Christchurch City Council

Christchurch City Council
ATTACHMENTS - UNDER SEPARATE COVER

Date:	**Wednesday 16 July 2025**
Time:	**9.30 am**
Venue:	**Boardroom, Fendalton Service Centre, Corner Jeffreys and Clyde Roads, Fendalton**

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Memos

Memo

Date: 15 April 2025
From: Gavin Hutchison
To: Te Pātaka o Rākaihautū – Banks Peninsula Community Board, Mayor and councillors
Cc: ELT
Reference: 25/740773

Banks Peninsula Stormwater Management Plan - Consultation opening

1. Purpose of this Memo Te take o tēnei Pānui

1.1 This memo provides an update on the Banks Peninsula Stormwater Management Plan.

1.2 The information in this memo can be shared once the consultation opens on Wednesday 16 April.

2. Update He Pānui

2.1 Consultation on Te Pātaka o Rākaihautū Banks Peninsula draft stormwater management plan (SMP) opens on Wednesday 16 April 2025 and closes on Tuesday 17 June 2025.

2.2 This is the seventh and final plan being prepared between 2020 and 2025 for the district's different stormwater catchments.

2.3 The plans set out the ways Council will meet the requirements of its 25-year Comprehensive Stormwater Network Discharge Consent (CSNDC), which was granted by Environment Canterbury in 2019.

2.4 Managing stormwater is important because it picks up pollution from the surfaces it flows over. This makes its way into local waterways impacting the water quality and health of our streams and rivers.

2.5 This plan will play a role in improving the area's waterways over time, making it a better place for wildlife and residents alike.

2.6 We're taking a slightly different approach to this plan, shaped by some major influencing factors:

2.6.1 Only the five largest settlements in Banks Peninsula generate significant amounts of contaminants.

2.6.2 The proportion of sediment from rural sources is so large that urban sediment need not be a priority.

2.6.3 Urban areas are major sources of zinc.

2.6.4 Dissolved copper (the most harmful fraction) is mostly sourced from brake pads. Copper in stormwater is expected to significantly diminish over time as low-copper brake pads become the norm.

2.6.5 Physical instream values such as riparian planting are necessary components of healthy waterways.

2.6.6 Flooding on the Peninsula is sourced from rural areas. It is not an urban effect and need not be dealt with by an SMP.

2.6.7 The Council must carry out some contaminant removal to be compliant with Condition 6.b. of the consent.

2.6.8 The Long Term Plan provides $8.6 million for the Banks Peninsula SMP.

2.7 With these factors in mind, three options have been developed for consultation with the four local rūnanga and the public. The three approaches are:

2.7.1 **Option 1 – Maximise enhancement:** Mostly environmental enhancement; a small amount of contaminant treatment.

2.7.2 **Option 2 – Treat the worst streams:** Treat stormwater entering priority waterways (i.e. those where contaminant exceedances are measured). A moderate amount of environmental enhancement.

2.7.3 **Option 3 – Maximise treatment:** Stormwater treatment only.

2.8 More detailed information on the options is available below:

Option 1: Maximise enhancement		**Approx. 3 treatment devices ($1.6m)** **Stream enhancement ($7m)**
Mitigation	**Mitigation quantity**	**Environmental/cultural benefit**
Contaminant load reduction Installing treatment devices at key locations	About 3 devices	Removes estimated: - 0.77 kg zinc p.a. - 0.1 kg copper p.a.
Stream improvement measures Enhance riparian planting Enhance spawning habitat	15km riparian planting 1km spawning habitat enhancement	Most biodiversity assistance Most instream habitat improvement
Instream sediment measures Sediment removal Stabilise stream banks	$1m sediment removal 1km stabilised stream banks	Reduces instream sediment cover Most instream habitat improvement
Improve Cultural Health Index score Rūnanga projects	$1.3m for biodiversity projects	Cultural Health Index score improves
This option would contribute toward eight measurable consent targets we have under the Land and Water Regional Plan.		

Option 2: Treat the worst streams		**Approx. 12 - 14 treatment devices ($4.7m)** **Stream enhancement ($3.9m)**
Mitigation	**Mitigation quantity**	**Environmental/cultural benefit**
Contaminant load reduction Installing treatment devices at key locations	About 12–14 devices	Removes estimated: - 2.9kg zinc p.a. - 0.22kg copper p.a.

Stream improvement measures Enhance riparian planting Enhance spawning habitat	9km riparian planting 0.3km spawning habitat enhancement	Biodiversity assistance Instream habitat improvement
Instream sediment measures Sediment removal Stabilise stream banks	$0.35m sediment removal 0.6km stabilised stream banks	Reduces instream sediment cover Instream habitat improvement
Improve Cultural Health Index score Rūnanga projects	$1.0m for biodiversity projects	Cultural Health Index score improves
This option would contribute toward eight measurable consent targets we have under the Land and Water Regional Plan.		

Option 3: Maximise treatment		**Approx. 22 treatment devices ($8.6m)** **No stream enhancement**
Mitigation	**Mitigation quantity**	**Environmental/cultural benefit**
Contaminant load reduction Installing treatment devices at key locations	22 devices	Removes estimated: - 7.5kg zinc p.a. - 0.53kg copper p.a.
Stream improvement measures Enhance riparian planting Enhance spawning habitat	0	No biodiversity assistance
Instream sediment measures Sediment removal Stabilise stream banks	0	Some sediment removal
Improve Cultural Health Index score Rūnanga projects	0	No biodiversity assistance
This option would contribute toward three measurable consent targets we have under the Land and Water Regional Plan.		

3. Conclusion Whakakapinga

3.1 Public consultation material including the summary document and full draft stormwater management plan will be available on letstalk.ccc.govt.nz/BanksPeninsulaSMP from 16 April.

3.2 Staff have met with the four rūnanga to discuss the SMP and stormwater issues, and to seek guidance on cultural matters and feedback on the draft options.

3.3 An information session with Te Pātaka o Rākaihautū – Banks Peninsula Community Board is planned for 26 May.

Attachments Ngā Tāpirihanga

There are no attachments to this memo.

Signatories Ngā Kaiwaitohu

Authors	Rose Averis - Senior Communications Advisor Paul Dickson - Drainage Engineer Emily Tredinnick - Healthy Water Bodies Facilitator Samantha Smith - Engagement Advisor
Approved By	Kevin McDonnell - Team Leader Asset Planning Gavin Hutchison - Acting Head of Three Waters

Submissions received on Te Pātaka o Rākaihautū Banks Peninsula Stormwater Management Plan, June 2025

Organisations / Businesses

<table>
<tr><th>ID</th><th>Submitter feedback</th><th>Name - Organisation</th></tr>
<tr><td>35896</td><td>Which of the following mitigation options do you prefer?
Option 2: Treat the worst streams

See attachment</td><td>Graeme Fraser – Diamond Harbour Community Association</td></tr>
<tr><td colspan="3">Staff response 35896
Council staff agree with the submission and agree that a lot more funding would be needed to introduce a truly effective suite of environmental or treatment measures.
The Council does have a project to reduce sediment runoff from Bayview Road, having had this source of sediment drawn to our attention by Karen Banwell on behalf of the Governors Bay Community Association.</td></tr>
<tr><td>35904</td><td>Which of the following mitigation options do you prefer?
None of these options

Do you have any feedback on the proposed mitigation options?
See attached document. Our group had different opinions on the proposed options and consequently have chosen "None of These Options".

See attachment</td><td>Jill Rice – Purau Residents Group AKA Purau Rate Payers Association</td></tr>
<tr><td colspan="3">Staff response 35904
We acknowledge that the SMP is not the perfect answer to contaminants of streams and harbours. The reference to microplastics acknowledges a relatively new class of contaminant without having the requirement (by way of consent conditions) or means to address it. Monitoring programmes are set in an Environmental Monitoring Programme, a separate process, which is beginning to consider monitoring for microplastics. The comment in the SMP acknowledges this (although not very explicitly).
The SMP doesn't address hillside erosion because (a) it deals with stormwater from settlements and (b) it is not resourced to do more than that. However, the submitter is right about what are some of the biggest sediment sources.
The SMP does not set baselines and targets because these have been set by the consent. The task of achieving NPS-FW (national) standards is so large and will take so long that Environment Canterbury has chosen to set targets that are both realistic and flexible. The Council could make greater progress but at greater cost. That would be appreciated by many but would be difficult for others to whom Council rates already seem high. Both councils are trying to achieve a difficult balance.</td></tr>
<tr><td>35910</td><td>See attachment</td><td>Colleen Philip – Sustainable Ōtautahi Christchurch</td></tr>
<tr><td colspan="3">Staff response 35910
The submission identifies many issues affecting water quality in streams and the harbour. It is correct that many of these issues are not dealt with or not fully dealt with or planned for by the SMP. In part this is because the scope of Council responsibilities is limited and in part there is a continual prioritisation of activities by the Council leading to a funding envelope for SMPs.
We trust that this SMP will not inhibit planning for a more sustainable future; we don't think it will. Perhaps the more important issues are how to develop public awareness and a more balanced way to value the natural environment against the built environment.
We appreciate the advocacy of Sustainable Ōtautahi Christchurch and encourage them to continue to bring these issues to the Council's attention through submissions to Long Term Plan hearings (to request additional funding for investigations and education) and potentially in a deputation to the Council.
The Council does require copper cladding on new builds to be coated (to encapsulate the copper). The Council is about to trial Storminators on 2 of the 10 Council buildings with untreated copper roof components. The Council does not have powers to require private owners to treat copper roof runoff but has called for legislation change in that regard.</td></tr>
<tr><td>35914</td><td>Which of the following mitigation options do you prefer?
Option 2: Treat the worst streams

See attachment</td><td>Karen Banwell – Governors Bay Community Association</td></tr>
<tr><td colspan="3">Staff response 35914
The submission identifies many issues affecting water quality in streams and the harbour. It is correct that many of these issues are not dealt with or not fully dealt with or planned for by the SMP. In part this is because the scope of Council responsibilities is limited and in part there has been a prioritisation of activities by the Council leading to a funding envelope for SMPs. It is not unreasonable to suggest that the Council could do more; however, the Council is a masthead for many environmental issues but is not, and perhaps should not, be seen as the only organisation through which change can occur.
It can be unclear what will be the most effective drivers of change. Awareness and education play a part. To that end staff will convey the substance of this and other submissions to the Council. Opportunities also exist for the public to influence councillors through deputations to the Council and at Long Term Plan hearings.</td></tr>
<tr><td>35925</td><td>See attachment</td><td>Matt Willoughby – Health New Zealand - Te Whatu Ora</td></tr>
</table>

Submissions received on Te Pātaka o Rākaihautū Banks Peninsula Stormwater Management Plan, June 2025

Individuals

ID	Submitter feedback	Name
33298	**Which of the following mitigation options do you prefer?** Option 1: Maximise enhancement	Lenka Silhankova
33318	**Which of the following mitigation options do you prefer?** Option 1: Maximise enhancement	Robert Goldie
33385	**Which of the following mitigation options do you prefer?** Option 1: Maximise enhancement **Do you have any feedback on the proposed mitigation options?** I favour allowing nature to re-establish an ecological balance - she's pretty quick at this once we get out of her way. No point spending money on treating the problems (ie. by removal of contaminants) when the source of the contaminants is not dealt with via regulating the types of coatings allowed in the construction of homes, pipes, and so on. So here's hoping the source of contaminants is also being addressed. I presume the budget for a limited number of removal devices is based on attending to the most extreme concentrations. Riparian planting should of course, focus on phytoremediation, eg. flax. **See attachment**	Frances Palmer
Staff response 33385 We agree, although contaminating materials are integral to the way we live our lives and the process of change may be difficult. Most practitioners agree that contaminants are best dealt with at source and the Council is in the early stages of educating industry and the public about this. It is hoped that non-contaminating materials will one day replace contaminating materials.		
33437	**Which of the following mitigation options do you prefer?** Option 2: Treat the worst streams **Is there any other feedback on the plan that you would like to share?** To treat the sediment load effectively an entire catchment approach should be taken - stabilising land prone to erosion, tunnel gullies and slips. this could be done by plantings and working with landowners to help retire inherently unstable land. In residential areas sediment control on new builds should be very closely monitored & enforced. possibly a earthworks season should be introduced to reduce risk of erosion. Some important catchments i.e. for water supply shouldn't have commercial forestry planted as the harvesting increases risk of excessive sediment and turbidity along with increase treatment costs.	luke challies
Staff response 33437 We agree, although contaminating materials are integral to the way we live our lives and the process of change may be difficult. Most practitioners agree that contaminants are best dealt with at source and the Council is in the early stages of educating ourselves, industry and the public about this. It is hoped that non-contaminating materials will one day replace contaminating materials.		
33605	**Which of the following mitigation options do you prefer?** Option 2: Treat the worst streams **Do you have any feedback on the proposed mitigation options?** Something needs to be done to mitigate the run off from the hill above Doris Faigan Lane. Over the last 2 days we have had a new waterfall spring up in our back garden because water from the hill is not adequately dealt with above us. **See attachment**	Stephen Palfrey
Staff response 33605 It is normal for a hillside property to have a cutoff drain on the uphill side to divert hillside runoff. The writer will investigate whether [redacted] Doris Faigan Lane has a cutoff drain; and the owner may wish to make the same enquiry with the Council's Building Control Unit. The Banks Peninsula SMP does not address hillside runoff and a hillside runoff problem will have to be dealt with outside the SMP.		
35246	**Which of the following mitigation options do you prefer?** Option 1: Maximise enhancement **Do you have any feedback on the proposed mitigation options?** We need to maximise the water quality improvements to ensure our natural habitat can recover. There ought to be included native planting on the hillside above Lake Forsyth to reduce the silt and contaminant loading.	Martin Wheldon

Submissions received on Te Pātaka o Rākaihautū Banks Peninsula Stormwater Management Plan, June 2025

ID	Submitter feedback	Name
Staff response 35246 That's correct and is a point made to the Council by the Waiwera Runanga. Administration of rural land is in the domain of Environment Canterbury (not the CCC) and that fact that most of the land is privately owned further complicates things. Forestry would seem to be a beneficial land use on many parts of Banks Peninsula.		
35900	**Which of the following mitigation options do you prefer?** None of these options **Do you have any feedback on the proposed mitigation options?** All three option suggest the installation of 'treatment devices' . I don't think that filtration can be a long term option because it will accumulate contaminants and eventually this (toxic) waste will end up in a landfill. This is incompatible with Council's own zero waste policy. Sure "treatment devices" can be a viable short term option until other measures take hold but no other measures or time frames are given and mandated. The cause of zinc and copper contamination for instance is not addressed. As an example, if zinc aluminum roofing is a major contributor this type of roofing material could be phased out to be replaced by materials that nature can break down (eg terracotta tiles). Sustainability will only be achieved when the root causes of contamination are addressed and not by trying to clean up or mitigate the mess. **Is there any other feedback on the plan that you would like to share?** It is astonishing that a 158 page SMP in 2025 mentions micro-plastics in a single sentence saying that it would be desirable that testing for 'emerging contaminants' would become part of the monitoring programme. We know that tire abrasion is a big contributor to the micro-plastic load in storm water, a factor that is quite easy to model and quantify. What kind of policies and strategies exist to address the micro-plastic load in storm water and where are the attempts to reduce the volume. The high sediment load, mainly dissolved BP loess, Whakaraupo and other receiving waterways on BP receive after heavy rainfall partially comes from active erosion sites on farmland and along road corridors. ESCPs are a good tool to monitor and enforce compliance for building sites involving earthworks but the SMP does not address all the other active erosion prone areas (overgrazing, neglect, steep road corridors with exposed banks) that have no topsoil/vegetation cover. The SMP documents the WQI of various BP streams but fails to set baselines and targets. Improve biodiversity' is a recurring tenet, but how is that quantified and what is the intended goal. How does the budget for storm water measures in the LTP / Annual Plan translate into improvements or is CCC with this SMP just administering the further decline of water quality on BP.	Thomas Kulpe
Staff response 35900 We acknowledge that the SMP is not the perfect answer to contaminants of streams and harbours. The reference to microplastics acknowledges a relatively new class of contaminant without having the requirement (by way of consent conditions) or means to address it. Monitoring programmes are set in an Environmental Monitoring Programme, a separate process, which is beginning to consider monitoring for microplastics. The comment in the SMP acknowledges this (although not very explicitly). The SMP doesn't address hillside erosion because (a) it deals with stormwater from settlements and (b) it is not resourced to do more than that. However, the submitter is right about some of the biggest sediment sources. The SMP does not set baselines and targets because these have been set by the consent. The task of achieving NPS-FW (national) standards is so large and will take so long that Environment Canterbury has chosen to set targets that are both realistic and flexible. The Council could make greater progress but at greater cost. That would be appreciated by many but would be difficult for others to whom Council rates already seem high. Both councils are trying to achieve a difficult balance.		
35923	**Which of the following mitigation options do you prefer?** Option 2: Treat the worst streams **Do you have any feedback on the proposed mitigation options?** The degradation of our stormwater comes from many sources so filtering alone will not address the contamination coming from other sources like sedimentation that smothers the seabed. Option 2 seems the most balanced though all sources of combination should be addressed to some extent. **Is there any other feedback on the plan that you would like to share?** Cass Bay is part of the Whaka Ora Healthy Harbour initiative and has planted 14000 natives since 2020, mostly in riparian planting and to stabilize land. The Whaka Ora Pest Programme has also been happening in our area. This has taken thousands of hours of passionate volunteer time and mahi and resulted in the return of kereru and bellbirds to Cass Bay. The banded kokopu that live in our streams now have the environment they need to thrive. This voluntary effort saves the council money. Filtering the amount of sediment through the riparian planting should reduce the amount going into the harbour and making it uninhabitable. Cass Bay is one of the few beaches in Whakaraupo that has not been closed due to contamination over the last couple of summers.	Jenny Healey
Staff response 35923 The amount of planting is impressive, and I wonder how many in the Council are aware of this project. Plants undoubtedly help to capture water-borne sediment, although plants may have a greater effect by stabilising hillsides and stream banks.		

Submitter ID: 33385

toxics

MDPI

Review

Phytoremediation: A Novel Approach of Bast Fiber Plants (Hemp, Kenaf, Jute and Flax) for Heavy Metals Decontamination in Soil—Review

Fera Nony Cleophas [1,2], Nur Zaida Zahari [1,2,*], Pavitra Murugayah [1], Sahibin Abd Rahim [1] and Ahmad Norazhar Mohd Yatim [1]

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Abstract: Heavy metal pollution in the environment is a major concern for humans as it is non-biodegradable and can have a lot of effects on the environment, humans as well as plants. At present, a solution to this problem is suggested in terms of a new, innovative and eco-friendly technology known as phytoremediation. Bast fiber plants are typically non-edible crops that have a short life cycle. It is one of the significant crops that has attracted interest for many industrial uses because of its constant fiber supply and ease of maintenance. Due to its low maintenance requirements with minimum economic investment, bast fiber plants have been widely used in phytoremediation. Nevertheless, these plants have the ability to extract metals from the soil through their deep roots, combined with their commercial prospects, making them an ideal candidate as a profit-yielding crop for phytoremediation purposes. Therefore, a comprehensive review is needed for a better understanding of the morphology and phytoremediation mechanism of four commonly bast fiber plants, such as hemp (*Cannabis sativa*), kenaf (*Hibiscus cannabinus*), jute (*Corchorus olitorius*) and Flax (*Linum usitatissimum*). This review article summarizes the existing research on the phytoremediation potential of these plants grown in different toxic pollutants such as Lead (Pb), Cadmium (Cd) and Zinc (Zn). This work also discusses several aids including natural and chemical amendments to improve phytoremediation. The role of these amendments in the bioavailability of contaminants, their uptake, translocation and bioaccumulation, as well as their effect on plant growth and development, has been highlighted in this paper. This paper helps in identifying, comparing and addressing the recent achievements of bast fiber plants for the phytoremediation of heavy metals in contaminated soil.

