# Discharge Options

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Prepared for

**Wairoa District Council**

Prepared by

L O W E
Environmental
I m p a c t

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# Discharge Options

## Wairoa District Council

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# 1 INTRODUCTION

## 1.1 Background

The Wairoa wastewater treatment system requires a replacement consent by May 2019. All discharge options, including the status quo and any preferred option, will have implications for the Wairoa District Council (WDC) and its ratepayers. Consideration of the cultural, recreational, environmental and financial values for a range of discharge options will help determine the best practicable option (BPO) for the Wairoa community.

## 1.2 Purpose

This report summarises and brings together combinations of generic reticulation, treatment, storage and discharge options. The summary of the discharge options shows how they are interdependent with storage volumes, treatment options, and the scale of inflow and infiltration (I & I) improvements.

The report is intended to provide a wide range of options which reflects the aspirations of the community (i.e. in particular the removal of the discharge from the river). This report is not intended to provide any recommendations for modifications to the current system, but merely identify a range of potential options which could be considered. The impact on the four pillars of social, recreational, cultural and financial are considered.

## 1.3 Scope

A range of practical options for treatment of Wairoa's wastewater are presented. Costs for each of the options are presented along with consideration as to the impact on the pillars of cultural, economic, recreational and environment.

The assessment is a very high level and the costs are approximate. While the costs include a contingency factor, they are more for relative comparison that absolute quantification.

# 2 OVERVIEW

## 2.1 General

This summary of options presents 22 reticulation, treatment, storage and discharge combinations. These options have been chosen based on knowledge of wastewater practices and are a very high level view of options.

The storage, treatment, and I & I options include the status quo and appropriate (but limited) upgrade options. This is not an exhaustive list, but it essentially encompasses the full spectrum of options and provides an indication of what is available and potentially suitable for the future of Wairoa's wastewater discharge.

## 2.2 Key Option Components

The following options for each component have been considered:

- **Discharge** options have been categorised as either:
  1. Status Quo;
  2. River;
  3. Ocean;
  4. Land; or
  5. Combination.

- **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).

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

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

- **Discharge:**
  - River – existing outfall;
  - River – new outfall;
  - 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.

Each option is presented in the following section and has a detailed description of what is included and the reasons behind its inclusion as an option. Additionally, estimated costings of each option have been identified. These are shown as both the total cost and the breakdown of annual cost per connection if the capital investment is financed over a 30-year loan period.

The key benefits and disadvantages are outlined and link to the pillar assessment of the cultural, environmental, financial, and recreational values. An explanation of the effect of each discharge on these values is included.

## 2.3 Option Combination Summary

The following table sets out a summary of the 22 option combinations.

**Table 2.1: Option Combinations**

| Option Code | Option Description |
|---|---|
| 1.1 | Status Quo |
| 1.2 | River-low bugs/24-hour continuous discharge |
| 2.1 | River-lowbugs |
| 2.2 | River-low bugs/HRLP-OLF |
| 2.3 | River-HRLP-OLF |
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| 5.2 | Combo-River/land-HRLP-OLF/90 day storage buffer |
| 5.3 | Combo-50% flow/River/land-HRLP-OLF/10 day storage buffer |
| 5.4 | Combo-50% flow/River/land-HRLP-OLF/90 day storage buffer |

## 2.4 Assumptions

The development of options, and in particular costs for the options, requires a series of assumptions to be made. These include:

**Costs:**
All costings are preliminary estimates, and costs generated from detailed design assessments could be less or perhaps significantly more expensive than the ranges indicated in this preliminary option assessment process.

**Storage:**
Storage pond sizing has been based on average daily winter flows of 4,000 $m^3$/d currently and 2,000 $m^3$/d for options where major reticulation improvements are included. These flows were used because elevated winter flows will generally drive storage volumes while summer flows will generally be discharged continuously when used for irrigation.

Discharge to river options 1.2 and 2.1-2.5 did not include any increased storage volume options because there is no benefit gained from larger storage. It is noted that, regardless of river flows being high or low, the tides and river flows provide good dilution and flushing volumes in the estuary.

All combo options 5.1-5.4 have assumed that storage of 120 days is not necessary, as the river should be able to receive wastewater more frequently during winter and the land can receive wastewater frequently during summer.

**Disinfection:**
UV treatment to reduce pathogen concentrations requires filtration as a pre-treatment, so this is included in all discharge to river options except 2.3 and in all discharge to land or combo options.

All combo options 5.1-5.4 include filtration and UV only for the irrigated wastewater component. It is not necessary for the river discharge and also reduces the size of the filtration/UV units and consequently reduces costs.

**Land Passage:**
HRLP works best for stable flow rates. Multiple HRLP beds could be used to expand the system to cope with storm flows. OLF could be a wetland or a vegetated swale - there are many potential design options.

The residual wastewater from HRLP-OLF will need to be collected and then pumped through the pipeline to the river or ocean discharge location, as pressure will be needed to force it out into the river or ocean environment.

All combo options 5.1-5.4 have assumed that the river discharge will require HRLP-OLF in order to address cultural values prior to the wastewater entering the river.

**Potential New River Discharge:**
A new river discharge location could be further up the main river stem, within the estuary, or within the lagoons east and west of the estuary. For cultural and environmental reasons (poor dispersion and flushing), the lagoons must be discounted as a viable option. Other river and estuary locations are unlikely to be assessed as any better than the existing location.

**Discharge to Ocean Considerations:**
Discharge to ocean options 3.1 and 3.2 did not include any increased storage volume or reticulation improvement options because there is no benefit gained from larger storage or reduced flows. It is noted that the ocean provides very high dilution regardless of wastewater flows and quality.

Discharge to ocean options do not require filtration or UV for pathogens because the ocean will rapidly disperse the discharge without adverse effects and is unlikely to form a visible plume. The only reason for any treatment improvement (land passage) is to address cultural values.

Discharge to ocean could remain restricted to overnight, but without out-going tide time restrictions. However, there is no environmental or recreational reason why it couldn't occur continuously on a 24 hour basis.

