River Health

Maintaining the health of the Manawatū River is a key outcome for our new wastewater treatment discharge solution. Each of the options being investigated will have different impacts on the river's water quality and on the growth of periphyton that, with the right balance, support a healthy river ecosystem.

Run-off, erosion and discharge of untreated sewage and industrial waste threaten river health. In 2011 council, industry, iwi and environmental agencies formed the Manawatū River Leaders' Accord – a commitment to improve river health and protect the river's land and water resources. Horizons and Palmerston North City Council work together to ensure wastewater is properly treated, water quality is monitored, stock are separated from the river, and soil erosion into the river is minimised. The successful wastewater option will need to provide a higher level of water quality to meet increased environmental standards and future proof the wastewater system for growth.

Three of the six shortlist options include discharge into Manawatū River and all three include some discharge to land. For each option to proceed, it needs to meet water quality and periphyton biomass targets specified in Horizons' One Plan.

To achieve the best outcomes for river health we can vary the:

- amount of treatment before discharge into the river
- amount of wastewater discharged to the river
- number of discharge points
- flow cut-off (stopping discharge when river flow is below a point).

The river is a complex ecosystem and we need to manage these controls to minimise environmental effects and keep the river safe for the local community and for swimmers, fishers, and other recreational users of the river.

During 2020, Nature Calls undertook investigations to model and quantify changes to water quality and river health that would occur under each of the three river discharge options and test controls to minimise environmental effects on the river.

Investigation Questions

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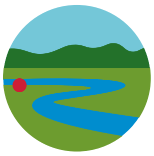
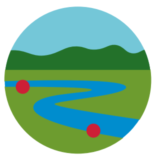
1. How will water quality and periphyton growth be affected under each of the river options?
2. Will each of the river discharge options meet One Plan for water quality and periphyton biomass?

Three shortlist options include discharge into the river.



Option 1
River discharge at the existing point (2 variants)



Option 2
River discharge at two points (2 variants)

Option 3
Land discharge, 97% and river discharge, 3% (2 variants)

Option 4
Land discharge, 45-55% and river discharge, 45-55% (4 variants)

For information about coastal discharge and discharge to land, see the Ocean Health and Land Health fact sheets. This summary focusses on river discharge options, other documents are available focussing on the other option.

Approach and method

We took a two stage investigation approach. Stage one explored impacts on water quality and periphyton growth under each of the three river discharge options. Stage two applied various settings for treatment, discharge volume and flow cut-off to find the most effective ways of reducing undesirable impacts to get the best river health outcomes and the least environmental effects.

Nitrogen and phosphorus find their way into the river through soil erosion and wastewater, and at high levels, these nutrients affect river health. To measure water quality, we test river concentrations downstream of the discharge point for:

- Dissolved Reactive Phosphorus (DRP), mostly from soil sediment and household cleaning products.
- Soluble Inorganic Nitrogen (SIN), mostly from fertiliser, soil erosion and human and animal waste.

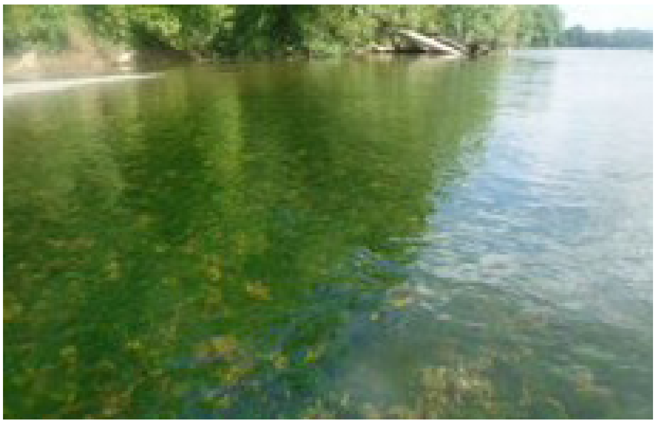
To measure river health, we assess the biomass (quantity of organic material) of periphyton in the river, measuring how often the amount exceeds 120mg and 200mg of chlorophyll (a green pigment in plants that enables them to absorb light for energy to photosynthesise) per square metre of river bed.