Keywords: phytoremediation; bast fiber plants; heavy metals; hemp; kenaf; jute; Flax; soil

check for updates

Citation: Cleophas, F.N.; Zahari, N.Z.; Murugayah, P.; Rahim, S.A.; Mohd Yatim, A.N. Phytoremediation: A Novel Approach of Bast Fiber Plants (Hemp, Kenaf, Jute and Flax) for Heavy Metals Decontamination in Soil—Review. *Toxics* **2023**, *11*, 5. https://doi.org/10.3390/toxics11010005

Academic Editors: Radka Podlipna, Stanislav Smrček and Ezio Ranieri

Received: 30 October 2022
Revised: 1 December 2022
Accepted: 16 December 2022
Published: 20 December 2022

1. Introduction

Industrialization includes the rapid growth in manufacturing and production as well as technological changes. Growth is required for better productivity, an increase in the standard of living, growth in population, urbanization and more. The rise in urbanization is also expected to go up to 60% by 2030. However, this transformation is causing a drastic change in Earth's ecosystem, negatively impacting the environment with air pollution, topsoil contamination, groundwater contamination and water pollution. Industrial wastes are more toxic compared to municipal wastes because of the presence of oil, grease, heavy metals, phenols, ammonia and more [1]. Emissions from mining, power plants and refineries are some of the major sources of hazardous toxic chemicals that pollute the environment.

Soil pollution is characterized as the accumulation of persistent toxic compounds, chemicals, salts, radioactive materials, or disease-causing agents, which adversely affect plant growth and animal health in soils. This pollution decreases the quality of the crop as the effect of using of pesticides and chemical fertilizers. Exposure to toxic and dangerous chemicals can increase the health risks to people living nearby and on polluted land. For example, heavy metals can enter humans' bodies through food, water, air and bioaccumulation over a period of time [2]. This could lead to acute and chronic illness in the central nervous system and peripheral nervous system [3]. Moreover, the toxic effects of heavy metals can cause an imbalance in the ecosystem of the soil. Heavy metals in soils exist in four different forms: dissolved ions, organic complexes, exchangeable ions and precipitates [4]. These compositions are dangerous because they tend to bioaccumulate in plant tissues. Metals such as zinc (Zn), nickel (Ni), manganese (Mn), iron (Fe) and copper (Cu) do contribute their importance in plant growth and help physiological processes such as the electron transfer system in photosynthesis. Other metals such as cadmium (Cd), arsenic (As), chromium (Cr), mercury (Hg) and lead (Pb) do not carry any known biological roles in plants. However, an excessive amount of heavy metal will affect biological and biochemical processes negatively by restraining growth and lowering the chlorophyll content of the plants. For instance, a plant with high lead concentrations fastens the production of reactive oxygen species (ROS), causing lipid membrane damage that ultimately leads to damage of chlorophyll and photosynthetic processes and suppresses the overall growth of the plant [5].

Heavy metal contamination in soil has a negative impact on the environment, especially on soil quality and plant growth. Once the plant is saturated with heavy metal, the plant dies due to the interruption in photosynthesis and protein synthesis. Elimination of heavy metals is difficult as it is irreversible and remediation needs to be done. Remediation can be divided into in-situ and ex-situ remediation. In-situ remediation is a process of remediation that does not require transport of contaminated soil to off-site treatment facilities. Ex-situ remediation, on the other hand, is the remediation technique that requires excavation of contaminated soil to an off-site treatment facility [4]. This process requires additional costs. However, the treatments are controlled and accelerated and provide better results in a shorter time. Examples of in-situ remediation are surface capping, encapsulation, electro-kinetics, soil flushing, immobilization, phytoremediation and bioremediation. Examples of ex-situ remediation techniques are landfilling, soil washing, solidification and vitrification [4].

Phytoremediation is a cost-effective remediation technique with ecological benefits and high public acceptance. This method is scientifically proven for the remediation of contaminants with the only limitations being the time-consuming process and the possibility of adverse effects on living beings due to biomagnification. This limitation can be overcome using non-edible commercial plants that have rapid growth rates and are easy to maintain. With these characteristics, a bast fiber plant with various plant parts is a good option for phytoremediation. They are also used in the production of a variety of products, such as paper, textiles, wrapping materials, rope, strings, baskets and so on, which will improve the socioeconomic status of people who live in contaminated areas or who use contaminated lands for agricultural purposes. Bast fibre, also known as phloem fibre, is a type of plant fibre derived from the phloem or bast that surrounds the stem of certain dicotyledonous plants. Bast fibres plants can be obtained from either cultivated herbs such as Flax, Hemp and Ramie, or from wild plants such as linden, wisteria and mulberry. The physical properties of different bast fibers that possess a series of characteristics: (1) ability to accumulate metals preferable in the above parts, (2) tolerance to accumulated metal concentrations, (3) production of high biomass and (4) not consumable by humans and animals, making them suitable for use in phytoremediation [6,7].

It is also crucial to understand that edible plants are not appropriate for phytoremediation because they may affect the health of humans or animals once they are consumed [8]. Therefore, fiber crops are said to be the best fit for phytoremediation. This is because fiber plants involve a cycle of planting and harvesting, which help to reduce the heavy metal contamination in the soil over time, and the harvested fiber is used to manufacture biomaterials such as paper and textiles. In this case, it does not enter the food chain and affects the environment negatively, such as harming humans or animal health. Apart from that, different plants have different methods for the removal and accumulation of heavy metals (Figure 1). For example, some plants can stabilize or decrease the mobility of the pollutants in the soil through accumulation in the roots through root hairs to stop contaminants' run-off, bulk erosion and air-borne transport [9]. Other plants may be involved in the process of plant uptake and release into the atmosphere through transpiration, which is known as phytovolatilization. Many phytoremediation processes are possible through better relationships in between plants, microbes, soil and contaminants. These different processes of phytoremediation perform different management options for a better end product to the environment [6].

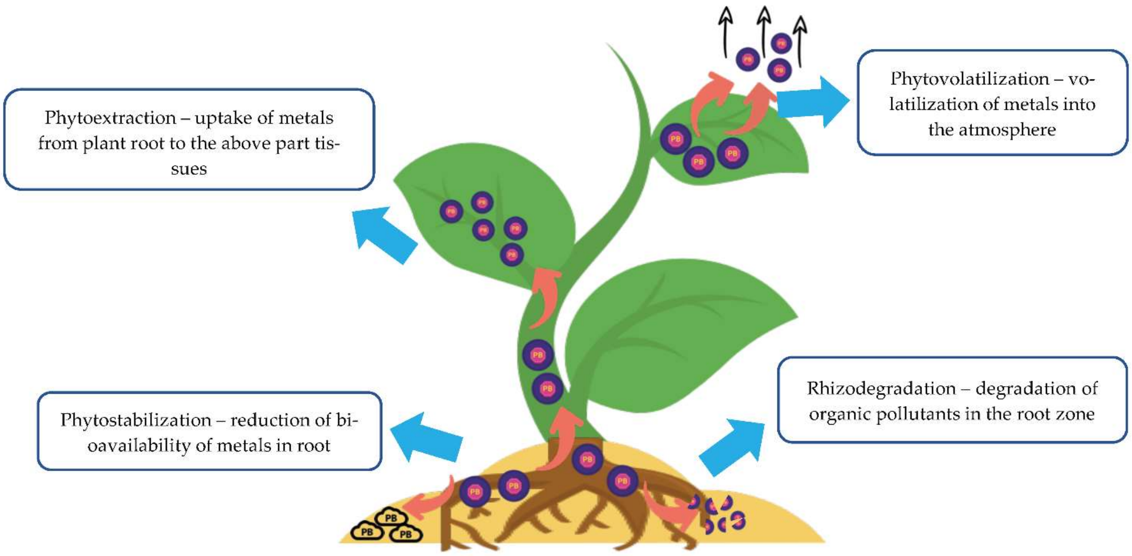

Figure 1. Mechanisms involved in the phytoremediation process.

This paper discusses the potential of four commonly used bast fiber plants namely *Cannabis sativa* (Hemp), *Hibiscus cannabinus* (Kenaf), *Corchorus olitorius* (Jute) and *Linum usitatissimum* (Flax) for phytoremediation of selective heavy metals, such as cadmium (Cd), lead (Pb) and zinc (Zn) from contaminated soil. The main goal of this paper is to provide references for suitable bast fiber plants for heavy metal treatment. In addition, this review summarises these plants' ability to accumulate heavy metal elements and reveals their potential for use as phyotoaccumulators or phytostabilizers via their uptake mechanisms. This emerging technology can be improved with natural and chemical amendments that make heavy metals bioavailable and soluble.

2. Bast Fiber Plants

2.1. Morphology and Characteristics of Bast Fiber Plants (Hemp, Kenaf, Jute and Flax)

Bast fibre is a natural fibre derived from the bast environment of certain dicotyledonous angiosperm plant stems. It is made up of cellulose and hemicellulose combined with a lignin or pectin mixture. In this paper, the potential of four different fiber plants from various places in the uptake of heavy metals from contaminated soil was highlighted. The four fiber plants are Hemp (*Cannabis sativa*), Kenaf (*Hibiscus cannabinus*), Jute (*Corchorus olitorius*) and Flax (*Linum usitatissimum*) (Table 1).

Hemp is a member of the Cannabaceae plant family, and the fibre derived from this plant is one of the strongest forms of natural fibre [10]. It has the potential to be an environmentally friendly and a highly sustainable crop if it is well managed. On the other hand, Kenaf and Jute come from the same family of Malvacea. Kenaf is a non-wood fiber that can be used for reinforcement and it is the world's third traditional crop after wood and bamboo, which originate in Asia and Africa [11]. Jute fibers are totally biodegradable as it is partially wood [12]. Flax is a member of the Linaceae family of plants, and because its exceptional qualities, Flax fibres are significant raw materials for textiles [12]. Flax and Hemp do not have much difference because they are both cellulose fibers, except that Hemp has ten chromosomes (2n = 20), whereas Flax has 15 pairs of chromosomes (2n = 30) [13]. Kenaf and Jute are woody-stemmed herbaceous dicotyledons grown in the tropics and subtropics.

Table 1. Morphology and specifics characteristics of bast fiber plants (Hemp, Kenaf, Jute and Flax).

Fiber Plants	Morphology					
	Roots	Stems	Leaves	Flowers	Seeds	Reference
Hemp (*Cannabis sativa*)	Root system is well developed with depth of about 1 to 1.5 m	The stems are normally hollow with diameter ranging from 5 to 25 mm. The base and top stem have different diameters. Mature plant reaches up to 5 m	The first true leaves are single leaflets; later leaves become palmate compounds. The second leaf pair consists of three leaflets per leaf, the third leaf pair has five leaflets per leaf, and so on, up to eleven leaflets per leaf	Male flowers and female flowers available. Female flowers are more compact	Hemp seeds are achenes seeds. Seeds are ellipsoid in shape, 2 to 7 mm long and 2 to 4 mm wide in diameter. Seeds vary in colour from light brown to dark green	[14]
Kenaf (*Hibiscus cannabinus*)	It has a prolific root system with a long taproot and extensive lateral roots	It mainly has unbranched stems and grows up to 4.5 m tall	Young leaves are simple and entire. Divided leaf can produce 3 to 10 entire young leaves prior to the first divided leaf	It produces large showy, light yellow, creamy coloured flowers that are bell-shaped and widely open. The flowers are solitary, short-stalked and auxiliary and are 8 to 13 cm in diameter with 5 petals, 5 sepals and numerous stamens	The seeds are normally brown with 6 mm long and 4 mm wide. The seeds of Kenaf are produced by the fruits, known as fruit capsules in 1.9 to 2.5 cm long and 1.3 and 1.9 cm in diameter with many seeds, around 20 to 26	[15]
Jute (*Corchorus olitorius*)	It has an extensive lateral branching and deep tap root system	The height range of the Jute plant is between 2 and 4 m. The stems are about 1 to 2 cm in diameter with few branches. The colour of the stem, petiole and leaf varies.	The leaves are edible with a bitter taste. Leaves are usually 6–10 cm long and 3.5–5 cm broad	It consists of small pale-yellow flower, bracts lanceolate, 2 to 3 cm wide, sepals 3 mm long and petals are 5 mm long	Seeds are greyish-black and angled	[16]
Flax (*Linum usitatissimum*)	It has short and branched tap root that can extend to a depth, of1 m, with side branches spreading to 30 cm	It has one main stem, but two or more branches (tillers) may develop from the base when plant density is low or with high soil nitrogen levels	The leaves are normally small and lance- shaped	The flowers parts are normally in units of five and can range from a dark to a very light blue, white or pale pink	The seeds are flat, oval and pointed at one end. Normally the seeds are covered in mucilage, giving it a high shine	[17]

2.2. *Application of Bast Fiber Plants (Hemp, Kenaf, Jute and Flax)*

Fiber plants are useful not only for phytoremediation but also in a variety of other fields in the world (Table 2). The bast fibre of hemp plants is used in the automotive industry and textile industry, whereas the whole plant part is used for feedstock and biofuel. Hurds are used for paper production and as a building material such as fiberglass. Hemp oil from the seeds is used in shampoos, soaps and bathing gels. The seeds are also applicable in the food industry as hemp milk and are used as a salad dressing. Technical commercial products such as oil paints, ink and coatings are also produced by these plants [18]. However, the usage of the plants is based on the quality of the hemp. On the other hand, Jute is the second most important fiber plant in the world, and it is also one of the cheapest-grown fiber plants in the tropical region. It is traditionally used to manufacture packaging materials such as sacking, ropes, twines and carpet-backing cloth. Moreover, diversified Jute is also used in the production of home textiles, composites, geotextiles, paper pulp, technical textiles, chemical products, handicrafts and fashion accessories. The woody central core is used as a rural building material for fences, fuel and for charcoal-making. In the Philippines, the leaves of Jute are used to treat headaches [19].

Kenaf also has its own uses and one of them is paper production. Kenaf paper is stronger and more resistant to yellowing compared wood paper and it requires fewer bleaching agents. Furthermore, Kenaf seeds produce edible oil, which is one of the best cooking oils. Dried Kenaf leaves are consumed as a vegetable in some countries because they contain 30% crude protein. The fruit of Kenaf helps in lowering blood pressure and the presence of vitamin C and antioxidants in Kenaf help in fighting some diseases. Kenaf will be used in new applications such as medicines, textiles, natural fiber compounds and environmental cleaning [20]. Flax is used for fruit, medications and textiles and has therefore been used for food processing. It has been of considerable significance for human civilization and growth for more than 8000 years. For many years, Flax was commonly used for the manufacture of fabrics, although nowadays, oil is the main source in production [21].

Table 2. World countries ranking of producing fibre plants.

Types of Fiber Plants / Ranking	Hemp (*Cannabis sativa*)	Kenaf (*Hibiscus cannabinus*)	Jute (*Corchorus olitorius*)	Flax (*Linum usitatissimum*)
1	China	India	India	Russia
2	Canada	China	Bangladesh	Canada
3	United States of America	Thailand	China	Kazakhstan
4	France	Brazil	Uzbekistan	China
5	Chile	Vietnam	Nepal	United States
6	North Korea	Cuba	South Sudan	India
7		Indonesia	Zimbabwe	
8		Pakistan	Egypt	
9		Pakistan	Vietnam	
10		Cambodia	Bhutan	
References	[22]	[23]	[24]	[25]

2.3. Case Study on Phytoremediation of Heavy Metals Pb, Zn and Cd by Bast Fiber Plants

In this study, Hemp (*Cannabis sativa*), Kenaf (*Hibiscus cannabinus*), Jute (*Corchorus olitorius*) and Flax (*Linum usitatissimum*) were chosen to compare their potential for phytoremediation of Pb, Cd and Zn in the soil (Table 3). Hemp plants were harvested from agricultural activities with acidic soil value. The concentrations of these metals were higher in the root than in the leaves and shoots. Hemp can tolerate high concentrations of Zn and most of the Zn absorbed is retained in the roots [26]. The uptakes of these heavy metals are significantly influenced by the pH of the soil. This statement is supported by the study caried out by Gray et al. [27], where the results showed that increasing the pH will cause a significant reduction in the concentration of cadmium in clover, lettuce, carrot and ryegrass.

Research conducted by Nizam et al. [28], highlighted that the concentration and uptake of Pb by the shoot were significantly higher than the root in the Kenaf plant. Most of the varieties grown in Pb contaminated soil accumulated more Pb in shoots than roots, indicating that Pb was easily transported from root to shoot in Pb-contaminated soil. This could be related to the Pb content and its relationship with other essential ions during nutrient uptake. Other studies by Shehata et al. [8] mention that Kenaf plants were irrigated with wastewater, and sulfur soil addiction with humic acid was used as foliar spraying and it showed the significant highest accumulation of cadmium, which was 0.87 mg/kg in the roots and 0.36 mg/kg in the shoots. They noticed that humic acids are the most active components in soil and compost as it improves the uptake and accumulation of heavy metals in the tissues' plant [29]. Cecília et al. [30], studied the phytoremediation of zinc and the results showed that Kenaf is able to absorb 233 mg/kg of zinc in the roots and 264 mg/kg in the shoots.

Furthermore, the studies about phytoremediation in untreated industrial wastewater from textile factories by Ahmed and Slima [31] show that there was very high concentration of Cd in the roots with 261.83 mg/kg and 41.35 mg/kg in the shoots of the Jute. In contrast, the concentration of Pb in the roots was 367.83 mg/kg, whereas in the shoots it was 370.43 mg/kg. This finding shows that the nutrients in the roots and shoots were decreased significantly because of contamination stress. Lead (Pb) is a toxic heavy metal that can inhibit plant growth, seedling development and root elongation [32]. They also state that Flax is a fibre plant that is suitable for growing in industrially polluted areas because its root system removes significant amounts of heavy metals from the soil and can be used as a potential crop for cleaning the soil of heavy metals [33]. Hosman et al. [34], studied the bioremediation potential of Flax under different concentration of Pb, Cd and Zn. The average ability of the Flax plant to remove heavy metals from soil was 49% for Cd, 68.6% for Pb and 71.76% for Zn. Following that, the highest accumulation of Cd was found in the root, whereas the highest accumulation of Pb and Zn was found in the capsule. He also reported that by increasing the metal concentration in the soil, there was a gradual increase in metal uptake in the Flax plant. Several phytotoxicity effects were observed when these metals exceeded the endogenous level [35].

Table 3. Heavy metal concentration in Bast Fiber Plants. Listed tissues represent those with the highest concentration of metals in the roots, leaves and shoots.

Types of Fiber Plants	Metals	Concentration (mg/kg^{-1})			Reference
		Roots	Leaves	Shoots	
Hemp (*Cannabis sativa*)	Pb	38.2	16.5	23.5	[33]
	Pb	14.6	2.22	2.07	[36]
	Cd	2.82	0.23	0.37	[36]
	Cd	1.03	0.55	0.98	[33]
	Zn	688.6	323.1	156	[36]
	Zn	66.8	40.0	54.5	[33]
Kenaf (*Hibiscus cannabinus*)	Pb	2.43	-	8.9	[28]
	Pb	329.66	-	867.55	[37]
	Cd	0.87	-	0.36	[8]
	Cd	0.25	-	0.14	[38]
	Zn	233.0	-	264.0	[30]
	Zn	114	65	-	[39]
	Zn	377.78	133.33	-	[40]
Jute (*Corchorus olitorius*)	Pb	21.74	-	-	[41]
	Pb	367.83	370.43	-	[31]
	Cd	163	-	48	[31]
	Cd	261.83	41.35	-	[42]
	Zn	148.53	151.42	-	[42]
Flax (*Linum usitatissimum*)	Pb	104.4	14.5	30.2	[33]
	Pb	310.56	-	-	[34]
	Cd	13.06	-	-	[34]
	Cd	8.69	1.62	7.27	[33]
	Zn	255.71	-	-	[34]
	Zn	211.8	32.6	62.9	[33]

2.4. Enhancing Phytoremediation of Heavy Metals of Bast Fiber Plants by Chemical and Microbiological Amendments

The phytoremediation potential of bast fiber plants can be increased by using chemical amendments in the soil and microbial enhancement through inoculation in the roots of plants. Chemical amendments play a key role in compensating for the relatively low heavy metal availability in soil, and it helps the plants' uptake and translocates metals toward the shoot [43]. Previous studies have reported that various chelators are employed to increase the solubility of metals in soil, including 1,2-cyclohexane-diaminetetraacetic acid (CDTA), ethylene glycol tetraacetic acid (EGTA) and diethylene-triaminepentaacetic acid (DTPA) [44–46]. One of the most effective chelating agents is ethylenediaminetetraacetic acid (EDTA), which can increase the solubility, absorption and complexation of metals (including Pb ions in soil) [5,47–49]. Furthermore, metal-EDTA complexes may form and function to significantly boost Pb ion absorption by plant roots and translocate them to shoots [50]. Hasan et al. [51] reported that metallothioneins produced by certain genes could withstand conditions where metal stress is present in the environment. Furthermore, this metal-binding protein with low molecular weight can facilitate the metal ion into the plant cells and translocate them via the xylem. In phytoremediation technologies, the addition of nutrients to plants may results in healthy plant growth with the development of flowers, leaves and branching of the root system, and can thus increase the level of uptake contaminant in the study area. However, an excessive amount of nutrients given to the plants can result in a significant reduction in plant growth. This symptom is known as nutrient toxicity. In a nutrient-enriched environment, the bioavailable fraction of metals may be reduced because of the binding to the nutrient anions. The uptake of heavy metals in plants may also be affected by competition since nutrient cations compete with the metal for uptake sites [52]. Thus, the uptake of the metal under investigation decreases with an increasing concentration of nutrients. However, a generous availability of nutrients promotes plant growth, which in turn creates an increasing number of uptake sites for metal in plants. This may increase the uptake as well as the metal concentrations in plants.