Discharge to ocean location could be near shore (500 m from the Hawke Bay side of the spit) or further off-shore (1 km or more off-shore). The advantages and disadvantages of near shore should be considered before considering the more expensive far shore option.

**Discharge to Land Considerations:**
Discharges to land options 4.1-4.8 require 90-120 days of storage due to the reasonably wet climate, poor soil drainage, and low soil water holding capacities. Only the rapid infiltration option can cope with smaller storage, but this is dependent upon the drainage from the rapid infiltration basin entering surface water in an environmentally sustainable manner and rate.

Land uses for options 4.1-4.8 could be pasture or forestry, but the actual type of land use is not critical to the assessments of values. The key factor is the daily application rate, as this determines the area of land required which affects the cost of purchasing or leasing land and the extent and cost of irrigation infrastructure.

Irrigation requires filtration to prevent nozzle blockages. Irrigation of pasture may require UV treatment, so this has been included in all land discharge options.

Discharges to land are very unlikely to be able to cope with the largest emergency storm flows, so a relief valve of discharging to the river or ocean must be included for such rare events.

Rapid infiltration option 4.9 requires dunes for highly porous and free-draining soils. There is a narrow strip of dune soils along the coast, but the availability of suitable sites close to the WWTP is limited. The coast and ocean processes are highly active/dynamic, so any site will need to be protected from coastal erosion. Rapid infiltration can also destabilise the dunes and be lost in storm erosion.

# 3 DISCHARGE OPTIONS

## 3.1 Status Quo

**Option:** 1.1 Status Quo
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** No changes or additional treatment technologies.
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** No changes (current river discharge location and timing controls - out-going tides during 6 pm-6 am)

**Approximate Cost Ranges and Associated Increases in Annual Rates**

| Total cost range: | $1.8M to $2.4M | Annual rates range: | $ 73.70 to $ 97.80 |
|---|---|---|---|

**Detailed Description:**
Existing reticulation renewal programme. No changes to treatment, storage, discharge location or discharge regime.

**Reasons for Inclusion in Option Assessment:**
Baseline against which other options need to be assessed. Current environmental effects and treatment performance are acceptable, but it is culturally unacceptable.

**Key Benefits:**
Minimal costs due to a lack of any upgrades or changes to any aspects of the wastewater system.

**Key Disadvantages:**
No environmental, cultural, or recreational improvements for the river. May be unacceptable for consenting.

**Pillar Assessments**

| Recreational Values | Environmental Values |
|---|---|
| The time of disharge should not impact river users, but could impact on public perception. Potential for public health concern due to limited pathogen treatment. | No more than minor impact on receiving environment from discharge, however in-river biota counts are low due to upstream silt sources. Discharging on out-going tides ensures good flushing and protects estuary except when river mouth is closed. |
| **Cultural Values** | **Financial Values** |
| Direct discharge to water without land passage is culturally offensive. | Consenting will be the only cost because nothing else is being changed or upgraded. The consent for this option is likely to be more expensive than all others due to cultural and community opposition. |

**Option:** 1.2 River-low bugs/24-hour continuous discharge
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** Filtration and UV to reduce pathogens
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** No change to river discharge location, but allowing for continuous 24-hour discharges.

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $1.6M to $2.2M Annual rates range: $ 62.66 to $ 86.09

**Detailed Description:**
Existing reticulation renewal programme. Filtration & UV to reduce pathogens. No additional storage. Continuous discharge to river. If necessary, summer discharges could be restricted to overnight out-going tides.

**Reasons for Inclusion in Option Assessment:**
Simpler discharge regime, but still addresses public health concerns.

**Key Benefits:**
Simplified discharge regime that helps keep the river discharge outlet clear of silt and needs no storage. UV treatment ensures that public health and recreational values are addressed.

**Key Disadvantages:**
No cultural improvements for the river, and minimal environmental improvement. May be unacceptable for consenting due to 24-hour direct river discharge without any cultural mitigation.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Will impact on public perception (24-hour discharges may be less acceptable than overnight restrictions), but UV treatment of pathogens ensures there is no risk to public health despite 24 hour discharge. | Low pathogens protects the river biota. Could have minor impact on upstream environment during in-coming tides. May have more of a dilution effect if discharging at lower rates over 24 hours. |
| **Cultural Values** | **Financial Values** |
| Direct discharge to water without land passage is culturally offensive. UV treatment of pathogens does not address this cultural value. | Consenting will be more expensive due to cultural and community opposition; 24-hour discharges may be contentious. Incorporation of UV treatment will be higher due to its capacity requirement for current flows. Costs of major reticulation upgrades, storage, and land expansion have been avoided. |

## 3.2 River

**Option:** 2.1 River-low bugs
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** Filtration and UV to reduce pathogens
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** No change to river discharge location or timing.

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $1.8M to $2.4M Annual rates range: $ 73.70 to $ 97.80

**Detailed Description:**
Existing reticulation renewal programme. Filtration & UV to reduce pathogens. No additional storage. Current discharge regime & location.

**Reasons for Inclusion in Option Assessment:**
Additional treatment solely to address pathogen numbers discharged to the river, which is the only environmental and public health concern, while maintaining current river discharge to minimise costs.

**Key Benefits:**
Addresses the public health risk of pathogens in the river. Minimal cost to construct and operate additional treatment.

**Key Disadvantages:**
No cultural improvements for the river and may be unacceptable for consenting. Treatment of current flows will require the largest capacity UV system of all options.

**Pillar Assessments**

| Recreational Values | Environmental Values |
|---|---|
| The time of disharge should not impact river users, but could impact on public perception. UV treatment of pathogens ensures there is no risk to public health. | Low pathogens protects river biota and ensures a less than minor impact on receiving environment from discharge. Discharging on out-going tides ensures good flushing and protects estuary except when river mouth is closed. |
| **Cultural Values** | **Financial Values** |
| Direct discharge to water without land passage is culturally offensive. UV treatment of pathogens does not address this cultural value. | Consenting will be more expensive due to cultural and community opposition. Incorporation of UV treatment will be higher due to its capacity requirement for current flows. Costs of major reticulation upgrades, storage, and land expansion have been avoided. |

**Option:** 2.2 River-low bugs/HRLP-OLF
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** HRLP or overland flow, then filtration and UV to reduce pathogens.
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** No changes to river discharge location or timing.

