at WWWTP can be more effective;
- to disinfect the treated wastewater prior to discharge so it avoids public health concerns when discharged (particularly to the river);
- to store treated wastewater for delayed irrigation and to extend the timeframe for ceasing all discharges to the river;
- to extend irrigation schemes so that the nutrients and water are beneficially recycled and to reduce discharges to the river so that they only occur during wetter seasons; and
- to generate improvements to river water quality upstream of Wairoa which are potentially much greater than would result from complete removal of Wairoa's wastewater from the river.

The timing of implementing each component is important to ensure that it is affordable for the community, and the following timing was proposed and subsequently adopted by WDC:

Within 5 Years

- Improvement of sections of the reticulation system (i.e. pipe relining)
- Improve treatment of effluent discharging from the WWTP to the estuary, allowing for 24 hour discharge
- Add an area of irrigation (<50 ha) close to treatment ponds
- WDC to advocate for Wairoa River Catchment initiatives

Within 10 years

- Expand wastewater irrigation area to WDC forestry block (landfill area) and neighbouring land
- Continue reticulation improvements
- Develop storage capacity to make treatment more effective and irrigation options more viable
- Catchment projects underway (i.e. riparian planting and retirement of grazing land in priority sub-catchments)

Within 20 years

- Further irrigation areas identified and infrastructure put in place (i.e. up to 300 ha of irrigation)
- Catchment project works have covered a significant portion (to be determined) of the catchment area

Within 30 years

- Removal of a significant portion(to be determined) of the wastewater discharge to the river
- Further irrigation areas identified (i.e. up to 600 ha of irrigation)
- The catchment area has had project works established over much of its area and maintenance of these areas will be ongoing

8.7 Public Consultation

The hui-a-hapu and community consultation feedback from public meetings, newspaper articles, website information, and public workshops during August to December 2017 confirmed that the selection criteria used by the Stakeholder Group and the final preferred option were acceptable and representative of the community's views on the preferred future management and discharge of Wairoa's treated wastewater. The Consultation Summary and its supporting documentation indicate the extent of consultation and its outcomes.

Additionally, the 2018-28 LTP consultation during May-June 2018 included descriptions of the proposed programme and budgets for its relevant components. The limited feedback from the community was relied upon by Councillors to approve the activities and budgets as originally proposed.

Since the development of the proposal, there have also been media releases, public meetings and events regarding support for environmental improvements along the Wairoa River. Funds have become available through several sources for community planting and environmental enhancement projects. There is clear community support and activity that is improving the river environment. Publicity is also raising public awareness and participation in these projects.

9 BPO ASSESSMENT

9.1 BPO Aims

As noted in the BPO definition in Section 3.1 above, the BPO must use the most appropriate current technologies that provide the most benefits for the least impacts on the selected receiving environment and at an affordable cost for its community. Due to competing and often conflicting demands, the BPO is typically the best balance of the range of options and view points.

9.2 Treatment BPO

The treatment performance of WWWTP has been adequate for its design and river receiving environment. Recent and future reticulation improvements will reduce the flow rates which will assist with maintaining or slightly improving its treatment performance. More consistent flows will at least improve the consistency of treatment.

There is no need to improve treatment except to remove pathogens to improve the acceptability of the discharge into the river and onto farms. The most effective and adaptable treatment technology for pathogen control is filtration and UV irradiation, and this is most effective when installed at the outlet of the WWWTP ponds. It would suit the existing WWTP design and its current effluent quality. It can be sized and operated to cope with fluctuating flows. It could be partly bypassed during storm events when the river is already carrying large loads of silt and pathogens, and therefore is insensitive to elevated wastewater pathogens and is not being used for recreational or fishing purposes.

The addition of filtration and UV irradiation as the **only** change to the wastewater treatment process is seen as the BPO because it is the most appropriate technology for the type of WWTP, wastewater flow regime, and wastewater parameters that require attention. It is also financially affordable and efficient.

Further treatment upgrades are not ruled out; but are best determined when inflow management has been further refined (once the proposed significant I&I have been completed) and the flow and composition parameters have been established. Also, particular land discharge opportunities may arise that have specific treatment requirements, and these can be implemented over time as needed.

9.3 Discharge BPO

The ocean and coastal dunes were found to be unacceptable discharge options despite potentially being more practicable and/or affordable than irrigation to land. HRLP-OLF and RI systems were rejected by the Stakeholder Group because they were seen as providing little benefit for cultural (tokenism) and environmental values, and would potentially become redundant as irrigation is developed in the long term. They therefore are **not** features of the BPO.

The ideal receiving environment is land, irrigated using a deficit application regime which would avoid drainage and maximise plant uptake of nutrients and water. However, in the Wairoa locality the terrain is generally hilly, the soils are poorly drained, and typically deficit irrigation can only occur for a few months each year when soils are dry during summer. Very large areas of land and very large storage would be required to achieve this type of discharge system. It would also be very expensive and unaffordable for the community unless implemented over many years.