Interactions between plants and microbes are crucial factors in determining the efficiency of phytoremediation [53]. These interactions are implicated to play an essential role in plant metal uptake. The beneficial microbes associated with plants directly improve the efficiency of the phytoremediation process by altering metal accumulation in plant tissues and indirectly by promoting shoot and root biomass production. Whiting et al. [54], reported that the biomass and zinc concentration in the shoots of *Thlaspi caerulescens* has been increased with the presence of rhizospheric bacteria. These bacteria can promote plant growth by inhabiting the plant roots [55] and are known as plant growth-promoting rhizobacteria (PGPR) [56]. The generation of phytohormones, specialized enzymatic activity, nitrogen fixation in the atmosphere and pathogen-depressing chemicals such sidephores and chelating compounds all contribute to the role of PGPR in promoting plant growth [57]. Sidephores and chelating compounds have been shown to promote plant growth even in the presence of heavy metals [58]. 1- aminocyclopropane- carboxylic acid deaminase is another plant growth-promoting compound that has been studied in relation to heavy metals (ACC deaminase). ACC is an intermediate of ethylene produced by stressed plants, and bacteria that produce ACC deaminase can reduce ethylene levels in plants, promoting plant growth [59].

In another study, Belimov et al. [60] discovered that bacteria containing ACC deaminase can improve plant growth in metals-polluted conditions. Meanwhile, Braud et al. [61], studied the phytoextraction of agricultural Cr and Pb with sidephore- producing bacteria, and highlighted that the inoculated Maize plant with bacteria enhanced the bioavailability and uptake of Cr and Pb. Khan et al. [62], investigated the (Ni) accumulation of mycorrhizal and non-mycorrhizal Flax plants at various concentrations of Ni, i.e., 0, 250, 350 and 500 ppm. He reported that the accumulation of metals was higher in mycorrhizal than in non-mycorrhizal plants. Additionally, mycorrhizal plants showed noticeably greater growth and development than non-mycorrhizal plants. The production of phytohormones by Arbuscular Mycorrhizal Fungi (AMF) can improve nutrient and water uptake as well as improve metal bioavailability and aid in the phytoremediation process [63]. Figure 2 shows the mechanism of plant-microbe association that supports metal phytoremediation.

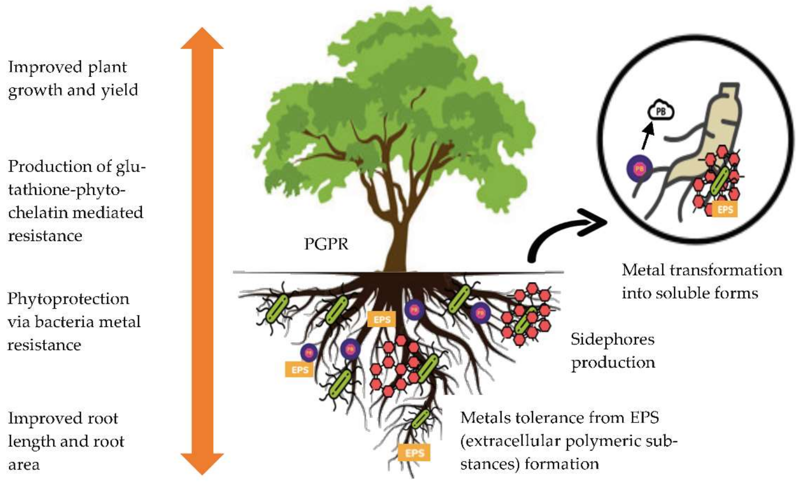

Figure 2. The mechanism of plant-microbe association that supports metals phytoremediation.

2.5. Molecular Mechanisms Involved in Microbial Resistance to Heavy Metals

Microorganisms have been involved in the mechanisms of adapting to heavy metals either in water or soil [64]. Some metals, such as copper, nickel and cobalt, are given to microorganisms as micronutrients for use in redox processes, to stabilise molecules through electrostatic interactions, to act as components of various enzymes and to regulate osmatic pressure. Otherwise, non-essential metals are recognized as having little nutritional value and may be toxic to microorganisms. To overcome the toxicity value, there are six metal mechanisms that exist in the microorganism, including the exclusion of the permeability barrier, intra- and extra-cellular sequestration, active transport efflux pumps, enzymatic detoxification and reduction in the sensitivity of cellular targets to metal ions.

2.5.1. Metal Exclusion by Permeability Barrier

The metal exclusion by the permeability barrier involves changes in the cell wall, membrane or envelope of microorganisms. This mechanism is an attempt by the organism to protect metal-sensitive and essential cellular components. Previous research has shown that bacteria form an extracellular polysaccharide coating that has the ability to bio-absorb heavy metal ions and prevent them from interacting with vital cellular components [65]. These bacteria's exopolysaccharide coating may provide sites for metal cation attachment [65]. For example, there are several strains of bacteria that demonstrated the ability to bind metals extracellularly, such as *Klebsiella aerogenes*, *Pseudomonas putida* and *Arthrobacter viscosus*. According to Scott and Palmer, [65] a protective layer of exopolysaccharide improves the survival of *K. aerogenes* strains in Cd (II) solutions. When compared to strains without their protective layer, these strains show a two-fold increase in Cd (II) accumulation. This protective layer appears to help reduce toxicity by preventing metal ion uptake and keeping metal ions away from sensitive cellular components.

2.5.2. Active Transport of the Metals Away from the Microorganisms

One of the largest categories of metal resistance systems is an active transport or efflux system by microorganisms. These methods involve the cytoplasmic export of harmful metals. These processes may be plasmid- or chromosomal-encoded. Normally, nutrient transport systems allow non-essential metals to enter the cell, but they are quickly expelled.

These efflux mechanisms are extremely selective for the cation or anion they export and can be either non-ATPase or ATPase-linked [66]. *Bacillus subtilis, S. aureus* and *E. coli* [67] are only a few of the microorganisms that have shown resistance to Cd (II). The plasmid-encoded cad system in *S. aureus*, as reported by Smith and Novick, [68] is the best-characterized Cd (II) resistance efflux. Early research shows that there are two distinct plasmid-mediated Cd (II) resistance mechanisms. The first has single cad loci (cadA) responsible for conferring resistance, and the second has two loci cadA and cadB [68]. cadA shares strong amino acid sequence homology with P-class ATPase, which functions as an ion pump [69]. CadA proteins have six major domains that work together to form a pump that removes Cd (II) from the cell's interior. An outer cytoplasmic metal binding region, a transmembrane domain and a transduction 'funnel' that may move bound Cd (II) to the membrane surface comprise the domain.

2.5.3. Intracellular and Extracellular Sequestration of Metals by Protein Binding

The accumulation of metals within the cytoplasm to avoid exposure to essential cellular components is known as intracellular sequestration. Metals that are commonly sequestered include Cd (II), Cu (II) and Zn (II). Otherwise, extracellular sequestration is the mechanism involved in the secretion of large amounts of glutathione. The production of metallothionein by *Synechococcus* sp. is an intracellular sequestration [70]. Two genes, smtA and smtB, make up *Synechococcus* sp. metal's resistance system. A metallothionein that binds Cd (II) and Zn is encoded by smtA. (II). High levels of Cd (II), Zn (II) and Cu (II) stimulate these genes, which are then suppressed by the smtB gene product. The smtB protein functions as a transacting transcriptional repressor, inhibiting the expression of smtA and the synthesis of metallothionein [70]. For extracellular sequestration in yeast, Murata et al. [71], reported that Saccharomyces *cerevisiae* may reduce the absorption of Ni (II) by excreting a gluthathione. Gluthathione binds with great affinity to heavy metals and carrying the methyglyoxal resistance gene and demonstrates the ability to form extracellular metal-gluthathione complexes in metal rich media [71].

2.5.4. Enzymatic Detoxification of Metals to a Less Toxic Form

Mercury resistance is a prime example of an enzymatic detoxifying system in bacteria. Mercury is classified as a toxic metal because it binds to and inactivates essential thiols found in enzymes and proteins. Microorganisms such as Gram-positive (*S. aureus, Bacillus* sp.) and Gram-negative bacteria (*E. coli, P. aeuruginosa and Thiobacillusf errooxidans*) have been shown to demonstrate resistance to the Hg (II) (*mer*) resistance operon. This operon not only transports and self-regulates resistance, but it also detoxifies Hg (II) [72]. The same side of these genes also encodes the creation of a periplasmic binding protein and membrane-associated transport proteins. Hg (II) in the immediate surroundings is gathered by the periplasmic binding protein and transported to the cytoplasm by transport proteins for detoxification.

2.5.5. Reduction in Metals Sensitivity of Cellular Targets

Rouch et al. [73], demonstrated that some microorganisms can adapt to the presence of hazardous metals by changing how sensitive some vital cellular components are, offering some degree of natural defense. Protection is achieved either by boosting the production of a specific cellular component to prevent a metal inactivation or by mutations that reduce sensitivity without changing basic function. The microorganism may potentially defend itself by creating metal-resistant parts or an alternative pathway to get around vulnerable parts. This adaptation was discovered in *E. coli* after exposure to Cd (II) [73]. Rouch et al. [73], highlighted that the longer an organism is exposed to Cd, the shorter its growth at the lag phase is (II). The extended lag phase is thought to be caused by a period of induction of DNA repair mechanisms. Natural resistance can develop as a result of normal cellular functions that provide the organism with a basic level of tolerance to heavy metals [73].

3. Advantages and Limitations of Phytoremediation

As mentioned earlier, phytoremediation is a promising method for cleaning up heavy metal-contaminated soils. Despite the numerous challenges, phytoremediation is regarded as a green remediation technology with enormous potential. The main advantages of this method are cost effectiveness, eco-friendliness and practicality compared to other mediation technologies. However, there are some limitations that need to be addressed in this process. This includes huge funds expenditure and human resources as well as favorable weather and climatic conditions for plants. The advantages and limitations of phytoremediation are described in detail in Table 4.

Table 4. The advantages and limitations of the phytoremediation process.

Advantages	Limitations	Reference
It is cost-efficient	It takes longer time to achieve the results as it is a slow process	[74,75]
Soil properties will not be affected during the process of phytoremediation, as it is environmentally friendly	The toxins, pH and concentration of contaminants must be below the plant's tolerance level	
Applicable for large, contaminated areas	Cannot be carried out in a medium with excessive concentration of contaminants suitable for shallow contamination (within the rooting zone) at non-excessive concentrations	[76]
Helps to reduce the possibility of soil erosion and prevent the metals in the affected area from leaching	Possibility of high toxins entering food chain because of poor management	
Can be used for both in situ and ex situ applications	Only suitable for shallow contamination, which means until the depth of the root	[77]
Has the potential to be a permanent treatment in treating a wide range of contaminants	The remediated plant biomass could be dangerous as it contains hazardous wastes	

4. Summary

Global trends toward sustainable development have brought phytoremediation as one of the emerging technologies for the decontamination of heavy metals in soil. Bast fiber plants are very promising candidates since they show tolerance to toxic trace elements in soils, have fast-growing and yield high biomass, have low maintenance, and are well known in the industrial sector. Based on the heavy metal content results in the fiber crops studied, the following conclusions can be drawn:

1. Heavy metal accumulation in bast fiber plants is clearly showed in vegetative and reproductive organs. Hemp (*Cannabis sativa)* is the crop that most strongly accumulates Zn followed by Kenaf (*Hibiscus cannabinus)*, Jute (*Corchorus olitorius),* and Flax (*Linum usitatissimum).* It is notable that Jute is more tolerant and best uptake potential for Cd as compared to others crops.
2. It is reported that the distribution of heavy metals Pb, Zn, and Cd is selective to roots as compared to shoot for all bast fiber plants studied.
3. It is suggested that Hemp, Kenaf, and Jute are suitable species for soil remediating of heavy metals Pb and Zn. Therefore, these species can be successfully cultivated for phytoremediation purposes since their root system can remove significant amounts of heavy metals from the soil.

Author Contributions: Conceptualization, F.N.C. and P.M.; data curation, N.Z.Z. and P.M.; methodology, N.Z.Z. and F.N.C.; validation, S.A.R. and N.Z.Z.; writing—original draft preparation, N.Z.Z. and P.M.; writing—review and editing, N.Z.Z. and A.N.M.Y.; supervision, N.Z.Z. and S.A.R.; funding acquisition, N.Z.Z. and F.N.C. All authors have read and agreed to the published version of the manuscript.

Funding: This review received no external funding. The cost of publication was borne by the Research Management Centre, Universiti Malaysia Sabah.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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Submitter ID: 33605

Submitter ID: 35896

Submission on behalf of the Diamond Harbour Community Association to the Christchurch City Council Draft Te Pātaka o Rākaihautū Banks Peninsula Stormwater Management Plan (SMP) – June 2025

The Association welcomes the draft plan and greatly appreciates the work done by its staff to draw together a range of scientific, academic and technical information relating to the special circumstances found on Banks Peninsula.

We note that the SMP is a requirement of the Environment Canterbury consent process, which has led to similar plans being developed for other catchments across the region, and that it fits into the broader framework of other plans, such as the District Plan and Integrated Water Strategy.

Within the context of this SMP, we encourage Christchurch City Council to adopt their proposed Option 2, (ie. 12-14 treatment devices costing $4.7 million, plus stream enhancement costing $3.9 million).

As the Council acknowledges, the environmental circumstances of Banks Peninsula are very different to other CCC catchments, and so mediation of problems such as pollution by heavy-metals and other toxic substances, sedimentation, and other threats to biodiversity will require solutions that are also very different.

We feel that the level of funding proposed under <u>any</u> of the existing options seems inadequate to result in effective results either by treatment devices or environmental measures. We therefore urge CCC to take urgent steps to increase this funding and to instigate other actions outside the scope of this plan. We strongly support Te Hapū o Ngāti Wheke's request for measures to reduce sediment discharges into Whakaraupo-Lyttelton Harbour to protect mahinga kai, as well as their call for better notification about and reduction of Ecoli (pathogens) in Whakaraupo.

It seems that there is a lot of work yet to be done in determining which of the outlined environmental enhancement measures will work best in each location. In terms of Diamond Harbour, we ask that CCC brings about the removal of crack willow from Morgan's Gully (which creates ongoing waterway problems) and the sealing of Bayview Road around the top of that Gully (which is a major source of run-off sediment in increasing weather events).

We urge the Council to increase liaison with organisations around the Peninsula (and Whakaraupo-Lyttelton Harbour in particular) who may have complementary goals and who may be undertaking research or enhancement activities which could require greater support in order to produce mutually beneficial results.

We support improved community education about stormwater but given the mainly rural nature of the Peninsula, we believe this should be tailored to meet the realities of our region rather than being something directed disproportionately at urban residents.

While we acknowledge the scope of the SMP is shaped by consent obligations, we believe there is significant opportunity for wider Council processes to support its outcomes. This includes integration with District Plan rules specific to Banks Peninsula, and stronger alignment with infrastructure planning for subdivisions and developments. Support for stormwater outcomes should not sit solely within the SMP framework, and we encourage Council to consider how resource consenting, infrastructure design, and broader planning tools can help reduce future stormwater impacts.

In summary, we support Option 2 as a constructive starting point. However, achieving meaningful improvements in the health of our catchments will require further investment, strengthened monitoring, and ongoing collaboration. We encourage Christchurch City Council to draw on existing partnerships and research, and to build flexibility into implementation, so that the plan can evolve alongside new understanding and community-led initiatives.

Graeme Fraser and Kat Miller, Diamond Harbour Committee Association.

Submitter ID: 35904

Purau Residents Group AKA Purau Rate Payers Association.

Feedback from Residents on the Storm Water Management Plan for Banks Peninsula, 16/06/25.

Residents feedback was mixed with preferences for different options. However a main theme coming through was to have longer term and better solutions to sediment run-off in particular. The proposed options did not give a summary of items that could be identified as a preferred option so the selection is **"None of These".**

Roading run-off is the biggest issue and contributor to sediment run-off.
Many driveways have no culverts or channels to divert or direct water carrying sediment away from the main road corridors which act as a feed directly into streams and rivers.
There is no mention of which rivers have been identified as severe and would need immediate attention.
Nutrient contributions should also include foul, in particular the nutrient contribution from Canadian Geese which continue to grow in numbers. Plans should be developed for annual culls.

Thanks Jill, my preferred option is no 1

I believe the SMP draft is a ruse. A stunt to make believe that something is done for the worsening water quality on BP when in fact CCC does nothing more than administering the further decline. Filtration cannot be a long term option because it produces (toxic) waste, which will end up in a landfill. This is incompatible with Council's own zero waste policy. Sure "treatment devices" can be a viable short term option until other measures take hold but no other measures or time frames are given and mandated.

The cause of zinc and copper contamination is not addressed. For instance, zinc aluminium roofing could be phased out to be replaced by materials that nature can break down (eg terracotta tiles). Sustainability will only be achieved when the root causes of contamination are addressed and not by trying to clean up the mess.
It is astonishing that a 158 page SMP in 2025 mentions micro-plastics in a single sentence saying that it would be desirable that testing for 'emerging contaminants' would become part of the monitoring programme. We know that tire abrasion is a big contributor to the micro-plastic load in storm water, a factor that is quite easy to model and quantify.
The high sediment load (dissolved BP loess) Whakaraupo receives after heavy rainfall partially comes from active erosion sites along road corridors. No suggestion to address this.
The easiest way to stay within the mandated ATLs (Attribute Target Levels of last consent) is to declare them to be 'aspirational' and then lower them - the ever shifting baseline ....

I am in favour of option three.
I fail to see what benefit a "cultural health index score" has to any biodiversity enhancement projects other than yet again more virtue signalling from the council. Not only that, we as humans have messed with biodiversity in the past with terrible outcomes.
So for me it's about keeping it simple...treat the worst streams and keep culture out of it.

Submitter ID: 35910

sustainable
ōtautahi christchurch

Submission to the Te Pātaka o Rākaihautū - Banks Peninsula Stormwater Management Plan

From:
Sustainable Ōtautahi Christchurch (SOC)
PO Box 1796
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www.sustainablechristchurch.org.nz

SOC formed in 2005 from the merger of Sustainable Cities Trust and Christchurch-Ōtautahi Agenda 21 Forum. Former members of both those groups are involved, along with a new generation of Ōtautahi-Christchurch people, who work towards the bold vision of Ōtautahi-Christchurch people "practising, living and demonstrating sustainability in all that they do."

We do wish to speak to our submission.

Primary Contact:
Colleen Philip, Chairperson
info@sustainablechristchurch.org.nz
[redacted]

Firstly, we wish to record our support for the submission from the **Diamond Harbour Community Association.**

We also wish to submit as follows…

There is a lot NOT covered by this plan; and this concerns us.
We realise the intent is to fulfil the requirements of the consent but are concerned that this narrow focus is not good enough for the wider long term management of stormwater in this area. By focussing on this primary objective there may be decisions made which adversely impact the ability for a comprehensive plan for stormwater management to be effective. This plan must not block necessary management for the future. It has to align with what is needed long term and this requires a full assessment of needs, a triaging of challenges and a practical plan to do what is required.

There is a 'bigger conversation'. The council needs to be committed to restoring healthy thriving waterways particularly for the sake of our freshwater and marine ecosystems. People need to understand what the issues are and how they can help and be able to access the tools to enable that.