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $2.M to $3.2M Annual rates range: $ 79.71 to $ 129.83

**Detailed Description:**
Existing reticulation renewal programme. HRLP/OLF to address cultural and environmental values. Filtration & UV to reduce pathogens (probably after HRLP/OLF). No additional storage. Current discharge regime & location.

**Reasons for Inclusion in Option Assessment:**
Additional treatment to address pathogens and cultural and environmental values while maintaining current river discharge to minimise costs.

**Key Benefits:**
Additional treatments address public health and cultural values while also improving the river environment.

**Key Disadvantages:**
Large modular HRLP and UV systems will be needed to handle the highly variable and large daily flows. May be unacceptable for consenting due to reliance on river receiving environment.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| The time of disharge should not impact river users, but could impact on public perception. HRLP design could be visually appealing, but position of HRLP could impact on current land users. Pathogen treatment ensures there is no health risk for contact recreation. | HRLP allows for some nutrient recycling and benefit to artificial wetland environment. Low pathogens and HRLP protect river biota and ensures a less than minor impact on receiving environment from discharge. Discharging on out-going tides ensures good flushing and protects estuary except when river mouth is closed. |
| **Cultural Values** | **Financial Values** |
| Favourable. Treated wastewater passes over papatuanuku before discharge to water. Pathogen treatment improves acceptability of kaimoana for consumption. | The costs of HRLP and UV treatment will be higher to cope with current flows, but the costa of major reticulation upgrades and storage have been avoided. Cost of consenting could be lower in recognition of the design addressing cultural and environmental values. |

**Option:** 2.3 River-HRLP-OLF
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** HRLP or overland flow.
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** No changes to river discharge location or timing.

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $1.7M to $3.M Annual rates range: $ 68.67 to $ 118.12

**Detailed Description:**
Existing reticulation renewal programme. HRLP/OLF to address cultural and environmental values. No filtration & UV to reduce pathogens. No additional storage. Current discharge regime & location.

**Reasons for Inclusion in Option Assessment:**
Additional treatment to address cultural and environmental values while maintaining current river discharge to minimise costs.

**Key Benefits:**
HRLP treatment addresses cultural values and contributes to improving the river environment.

**Key Disadvantages:**
Does not address the public health risk of pathogens in the river. A large modular HRLP will be needed to handle the highly variable and large daily flows. May be unacceptable for consenting due to reliance on river receiving

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Lack of pathogen treatment after HRLP could increase pathogen counts at outlet to river, but time of disharge should not impact river users, but could impact on public perception. HRLP design could be visually appealing, but position of HRLP could impact on current land users. | HRLP protects river biota and ensures a less than minor impact on receiving environment from discharge. HRLP allows for some nutrient recycling and could be an attractant for wildlife, but could increase pathogen counts at outlet to river. |
| **Cultural Values** | **Financial Values** |
| Favourable, as treated wastewater passes over papatuanuku before discharge to water, but the lack of pathogen treatment does not improve the acceptability of kaimoana for consumption. | The cost of HRLP will be higher to cope with current flows, but the costs of major reticulation upgrades, storage, and UV have been avoided. Cost of consenting could be lower in recognition of the design addressing cultural and environmental values. |

**Option:** 2.4 River-50% flow/low bugs/HRLP-OLF
**Reticulation:** Major upgrades (flows of 1,800 $m^3$/d average and 3,500 $m^3$/d peak)
**Treatment:** HRLP or overland flow, then filtration and UV to reduce pathogens.
**Storage:** No changes (5,400 $m^3$ for 3-4 days of inflows).
**Discharge:** No changes to river discharge location or timing.

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $15.6M to $34.4M Annual rates range: $ 623.04 to $ 1,379.12

**Detailed Description:**
Intensive reticulation renewal programme to reduce flows. HRLP/OLF to address cultural and environmental values. Filtration & UV to reduce pathogens (probably after HRLP/OLF). No additional storage. Current discharge regime & location.

**Reasons for Inclusion in Option Assessment:**
Intensive reticulation to improve flow management, which will reduce the sizes and improve the stability of UV and HRLP systems. Additional treatment to address public health, cultural and environmental values.

**Key Benefits:**
Filtration and UV units can be smaller than would be needed for current flows. HRLP will receive more consistent gentle flows and can be smaller than would be needed for current flows. Additional treatments address public health and cultural values while also improving the river environment.

**Key Disadvantages:**
Significant reticulation upgrade costs may be unaffordable for the community or less efficient expenditure than treating and dsicharging the current flows. May be unacceptable for consenting due to reliance on river receiving environment.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| The time of disharge should not impact river users, but could impact on public perception. HRLP design could be visually appealing, but position of HRLP could impact on current land users, however the smaller size for smaller flows will mitigate this. Pathogen treatment ensures there is no health risk for contact recreation. | Lower flow reduces effects on environment. HRLP allows for some nutrient recycling and benefit to artificial wetland environment. Low pathogens and HRLP protect river biota and ensures a less than minor impact on receiving environment from discharge. Discharging on out-going tides ensures good flushing and protects estuary except when river mouth is closed. |
| **Cultural Values** | **Financial Values** |
| Favourable, as treated wastewater passes over papatuanuku before discharge to water. Pathogen treatment improves acceptability of kaimoana for consumption. | The costs of HRLP and UV treatment will be lower due to reduced flows, but the cost of major reticulation upgrades has been incurred instead. The cost of storage has been avoided too. Cost of consenting could be lower in recognition of the design addressing cultural and environmental values. |

**Option:** 2.5 River(new)-low bugs -HRLP-OLF
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** HRLP or overland flow, then filtration and UV to reduce pathogens.
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** New river discharge location but perhaps retain existing discharge timing.