Computer modelling is used to analyse historical data and predict future impacts. The PointSIM model was utilised for Nature Calls to represent the Manawatū River ecosystem including all the factors and processes that comprise it. The model uses mathematical formulas based on our knowledge of the biological and physical processes of the river, treatment systems, river flows and discharge volumes to predict the effects on river health when we vary the discharge of wastewater to the river.

We regularly monitor and report on DRP, SIN and periphyton concentrations in the river. Feeding historical data from monitoring into the model enables us to identify causes, effects and patterns to make evidence based predictions about future levels of these nutrients and organisms.

What is periphyton?

Periphyton is the algae, bacteria and microbes that grow on the riverbed. While it plays an essential role in a healthy river ecosystem, high nutrient concentrations and seasonal factors can lead to excessive periphyton growth which degrades the river for recreational use, clogs waterways and taints the water, making it toxic to animals. Wastewater discharge is just one of many contributors to periphyton growth.



These two photos were taken in December 2019 and show periphyton growth in the Manawatū River. The left photo was taken upstream and shows the riverbed clear of growth. The photo on the right is taken downstream, with periphyton covering much of the riverbed.

Wastewater quality controls

Treatment

The Best Practicable Option (BPO) includes upgrades to the wastewater treatment plant, moving away from chemical processes towards biological processes to improve the way we remove phosphorus and nitrogen from wastewater.

- Alum dosing is used to remove phosphorus by chemically binding phosphorus particles together so they settle into the river bed, becoming unavailable to "feed" potentially toxic algae. While alum can increase the acidity of river water under high or low pH conditions, short term targeted use of alum has been found to cause no harmful effects.
- Biological Nutrient Removal (BNR) uses bacteria to remove nitrogen and phosphorus from wastewater. Compared with chemical processes, BNR increases the amount of sludge but is more sustainable, more cost efficient and has reduced impacts on the environment.

Adaptive water quality management

At high water volume, wastewater becomes diluted and there is little to no change in water quality. At low volume the river is more sensitive to the introduction of phosphorus and nitrogen from wastewater. Using an Adaptive Management Regime enables us to respond to river conditions by varying when and how much wastewater we discharge into the river. Two controls we used in modelling are:

- Discharge volume – the amount of wastewater discharged in cubic metres can be increased or reduced depending on the volume of the river
- Flow cut off – when river flow gets below a certain point we stop discharging to the river completely and switch or increase our percentage of discharge to land, depending on the shortlist option.

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Results - How did the options perform?

Each of the three river options was fed into the model and here's what we found:

Option 1:
River discharge at existing point

This option proposes to continue discharge into the river at the existing point (Totara), with a small percentage discharged to land when river flows are low. This option includes expansion and upgrading the Totara wastewater treatment plant.

Our stage one findings suggest that this option probably wouldn't meet the water quality and periphyton levels required for consent without significantly increasing the level of treatment.

Stage two investigations explored two additional treatment options - alum dosing to reduce DRP and biological nutrient removal to break down and consume Phosphorus and Nitrogen, reducing SIN. The model outputs demonstrated that with these additional treatments the wastewater should meet One Plan targets.

Another option to reduce concentrations in the river is to increase the flow cut off point and discharge the balance of wastewater to land.

Conclusion:

While option 1 as proposed would not meet One Plan targets, increasing the amount of wastewater discharged to land should meet them. An Adaptive Management Regime is recommended for this option so that additional treatment and discharge to land options are researched, planned and ready to use safely and effectively when required.

Option 2:
River discharge at existing + new point (Opiki)

Option 2 would use three separate wastewater discharge points – two into the Manawatū River at the existing Totara location and a new location downriver of the Opiki Bridge. The third discharge point would be to land.

River flow volumes would determine which of the three discharge points is used at any given time. Discharge during high flow volumes (30 – 40% of the time) would be through the existing Totara point. When the river drops below intermediate flows discharge would be taken downriver to below Opiki Bridge. A portion of wastewater would be irrigated to land during dry periods.