As an organisation involved with education about sustainability issues including issues around water sensitivity we are very conscious of the need for community education about all issues related to stormwater management. Both about the broader issues, and specifics. For example that zinc and copper are not a problem in soil but are in water and the implications for roofing.

SOC have done education and awareness raising about on-site solutions to stormwater management including rain gardens, collection tanks, permeable surfaces, green roofs and drainpipe filters especially for copper roofing (e.g. Storminator being developed by Canterbury University)) and would like to see citizens more aware and more enabled to do things themselves on private property that are positive and appropriate for their specific site. Education needs to be about positive options, not just an attempt to stop the negative behaviours.

It is important that skilled knowledgeable people are employed to check for sediment issues in catchments.
Sediment is the major issue on the Diamond Harbour part of the area covered by this plan. What monitoring/measurement of the extent of the problem has been done; and how do you plan to measure /prove any improvements?

There is a need to identify sensitive areas. We cannot see that this has been done. What streams do you identify as the 'worst' streams?

The metals noted as of concern in this plan are less of an issue in some parts of the Banks Peninsula area but are a problem still and may well be in the future. Practical solutions are required. What about banning copper in new builds and renovations?

SOC strongly supports Council working with the community identifying probable or actual heavy metal contamination sources. We would like Council to work with private properties with existing copper roofing to install treatment of roof water at source (e.g. a drainpipe filter system) or otherwise if land is available, using rush and reed plants in a wetland nature- based treatment solution. To reduce zinc stormwater contamination loads we suggest maintaining paint on roofing, and / or similar treatment measures as above.
For heavy industry we would support the Council work with industries and monitor stormwater treatment and quality through Environmental Management Plans, with emphasis on quality site housekeeping and pollution prevention, with special emphasis given to high-risk areas such as the port, boat antifouling preparation areas and petrol stations.

SOC support nature based solutions being used wherever possible, when the evidence supports them. We note that this stormwater plan proposes a number of "treatment devices". Both while necessary mitigation are less desirable than stopping contaminants at source hence the need for ongoing education and awareness raising.

This is partly why we support Option 2. A combination of treatment devices where useful and of other mitigation with money to support indigenous biodiversity, and community involvement.

We were veering away from Option 2 because it did focus on "Treat the worst streams" and we were concerned this had potential to ignore other areas. SOC would like a focus on continued monitoring, so we can see where we have started and how we are tracking. It would need to include all areas concerned.

According to the consent conditions, and summarised in the SMP, the SMP should:
1. Identify the current environmental state and sensitive areas.
2. Assess contributions from current and future activities.
3. Forecast trends related to urban growth, climate change, etc.
4. Develop mitigation tools — including planning, education, and enforcement.
5. Evaluate mitigation effectiveness through modelling and monitoring.
While some of these aspects are addressed, the link between the findings and the proposed programme still feels underdeveloped. How are each of the options, including option 2 going to cover this?

Further…
Specific Areas for Strengthening the Plan - Keeping in mind the SMP must clearly support the requirements of Consent CRC252424.
• Flood modelling: While the catchment is acknowledged as being predominantly rural, the consent specifically excludes discharges from areas outside the designated Banks Peninsula settlement areas. The consent also includes responses to flood modelling. The SMP itself acknowledges the significant influence of rural runoff on the urban stormwater networks. This creates a gap that may need to be revisited, especially where rural flooding impacts settlement areas.

• Contaminant Load Reduction and Biodiversity Protection: The plan should place greater emphasis on reducing sediment, copper, zinc and other pollutants. This goes hand-in-hand with improving mahinga kai and biodiversity, especially in known spawning habitats.

• Monitoring Coverage and Use of Independent Data:
The proposed 6 current monitoring sites and 21 additional sites are a good start, but we should ask whether this is truly sufficient for a catchment of this complexity. The plan should also look to integrate data from:
o Whaka Ora Healthy Harbour
o Lyttelton Port investigations
o ECan records
o PDP reports and desktop assessments
o Other independent ecological and coastal reports already available

• Mitigating Urban Growth and Climate Pressures:
The plan should clearly demonstrate how proposed actions will help mitigate the effects of urban intensification, sea level rise, and changing rainfall patterns. These need to be central to the programme if we want long-term resilience.

• Regulatory Levers and Design Standards:
Bylaws need to be used more effectively, particularly in:
o Enforcing erosion and sediment controls in all new developments
o Requiring on-site treatment features like rain gardens, biofiltration near car parks, and improved stormwater storage
o Tank overflows from 10L rainwater tanks should also be controlled, especially during heavy rainfall events. The current lack of requirement for overflow control creates a missed opportunity to manage peak discharges and reduce contaminant transport.
• Community Engagement and Education:
A robust public education strategy should be part of the SMP. R

Akaroa and Akaroa Harbour
Stormwater entering cracked or broken sewer pipes contribute to the loading on the wastewater system, increasing risk of a breach that would adversely affect ecosystems, mahinga kai, fisheries and human health. Stormwater entering the wastewater system increases the need for expensive sewerage infrastructure and treatment solutions.

Wastewater exiting cracked or broken sewer pipes, allowing contamination groundwater to enter the stormwater system in Akaroa, will eventually contaminate fresh and coastal waters, detrimental to the ecosystem, mahinga kai, fishery and human health.

Recently SOC had a stall at the Estuary Fest and ran a questionnaire, and with photos asking people which was the household stormwater sump and which was the wastewater sump. Many were not sure.

Property owners need to be educated, aware, and accountable for the status of both their sewer and stormwater systems and know what steps they could take within their own properties to mitigate contamination risks to the harbour, and therefore, reduce the likelihood of large increases in their Council rates

All measures should be undertaken to prevent stormwater entering wastewater systems, and wastewater entering stormwater systems, on both private and council owned land around the harbour.

In Conclusion (and this aligns with the DHCA submission)

While we acknowledge the scope of the SWMP is shaped by consent obligations, we believe there is significant opportunity for wider Council processes to support its outcomes. This includes integration with District Plan rules specific to Banks Peninsula, and stronger alignment with infrastructure planning for subdivisions and developments. Support for stormwater outcomes should not sit solely within the SWMP framework, and we encourage Council to consider how resource consenting, infrastructure design, and broader planning tools can help reduce future stormwater impacts.

In summary, we support Option 2 as a constructive starting point. However, achieving meaningful improvements in the health of our catchments will require further investment, strengthened monitoring, and ongoing collaboration. We encourage Council to draw on existing partnerships and research, and to build flexibility into implementation so the plan can evolve alongside new understanding and community-led initiatives.

Submitter ID: 35914

Governors Bay Community Association (Inc.)

The Governors Bay Community Association
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The Governors Bay Community Association submission to the Te Pātaka o Rākaihautū – Banks Peninsula Stormwater Management Plan

The Governors Bay Community Association works on behalf of the local Governors Bay community with local government and any other appropriate organisations for the development of community services in Governors Bay and surrounds. We promote the provision of community facilities and services and represent the interests of the community.

We do not wish to speak to our submission,

Contact:

The Secretary GBCA – governorsbaycommunity@gmail.com

Background

CCC are required to prepare a Stormwater Management Plan for settlements within Banks Peninsula as part of the Comprehensive Stormwater Discharge Consent. It applies only to within the 24 settlements throughout the peninsula where stormwater infrastructure is located. This submission applies only to Whakaraupō Lyttelton Harbour and primarily to Governors Bay and surrounds.

Climate change is intensifying the frequency and severity of weather events, including storms and heavy rainfall. Urban areas are particularly vulnerable to the challenges posed by these changes. Effective stormwater management helps us to prepare and to cope with extreme weather by enhancing infrastructure resilience and reducing vulnerabilities to climate-related flooding and pollution.

GBCA points to The Mahaanui Iwi Management Plan sets out the statement of objectives, issues and policies for natural resource and environmental management in the collective area of the six Ngāi Tahu Papatipu Rūnanga including Te Pātaka o Rākaihautū - Banks Peninsula. We agree with all policies outlined within the document.

Comments

First, we wish to support the submission from Mahaanui Kurataiao Ltd on behalf of Te Hapu Ngāti Wheke Rūnanga.

Second, we wish to state that there is much that has not covered by the SMP and we find this a worry and a disappointment. We do understand that the plan must meet the requirements of the consent conditions but what has been prepared does not look to the longer-term management of stormwater for the whole peninsula. There is deeper strategic planning and community engagement required to manage some of the stormwater issues found here. The proposed programme of work does address some issues, but it certainly needs further work – it is not well developed to manage many of the issues.

Governors Bay Community Association (Inc.)

Stormwater management is a critical aspect of managing our urban areas for environmental and sustainability reasons. It involves planning, designing, and implementing strategies to manage runoff water from rain to minimise harm to natural areas and ecosystems, infrastructure, and health. With increasing weather intensities there is a strong need for effective stormwater management. We do appreciate this is difficult in steep catchments and where stormwater practices were not initially applied well.

Banks Peninsula waterways are unique environments within Canterbury, with high ecological values and, therefore, these waterways require a high level of protection from development, including urban stormwater. The focus should be on improvements to water and to habitat.

Sediment load is one of our greatest concerns especially in relation to housing developments. Forestry blocks are also a large source of sediment for the harbour. We understand that forestry is not included in this document, although there are areas where sediment sources from forestry blocks do enter settlement stormwater infrastructure. Examples are Charteris Bay – Bayview Road and in Governors Bay on Governors Bay Road near the CCC water tank.

It is important that sediment is also managed from roadsides entering the harbour. We understand this is a wicked problem with water coming from private landowners onto road reserves that go into the stormwater drains then into streams and finally into the harbour. Joining the actions across council areas and improving management tools would help to improve stormwater, the waterways and then the harbour.

Recommendation - identification of sediment hotspots within urban areas that would then be managed through the broader annual planning processes of Council.

E coli counts are high in the harbour, this is likely to need multiple issues for management. Wastewater should not be entering the streams and harbour through the stormwater network. It is our understanding that Corsair Bay recently had the wastewater system tested for leaks and found multiple issues such as broken wastewater pipes and illegal and aged wastewater connections to the stormwater. Please apply this testing to other settlements within Whakaraupō.

There are likely to be many broken or damaged sewerage pipes that are affecting the stormwater network. The wastewater and drinking water supply pipework are often damaged after very large and heavy loads taken by truck from Lyttelton Port via Gebbies Pass are an issue. Many of these are documented in Snap Send Solve. Long term planning about how to manage this is required.

Recommendation - investigate direct discharges into streams within the urban settlements

Governors Bay – situated at the bottom of Dyers Pass there is an issue with pollution from copper brakes. Many people in Christchurch do not know how to use car gears rather than brakes and you can smell break linings in the weekend when non-locals visit. Zephyr Stream is a sensitive catchment and should be well protected.

Innovative stormwater projects such as green roofs, local landscaped detention basins, houses with tanks not only serve functional purposes but can also support resilience. There have been attempts are green infrastructure in Governors Bay, but it was done exceptionally badly with poor outcomes. Treating steep hill suburbs like they are on the flat with concrete kerbs taking water away does not

Governors Bay Community Association (Inc.)

work well after heavy rain. Replacing traditional asphalt and concrete with permeable pavements allows water to seep into the ground and reduce runoff. Educating communities about the importance of stormwater management encourages more collective action.

Recommendation – greater investment in community engagement about how to manage stormwater on local properties including adding water storage tanks from roofs.

Conclusion

Stormwater management is a vital component of building community resilience at the same time as protecting the environment. By investing in sustainable systems, promoting green infrastructure, and very importantly building public awareness, the impacts of stormwater can be reduced.

While we acknowledge the scope of the WMP fulfils the requirements of the consent conditions this does not exclude having a stronger long-term focus with enhanced environmental outcomes. Plans to manage stormwater need to intersect and integrate into other council processes. Stormwater outcomes should not be just within the SWP, we ask that Council ensure how all decisions made across the peninsula whether resource consents, biodiversity work, road management and maintenance and infrastructure are all coordinated better to help to improve environmental outcomes.

We support Option 2 as a starting point but consider that the health of the waterways and the harbour requires a different approach, one that is incorporates broader planning tools and infrastructure designs.

Submitter ID: 35925

Health New Zealand
Te Whatu Ora

16 June 2025

Christchurch City Council
53 Hereford Street
CHRISTCHURCH

Tēnā koutou

Public health advice on Te Pãtaka o Rakaihautu Banks Peninsula Stormwater Management Plan

1. We are providing public health advice on Christchurch City Council's Te Pātaka o Rākaihautū Banks Peninsula Stormwater Management Plan. Health New Zealand – Te Whatu Ora has statutory obligations under the Pae Ora (Healthy Futures) Act 2022 and the Health Act 1956 to improve, promote and protect the health of people and communities. This advice has been prepared by the National Public Health Service (NPHS) Te Waipounamu of Health New Zealand – Te Whatu Ora. NPHS Te Waipounamu provides public health services to the Waitaha-Canterbury region including Banks Peninsula.
2. Christchurch City Council's proposed Te Pātaka o Rākaihautū Banks Peninsula Stormwater Management Plan focuses on addressing water quality and improving waterway health. Poor waterway quality has the potential to significantly affect public health.
3. The following outlines our technical advice on Christchurch City Council's proposal for stormwater management on Banks Peninsula.

Specific Advice

4. The Plan has significant public health implications from direct impacts through the potential exposure of the community to pathogens, heavy metals and other contaminants in stormwater when it mixes with recreational water and sewage overflows. This occurs not only during wet weather events but also during dry weather base flow associated with run off from non-storm sources such as lawn and garden irrigation and vehicle washing. There may also be indirect impacts such as restrictions on access to essential and emergency services, including health services, during wet weather events.
5. NPHS Te Waipounamu supports Council's proposal of varied mitigation strategies that include device usage, biodiversity and instream habitat improvement to limit adverse effects of stormwater discharges on surface and groundwater quality and quantity to improve waterway health. Varied mitigation strategies are required due to the diverse nature of the Banks Peninsula area with most of the catchment being rural with small urban settlements around the coast.
6. NPHS Te Waipounamu acknowledges Council's awareness of the need to not only mitigate any adverse effects on any new urban growth but to also improve stormwater quality in existing developed areas.

Te Kāwanatanga o Aotearoa
New Zealand Government

7. NPHS Te Waipounamu encourages Council to address issues associated with flooding within the Plan. Although the primary focus of the Plan is water quality and improving waterway health, the potential for flooding due to the rural origin of runoff and the steep hillsides of Banks Peninsula cannot be overlooked. The frequency of extreme rainfall events resulting in flooding has increased because of climate change and this is likely to continue.

8. Stormwater runoff generated by rainfall events where water is unable to soak into the ground carry with them an array of contaminants including sediments, hydrocarbon fuels, domestic and wild animal faeces and heavy metals https://www.esr.cri.nz/media/lmljcmuf/esr-environmental-health-report-wastewater-stormwater.pdf. Heavy metals and pathogens are thought to be the main drivers of human health risk associated with exposure to stormwater.

9. NPHS Te Waipounamu supports Council's acknowledgement of the importance of relationships with the regional council. Discussions between local and regional councils on the interaction between the stormwater and flood protection systems are essential to ensure that stormwater ingress into sewers is managed to reduce the risk of sewage overflows and flood risk from stormwater ponding.

10. NPHS Te Waipounamu supports either Option 1 or 2 proposed in the Plan. Both these options provide a range and breadth of mitigation measures to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity, which in turn have the potential to improve waterway health indicators for Banks Peninsula.

11. NPHS Te Waipounamu does not wish to be heard with respect to this technical advice.

Ngā mihi

[redacted]

Vince Barry
Regional Director
National Public Health Service
Te Waipounamu Region

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Te Waipounamu Region

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Comprehensive Stormwater Network Discharge Consent (CRC252424)

Mahere Wai Āwhā
Stormwater Management Plan for the Settlements of Te Pātaka o Rākaihautū – Banks Peninsula

Christchurch City Council

July 2025

Christchurch City Council

Internal Document Review and Approval

Prepared By	**Reviewed By**	**Approved By**	**Signature**	**Date**
Jig Dhakal Paul Dickson Joe Harrison Katie Kerr Emily Tredinnick	Kevin McDonnell			2/7/2025
This Version: 0.9 < 0.1 Initial Draft, report still to be completed by author 0.5 Draft, for verification/fact checking by team leader/manager 0.7 Draft, for review and approval by manager / head of department 0.9 Final, for approval by the Council 1.0 Published >				**TRIM 24/327586**

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List of Abbreviations

Abbreviation	Definition
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval, the long-term average interval between floods
ATL	Attribute Target Level
BMP	Best Management Practice
BP	stands for Te Pātaka o Rākaihautū –Banks Peninsula
CCC	Christchurch City Council
CHI	Cultural Health Index
CLM	Contaminant Load Model
DIN	Dissolved Inorganic Nitrogen
DRP	Dissolved Reactive Phosphorus
ECan	Environment Canterbury
E. coli	*Escherichia coli*
GIS	Geographic Information System
GWL	Groundwater Level
HAIL	Hazardous Activities and Industries List
IGSC	Interim Global Stormwater Consent
IPCC	Intergovernmental Panel on Climate Change
ISQG	Interim Sediment Quality Guidelines
LLUR	Listed Land Use Register
LTP	Long Term Plan
LWRP	Land and Water Regional Plan
ppb	Parts per billion
PAH	Polycyclic Aromatic Hydrocarbon
QMCI	Quantitative Macroinvertebrate Community Index
RMA	Resource Management Act
SMP	Stormwater Management Plan
UDS	Greater Christchurch Urban Development Strategy

1 Executive Summary

A Stormwater Management Plan (SMP) for the Settlements of Te Pātaka o Rākaihautū – Banks Peninsula is required by the Comprehensive Stormwater Network Discharge Consent (CRC252424). Its purpose is to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity and to improve the quality of receiving waterbodies. The stormwater management plan sets out methods the Council will implement to meet the consent targets in the consent.

The SMP applies only within the Peninsula's 24 urban settlements with stormwater networks, as shown in **Error! Reference source not found.**.

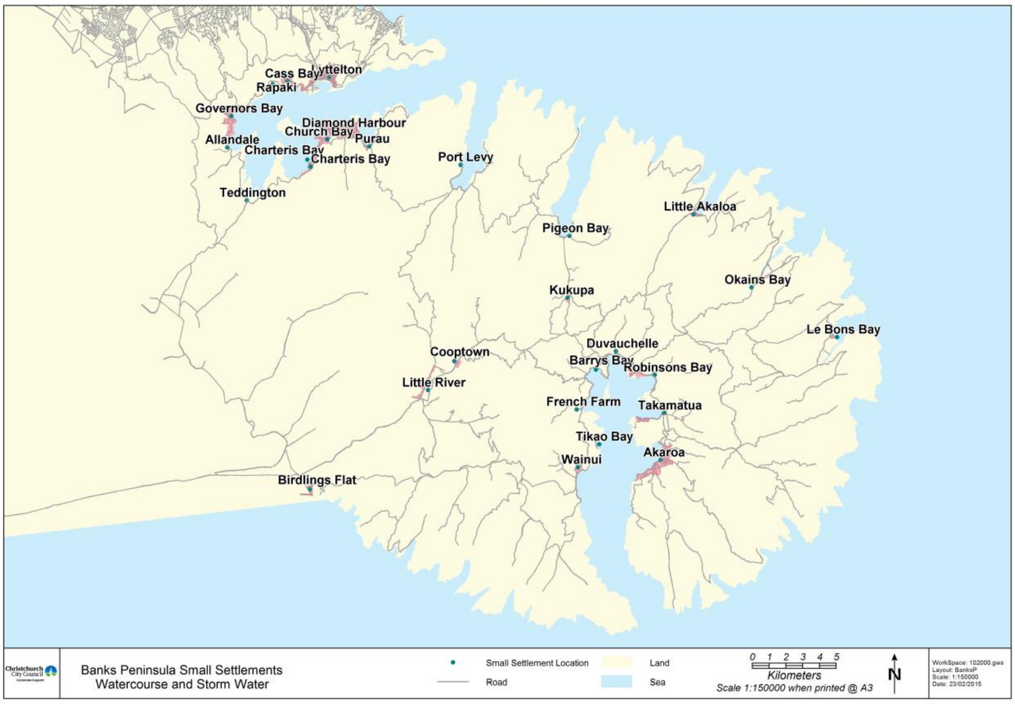

Figure 1: Te Pātaka o Rākaihautū – Banks Peninsula Settlements

Most of the catchment is rural, with the urbanised areas generally located on the coasts of the harbours. There are several challenges in dealing with urban settlement stormwater when it receives large inputs from upstream rural catchments including:

- High sediment run off
- Limited water quality information and separation of rural versus urban sources.