**Impracticable, no suitable sites with any environmental gains**

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $3.2M to $5.2M Annual rates range: $ 129.16 to $ 207.91

**Detailed Description:**
Existing reticulation renewal programme. HRLP/OLF to address cultural and environmental values. Filtration & UV to reduce pathogens (probably after HRLP/OLF). No additional storage. Current discharge regime but at a new location within the river.

**Reasons for Inclusion in Option Assessment:**
A new river discharge location has been discussed previously and needs to be considered as a potential option.

**Key Benefits:**
A different river discharge location might be more acceptable to the community, ensure faster dispersion and flushing out to sea, and less prone to siltation problems than the current river discharge location. Additional treatments address public health and cultural values while also improving the river environment.

**Key Disadvantages:**
A changed location within the river may be seen as providing no benefit to the river while adding unnecessary costs. Large modular HRLP and UV systems will be needed to handle the highly variable and large daily flows. May be unacceptable for consenting due to reliance on river receiving environment.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| The time of disharge should not impact river users, but could impact on public perception. HRLP design could be visually appealing, but position of HRLP could impact on current land users. Pathogen treatment ensures there is no health risk for contact recreation. New location of discharge may impact on where exisitng recreational activities are pursued. | HRLP allows for some nutrient recycling and benefit to artificial wetland environment. Low pathogens and HRLP protect river biota and ensures a less than minor impact on receiving environment from discharge. Discharging on out-going tides ensures good flushing and protects estuary except when river mouth is closed. |
| **Cultural Values** | **Financial Values** |
| Favourable, as treated wastewater passes over papatuanuku before discharge to water. Pathogen treatment improves acceptability of kaimoana for consumption. | The costs of HRLP and UV treatment will be higher to cope with current flows, but the costs of major reticulation upgrades and storage have been avoided. Cost of consenting could be lower in recognition of the design addressing cultural and environmental values. |

## 3.3 Ocean

**Option:** 3.1 Ocean
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** No changes
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** New ocean discharge location but perhaps retain existing discharge timing.

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $7.5M to $27.M Annual rates range: $ 300.31 to $ 1,081.11

**Detailed Description:**
Existing reticulation renewal programme. No changes to treatment or additional storage. New ocean outfall (either 500 m off-shore or 1 km off-shore). Current overnight out-going tide or continuous 24-hour discharge regime.

**Reasons for Inclusion in Option Assessment:**
Discharge uses a nearby receiving environment with the highest capacity to receive and disperse the discharge without adverse effects.

**Key Benefits:**
The ocean has the greatest capacity to receive the discharge without timing or volume restrictions. No need to upgrade reticulation, treatment, or storage.

**Key Disadvantages:**
No cultural improvements for effects on water, potentially culturally offensive pipeline route through estuary/lagoon and spit, and installing a pipeline to the ocean outfall will be expensive and technically difficult to

**Pillar Assessments**

| Recreational Values | Environmental Values |
|---|---|
| Less than minor impact except close to the discharge structure, may impact on public perception due to lack of pathogen treatment and/or if discharge is visible in the ocean. | Very low impact on receiving environment due to very large and rapid dispersion. |
| **Cultural Values** | **Financial Values** |
| Direct discharge to water without land passage is culturally offensive, but discharge to the ocean seems preferable to using the river. | Construction of an ocean outfall is expensive due to its technical design and installation requirements. Costs of major reticulation upgrades, additional treatment, storage, and land expansion have been avoided. Consenting costs will depend on the level of public support or opposition. |

**Option:** 3.2 Ocean-HRLP-OLF
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** No changes except HRLP-OLF on outlet.
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** New ocean discharge location but perhaps retain existing discharge timing.

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $8.2M to $28.3M Annual rates range: $ 326.34 to $ 1,133.16

**Detailed Description:**
Existing reticulation renewal programme, and no additional storage. HRLP to address cultural values prior to new ocean outfall (either 500 m off-shore or 1 km off-shore). Current overnight out-going tide or continuous 24-hour discharge regime.

**Reasons for Inclusion in Option Assessment:**
HRLP addresses cultural values and discharges to a nearby receiving environment with the highest capacity to receive and disperse the discharge without adverse effects.

**Key Benefits:**
HRLP addresses cultural values while discharging to the ocean has the greatest capacity to receive the discharge without timing or volume restrictions. No need to upgrade reticulation, treatment, or storage.

**Key Disadvantages:**
Large modular HRLP system will be needed to handle the highly variable and large daily flows. Potentially culturally offensive pipeline route through estuary/lagoon and spit, and installing a pipeline to the ocean outfall will be expensive and technically difficult to achieve.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Less than minor impact except close to the discharge structure, may impact on public perception due to lack of pathogen treatment and/or if discharge is visible; HRLP design could be visually appealing; position of HRLP could impact on current land users. | Very low impact on ocean receiving environment due to very large and rapid dispersion; HRLP could be an attractant for wildlife, but could increase pathogen counts prior to discharge to ocean. |
| **Cultural Values** | **Financial Values** |
| Favourable, as treated wastewater passes over papatuanuku before discharge to water, and the ocean seems preferable to using the river. | Construction of an ocean outfall is expensive due to its technical design and installation requirements. The cost of constructing an HRLP is an additional cost, which will be reasonably signficant for managing the current flows. Costs of major reticulation upgrades and storage have been avoided. Consenting costs will depend on the level of public support or opposition. |

## 3.4 Land

**Option:** 4.1 Land-90 day storage buffer/irrigation rate 1
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** No changes except filtration and UV on outlet.
**Storage:** 90-day storage (360,000 $m^3$).
**Discharge:** New land irrigation system, applying an average of 5 mm/d

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $12.8M to $27.5M Annual rates range: $ 511.68 to $ 1,101.67

**Detailed Description:**
Existing reticulation renewal programme. Irrigation at a daily average of 5 mm/d. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 90 days of flows.