For all of these reasons, a deficit irrigation system **on its own** is **not** the BPO. However, it remains as the idealistic aspiration for the long-term future. It is accepted that the discharge BPO for WWWTP **must** include a continuation of the discharge to the river, at least in some form and for the foreseeable future. The BPO does however include the gradual and on-going development of deficit irrigation across farm land, with active on-going efforts to keep expanding the irrigated land areas and optimise the storage management and rates of irrigation to minimise (and hopefully ultimately cease) the discharges to the river.

The existing river discharge was not supported due to conflict with cultural values and its contributions of pathogens and other contaminants to the river which can lead to public health and perception concerns. A land passage system was not accepted as providing adequate treatment or cultural benefit to allow a river discharge to continue under its current framework. The minimum means of making a continuation of a river discharge acceptable was to remove pathogens prior to its discharge, as this addressed the cultural values (to some extent), public health, and recreation concerns. A filtration and UV system at the outlet to the WWWTP was accepted as suitable for this enhanced treatment and public health protection purpose. As indicated in Section 7.2.3 above, reductions of pathogen numbers in the discharge would enable it to be suitable for contact recreation within a short distance of the outfall.

The only practicable means of **reducing** the discharge volumes and frequencies to the river is to reduce I & I through reticulation improvements, and then store and irrigate as much as possible to land instead of the river. The expansion of irrigation schemes across greater land areas is the only feasible means of reducing the river discharges and potentially ceasing the river discharges in future if enough land and storage can be provided. The BPO must include discharges to the river until land discharges are able to reliably discharge every year's wastewater volume, and it is recognised that it may not be practicable to ever expect that enough storage and irrigation will be able to be developed in order to ensure that the river discharge will cease at all times of each year.

The UV treatment enables the river discharge regime to change from out-going overnight tide restrictions to potentially a continuous 24-hour 7-day regime, as it will improve the protection of public health and recreational values within a shortened distance of the outfall. In addition, the development of irrigation will reduce and ultimately avoid summer discharges when river discharges would be the most sensitive timing for low river flows, ecology, recreation, and public health.

The result of summer irrigation and UV treatment is that it is unnecessary to impose river flow restrictions on the discharges such as only allowing discharges when the river is at or above its median or 20FEP flow. Avoiding such river discharge restrictions also avoids the imposition of potentially large and expensive storage. It also avoids needing to enlarge or duplicate the river outfall pipeline to cope with discharging stored volumes at very high flow rates over very short timeframes.

There is a practical need to keep the river outlet clear of silt, so continuous flows are better than intermittent flows for preventing the settlement of river silt into the outlet. A 24/7 discharge also avoids needing to enlarge or duplicate the river outfall pipeline to cope with flows, as large storm flows won't need to be stored and discharged later in a short timeframe at high velocity. An additional benefit of a 24/7 river discharge regime is that it won't need storage at WWWTP. It is noted, however, that ceasing the river discharge during summer months and shoulder seasons will mean that siltation of the outfall needs to be managed effectively.

10 CONCLUSIONS

A thorough BPO selection process has been followed by WDC using technical advisors, a targeted Stakeholder Group, hui-a-iwi, and public meetings to identify the concerns, design constraints, evaluation criteria, aspirations, and ranking methodology for assessing options. A wide range of potential combinations of changes to each section of the wastewater system provided an overview of the continuum of options. The options were narrowed down by the Stakeholder Group and then refined.

The BPO is considered to be continued discharge to Wairoa River while implementing a package of wastewater irrigation to a series of farms, reductions of reticulation leakage and pump station overflows, installation of filtration and UV treatment at the WWTP outlet, installation of treated wastewater storage, and support for wider Wairoa River catchment improvement projects.

The discharge aspects of the Package include:

- modest flow reductions (which reduce how much needs to be treated and discharged);
- filtration and UV treatment;
- discharges to the river potentially on a continuous 24/7 basis when storage is full and river flows are high;
- storage (gradually increasing over time); and
- irrigation gradually implemented across more farmland over time.