Due to the size, geography and mostly rural land use of Te Pātaka o Rākaihautū – Banks Peninsula waterway monitoring sites are currently sited in the larger settlements. Council has been monitoring surface water quality at three waterway and three coastal sites for three years. Overall, the Water Quality Index (WQI) for Te Pātaka o Rākaihautū – Banks Peninsula is considered 'Poor'. To improve monitoring information Pattle Delamore Partners were engaged to undertake some further water quality and ecological monitoring (see Section 6.3). Based on the monitoring, Aylmers Stream, Cass Bay Drain, Stream Reserve Drain, Walnut Stream and Lyttleton Harbour have been identified as priority areas.

Te Pātaka o Rākaihautū waterways are special environments within Canterbury, with higher ecological values including distinct native fish populations than other Christchurch District streams. These waterways merit a high level of protection from human impacts, including urban stormwater. There are limitations with traditional stormwater treatment methods, therefore alternative measures for improving waterway health are considered.

Water quality and improving waterway health is the primary focus. Stormwater contaminants will be captured in 9 – 12 filter devices in priority areas. Stormwater filters are effective but individually treat quite small areas and can be difficult to install. Therefore, the SMP proposes environmental improvements including riparian planting for shading and bank stabilisation and dredging of contaminated sediments. This is an amalgam of the Options 1 and 2 released for public consultation. The duration of this stormwater management plan is 10 years.

Part One: Plan Initiation

2 Background

2.1 Purpose and scope

The purpose of a Stormwater Management Plan (SMP) is defined in condition 6 of the Comprehensive Stormwater Network Discharge Consent (CSNDC), CRC252424, and includes contributing to meeting contaminant load reduction standards, setting (and meeting) additional contaminant load reduction targets and demonstrating the means by which Receiving Environment Objectives and Attribute Target Levels will be met.

The aim of the CSNDC is to limit the adverse effects of stormwater discharges on surface and groundwater quality and quantity with the aim of improving waterway health indicators. The CSNDC promotes progressive water quality improvement toward targets set in the CSNDC through the use of best practicable options for stormwater quality improvement and peak flow mitigation.

Stormwater management plans set out the means the Council will use to comply with the conditions in the CSNDC. The SMP is given effect through the Council's Long Term Plan (LTP), which is a statutory process. The relative timing of LTP processes and the SMP limit initiatives to those that are already funded.

The SMP process includes:

1. Identify the existing state of the environment and sensitive areas in the catchment.
2. Identify the contributions by existing and future activities to stormwater quality and quantity.
3. Estimate trends in water quality and quantity from urban growth, technology, lifestyle, climate, etc.
4. Develop measures to control or mitigate effects (including planning, education, enforcement, source control, etc as funded in the LTP), and address concerns of the community.
5. Estimate the effectiveness of chosen mitigation measures through contaminant load and flood modelling and monitoring of the receiving environments.

2.2 Stormwater Management Plan Catchments

This SMP is one of seven plans being prepared over the period 2020 to 2025 for the Ōpāwaho-Heathcote, Huritini-Halswell, Te Ihutai-Estuary and Coastal, Ōtūkaikino, Ōtākaro-Avon and Pūharakekenui-Styx catchments and the Settlements of Te Pātaka-o-Rākaihautū-Banks Peninsula. Figure 2 illustrates the boundaries for each SMP.

Figure 2: Area Covered by the Comprehensive Stormwater Network Discharge Consent.

Modest growth is projected for settlements of Te Pātaka o Rākaihautū – Banks Peninsula therefore it is considered unlikely that growth will have a substantial impact on the health of the waterways in this catchment during the SMP term. Stormwater from new developments will be treated to mitigate new contaminant generation.

2.3 Regional Planning Requirements

2.3.1 Canterbury Regional Policy Statement

The Canterbury Regional Policy Statement (CRPS) sets out how natural and physical resources are to be sustainably managed in an integrated way. The needs of current and future generations can be provided for by maintaining or improving environmental values. The CRPS requires that objectives, policies and methods are to be set in regional plans, including the setting of minimum water quality standards.

2.3.2 Land and Water Regional Plan

The Canterbury Land and Water Regional Plan encourages the development of stormwater management plans under Rule 5.93. The intention of the rule is that SMPs will be developed to show how a local authority will meet the relevant policy on water quality.

2.3.3 Greater Christchurch Urban Development Strategy

The Greater Christchurch Urban Development Strategy (UDS) Partnership has been working collaboratively for over a decade to tackle urban issues and manage the growth of the city and its surrounding towns.

- The strategy was prepared under the Local Government Act 2002 and it is to be implemented through various planning tools, including: Amendments to the CRPS;
- Changes to regional and district plans to reflect the CRPS changes.
- Stormwater planning to give effect to the LWRP; and
- Outline Development Plans for new development areas ('Greenfield areas') and existing re-development areas ('Brownfield areas').

Preparation of this SMP plays a role in implementing the UDS.

2.4 Non-Statutory Documents

- Integrated Water Strategy 2019
- Surface Water Implementation Plan (to be developed)
- Mahaanui Iwi Management Plan 2013
- Ngāi Tahu Freshwater Policy Statement (Te Rūnanga O Ngāi Tahu 1999)
- Infrastructure Design Standard (Christchurch City Council 2010)
- Waterways, Wetlands and Drainage Guide (Christchurch City Council 2003)
- Erosion and Sediment Control Toolbox for Canterbury (Environment Canterbury)
- Healthy Waterbodies Action Plan (draft)

2.5 The Council's Community Outcome for Water

The Christchurch City Council has adopted community outcomes to promote community wellbeing. The Water Outcome Healthy Environment includes Healthy water bodies.

Water is a taonga, of fundamental importance to the life of the community and crucial to the health of the environment in which the community lives.

The health of our water will be a key factor in setting the course for our environmental, social, cultural and economic wellbeing, now and into the future.

Specifically, for our district:

- Water is cared for in a sustainable and integrated way and in partnership with Papatipu Rūnanga and Te Rūnanga o Ngāi Tahu, in line with the principle of kaitiakitanga.
- Water quality and ecosystems are protected and enhanced.
- Our waterways support diverse and abundant mahinga kai.

2.6 The District Plan

The Christchurch District Plan promotes responsible stormwater disposal under Chapter 8 for Subdivision, Development and Earthworks through:

Policy 8.2.3.4 – Stormwater Disposal:

District-wide:

i. Avoid any increase in sediment and contaminants entering water bodies resulting from stormwater disposal.

ii. Ensure that stormwater is disposed of in a manner which maintains or enhances the quality of surface water and groundwater.

iii. Ensure that any necessary stormwater control and disposal systems and the upgrading of existing infrastructure are sufficient for the amount and rate of anticipated runoff.

iv. Ensure that stormwater is disposed of in a manner which is consistent with maintaining public health.

Outside the central city:

- Encourage stormwater treatment and disposal through low-impact or water-sensitive designs that imitate natural processes to manage and mitigate the adverse effects of stormwater discharges.
- Ensure stormwater is disposed of in stormwater management areas so as to avoid inundation within the subdivision or on adjoining land.
- Where feasible, utilise stormwater management areas for multiple uses and ensure they have a high-quality interface with residential activities or commercial activities.
- Incorporate and plant indigenous vegetation that is appropriate to the specific site.
- Ensure that realignment of any watercourse occurs in a manner that improves stormwater drainage and enhances ecological, mahinga kai and landscape values.
- Ensure that stormwater management measures do not increase the potential for bird-strike to aircraft in proximity to the airport.

- Encourage on-site rain-water collection for non-potable use.
- Ensure there is sufficient capacity to meet the required level of service in the infrastructure design standard or if sufficient capacity is not available, ensure that the effects of development are mitigated on-site.

Policy 8.2.4.1 - Water quality:

a. Ensure earthworks do not result in erosion, inundation or siltation, and do not have an adverse effect on surface water or groundwater quality.

and Policy 8.2.5.1 - Land stability

a. Avoid earthworks that will create a significant risk to people and property through subsidence, rockfall, cliff collapse, erosion, inundation, siltation or overland flows.

District Plan Policies 8.9.2.2 and 8.9.2.3 make earthworks subject to a consent. Conditions of consent for earthworks over a threshold include the requirement for an Erosion and Sediment Control Plan (ESCP). An ESCP is submitted and approved with a consent application and its implementation is verified by building consent and/or resource consent officers.

2.7 Bylaws

The reviewed Stormwater and Land Drainage Bylaw 2022 restricts discharges of any material, hazardous substance, chemical, sewage, trade waste or other substance that causes or is likely to cause a nuisance, into the stormwater network. Minimum standards can be applied by resolution of the Council.

The Traffic & Parking Bylaw 2017 allows the Council to require an offender to remove material spilled onto roads.

2.8 Building Act

The Council can use powers under the Building Act to require ESCPs to be submitted when an associated land use consent is not required.

2.9 Integrated Water Strategy 2019

Objectives 3 and 4 of the Christchurch City Council's draft Integrated Water Strategy are summarised as *"enhancement of ecological, cultural and natural values and water quality improvement."*

The preferred strategy option for achieving the objectives is to *"continue … the implementation of the current approach to stormwater management (embodied by the development of the Stormwater Management Plans) …"*

2.10 Infrastructure Design Standard

The Infrastructure Design Standard 2016 (IDS) is the Council's development code and is a revision of the Christchurch Metropolitan Code of Urban Subdivision 1987. The IDS promotes environmental protection via a values-based design philosophy and consideration of biodiversity and ecological function. Refer to the IDS Section 5.2.3: Four Purposes for more details.

2.11 Te Rūnanga o Ngāi Tahu Freshwater Policy Objectives and Policies

Te Rūnanga o Ngāi Tahu Freshwater Policy (Ngāi Tahu, 1999) lists several water quality and water quantity objectives and policies that apply generally to the Ngāi Tahu Takiwā. Objectives and policies of note, and of relevance to this SMP, are summarised below[1].

Objective 2: Mauri – Restore, maintain, and protect the mauri of freshwater resources.

Policy 2: Accord priority to ensuring the availability of sufficient quantities of water of appropriate water quality to maintain and protect the mauri of a waterbody.

Policy 3: Adopt catchment management planning as the means of achieving integrated management.

[1] Issues and policies that have been included in this SMP are related to stormwater quantity and quality issues, but they should be read in conjunction with the entirety of the MIMP.

Objective 3: Mahinga Kai – To maintain vital, healthy mahinga kai populations and habitats capable of sustaining harvesting activity.

Policy 2: Restore and enhance the mahinga kai values of rivers, streams, wetlands, and riparian margins.

Policy 3: Ensure that activities in the upper catchments have no adverse effect on mahinga kai resources in the lower catchments.

Objective 4: Kaitiakitanga – To promote collaborative management initiatives that enable the participation of Ngāi Tahu in freshwater management.

Policy 4: Improve the integration of western science and traditional local knowledge in order to develop a better understanding of all water use planning related matters.

2.12 Mahaanui Iwi Management Plan Objectives and Policies

The Mahaanui Iwi Management Plan sets out the statement of objectives, issues and policies for natural resource and environmental management in the rohe of the six Ngāi Tahu Papatipu Rūnanga, as shown in Figure 3 located in central Canterbury area, including Te Pātaka o Rākaihautū - Banks Peninsula. The Te Pātaka o Rākaihautū – Banks Peninsula SMP acknowledges the Iwi Management Plan policies and can contribute to policies which fall within the scope of a stormwater management plan (SMP). See Section 9.2 for more detail.

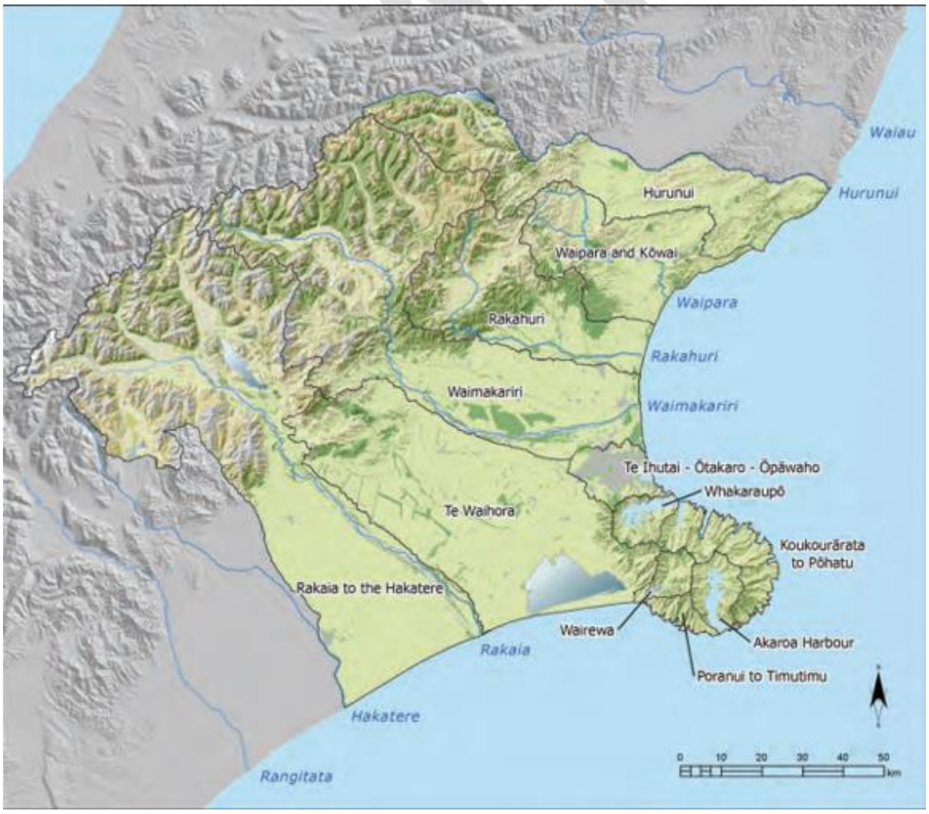

Figure 3: Nga Pakihi Whakatekateka o Waitaha and Te Pātaka o Rākaihautū - the takiwā covered by the Mahaanui Iwi Management Plan 2013 (MIMP, 2013).

2.12.1 Whakaraupō

Issue WH1: The cultural health of the harbour is at risk as a result of:

(a) Discharge of wastewater;

(b) Sedimentation;

(c) Stormwater run off; and

(d) Inflow from streams carrying increased sediment and nutrient loads.

Policy WH1.2: To require that Whakaraupō is managed for mahinga kai first and foremost. This means: Water quality in Whakaraupō is consistent with the protecting of mahinga kai habitat and enabling customary use.

Policy WH1.4: To adopt a holistic approach to restoring the cultural health of Whakaraupō. This means: Recognising the cumulative effects of all activities on the cultural health of the harbour.

Policy WH1.5: To require the elimination of the discharge of wastewater to Whakaraupō, as this is inconsistent with Ngāi Tahu tikanga and the use of the harbour as mahinga kai.

Policy WH1.7: To advocate that local authorities develop a regional management strategy for addressing soil loss in the Whakaraupō catchment and sedimentation of the harbour.

Issue WH3: The protection and enhancement of waterways and waipuna is essential to improving the cultural health of the catchment.

Policy WH3.1: To require that all waipuna of Ngā Kōhatu Whakarakaraka o Tamatea Pōkai Whenua (the Port Hills) are recognised and managed as wāhi taonga.

Policy WH3.2: To require that all waterways of Ngā Kōhatu Whakarakaraka o Tamatea Pōkai Whenua (the Port Hills) are recognised and provided for as wāhi taonga.

2.12.2 Koukourarata to Pōhatu

Issue KP7: Protection of waipuna as a wāhi taonga of particular importance.

Policy KP7.1: To require that all waipuna from Koukourarata to Pōhatu are recognised and managed as wāhi taonga.

Policy KP7.2: To identify opportunities to restore degraded waipuna.

Issue KP8: Degradation and widespread loss of indigenous biodiversity and implications for the health of the land, water and communities, including but not limited to:

(a) Loss of mahinga kai resources and opportunities; and

(b) Effects on the relationship of tāngata whenua with taonga species.

Policy KP8.1: To support and initiate protection, enhancement and restoration activities for sites identified by tangata whenua.

2.12.3 Akaroa Harbour

Issue A5: Effects on waterways and waipuna as a result of:

(a) Stormwater run-off;
(b) Indigenous riparian vegetation removal;
(c) Stock access;
(d) Abstractions associated with rural land use; and
(e) Sedimentation from earthworks and vegetation clearance activities.

Policy A5.1: To support the development on an integrated catchment management plan (ICMP) for Akaroa Harbour to address water quality and quantity issues in the catchment, recognising and providing for:

(a) Mauri and mahinga kai as first order priorities;
(b) The relationship between groundwater and surface water; and
(c) The effects of land use on water quality and quantity.

Policy A5.3: To improve water quality in the Akaroa Harbour, with particular focus on:

(a) Eliminating existing discharges and pollutants;
(b) Establishing native riparian buffer zones along all waterways and drains;
(c) Restoring degraded waipuna and wetlands;
(d) Requiring appropriate controls on land use to control sedimentation; and
(e) Prohibiting stock access to waterways, wetlands and waipuna.

Policy A5.4: To require that waipuna in the Akaroa Harbour catchment are recognised and provided for as wāhi taonga.

2.12.4 Poranui to Timutimu

Issue PT4: Protecting the mauri of waterways in the southern bays catchments.

Policy PT4.1: To require that waterways in the southern bays catchments are managed Ki Uta Ki Tai.

Policy PT4.2: To require that waipuna in the southern bays catchments, as the source of many waterways, are recognised and protected as wāhi taonga.

Policy PT4.3: To encourage landowners to take responsibility for riparian planting and management and to support incentives and funding schemes to assist them to do so.

2.12.5 Wairewa

Issue W1: The cultural health of Te Roto o Wairewa is degraded as a result of:

(a) Lake level management based on arbitrary trigger levels;
(b) Decline of the tuna population;
(c) Contaminants entering the lake as a result of inappropriate land use on lake edge margins;
(d) Nutrient rich sediment entering the lake as a result of poor land cover and inappropriate land use in the catchment: and

(e) Poor water quality in lake tributaries.

Issue W2: Lake level management should achieve outcomes consistent with the protection and restoration of mahinga kai and other cultural values associated with Te Roto o Wairewa.

Issue W3: The cultural health of waterways in the catchment has declined as a result of:

Stock access and run-off;

Degradation of riparian areas;

Sewage and stormwater disposal; and

Soil erosion and sedimentation.

Policy W3.1: To require that waterways in the Te Roto o Wairewa catchment are managed as kōhanga, consistent with managing the catchment as mahinga kai. This means:

(a) Protection of mauri as a first order principle; and

(b) Prohibit the discharge of contaminants to waterways.

Policy W3.2: To address water quality issues in the rivers and streams of the catchment.

2.12.6 Te Waihora

This SMP does not include Te Waihora because there is no urban stormwater discharging into Te Waihora from Christchurch District. Birdlings Flat settlement discharges directly to the coast. The Huritini-Halswell SMP should be referenced for stormwater discharges from Christchurch City to Te Waihora.

2.13 Goals and Objectives for Surface Water Management

The Te Pātaka o Rākaihautū -Banks Peninsula SMP is intended to be consistent with the *Integrated Water Strategy 2019* which identifies overall goals and objectives for surface water management. Jointly these plans will support so far as is practicable the *Mahaanui Iwi Management Plan* (Jolly, Lobb, & Ngā Papatipu Rūnanga, 2013) objectives for Whakaraupō, Koukourarata to Pōhatu, Akaroa Harbour, and Wairewa.

The Council's high-level goals in the Integrated Water Strategy are:

Goal 1: The multiple uses of water are valued by all for the benefit of all.

Goal 2: Water quality and ecosystems are protected and enhanced.

Goal 3: The effects of flooding, climate change and sea level rise are understood, and the community is assisted to adapt to them; and

Goal 4: Water is managed in a sustainable and integrated way in line with the principles of kaitiakitanga.

The CSNDC sets freshwater outcomes based on Land and Water Regional Plan (LWRP) targets, known as Attribute Target Levels (ATLs). The CSNDC Environmental Monitoring Programme (EMP) will assess the ecological and cultural health of waterways and coastal areas and progress made under the SMP. The EMP assesses a range of parameters, and progress can be measured against the ATL guidelines for macroinvertebrate indices, macrophytes, periphyton, siltation and a range of water quality parameters.