**Reasons for Inclusion in Option Assessment:**
100 % land discharge at highest daily rate possible with minimal storage and avoiding expensive reticulation upgrade.

**Key Benefits:**
River discharge is avoided if discharges to land exceed soil moisture limits in winter. Pasture benefits from water and nutrients. Avoids reticulation upgrade costs.

**Key Disadvantages:**
Large and expensive storage. Large irrigation area. May not be feasible during winter due to high soil moisture and wastewater flows.

**Pillar Assessments**

| Recreational Values | Environmental Values |
|---|---|
| Any current land use will be affected by when and where irrigation is applied. River discharge is avoided. | Low impact on environment; restricted storage may result in irrigation above soil moisture deficit |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku and some nutrients will be used to grow pasture. | Large storage and large irrigation area are costly, but costs of major reticulation upgrades have been avoided. Cost of consenting could be modest. |

**Option:** 4.2 Land-120 day storage buffer/irrigation rate 1
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** No changes except filtration and UV on outlet.
**Storage:** 120-day storage (480,000 $m^3$).
**Discharge:** New land irrigation system, applying an average of 5 mm/d

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $16.M to $34.M Annual rates range: $ 639.80 to $ 1,362.72

**Detailed Description:**
Existing reticulation renewal programme. Irrigation at a daily average of 5 mm/d. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 120 days of flows.

**Reasons for Inclusion in Option Assessment:**
100 % land discharge at highest daily rate possible with large storage while avoiding expensive reticulation upgrade.

**Key Benefits:**
River discharge is avoided if discharges to land exceed soil moisture limits in winter. Pasture benefits from water and nutrients. Avoids reticulation upgrade costs.

**Key Disadvantages:**
Very large and expensive storage. Large irrigation area. May not be feasible during winter due to high soil moisture and wastewater flows.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied. River discharge is avoided. | Med-low impact on environment, extra storage lowers risk of irrigating above soil moisture deficit |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku and some nutrients will be used to grow pasture. | Large storage and large irrigation area are costly, but costs of major reticulation upgrades have been avoided. Cost of consenting could be modest. |

**Option:** 4.3 Land-50% flow/90 day storage buffer/irrigation rate 1
**Reticulation:** Major upgrades (flows of 1,800 $m^3$/d average and 3,250 $m^3$/d peak)
**Treatment:** No changes except filtration and UV on outlet.
**Storage:** 90-day storage (180,000 $m^3$).
**Discharge:** New land irrigation system, applying an average of 5 mm/d

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $21.6M to $48.1M Annual rates range: $ 864.98 to $ 1,927.91

**Detailed Description:**
Intensive reticulation renewal programme to reduce flows. Irrigation at a daily average of 5 mm/d. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 120 days of flows.

**Reasons for Inclusion in Option Assessment:**
100 % land discharge at highest daily rate possible with large storage and reduced flows.

**Key Benefits:**
Storage size and irrigated land area have been minimised by upgrading reticulation. River discharge is avoided if discharges to land exceed soil moisture limits in winter. Pasture benefits from water and nutrients.

**Key Disadvantages:**
Large and expensive storage. Large irrigation area. May not be feasible during winter due to high soil moisture and wastewater flows.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied. River discharge is avoided. | Very low impact on environment and smallest irrigation land area; reduced flow and large storage ensure irrigation occurs at suitable rates and when most beneficial to soils and pasture; high safety margin with large storage volume. |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku and some nutrients will be used to grow pasture. | Large storage and large irrigation area are costly, and costs of major reticulation upgrades have also been incurred. Cost of consenting could be modest. |

**Option:** 4.4 Land-50% flow/120 day storage buffer/irrigation rate 1
**Reticulation:** Major upgrades (flows of 1,800 $m^3$/d average and 3,250 $m^3$/d peak)
**Treatment:** No changes except filtration and UV on outlet.
**Storage:** 120-day storage (240,000 $m^3$).
**Discharge:** New land irrigation system, applying an average of 5 mm/d

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $23.2M to $51.4M Annual rates range: $ 929.28 to $ 2,059.25

**Detailed Description:**
Intensive reticulation renewal programme to reduce flows. Irrigation at a daily average of 5 mm/d. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 120 days of flows.

**Reasons for Inclusion in Option Assessment:**
100 % land discharge at highest daily rate possible with large storage and reduced flows.

**Key Benefits:**
Storage size and irrigated land area have been minimised by upgrading reticulation. River discharge is avoided if discharges to land exceed soil moisture limits in winter. Pasture benefits from water and nutrients.

**Key Disadvantages:**
Large and expensive storage. Large irrigation area. May not be feasible during winter due to high soil moisture and wastewater flows.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied. River discharge is avoided. | Very low impact on environment and smallest irrigation land area; reduced flow and large storage ensure irrigation occurs at suitable rates and when most beneficial to soils and pasture; high safety margin with large storage volume. |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku and some nutrients will be used to grow pasture. | Large storage and large irrigation area are costly, and costs of major reticulation upgrades have also been incurred. Cost of consenting could be modest. |

**Option:** 4.5 Land-90 day storage buffer/irrigation rate 2
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** No changes except filtration and UV on outlet.
**Storage:** 90-day storage (360,000 $m^3$).
**Discharge:** New land irrigation system, applying an average of 0.8 mm/d

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $22.M to $59.8M Annual rates range: $ 880.60 to $ 2,392.92

**Detailed Description:**
Existing reticulation renewal programme. Irrigation at a daily average of 0.8 mm/d. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 90 days of flows.

**Reasons for Inclusion in Option Assessment:**
100 % land discharge at low daily rate with minimal storage and avoiding expensive reticulation upgrade.

**Key Benefits:**
River discharge is avoided if discharges to land exceed soil moisture limits in winter. Pasture benefits from water and nutrients. Avoids reticulation upgrade costs.