Modelling indicates this option will result in a significant increase in DRP concentration and a small decrease in SIN concentrations in the river at the proposed flow cut-off levels compared with current levels, but not enough to meet targets. However, if we discharge 100% of wastewater to land at low flows (less than 37.5m3/s), SIN levels are compliant without the need for additional treatment.

Initial results suggest that alum dosing may be necessary to treat DRP levels at flows up to 80m3/s and further investigation indicated that DRP reductions could be met by additional treatment and sending 75% of average dry weather flow (ADWF) to land when river flows are below 37.5m3/s. Another option is to move the discharge point to below the Oroua River where One Plan target for DRP is less stringent.

Conclusion:

None of these options provide for adequate reduction in SIN without additional treatments or increasing the proportion of discharge to land at low flows.

Option 4:
Land + River

Under option 4, 45 - 55% of treated wastewater would be applied to land with the rest discharged to the Manawatū River from the existing Totara discharge point. Wastewater would only be discharged into the river when the flow is above 80m3 per second, when the river is less sensitive to changes from wastewater.

This option would see SIN and DRP concentrations in the river reduce to meet the One Plan target. Periphyton biomass downstream of the discharge point would be no more likely to exceed the levels upstream, indicating this option does not affect periphyton levels.

Modelling of Option 4 revealed that reducing the flow cut-off from 80m3 to 62m3/s would have no material effects on periphyton biomass. Adding this treatment into the model, we found that the flow cut off volume could be further reduced to 54.5m3/s without compromising the water quality or periphyton concentrations achieved through treatment.

Conclusion:

This option should meet the One Plan target and consent requirements for water quality and periphyton. It could provide flexibility in setting the percentage of discharge to land and river without negatively impacting river health.

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Key outcomes for the Best Practicable Option (BPO).

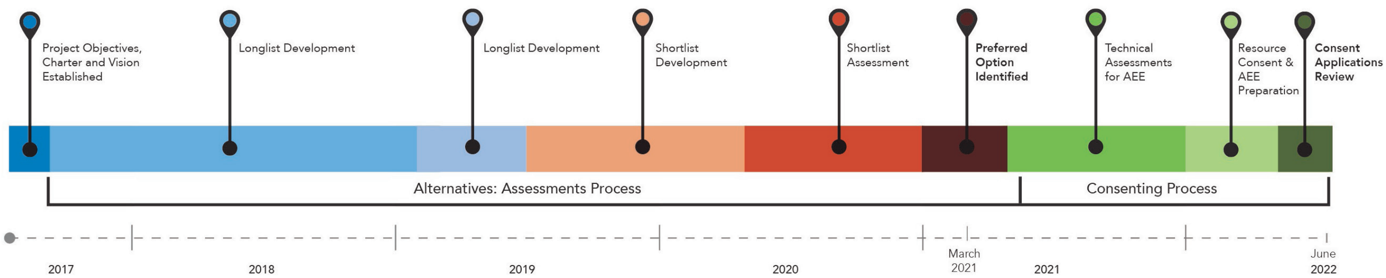
The preferred shortlist option will:

- Protect public health and minimise public health risks.
- Minimise environmental effects on air, land and water, minimise whole-of-life carbon emissions and optimise resource recovery.
- Contribute to improving the health and mauri of the Manawatū River.
- Be developed with the active engagement of the community and key stakeholders.
- Be affordable and cost effective.
- Be innovative and evidence based.
- Be sustainable, enduring, and resilient. Take an integrated approach to the management and cumulative effects on the Manawatū River catchment.
- Facilitate long term growth and economic development.
- Enhance people’s use and enjoyment of the Manawatū River.

About this project

The Nature Calls project takes a fresh look at how we manage wastewater in Palmerston North and what we need to achieve before 2022 to future-proof our wastewater management and infrastructure. The process involves engagement with iwi, the community and stakeholders as well as technical investigations, including this one. The timeline below shows expected project progress through to June 2022 when the consent applications for the preferred option will be lodged.

Project timeline



For more information, contact us.

For more information about wastewater, the Nature Calls project and the shortlist options:

Visit www.pncc.govt.nz/naturecalls

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