The SMP programme will contribute toward delivery on these objectives through improving water quality in the rivers and streams. Other plans and programmes must play a part in restoring riparian margins and protecting and restoring springs and mahinga kai to deliver on tangata whenua and LWRP objectives.

Other sources and reports that have informed the SMP include:

- State of the Takiwā;
- Ecological, surface water and sediment quality monitoring undertaken as part of Christchurch City Council's Environmental Monitoring Programme (EMP)[2] and SMP specific monitoring (Green, 2024);
- Listed Land Use Register (contaminated sites database, ECan);
- Groundwater and springs study (PDP 2023);
- Wet weather sampling; and
- Banks Peninsula contaminant load model (DHI 2024).

[2] The Comprehensive Stormwater Network Discharge Consent Environmental Monitoring Programme can be viewed here: https://ccc.govt.nz/assets/Documents/Environment/Water/Monitoring-Reports/2025/Comprehensive-Stormwater-Network-Programme_Version-10.pdf

3 Principal Stormwater Management Issues

The Peninsula's environment is affected in many places by human activities and their after-effects. Deforestation has left about 1% of the pre-1860 forest cover with much of the deforested land having become pastoral. Land use changes over time have led to increased soil erosion and sediment yields (Hart, 2004), although flat land in the heads of bays represents thousands of years of natural accretion. Slips and under-runners are a feature of hill slopes and, along with stream bank erosion, deliver sediment into streams, lakes and harbours.

Settlements bring a range of urban activities, including land development, road transport and occupation, from which a range of urban contaminants enter streams and coastal waters. Water quality monitoring is increasingly sampling heavy metals in stormwater runoff and present in streambed sediments. Development can alter stream habitats and flows by encroaching into riparian margins and altering flow paths. Bridges and culverts can be barriers to fish passage.

Compromised cultural health of the waterbodies and the harbours is an issue for tangata whenua.

Flooding generated by rural hill runoff occasionally occurs in some settlements. The rolling nature of the landscape elevates most houses above flood levels but some houses on narrow floodplains near streams are vulnerable. Neither the regional nor the district council normally seek to mitigate rurally-sourced flooding because most of the Peninsula does not pay a drainage rate. Affected residents perceive a disparity of service between small communities and the city.

Table 1: Key issues for each settlement

Settlement	Size (Ha)	Principal Issues
Akaroa	152	Metal exceedances in surface waters and instream sediment. Flooding on some low-lying properties near streams and the coast.
Lyttleton, Corsair Bay, Cass Bay	297	Metals exceedances in surface waters. Blocked inlets can lead to stormwater bypassing through private properties
Cass Bay	30	Metals exceedances in surface waters. Blocked inlets can lead to stormwater bypassing through private properties
Rapaki (papakainga)	320	Hillside sediment entering the harbour Minor stream erosion Marae possibly floodable
Diamond Harbour including Charteris Bay	279	Waterways discharge sediment during rainfall; under-runners in hillsides Sufficient population to discharge elevated heavy metals in runoff

Governors Bay	99	Metal exceedances in surface waters
Little River	240	Main road flooding from Okana River at approximately 2-5 yearly intervals
Robinsons Bay	65	Effects below threshold for reporting
Pigeon Bay	4	Effects below threshold for reporting
Kukupa	12	Effects below threshold for reporting
Birdlings Flat	24	Effects below threshold for reporting
Little Akaloa	16	Occasional flooding and the potential for future coastal inundation
Okains Bay	39	Occasional need for drain maintenance reported
Le Bons Bay	14	Flooding / Coastal Inundation
Wainui	35	Effects below threshold for reporting
Tikao Bay	6	Effects below threshold for reporting
French Farm	7	Effects below threshold for reporting
Duvauchelle	56	Swollen streams can flood the state highway
Takamatua	27	Effects below threshold for reporting
Purau	8	Effects below threshold for reporting
Moepuku	45	Effects below threshold for reporting
Allandale	63	Effects below threshold for reporting
Koukourārata-Port Levy (papakainga)	538	A small group of houses in Port Levy is flood prone.

"Size" is the area of urban or papakainga zoning

Part Two: The Catchment

4 Catchment Description

Te Pātaka o Rākaihautū - Banks Peninsula lies on the eastern margin of the Canterbury Plains. For the purposes of the CSNDC the peninsula south-east of the summit of the Port Hills is defined as an SMP catchment. The SMP applies only to the 24 settlements that have a stormwater network. The rest of the catchment is mostly rural and open/conservation space. Urban zonings in settlements occupy 500 hectares in total.

4.1 Geography

According to legend*: "The ancestor Rākaihautū dug the lakes of the Te Wai Pounamu, the South Island, and rested his great kō, or digging stick, on the hills above Akaroa creating one of Aotearoa New Zealand's most unique landforms.*[3]*"*

Te Pātaka o Rākaihautū - Banks Peninsula is the largest true peninsula in New Zealand with an area covering about 116,000 hectares. Banks Peninsula sits on top of the remains of four volcanic systems, named Lyttelton, Mt. Herbert, Akaroa and Diamond Harbour (Dwyer, 2014).

The peninsula was originally a volcanic island formed by volcanic activity over a period from twelve to six million years ago. Once volcanic activity ceased the area was relatively stable during the Pleistocene era. Approximately 20,000 years ago, out-washed gravels from the glaciated Southern Alps fanned out to form the Kā Pākihi Whakatekateka a Waitaha - Canterbury Plains, which extended to meet the island, joining it to the rest of Te Wai Pounamu - South Island and forming the Peninsula we know today.

The two main harbours, Whakaraupō - Lyttelton and Akaroa, were formed by volcanic eruptions that shaped calderas which later eroded and became inundated by the sea. Both harbours are ringed by peaks of between 700-900 m; Mt Herbert, the highest point on the peninsula, is 919 m above sea level.

4.2 Geology

The Peninsula's geology is diverse, with rocky cliffs, sandy beaches, and volcanic formations. The area is known for its unique volcanic landforms, such as sea caves, sea stacks, and volcanic dykes. Topography is generally hilly with many steep slopes on the inner walls of the calderas and the outer walls ranging from hilly at higher elevations to rolling nearer the coast. Lava flows have formed a series of benches along the ridges.

Lyttelton Volcanic Complex formed between 11 – 9.7 million years before present (Ma) through discontinuous lava flows and ash and tephra ejections. Mt Herbert was active from 9.7 to 8 Ma beginning from vents in the Lyttelton crater. The largest volcano, Akaroa, was active between 9-8 Ma with its centre under Onawe Peninsula. A younger group of volcanics are found on the flanks of the Lyttelton Volcano in Diamond Harbour from eruptions 7-5.8 million years ago.

[3] (https://rtnz.org.nz/wp-content/uploads/2023/12/dmp-te-pataka-o-rakaihautu-banks-peninsula-at-a-glance.pdf

Faulting and sea and rainfall erosion opened the two calderas to the sea.

Visible ridges are composed of lava flows from the Lyttelton, Mt. Herbert, Akaroa and Diamond Harbour volcanic complexes and hold a great range of volcanic history (Figure 4).

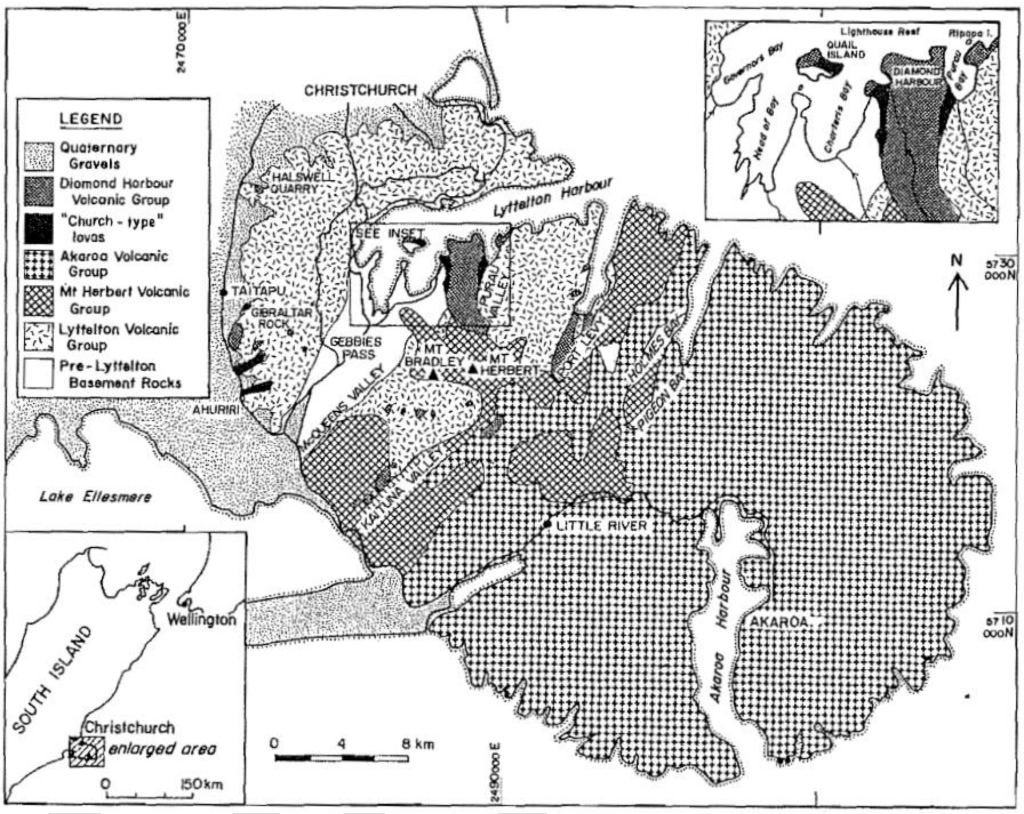

Figure 4**:** A geological map of Banks Peninsula simplified to the four largest volcanic groups present. Sourced from Sewell, 1988.

4.3 Soils

Banks Peninsula is mantled with loess transported by wind from the floodplain of the Waimakariri River. The thickest deposits of loess on the peninsula are found on regular slopes at lower elevations, although there are also some deposits 1-2 m thick on rolling tops near the summit. On steep slopes little or no loess is deposited. Soils often contain minerals and nutrients derived from volcanic rocks, providing a suitable environment for agriculture.

Two distinct types of loess are found on the peninsula, calcareous and non-calcareous, named Birdlings Flat and Barrys Bay Loess respectively; mostly found in separate areas although there is some intermingling on the inner wall of Whakaraupō -Lyttelton Harbour.

Birdlings Flat loess is coarse, having a fine sandy loam to loamy fine sand texture and is intermingled with windblown fine sand on the lower spurs next to the floodplain and estuary.

Barrys Bay loess is found round the heads of inlets, on some lower valley slopes and on ridge tops toward the east. This loess is fine, being mostly of silt loam texture with some fine sandy loam at lower elevations.

Loess soil particles tend to be single-sized, and soils are open and permeable. Loess is readily eroded by water and can be affected by sub-surface tunnels (under-runners).

Under-runners (tunnels) are often encountered in hill catchments due to the soils. The Port Hills are mainly covered by volcanic colluvium with varying levels of loess deposition. Loess soils are highly erodible and are an important consideration when dealing with hill waterways and development on the Port Hills. Loess is dispersive when wet and prone to shallow seated landslides or under-runners and tunnel gullying. Tunnel gullies typically start as a desiccation crack from wet and dry cycling. The control of surface and subsurface water is a key factor in maintaining the stability of loess slopes (Griffiths 1973).

4.4 Harbours, Lakes and Waterbodies

Banks Peninsula waterways form radial patterns on the inside and outside of two major volcanic cones. The steep landscape is dissected by many valleys and bays into which more than 100 streams flow, although some only do so in winter. Most catchments are short (less than 10 km long) and very steep, with lowland stream reaches generally only a few kilometres long. Most streams most flow directly into the harbours and sea; it is difficult for lakes and wetlands to form in the Peninsula’s steep-sided valleys and limited flat land. The one significant freshwater body is Te Roto o Wairewa (Lake Forsyth), although a few waterways between Lansdowne and Kaituna Valleys flow into Te Waihora-Lake Ellesmere (which is outside this SMP area). Streams are spring-fed by water seeping from cracks in the basement rock. Annual rainfall on the hilltops is up to twice the lowland rainfall (WWDG Ch 21), helping to maintain base flows.

4.4.1 Akaroa Harbour

Akaroa is the large harbour on the southern coast of Te Pātaka-a-Rākaihautū. Whakaroa is another spelling of Akaroa. ‘Whanga’, or ‘Whaka’ in the Kāi Tahu dialect means harbour, and ‘roa’ translates to mean long. Akaroa was occupied by iwi such as Hāwea, Waitaha, Rapuwai, and Kāti Māmoe prior to the southern Kāi Tūhaitara migration to Canterbury. Te Ake was one of several Ngāi Tahu tūpuna who claimed land during this migration. By placing his tokotoko (walking stick, staff, pole) at the head of the harbour Te Ake claimed ownership of the harbour. Akaroa continues to be a renowned mahinga kai for local Kāi Tahu hapū based at the small kāinga of Ōnuku.

The northeastern bays have extensive intertidal mudflats that are classified as significant coastal wetland habitat (Green, 2024) and provides habitat for a wide variety of native wetland birds.

Several waterways flow into Akaroa Harbour from the upper rural hill areas with many going through urban settlements before discharging into the harbour. The main waterways flowing through urban areas include Takamatua, Oinako - Grehan, Wai-iti – Balguerie, Waipirau – Walnut and Aylmers Streams.

Takamatua is the long stream that flows into the bay of the same name between Ōtipua (Takamatua Hill) and Te Umu-Te-Rehua (Hammond Point) on the eastern side of Akaroa

Harbour. Its catchment is largely rural land-use with a small area of residential and open parkland near the coast.

Ōinako - Grehan Stream is a small stream at Ōtāhuhua (Childrens Bay) named after a Ngāti Māmoe ancestor who was killed here. Ōinako escaped from the Ngāti Māmoe pā of Parakākāriki at Ōtānerito Bay when it was attacked by Moki and his Ngāi Tūhaitara war-party who were searching for Tūtekawa. Following the death of Tūtekawa various Ngāi Tahu rangatira (chiefs) claimed land on the Peninsula. One of these was Tūtakakahikura who was travelling from Pōhatu (Flea Bay) to Te Ruahine, and then down Akaroa Harbour before encountering Ōinako at a stream within the harbour. This encounter resulted in Tūtakakahikura killing Ōinako, and the stream has been known by his name ever since.

Akaroa's four main waterways flow through developed urban areas meaning they are likely impacted by stormwater-derived contaminants. All these waterways can be defined as having high ecological value as they are listed as sites with ecological significance (Green, 2024) and most support inanga spawning habitat. However, the waterways all receive stormwater inputs from the multiple outfalls in the town.

Figure 5: Takamatua Stream, a tributary of the Akaroa Harbour, looking downstream.

4.4.2 Te Roto o Wairewa - Lake Forsyth

Te Roto o Wairewa was dug by the Waitaha exploring ancestor Rākaihautū with his kō (digging stick) named Tūwhakaroria. After Waitaha arrived at Whakatū / Nelson in the Uruao waka, Rākaihautū divided his people into two groups. Rākaihautū led his group down the middle of the island to Murihiku / Southland, and then back up the east coast, digging the freshwater lakes of Te Waipounamu. After digging Te Roto o Wairewa, Rākaihautū placed his kō into the ground at Akaroa Harbour, and changed its name to Tuhiraki. Wairewa was claimed by the Ngāi Tahu ancestor Makō on hearing of the rich mahinga kai resources of the area. Wairewa is renowned historically for its abundance of tuna and is one of only two customary lakes in New Zealand, with the tuna fishery of Wairewa becoming legally exclusive to Ngāi Tahu whānui in 1986.

The Ōkiri-Okana River and the wider Wairewa area were claimed by the Ngāi Tahu ancestor Makō for the rich mahinga kai resources of the area. When the tūpuna Kaiapu and Tamakino returned to Kaikōura from their southern journey of Te Waipounamu, they described to other Ngāi Tahu leaders in detail the vast amount of mahinga kai resources that they came across. These waterways support significant ecological values including inanga spawning habitats and at-risk freshwater species and flow into Wairewa which is considered a Site of National Significance (Green, 2004).

Figure 6: The head of Te Roto O Wairewa showing the confluence of the Ōkana and Ōkuti Rivers

Little River is in the Ōkiri – Okana River catchment. Police Creek, Hukahuka Turoa Stream and Opuahou Stream all feed into the Ōkiri – Okana before joining with the Ōkuti River. The combined streams form the Takiritawai River which flows into the head of Te Roto o Wairewa.

4.4.3 Te Waihora - Lake Ellesmere

Te Waihora, also known as Te Kete-ika-a-Rākaihautū and Te Kete-ika-a-Tūtekawa, is a large, shallow, brackish coastal lake, spreading from the western shores of Te-Pātaka-a-Rākaihautū (Banks Peninsula) down to the settlement of Taumutu. The name Te Waihora is a geographical term meaning “water spread out”. The lake was a renowned mahinga kai for local Ngāi Tahu, particularly for tuna, pātiki (flounders), aua (mullet), and a variety of ducks.

The main tributaries of Te Waihora – Lake Ellesmere that relate to this SMP include the Ōkana Stream and Kaituna River. The Ōkana is a small stream that flows from the eastern valley of the Kaituna Valley into the Kaituna River, on Te Pātaka-a-Rākaihautū.

The Kaituna River runs off the western flanks of Te Pātaka-a-Rākaihautū into the eastern part of Te Waihora. The river flows into what is now commonly known as the Kaituna Lagoon but was traditionally known as Motumotuao. The name Kaituna refers to the abundance of tuna (eels) in the area. Kaituna was a key ara tawhito (traditional travel route) which provided direct access from Whakaraupō and Koukourarata to the rich mahinga kai of Te Waihora.

4.4.4 Whakaraupō - Lyttelton Harbour

Whakaraupō is the Māori name for the harbour where Rāpaki is located. 'Whanga', or 'Whaka' in Kāi Tahu dialect, means harbour, and 'raupō' (bulrush — *Typha orientalis*) is the well-known and easily recognisable wetland plant. Raupō stalks were traditionally used for thatching the walls and roofs of whare, and the yellow pollen collected from raupō was used to make a type of cake. Originally Whakaraupō specifically referred to 'The Head of the Bay' where significant stands of raupō were found; a very small patch of raupō remains there today.

Lyttleton, Governors Bay, Cass Bay, Coarsair Bay, Charteris Bay and Diamond Harbour are the main urban settlements within the Whakaraupō - Lyttelton Harbour catchment. Many waterways in this area are short and run directly to the harbour. The main waterways that flow through urban settlements and are the focus of this SMP include Governors Bay and Stream Reserve Drains and Cass and Corsair Bay Drains.

Governors Bay Drain and Stream Reserve Drain are fed from upper catchments of remnant native vegetation before flowing through the urban settlement areas and discharging into coastal wetland and mudflat habitat at the head of the harbour.

Cass Bay Drain and Corsair Bay Drain have intermittent flows in the upper headwaters. These waterways are sourced from tussock lands with some small patches of native vegetation before being largely piped within the settlement areas with outflows into the harbour.

The waterways within Charteris Bay and Diamond Harbour are ephemeral within steep, fast draining catchments. There are limited stormwater outfalls in this area as outfalls largely are direct to the harbour.

Figure 7: Whakaraupō, looking out to Diamond Harbour

4.4.5 Koukourarata - Port Levy

Koukourarata is a long, sheltered bay on the northern coastline of Te Pātaka-a-Rākaihautū. Koukourarata is home to Puāri Pā, which was the largest Ngāi Tahu settlement throughout Canterbury in the mid-1800s following the fall of Kaiapoi Pā. Koukourarata Stream flows into the eastern side of Port Levy.

The bay was named by Moki after a stream in Te Whanganui-a-Tara / Wellington which recalls the birth of his father, Tūāhuriri. The name Koukourarata recalls an incident that occurred in Te Whanganui-a-Tara and involved a senior Ngāi Tahu woman by the name of Rākaitekura, the mother of Tūāhuriri. Before she married Te Aohikuraki and had Tūāhuriri, Rākaitekura was married to the Ngāti Kahungungu/Ngāi Tara chief Tūmaro. She committed adultery, and when Tūmaro found out, he took her to a stream near Mount Crawford and told her to wash herself and bind (koukou) her hair. Tūmaro then led Rākaitekura back to the marae and delivered (rarata) her to her people. The stream where Rākaitekura washed herself was named Koukourarata.