**Key Disadvantages:**
Very large land area required for irrigation and large storage pond. Unlikely to be feasible within soil moisture limits for more than a few dry months each year.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied. This option has one of the largest land area requirements, so potentially elevates the perception of effects on more neighbours and landowners. River discharge is avoided. | Low impact on environment but discharges to a larger land area; restricted storage may result in irrigation above soil moisture deficit more frequently than desirable, and this causes adverse effects on soils and pasture. |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku and most of the nutrients will be used to grow pasture. | Very large storage and very large irrigation area are costly, but costs of major reticulation upgrades have been avoided. Cost of consenting could be modest. |

**Option:** 4.6 Land-120 day storage buffer/irrigation rate 2
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** No changes except filtration and UV on outlet.
**Storage:** 120-day storage (480,000 $m^3$).
**Discharge:** New land irrigation system, applying an average of 0.8 mm/d

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $25.2M to $66.3M Annual rates range: $ 1,008.73 to $ 2,653.97

**Detailed Description:**
Existing reticulation renewal programme. Irrigation at a daily average of 0.8 mm/d. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 120 days of flows.

**Reasons for Inclusion in Option Assessment:**
100 % land discharge at low daily rate with large storage and avoiding expensive reticulation upgrade.

**Key Benefits:**
River discharge is avoided if discharges to land exceed soil moisture limits in winter. Pasture benefits from water and nutrients. Avoids reticulation upgrade costs.

**Key Disadvantages:**
Very large land area required for irrigation and very large storage pond. Unlikely to be feasible within soil moisture limits for more than a few dry months each year.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied. This option has one of the largest land area requirements, so potentially elevates the perception of effects on more neighbours and landowners. River discharge is avoided. | Med-low impact on environment, extra storage lowers risk of irrigating above soil moisture deficit |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku and most of the nutrients will be used to grow pasture. | Very large storage and very large irrigation area are costly, but costs of major reticulation upgrades have been avoided. Cost of consenting could be modest. |

**Option:** 4.7 Land-50% flow/90 day storage buffer/irrigation rate 2
**Reticulation:** Major upgrades (flows of 1,800 $m^3$/d average and 3,250 $m^3$/d peak)
**Treatment:** No changes except filtration and UV on outlet.
**Storage:** 90-day storage (180,000 $m^3$).
**Discharge:** New land irrigation system, applying an average of 0.8 mm/d

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $27.7M to $69.6M Annual rates range: $ 1,110.94 to $ 2,788.75

**Detailed Description:**
Intensive reticulation renewal programme to reduce flows. Irrigation at a daily average of 0.8 mm/d. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 90 days of flows.

**Reasons for Inclusion in Option Assessment:**
100 % land discharge at low daily rate with minimal storage and reduced flows.

**Key Benefits:**
Storage size and irrigated land area have been minimised by upgrading reticulation. River discharge is avoided if discharges to land exceed soil moisture limits in winter. Pasture benefits from water and nutrients.

**Key Disadvantages:**
Very large land area required for irrigation and moderate storage size. Unlikely to be feasible within soil moisture limits for more than a few dry months each year. Expensive reticulation upgrades.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied. River discharge is avoided. | Very low impact on environment; reduced flow concentrates wastewater but will decrease risk of reduced storage during times of soil saturation |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku and most of the nutrients will be used to grow pasture. | Large storage and very large irrigation area are costly, and costs of major reticulation upgrades have also been incurred. Cost of consenting could be modest. |

**Option:** 4.8 Land-50% flow/120 day storage buffer/irrigation rate 2
**Reticulation:** Major upgrades (flows of 1,800 $m^3$/d average and 3,250 $m^3$/d peak)
**Treatment:** No changes except filtration and UV on outlet.
**Storage:** 120-day storage (240,000 $m^3$).
**Discharge:** New land irrigation system, applying an average of 0.8 mm/d

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $29.4M to $72.9M Annual rates range: $ 1,175.23 to $ 2,920.08

**Detailed Description:**
Intensive reticulation renewal programme to reduce flows. Irrigation at a daily average of 0.8 mm/d. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 120 days of flows.

**Reasons for Inclusion in Option Assessment:**
100 % land discharge at low daily rate with large storage and reduced flows.

**Key Benefits:**
Storage size and irrigated land area have been minimised by upgrading reticulation. River discharge is avoided if discharges to land exceed soil moisture limits in winter. Pasture benefits from water and nutrients.

**Key Disadvantages:**
Very large land area required for irrigation and moderate to large storage size. Unlikely to be feasible within soil moisture limits for more than a few dry months each year. Expensive reticulation upgrades.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied. River discharge is avoided. | Very low impact on environment; reduced flow concentrates wastewater but less to apply; high safety margin with storage buffer |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku and most of the nutrients will be used to grow pasture. | Very large storage and very large irrigation area are costly, and costs of major reticulation upgrades have also been incurred. Cost of consenting could be modest. |

**Option:** 4.9 Land-rapid infiltration
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** No changes
**Storage:** No changes (5,400 $m^3$ for 2-3 days of inflows).
**Discharge:** New rapid infiltration to land discharge location but perhaps retain existing discharge timing.

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $4.3M to $9.9M Annual rates range: $ 172.68 to $ 394.48

**Detailed Description:**
Existing reticulation renewal programme. Rapid infiltration to address cultural and environmental values, and to minimise required land area. No filtration & UV to reduce pathogens. No additional storage.

**Reasons for Inclusion in Option Assessment:**
Rapid infiltration is a very compact 100 % land discharge option that avoids some infrastructure and land costs.

**Key Benefits:**
Smallest land area and low to moderate cost if close to WWTP.

**Key Disadvantages:**
Difficult to find a suitable site that will be safe from erosion and away from cultural sites. Discharge contaminates groundwater. May need to install several km of reticulation from WWTP to discharge location.