Each of these aspects are believed to be the BPO for Wairoa's wastewater system because:

- all components of the Package have been selected in order to function effectively as an integrated wastewater management and discharge system;
- the timing of implementation in stages is affordable for the community and matches the timing of future flow reductions being achieved;
- flow reductions are important to minimise pumping requirements, stabilise wastewater treatment processes, minimise storage requirements, and minimise discharge volumes including pump station overflow discharges to the river during storm events;
- the scale of flow reductions proposed is affordable and will be sufficiently effective in the medium to long term to suit the future discharge regimes;
- the existing treatment plant design is acceptable for its loads and it does not need augmentation for performance reasons;
- the addition of filtration and UV disinfection to the outflow from WWWTP is primarily responding to cultural, recreational, and public health values when discharging to the river;
- the addition of filtration and UV disinfection potentially allows the river discharge timing to be changed from overnight out-going tides to continuous 24/7 when storage is full and river flows are high;
- the continuous 24/7 discharge to the river is seen as beneficial for minimising storage requirements, keeping the outfall free of silt, reducing flow rates and surcharging within the discharge pipeline, and avoiding the need to increase the discharge pipe capacity;
- storage is an expensive aspect which is best implemented as irrigation areas are expanded because storage is mostly required for enabling deferred irrigation, not so much for the avoidance of river discharges;
- irrigation is the preferred means of land discharge as an alternative to the river;
- deficit irrigation regimes will improve pasture resilience, improve soil nutrient levels, avoid erosion, prevent drainage, and protect groundwater and surface water quality;
- gradual irrigation implementation is affordable and allows for proving its effectiveness and lack of adverse effects while optimising the application regime;

- gradual irrigation allows for the identification and development of new areas as farmers become interested;
- upstream environmental improvements can clearly improve the river water quality much more than complete removal of WWWTP's discharge; and
- every aspect of the integrated Package is the most effective and efficient use of WDC's limited finances to manage the community's wastewater while protecting and enhancing the environment.

Although this BPO is likely to cost more than the WDC's 2015-25 Long Term Plan (2015-25 LTP) budget of $4.75M, it remains affordable at about $6-7M during 2018-28 as proposed in WDC's 2018-28 LTP and implementation of the remaining aspects of the Package over the following 25 years will ensure that the costs are spread affordably over those years.

The BPO described in this report can form the foundation for refining the details of the design, operation, and implementation timing of each aspect of the reticulation, treatment, storage, and discharge systems. Many of these details are intended to be developed and described in the Conceptual Design (LEI, 2018:C1.0) report. The BPO needed to be developed and confirmed to provide certainty of the key aspects of the future systems before such a conceptual design process could commence.

The future resource consent application documents will rely upon the conceptual design details for assessing its likely effects on the environment and developing appropriate resource consent conditions. The consent application will also rely upon this BPO report to satisfy the RMA requirement that a nominated discharge is the BPO for the system and its locality.

11 REFERENCES

Bioresearches (1996) Wairoa Sewage Treatment Plant Discharge Effects on the Wairoa Estuary

Cawthron (2007) Wairoa District Council Wastewater Outfall Dye Dilution Study

EAM (2007) Assessment of Ecological Effects on the Wairoa River Estuary from the Wairoa Wastewater Treatment Plant Outfall

EAM (2011) Investigation of groundwater infiltration of the Wairoa District Council reticulated wastewater network.

EAM (2012) Monitoring of Benthic Effects of the Wairoa District Council Wastewater Treatment Plant Outfall Discharge at Sites in the Lower Wairoa River Estuary: 2011 Survey

Hawkes Bay Regional Council (2006) Regional Resource Management Plan. Republished in part 1 October 2015.

Hawkes Bay Regional Council (2014) Regional Coastal Environment Plan

Lowe Environmental Impact (2015:A1I1) Wairoa Wastewater Discharge Re-Consenting Summary of Wastewater and Stormwater Overflow Issues

Lowe Environmental Impact (2017:A2I1) WWTP System Data and Compliance Summary

Lowe Environmental Impact (2017:A2I2) Current Outfall Pipe Description

Lowe Environmental Impact (2017:A3I2) Existing Environmental Data Summary

Lowe Environmental Impact (2017:A7D1) Discharge Options

Ministry for the Environment (2017) National Policy Statement for Freshwater Management 2014. Updated August 2017.

Ministry for the Environment and Department of Conservation (2010) New Zealand Coastal Policy Statement

Opus International Consultants (2017) Wairoa WWTP Outfall Model Build and Assessment Report

Triplefin (2018:A3I1b) Benthic Effects Monitoring of the Wairoa District Council Municipal Wastewater Outfall at Sites in the Lower Wairoa River Estuary: 2017 Survey

Wairoa District Council (2015) Long Term Plan 2015-25.

Wairoa District Council (2018) Long Term Plan 2018-28 Consultation Document. https://wairoadc.govt.nz/assets/Document-Library/Long-Term-Plan-2018-28/Consultation-Document-LTP-2018-28.pdf

Wairoa District Council (2018) Endorsement of the Preferred Way Forward for the Wairoa Wastewater Discharge Consent. Council paper for Wairoa District Council meeting agenda 30 January 2018. https://wairoadc.govt.nz/assets/Document-Library/Long-Term-Plan-2018-28/Supporting-Documents-2018-28/Wastewater-Discharge-Consent-Best-Practicable-Option-report.pdf