4.4.6 Stormwater Systems

The largest settlement Lyttelton has a fully constructed stormwater network in which its eight hillside waterways have been piped since the beginning of the 20th century. This was initially for reasons of hygiene but also reclaimed land and facilitated township expansion. In the next largest settlements Diamond Harbour and Governors Bay, stormwater discharges into ephemeral valleys from multiple short lengths of pipe. Some private stormwater in these areas discharges onto hillsides where it causes erosion in places. Akaroa, Duvauchelle and Little River have short lengths of stormwater mains that discharge into streams that are mostly flowing. In smaller settlements, which are the majority, roadside drains and culverts are the main parts of the stormwater network and convey stormwater for relatively short distances, discharging it into streams or watercourses.

Most stormwater receives no detention or treatment. There are some treatment devices, including the Stormfilter™ at Black Point which was installed to mitigate the effects of development. A sand filter at Governors Bay is currently being converted to a raingarden/ biofiltration device. The sand filter was a temporary device until the upstream catchment (number of dwellings) reached a predetermined threshold.

Except for Little River, Cooptown and Kukupa, settlements are coastal with a rural hinterland. In many cases including Little River the rural catchment delivers hillside water through or past the settlement, causing the majority of stormwater problems experienced by settlements.

Table 2: Stormwater networks in settlements, summarised

Settlement	Stormwater Network
Akaroa	Four main streams flow through Akaroa from hill catchments to the east. Grehan Stream, Balguerie Stream, Walnut Stream and Aylmers Stream flow all year round from sizeable, largely pastoral catchments. Through the town the streams are separated by low ridges. Most urban stormwater is collected onto roads and discharged into the four significant streams and some minor watercourses via short pipe runs. Networks and longer lengths of pipe are less common but some longer lengths of pipe discharge onto beaches. South Akaroa is drained by ephemeral hill waterways and has relatively few stormwater pipes.
Lyttleton	Before European settlement Lyttelton was transected by 7 hillside waterways, with another in Corsair Bay. These were piped c 1900 with large, brick stormwater mains which carry hillside water through the town and pick up town stormwater. The waterways are sufficiently close to limit the need for major laterals. Steep streets convey stormwater quite readily so that relatively few stormwater pipes are needed. Many street catchpits deliver stormwater directly into mains. More laterals are installed in the commercial centre where roads are flatter and stormwater capture is more critical. Smaller stormwater mains drain the hillside in the eastern part of the town. Lyttleton Port has its own stormwater network and is excluded from the CSNDC. The treatment systems in that area are not considered within this SMP.
Cass Bay	Three main waterways capture the rural hillside catchments and urban stormwater and discharge to the bay. Approximately half of the original waterway length has been piped. Topography leads road and private stormwater into the waterways via road sumps. A more extensive network

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	serves a developing area in the west of the settlement. This subdivision has a sand filter treatment device
Corsair Bay	Road culverts and some pipes into Corsair Bay waterway.
Charteris Bay	Drainage is based around roadside channels which discharge into streams or in a few cases directly into the bay.
Diamond Harbour	Newer areas in western Diamond Harbour have short stormwater networks, often 1 or 2 pipes which discharge into major waterways or over coastal cliffs. The older, eastern Diamond Harbour area has relatively few stormwater pipes. Most stormwater flows in road side channels or roadside swales before entering waterways via short lengths of pipe. A more extended network in Black Point subdivision brings stormwater from two catchments into vaults for treatment by cartridge filters.
Governors Bay	Roadside channels provide most of the stormwater conveyance. Channels discharge into relatively frequent hill waterways. Most stormwater pipes are short runs taking stormwater from roads into hill waterways. Network plans do not show how many houses discharge roof water onto hillsides. Newer subdvisions can have a more extended pipe system discharging into roadside channels or waterways.
Little River	The northern, residential area of Little River is served mostly by roadside swales and open drains which lead across the state highway to the Okana River. The town centre is drained by pipes leading into a roadside drain which discharges to the Okana River. Hillside runoff from west of the town is collected in swales and piped beneath the state highway to the Okana River
Robinsons Bay	Most of the settlement of Robinsons Bay is on a rocky headland adjoining and south of Duvauchelle. Older houses appear to discharge stormwater onto hillsides. Newer houses are served by short lengths of pipe that drain properties and/or roads to hillside gullies.
Pigeon Bay	Pigeon Bay and Starvation Gully Roads collect water from the residential areas and discharge to sea, however most of the water in the stream drains the rural catchment. Several single-pipe road crossings discharge into the sea directly from rural land
Kukupa	No formal network. Road verges convey stormwater which is mostly road and hillside runoff.
Birdlings Flat	No stormwater network is needed due to very permeable ground.
Little Akaloa	Natural waterways convey hillside water to road culverts leading to the coast. There is no stormwater network but one pipe drains Lukes Road.
Okains Bay	The settlement of Okains Bay is spread out and sparse. Houses and farm land between Okains Bay Road and the river are drained by open drains and swales. A few road crossings also discharge to drains and swales leading to the Opara Stream.

LeBons Bay	There is no stormwater network; houses are assumed to discharge to soak pits in the sandy ground. Roads discharge to grass verges. A stream runs though the residential area and discharges to the beach through a Council-maintained drain through sandhills.
Wainui	Stormwater is discharged onto roadsides or into gullies and streams. Road stormwater may discharge to the foreshore via short pipes. Newer subdivisions are served with some lengths of pipework in a more formal way.
Tikao Bay	Too small to have a stormwater network. Drainage into streams or onto hillsides.
French Farm	No formal stormwater network is indicated on maps. Stormwater likely to discharge into shallow water pathways. Some road culverts.
Duvauchelle	Stormwater is discharged onto roadsides and into gullies and streams. Road stormwater discharges to gullies and streams via short pipes. Discharges from older properties (baches) are unrecorded and may be onto/into land. Newer subdivisions, with smaller sections, have common pipework which drains to a waterway. Stormwater from a residential area on Pawsons Valley road is piped to the foreshore.
Takamatua	The network is mostly roadside drains and road culverts draining either to Takamatua Stream (east of the highway) or to the foreshore, in the beach settlement. Some new hillside pipework discharges into two sedimentation basins, each with a discharge point into the bay.
Purau	Purau drainage is based around two natural streams and roadside drains on two roads parallel to the valley axis. Properties are assumed to drain to roadside swales, which drain into the streams. A few road culverts drain roadside swales to the foreshore.
Allandale	No urban area and no stormwater network
Koukourarata/Port Levy	The settlement is crossed by a number of hillside streams that accept road and property stormwater. The only stormwater pipes are road culverts. Some roadside swales/drains.

Maps of the stormwater network in settlements can be found in Appendix B.

4.5 Groundwater – Physical

The groundwater systems on Te Pātaka o Rākaihautū - Banks Peninsula are separated in multiple catchments that are defined by prominent ridgelines. Water recharge into groundwater occurs directly from rainfall through shallow soil or bedrock, primarily in the upper hill slopes where the climate is wetter.

4.5.1 Groundwater Movement Through the Strata

Volcanic successions form heterogeneous strata with groundwater predominantly contained in jointed basalt lava flows and their autobreccias[4] (Sanders, 1986). Tuff[5] layers or massive lavas interbedded with the jointed lava flows act as leaky basal low permeability zones, and hence the groundwater network acts as a series of irregularly shaped perched water bodies (Parker, 1989). Permeable volcanic colluvium[6] (Sanders, 1986), and lava units with a high concentration of fractures (Namjou, 1988) are important for the vertical transmission of water. Basal autobreccias are more important for lateral groundwater flow (Namjou, 1988).

4.5.2 Discharge

Groundwater may be released from the volcanic bedrock as a spring or may leak into overlying loess/loess-colluvium and alluvium[7] layers (Sanders, 1986). When groundwater reaches the base of a valley it may concentrate into one or more stratified zones within alluvium profiles. This is particularly relevant for long valleys with a lower elevation base where there are successions of colluvium-alluvium, and often sand, silt or clay sequences from marine transgressions/ regressions, as in the Kaituna Valley (Namjou, 1988). Alluvial deposits overlying volcanic strata in the lower parts of the valleys are the main Banks Peninsula aquifer systems. They have limited storage capacity (ECan, 2014), and the few studies on the residence times of water in these aquifers suggest ages of up to 15 years (Taylor & Stewart, 1979).

Groundwater discharges occur in multiple springs. The location of springs emerging from both the volcanic and loess colluvium cover are typically controlled by strata within the underlying bedrock, and typically emerge at sites where there is an increase in slope angle (Sanders, 1986).

Most springs occur on the steeper valley sides, typically towards the heads of the valleys; for example 73% of the 200 springs mapped in the French Farm area occur above 250 m elevation, and 66% of the 470 springs mapped in Pigeon Bay occur above 300 m elevation (Sanders 1986). Namjou (1988) noted that most springs occur in clusters along horizontal horizons, representing perched groundwater layers. Flow rates of <2.5 L/min are characteristic for most springs, however some springs with higher flow rates (>15 L/min) occur closer to the summits/tops of the catchments (Sanders, 1986; Parker 1989). Springs emerging from alluvium in the valley floors are uncommon.

Discharges from springs show seasonal trends: there is a peak in winter followed by a general decrease in discharge through spring to autumn. Many springs are intermittent and dry during the summer months.

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[4] Cooling lava, broken and reformed during a lava flow.

[5] Consolidated ash

[6] Surface deposit transported predominantly by gravity.

[7] Loose clay, silt sand or gravel deposited by running water

5 Tangata Whenua Cultural Values

5.1 Te Ao Māori Overview

"Ko te wai te oranga o ngā mea kātoa.

Water is the life giver of all things."

Water is a significant cultural resource that connects Ngāi Tahu to the landscape and the culture and traditions of their tūpuna (ancestors). All water originated from the separation of Ranginui (Sky Father) and Papatūānuku (Earth Mother) and their continuing tears for one another. Rain is believed to be Rangi's tears for his beloved Papatūānuku, and mist is regarded as Papatūānuku's tears of grief for Rangi.

From a Te Ao Māori worldview, water is a taonga (an invaluable treasure) given by ancestors to provide and sustain life. The taonga value not only refers to the water itself, but the resources living in the water, and the resources in the wider environment that are sustained by water.

Ngāti Tahu consider that its relationship with the waters of its rohe (region) has been eroded over the last 150 years. The current cultural health of the waterways and groundwater across the Waitaha / Canterbury region is evidence that water management and governance in the takiwā (territories) has failed to protect freshwater resources. Surface and groundwater resources are over-allocated in many catchments and water quality is degraded by urban and rural land use. This has significant effects on the relationship of Ngāi Tahu to water, particularly with regard to mauri (life essence), mahinga kai, cultural wellbeing and indigenous biodiversity.

For tangata whenua, restoration of the cultural health of freshwater resources across the region is important for the present generation, as kaitiaki (guardians), and to ensure that the taonga is available for future generations.

"Mō tātou, ā, mō kā uri ā muri ake nei.

For us and our children after us."

As outlined in the Mahaanui Iwi Management Plan (2013), the maintenance of water quality and quantity is a critical management issue for tangata whenua and there is a need to rethink the way water is valued and used, including the kind of land uses water is supporting, and the use of water as a receiving environment for contaminants such as sediment and nutrients.

Changing the way water resources are valued must underpin and drive the change needed in the way freshwater resources are managed and used. Water is a taonga, and the collective responsibility for protecting the mauri of this taonga is a fundamental principle of the Ngāi Tahu Freshwater Policy. The right to use water must be prefaced on a responsibility to care for water.

There are several key values, principles and concepts that underpin the Te Ao Māori worldview and shape the way Ngāi Tahu view the environment and subsequent resource management. A brief overview of a few of these is provided; for more detail see Section 4.2 of the Mahaanui Iwi Management Plan (2013).

5.1.1 Te Mana o Te Wai

Te Mana o te Wai is a concept that refers to the fundamental importance of water and recognises that protecting the health of freshwater protects the health and well-being of the wider environment. It protects the mauri of the wai (water). Te Mana o te Wai is about restoring and preserving the balance between water, the wider environment, and the community.

Te Mana o te Wai encompasses six principles relating to the roles of tangata whenua, and other New Zealanders in the management of freshwater. For detail on these principles see Section 1.3 of the National Policy Statement for Freshwater Management (2020).

5.1.2 Ki Uta Ki Tai

The principle of Ki Uta Ki Tai (from the mountains to the sea) reflects the holistic nature of traditional resource management, particularly the interdependent nature and function of various elements within a natural environment's catchment; it recognises the connection between land, groundwater, surface water and coastal waters.

5.1.3 Whakapapa

Whakapapa (genealogy) is the central pillar of Ngāi Tahu's framework for managing resources, setting out and effectively explaining the relationships between the various elements of the world around us, including human beings.

5.1.4 Mauri

Mauri is often described as the 'life force' of any given place or being. It can also be understood as a measure or an expression of the health and vitality of a place or being. The concept embodies the Ngāi Tahu understanding that there are both physical and metaphysical elements to life, and that both are essential to overall well-being.

Mauri can change either naturally or through human intervention and Ngāi Tahu use both physical and spiritual indicators to assess its strength. Physical indicators include, but are not limited to, the presence and abundance of mahinga kai fit for consumption or cultural purpose. Spiritual indicators are often recalled in kōrero pūrākau (traditional stories and myths) to explain the intrinsic connection between the physical and metaphysical.

5.1.5 Kaitiakitanga

Kaitiakitanga is fundamental to the relationship of Ngāi Tahu with the natural environment. The responsibility of kaitiakitanga is twofold: first, there is the ultimate aim of protecting mauri and, second, there is the duty to pass the environment on to future generations in a state which is as good, or better than, the current state. To Ngāi Tahu, kaitiakitanga is not just passive custodianship, or the simple exercising of traditional property rights, but entails an active exercise of responsibility in a manner beneficial to the resource.

5.1.6 Mahinga Kai

Mahinga kai is a critical aspect to the traditional way of life of Māori; it relates to food and other natural resources. Resource interests include seasonal timetables and other practices to best utilise the resources available. Therefore, mahinga kai includes the process of food gathering, the way it is gathered, the place it is gathered from, and all aspects of the actual resource itself.

5.2 Te Rūnanga o Ngāi Tahu

Ngāi Tahu is the iwi (tribe) holding mana whenua over a large portion of Te Waipounamu / the South Island. The modern iwi originates from three main tribal strands; Waitaha, Ngāti Mamoe and Ngāi Tahu. Through intermarriage, warfare and alliances, these tribal groups migrated, settled, occupied, amalgamated, and established mana whenua prior to European arrival. Specific hapū (or sub-tribes) established control over distinct areas of the island and have maintained their mana over these territories to this day.

Te Rūnanga o Ngāi Tahu is the mandated iwi authority established by Ngāi Tahu whānui under Section 6 of the Te Rūnanga o Ngāi Tahu Act 1996 to protect the beneficial interests of all members of Ngāi Tahu, including the interests of the Papatipu Rūnanga and its members. Te Rūnanga o Ngāi Tahu is governed by elected representatives from each of the 18 Papatipu Rūnanga and has an administrative office as well as a number of commercial companies.

5.3 Papatipu Rūnanga

Mana whenua represents the ability to influence and exercise control over a particular area, or region, and act as its kaitiaki. Mana whenua is derived from whakapapa (genealogy) and is protected and secured through continued occupation of ancestral lands (aki kā roa), the continued use of resources (mahinga kai) and the protection of the mauri of resources and the environment. There are five Papatipu Rūnanga who hold mana whenua in their traditional takiwā, they are summarised below:

5.3.1 Ōnuku Rūnanga

Ōnuku Rūnanga is the administrative council and representative of the hapū of Ngāi Tārewa and Ngāti Irakehu who hold mana whenua over their traditional takiwā, or tribal area which is centred on Ōnuku and the hills and coasts of Akaroa.

5.3.2 Te Rūnanga o Koukourārata

The takiwā of Te Rūnanga o Koukourarata centres on Koukourarata and extends from Pōhatu Pā, to the shores of Te Waihora / Lake Ellesmere and includes Te Kaituna (the Kaituna River).

5.3.3 Wairewa Rūnanga

Wairewa Rūnanga is the administrative council and representative of the hapū of Ngāti Irakehu and Ngāti Mako who hold mana whenua over their traditional takiwā, or tribal area. The takiwā of Wairewa Rūnanga is centred on Wairewa and the catchment of the lake Te Roto o Wairewa and the hills and coast to the adjoining takiwā of Koukourārata, Ōnuku Rūnanga, and Te Taumutu Rūnanga.

5.3.4 Te Hapū o Ngāti Wheke (Rāpaki)

The small settlement of Rāpaki sits on the shores of Whakaraupō (Lyttelton Harbour) under the mountain Te Poho o Tamatea (the breast of Tamatea).

Today, Rāpaki is home to Te Hapū o Ngāti Wheke whose takiwā centres on Rāpaki and includes the catchment of Whakaraupō and has a shared interest in Te Kaituna with Te Rūnanga o Koukourārata.

5.4 Cultural Position Statement

Mahaanui Kurataiao (MKT) is responsible for preparing a Position Statement which is the Te Rūnanga o Ngāi Tahu designated means of providing a cultural impact assessment and will reflect the monitoring of this SMP. The Position Statement will be submitted to Environment Canterbury together with this SMP.

Where appropriate, recommendations within the Position Statement will be captured in the updated Implementation Plan. If actions are recommended that sit outside of the SMP then other relevant departments within Council will be made aware of the recommendations, and other avenues will be initiated.

5.5 Monitoring of Mana Whenua Values

Cultural health monitoring will be undertaken in accordance with the Environmental Monitoring Programme with the appropriate Papatipu Rūnanga. This monitoring will help Council identify specific areas of concern or values that are important to protect e.g. stream habitats that should be prioritised for riparian planting, bank stabilisation, and focus areas for source control and education programmes.

6 The Receiving Environment

6.1 Contaminants in Stormwater

6.1.1 Contaminants and Contaminant Sources

Urban activities can cause adverse environmental effects by discharging contaminants into stormwater that are harmful to aquatic life. In Banks Peninsula, stormwater contaminants differ from other, larger urban areas within the Christchurch area. This is because the urban areas are typically smaller, and there is a higher proportion of low intensity agricultural land-use within the catchment. However, typical contaminants associated with urban activities such as heavy metals are still present.

Urban contaminant sources within Banks Peninsula include runoff from impervious surfaces, including roads, roofs, industrial and commercial buildings. Surface runoff also occurs from rural land use; however, this is outside the scope of the SMP. The main urban contaminants in the Banks Peninsula area have been identified as suspended solids, dissolved and particulate zinc and copper. Rural stormwater contaminants include nutrients (nitrogen and phosphorus) and faecal pathogens.

6.1.2 Suspended Solids

Dust, sediment, grit and particles of all types are capable of being transported in stormwater, referred to as total suspended solids (TSS). Sources of suspended solids within Banks Peninsula catchments include streambank erosion, overland flow and runoff from rural land, tyre and brake wear from roads and paint coating and roof coating breakdown (Davis et al. 2001). Sediment can decrease the clarity of the water and can negatively affect the photosynthesis of plants and therefore primary productivity within streams. It can also interfere with feeding through the smothering of food supply and can clog suitable habitat for species.

TSS has shown to exceed guidelines in Banks Peninsula, particularly at Stream Reserve Drain in Governors Bay. During wet weather sampling, TSS was recorded above the ATL in many streams and coastal sites.

6.1.3 Metals

Heavy metals, in particular, copper, lead and zinc, can be toxic to aquatic organisms at high concentrations and can result in reduced fecundity, maturation, respiration and behaviour (Harding 2005). The toxicity of metals in freshwater is affected by several abiotic factors, including organic carbon, hardness, pH, temperature and alkalinity (Warne et al, 2018).