**Pillar Assessments**

| Recreational Values | Environmental Values |
|---|---|
| Any current land use will be affected by when and where irrigation is applied, but this is likely to be small and coastal (it needs sandy soils) and may only concern a couple of neighbours or recreational areas. | There is no beneficial nutrient recycling through plants due to speed and large volumes of drainage. It will cause groundwater contamination adjacent to the shore, but occupies a very small land area and avoids the river. |
| **Cultural Values** | **Financial Values** |
| Favourable, as all wastewater passes over and through papatuanuku, but its rapid and large drainage close to open water may be less acceptable than irrigation. The site will need to avoid culturally significant areas along the coastline. | The cost of rapid infiltration will be higher to cope with current flows, but the costs of major reticulation upgrades, storage, and UV have been avoided. Long reticulation to a distant site could be costly. Cost of consenting could be lower in recognition of the design addressing cultural and environmental values. |

## 3.5 Combination

**Option:** 5.1 Combo-River/land-HRLP-OLF/14 day storage buffer
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** HRLP-OLF for river discharges, and filtration and UV for irrigation only
**Storage:** 14-day storage (56,000 $m^3$).
**Discharge:** New irrigation to land system and existing river discharge (perhaps retain existing river discharge timing).

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $5.4M to $12.8M Annual rates range: $ 214.50 to $ 514.15

**Detailed Description:**
Combined land and river discharge system. Existing reticulation renewal programme. Irrigation at a daily average of 5 mm/d when soils allow. Filtration and UV to avoid irrigator blockages and public health risks. Small storage for 14 days of flows. Only discharge to river when irrigation is not possible and storage is nearly full. River discharges pass through HRLP-OLF to address cultural values.

**Reasons for Inclusion in Option Assessment:**
Summer irrigation and small storage to reduce river discharge while avoiding expensive reticulation upgrade.

**Key Benefits:**
Diverts most wastewater from the river to benefit pasture instead during summer. Addresses cultural values for river discharge. Avoids reticulation upgrade costs and keeps storage costs lower.

**Key Disadvantages:**
Is not capable of discharging all wastewater to land during summer due to limited storage and elevated flows during storms. Moderate land area required for irrigation. Complex discharge management and monitoring could be a burden.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied, including HRLP. Negative public perception of discharge to water still occurring at times. | Small land area for pond and moderate area for irrigation. Pasture will benefit from nutrients and water during summer. Most wastewater will discharge to land during summer, but the small storage volume and lack of reticulation upgrade will force the occasional discharge to the river during summer storms and will not significantly reduce the winter discharges to the river. |
| **Cultural Values** | **Financial Values** |
| Favourable, as some wastewater will be discharged to land during summer, while the discharge to the river will pass over and through papatuanuku (HRLP-OLF) first. | Land area for irrigation and HRLP will be costly, but small storage minimises costs. Costs of major reticulation upgrade have been avoided. Complex discharge management and monitoring could be a burden. |

**Option:** 5.2 Combo-River/land-HRLP-OLF/90 day storage buffer
**Reticulation:** No changes (current flows of 2,700 $m^3$/d average and 6,500 $m^3$/d peak)
**Treatment:** HRLP-OLF for river discharges, and filtration and UV for irrigation only
**Storage:** 90-day storage (360,000 $m^3$).
**Discharge:** New irrigation to land system and existing river discharge (perhaps retain existing river discharge timing).

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $13.5M to $29.5M Annual rates range: $ 540.30 to $ 1,179.75

**Detailed Description:**
Combined land and river discharge system. Existing reticulation renewal programme. Irrigation at a daily average of 5 mm/d when soils allow. Filtration and UV to avoid irrigator blockages and public health risks. Moderately large storage for 90 days of flows. Only discharge to river when irrigation is not possible and storage is nearly full. River discharges pass through HRLP-OLF to address cultural values.

**Reasons for Inclusion in Option Assessment:**
Summer irrigation and moderate storage to reduce river discharge while avoiding expensive reticulation upgrade.

**Key Benefits:**
Diverts almost all wastewater from the river to benefit pasture instead during summer and shoulder seasons. Addresses cultural values for river discharge. Avoids reticulation upgrade costs.

**Key Disadvantages:**
Large storage volume is expensive. Moderate to large land area required for irrigation. Complex discharge management and monitoring could be a burden.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied, including HRLP. River discharges will only occur during large summer storms and winter when recreation is low or nil. | Moderate land area for pond and moderate to large area for irrigation. Pasture will benefit from nutrients and water during summer. Almost all wastewater will discharge to land during summer. However, the lack of reticulation upgrade will force occasional discharges to the river during large summer storms and will not significantly reduce the winter discharges to the river. |
| **Cultural Values** | **Financial Values** |
| Favourable, as most summer flows of wastewater will be discharged to land, while the discharge to the river at other times will pass over and through papatuanuku (HRLP-OLF) first. | Land area for irrigation and HRLP and large storage increases costs. Costs of major reticulation upgrade have been avoided but have forced the construction of larger storage and irrigation areas. Complex discharge management and monitoring could be a burden. |

**Option:** 5.3 Combo-50% flow/River/land-HRLP-OLF/14 day storage buffer
**Reticulation:** Major upgrades (flows of 1,800 $m^3$/d average and 3,250 $m^3$/d peak)
**Treatment:** HRLP-OLF for river discharges, and filtration and UV for irrigation only
**Storage:** 14-day storage (28,000 $m^3$).
**Discharge:** New irrigation to land system and existing river discharge (perhaps retain existing river discharge timing).

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $17.9M to $41.M Annual rates range: $ 716.63 to $ 1,643.44

**Detailed Description:**
Combined land and river discharge system. Intensive reticulation renewal programme. Irrigation at a daily average of 5 mm/d when soils allow. Filtration and UV to avoid irrigator blockages and public health risks. Small storage for 14 days of flows which have been reduced by reticulation upgrade. Only discharge to river when irrigation is not possible and storage is nearly full. River discharges pass through HRLP-OLF to address cultural values.

**Reasons for Inclusion in Option Assessment:**
Summer irrigation and small storage with reduced flows to reduce river discharge.

**Key Benefits:**
Diverts almost all wastewater from the river to benefit pasture instead during summer. Addresses cultural values for river discharge. Reduced flows resulting from reticulation upgrade have reduced storage volume and land area for irrigation and HRLP. Very small storage minimises this cost.

**Key Disadvantages:**
Very small storage and moderate irrigation area. Expensive reticulation upgrades. Complex discharge management and monitoring could be a burden.

**Pillar Assessments**

| Recreational Values | Environmental Values |
|---|---|
| Any current land use will be affected by when and where irrigation is applied, including HRLP. River discharges will only occur during large summer storms and winter when recreation is low or nil. | Very small land area for pond and moderate area for irrigation. Pasture will benefit from nutrients and water during summer. Almost all wastewater will discharge to land during summer, but the small storage volume will force rare discharges to the river during large summer storms and will not significantly reduce the winter discharges to the river. |
| **Cultural Values** | **Financial Values** |
| Favourable, as most wastewater will be discharged to land during summer, while the discharge to the river will pass over and through papatuanuku (HRLP-OLF) first. | Land area for irrigation and HRLP will be more modest and small storage minimises costs. Costs of major reticulation upgrade have been incurred but have reduced the storage and irrigation costs. Complex discharge management and monitoring could be a burden. |

**Option:** 5.4 Combo-50% flow/River/land-HRLP-OLF/90 day storage buffer
**Reticulation:** Major upgrades (flows of 1,800 $m^3$/d average and 3,250 $m^3$/d peak)
**Treatment:** HRLP-OLF for river discharges, and filtration and UV for irrigation only
**Storage:** 90-day storage (180,000 $m^3$).
**Discharge:** New irrigation to land system and existing river discharge (perhaps retain existing river discharge timing).

**Approximate Cost Ranges and Associated Increases in Annual Rates**

Total cost range: $22.M to $49.4M Annual rates range: $ 880.60 to $ 1,979.97

**Detailed Description:**
Combined land and river discharge system. Intensive reticulation renewal programme. Irrigation at a daily average of 5 mm/d when soils allow. Filtration and UV to avoid irrigator blockages and public health risks. Storage for 90 days of flows which have been reduced by reticulation upgrade. Only discharge to river when irrigation is not possible and storage is nearly full. River discharges pass through HRLP-OLF to address cultural values.

**Reasons for Inclusion in Option Assessment:**
Summer irrigation and small storage with reduced flows to reduce river discharge.

**Key Benefits:**
Best combination to maximise irrigation and minimise river discharges. Diverts all wastewater from the river to benefit pasture during summer and shoulder seasons. Addresses cultural values for river discharge. Reduced flows resulting from reticulation upgrade have reduced storage volume and land area for irrigation and HRLP.

**Key Disadvantages:**
Moderate storage volume and moderate to large irrigation area. Expensive reticulation upgrades. Complex discharge management and monitoring could be a burden.

**Pillar Assessments**

| **Recreational Values** | **Environmental Values** |
|---|---|
| Any current land use will be affected by when and where irrigation is applied, including HRLP. River discharges will only occur during very large summer storms and winter when recreation is low or nil. | Small to moderate land area for pond and moderate to large area for irrigation. Pasture will benefit from nutrients and water during summer. The large storage volume and reduced flows will avoid discharges to the river during summer except during very large summertime storms, and will help to reduce the winter discharges to the river. |
| **Cultural Values** | **Financial Values** |
| Favourable, as almost all summer flows of wastewater will be discharged to land, while the discharge to the river at other times will pass over and through papatuanuku (HRLP-OLF) first. | Land area for irrigation and HRLP and moderate-large storage increases costs. Costs of major reticulation upgrade have been incurred but have reduced the storage and irrigation costs. Complex discharge management and monitoring could be a burden. |

# 4 SUMMARY OF COSTINGS

The 22 option combinations are summarised below and are ranked based on their cost.

**Table 4.1: Option combination costs**

| Option Code | Option Description | Average Total Cost ($) | Average rate increase ($/year) |
|---|---|---|---|
| 1.1 | Status Quo | 1,857,500 | 74 |
| 1.2 | River-low bugs/24-hour continuous discharge | 2,141,550 | 86 |
| 2.1 | River-lowbugs | 2,141,550 | 86 |
| 2.3 | River-HRLP-OLF | 2,332,500 | 93 |
| 2.2 | River-low bugs/HRLP-OLF | 2,616,550 | 105 |
| 2.5 | River(new)-low bugs -HRLP-OLF | 4,209,050 | 169 |
| 4.9 | Land-rapid infiltration | 7,082,172 | 284 |
| 5.1 | Combo-River/land-HRLP-OLF/10day storage buffer | 9,098,713 | 364 |
| 3.1 | Ocean | 17,250,000 | 691 |
| 3.2 | Ocean-HRLP-OLF | 18,225,000 | 730 |
| 4.1 | Land-90 day storage buffer/irrigation rate 1 | 20,146,100 | 807 |
| 5.2 | Combo-River/land-HRLP-OLF/90 day storage buffer | 21,478,600 | 860 |
| 2.4 | River-50% flow/low bugs/HRLP-OLF | 25,001,250 | 1001 |
| 4.2 | Land-150 day storage buffer/irrigation rate 1 | 25,005,800 | 1001 |
| 5.3 | Combo-50% flow/River/land-HRLP-OLF/10 day storage buffer | 29,470,583 | 1180 |
| 4.3 | Land-50% flow/90 day storage buffer/irrigation rate 1 | 34,875,340 | 1396 |
| 5.4 | Combo-50% flow/River/land-HRLP-OLF/90 day storage buffer | 35,720,340 | 1430 |
| 4.4 | Land-50% flow/150 day storage buffer/irrigation rate 1 | 37,318,176 | 1494 |
| 4.5 | Land-90 day storage buffer/irrigation rate 2 | 40,877,037 | 1637 |
| 4.6 | Land-150 day storage buffer/irrigation rate 2 | 45,736,738 | 1831 |
| 4.7 | Land-50% flow/90 day storage buffer/irrigation rate 2 | 48,695,965 | 1950 |
| 4.8 | Land-50% flow/150 day storage buffer/irrigation rate 2 | 51,138,801 | 2048 |