The predominant copper source in urban stormwater is from vehicle-related activities. Copper is released from the wear and tear of brake pads and tires, which then accumulates in urban road dust and is washed into water bodies during rain events. Zinc is used as a protective coating for steel on corrugated iron roofs, rooftop ventilators, chain link fencing, lighting poles and various barriers and fences. Although a zinc layer is long-lived it is slowly being dissolved by rainwater. Farm buildings often have unpainted galvanised roofs and can be significant sources of zinc. Residential areas typically have painted or tile roofs, but many of these have older paint coatings in poor condition and can be significant sources of zinc. Since the discontinuation of lead-based products, lead contamination in stormwater has become less of a concern. However, there are still sources of lead arising from road runoff and vehicle emissions, as well as industrial land use, including older paints.

Exceedances of all three heavy metal ATLs have been recorded during baseflow conditions in Aylmers Stream, Akaroa, while Lyttleton Harbour and Akaroa waterways have recorded exceedances for copper and zinc. During wet weather sampling, exceedances for copper and zinc, were common.

6.1.4 Nutrients and Pathogens

In Banks Peninsula, low intensity agricultural land use is widespread and contributes nutrients to stormwater flows. Nutrients are essential for plants, but high nutrient concentrations can lead to excessive aquatic plant growth. Dissolved reactive phosphorus (DRP) and dissolved inorganic nitrogen (DIN), the bioavailable portions of phosphorus and nitrogen, contribute to instream plant growth (periphyton, macrophytes).

Contamination from agricultural land use runoff and discharges, waterfowl, and human sewage discharge (effluent disposal fields and leaky septic tanks) are the main sources of pathogens in Banks Peninsula waterways. Pathogens pose potential public health risks. It is noted that the focus of this SMP is on urban stormwater impacts, not rural. Therefore, nutrients and pathogens are mentioned only in relation to characterising the current state of the waterways. Further discussion on nutrients and pathogens are provided in Green (2024).

6.2 Monitoring Sites

The Council monitors surface water quality monthly at 51 sites across the district, including three waterway sites within the Te Pātaka o Rākaihautū Banks Peninsula catchment, and three Coastal sites as outlined in Table 3 and Figure 8**.** All stream sites are in waterways classified in the Land and Water Regional Plan as “Banks Peninsula”. In addition to these Council sites, Environment Canterbury have a range of State of the Environment sites within the Banks Peninsula catchment. Sites relevant to stormwater management are listed in Table 2.

Monitoring at an additional 22 sites was undertaken to inform the SMP (Green, 2024). (Figure 8, Table 2). The intention was to characterise the effects of stormwater discharges from urban areas on freshwater and coastal receiving environments. Hereafter, these additional 22 sites are referred to as “stormwater investigation” sites, to differentiate them from the Council and Environmental Canterbury monitoring sites. Data from the Council and Environment Canterbury monitoring sites, and the stormwater investigation sites, were used to summarise the condition of stream and coastal sites across Banks Peninsula.

Table 3: Monitoring sites within Te Pātaka o Rākaihautū / Banks Peninsula catchment. BP and CW Site IDs represent Council long term monitoring sites, SQ represents Environment Canterbury sites. All remaining site IDs are sourced from the stormwater investigation report (Green, 2024).

Catchment	Site ID	Stream/Bay	Site Location	Monitoring Type
Akaroa Harbour	BP04	Aylmers Stream	Downstream of Rue Jolie, next to Bruce Terrace	Monthly surface water quality, 5-yearly aquatic ecology and sediment quality
	AK2		Upstream of stormwater outfalls	Water quality (baseflow, wet), sediment quality, invertebrates, habitat assessments, fish
	AK1		Downstream of stormwater outfalls	Water quality (wet), sediment quality, invertebrates, habitat assessments, fish, eDNA. Baseflow water quality (BP04)
	BP03	Balguerie Stream	Balguerie Stream Downstream of Settlers Hill	Monthly surface water quality, annual aquatic ecology, 5-yearly sediment quality
	SQ00170		Balguerie Stream at Balguerie Road	Monthly surface water quality, invertebrates. Supplements site BP03.
	AK5		Upstream of stormwater outfalls	Water quality (baseflow, wet), sediment quality, invertebrates, fish
	AK4		Downstream of stormwater outfalls	Water quality (baseflow, wet), sediment quality, invertebrates, habitat assessments, fish, eDNA
	AK7	Grehan Stream	Upstream of stormwater outfalls	Water quality (baseflow, wet), sediment quality, invertebrates, habitat assessments, fish
	AK6		Downstream of stormwater outfalls	Water quality (wet)
	WS	Walnut Stream	Upstream of stormwater outfalls	Water quality (wet)
	AK3	Walnut Stream	Downstream of stormwater outfalls	Water quality (wet)

Christchurch City Council

	CW01	Akaroa Harbour	Termination of Rue Balguerie	Monthly surface water quality, 5-yearly wet weather surface water quality
	CW04	Akaroa Harbour	Akaroa Harbour	Water quality (wet)
	SQ35811	Robinsons Bay	Intersection of Robinsons Bay Valley Rd with SH75	Water and sediment quality
	SQ35812	Childrens Bay	Beginning of Childrens Bay Farm walkway	
	SQ35814	Takamatua Bay	Southern end of Takamatua beach	
	AH1	Duvauchelle Bay	West of Pawsons Stream outlet	Water quality (wet), sediment quality
	AH2	French Bay	South of Balguerie Stream outlet	
Lake Forsyth/ Te Roto o Wairewa	SQ33056	Ōkana River	At SH75	Monthly surface water quality, invertebrates.
	LR2		Ōkana River (U/S)	Water quality (wet)
	LR1		Ōkana River (D/S)	Water quality (baseflow, wet), sediment quality, habitat assessments, fish, eDNA
	LR4		Hukahuka Turoa Stream (U/S)	Water quality (baseflow, wet), sediment quality, invertebrates, habitat assessments, fish
	LR3		Hukahuka Turoa Stream (D/S)	
Lyttelton Harbour/ Whakaraupō	BP01	Stream Reserve Drain	Above Outfall to Governors Bay	Monthly surface water quality, 5-yearly aquatic ecology and sediment quality
	GB3		Upstream of stormwater outfalls	Water quality (wet), habitat assessments, supplemented with SQ34884.
	GB2		Downstream of stormwater outfalls	Water quality (wet), supplemented with BP01

	GB1		Governors Bay Drain (D/S)	Water quality (wet), eDNA
	SQ34884	Governors Bay Drain	Downstream of stormwater outfalls	Monthly surface water quality, invertebrates. Supplements site GB3.
	CB2	Cass Bay Drain	Upstream of stormwater outfalls	Water quality (wet)
	CB1		Downstream of stormwater outfalls	Water quality (baseflow, wet), sediment quality, invertebrates, habitat assessments, eDNA
	CW02	Lyttelton Port	Small Wharf Opposite Voelas Road	Monthly surface water quality, 5-yearly wet weather surface water quality
	CW03	Cass Bay	Eastern Side off Cass Bay Walkway	
	LH2	Cass Bay	Outlet of unnamed Cass Bay stream	Sediment quality
	LH1	Corsair Bay	Outlet of unnamed Corsair Bay stream	Water quality (wet), sediment quality
	LH3	Diamond Harbour	Outlet of eastern unnamed Diamond Harbour stream	Water quality (wet), sediment quality
	SQ35808	Governors Bay	North of Governors Bay jetty	Monthly water and sediment quality
	SQ35809	Charteris Bay	East of Te Wharau Stream outlet	

Notes: U/S and D/S represents sites located up and downstream of Council stormwater outfalls. Waterway site data available on LAWA website. Marine sites within Akaroa and Lyttelton Harbours not included.

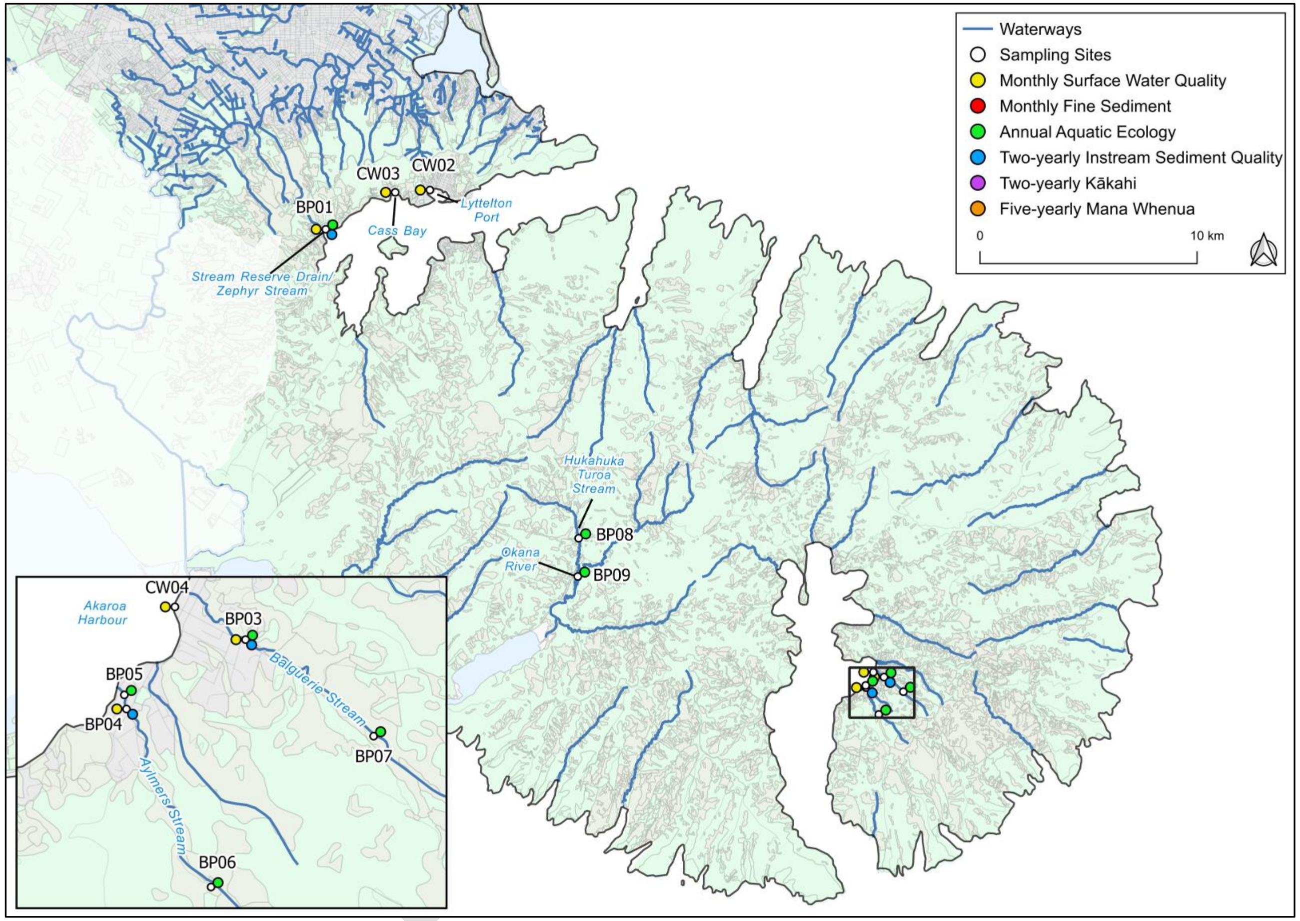

Figure 8: Location of surface water, instream sediment and aquatic ecology monitoring sites in the Pātaka o Rākaihautū / Banks Peninsula Stormwater Management Plan area (from Christchurch City Council EMP V.10)

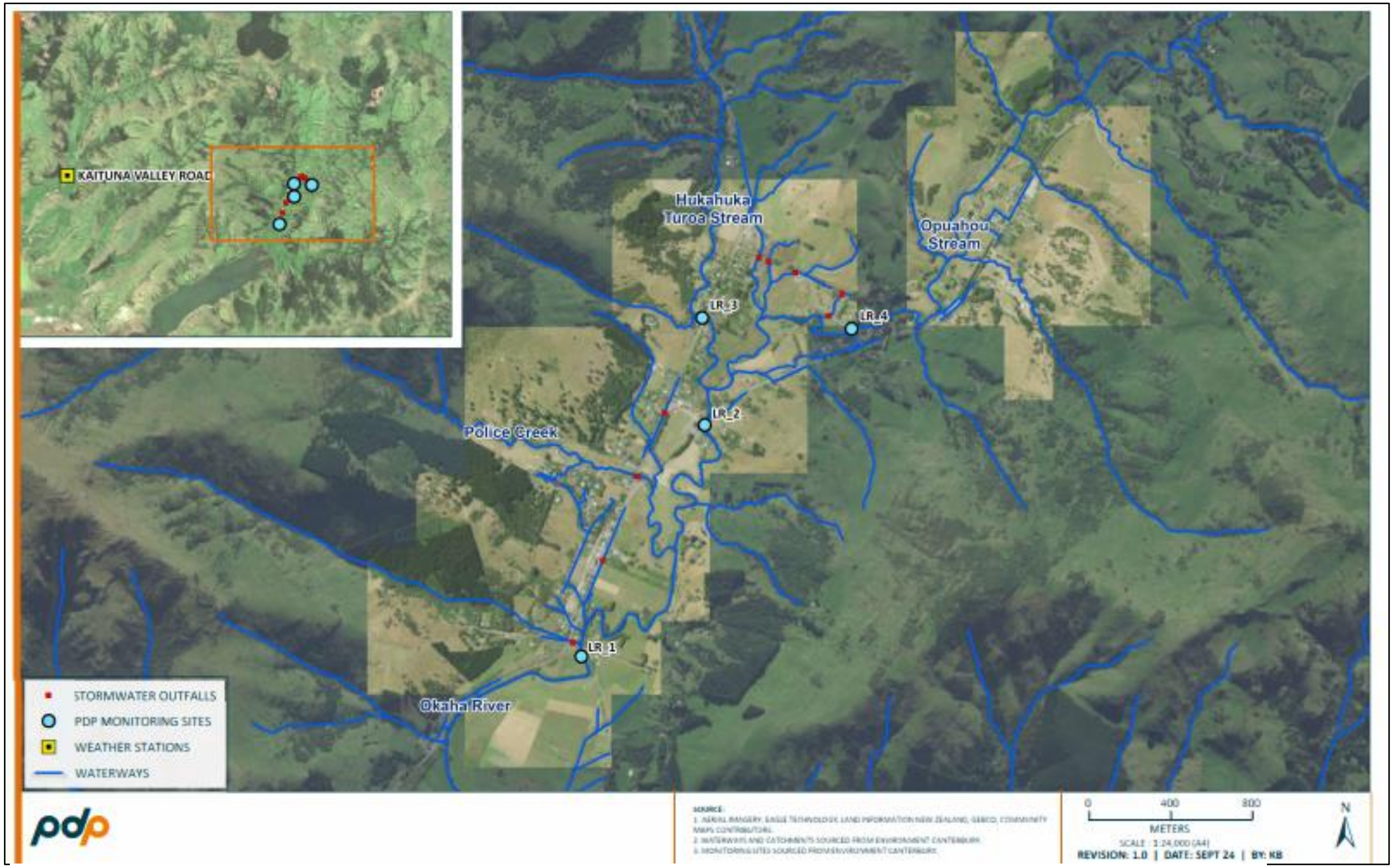

Figure 9: Monitoring sites within Te Roto o Wairewa - Lake Forsyth catchment (Green, 2024).

Figure 10: Monitoring sites in Whakaraupō Lyttleton Harbour (Green, 2024).

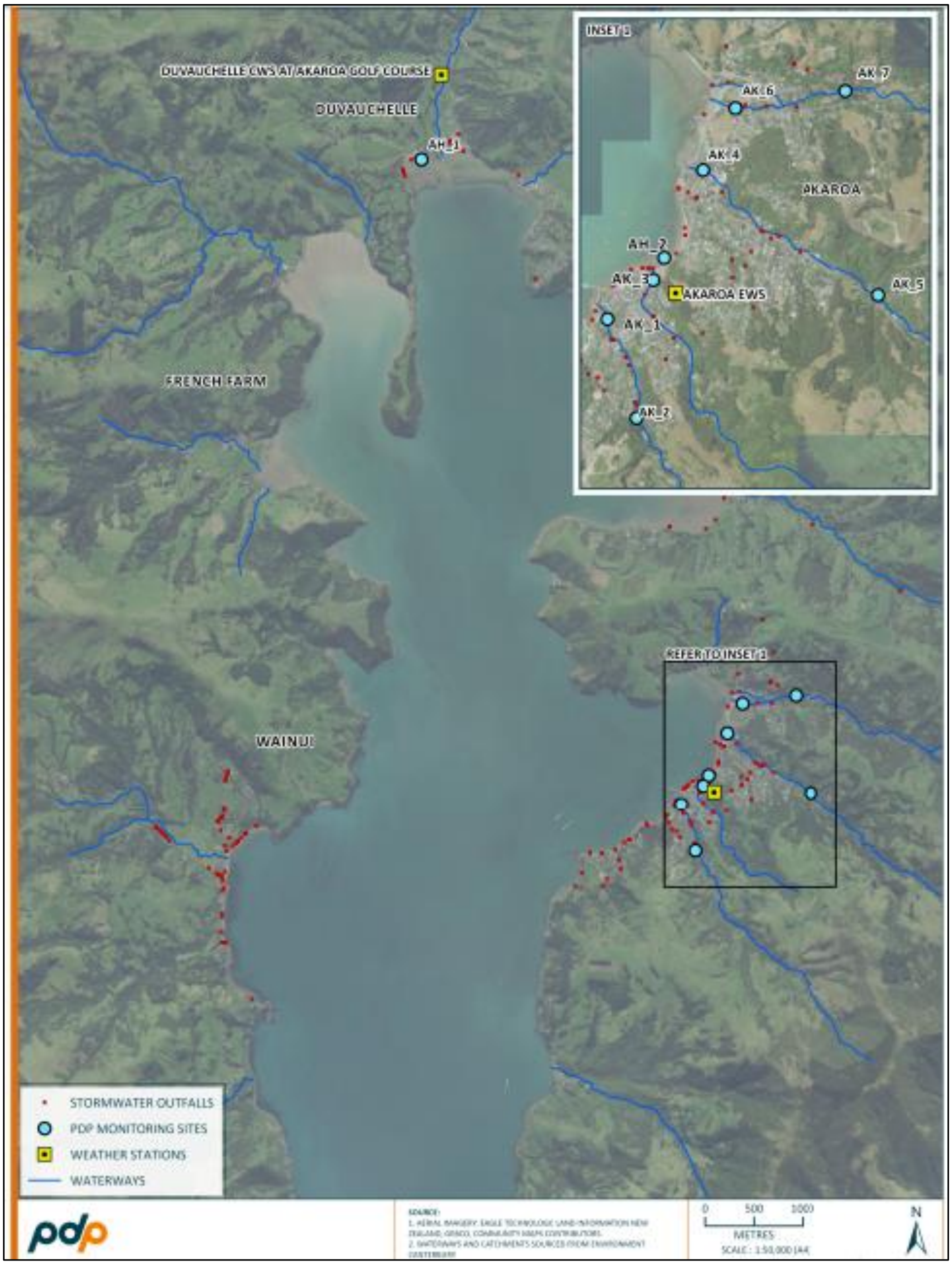

Figure 11: Monitoring sites in Akaroa Harbour (Green, 2024).

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6.3 Water Quality

Council collects surface water quality data monthly from three stream sites (Aylmers Stream, Balguerie Stream and Stream Reserve Drain) and three coastal sites (Akaroa Harbour, Lyttelton Port and Cass Bay). Summary water quality results for Banks Peninsula catchments assessed for urban stormwater effects are provided in subsections below.

Council water quality samples at the three long-term sites generate a water quality index (WQI) score (Noakes and Marshall, 2024a). The WQI is used to consolidate data from 11 individual water quality parameters into a single index value that ranges from 0 to 100, with 100 representing high water quality. The WQI is comprised of the following parameters: dissolved copper, dissolved zinc, pH, total suspended solids, dissolved oxygen, temperature, biochemical oxygen demand, total ammonia, nitrate-nitrogen, dissolved reactive phosphorus, and the faecal pollution indicator Escherichia coli (*E. coli*). In 2024, WQI scores at Banks Peninsula were 55.3 and 58.4 (indicating 'poor' water quality) at the Aylmers Stream and Stream Reserve Drain sites, respectively and 74.5 (indicating 'fair' water quality) at the Balguerie Stream site. There are no temporal trends for the WQI available for these sites. When comparing all CSNDC sites, Banks Peninsula had the lowest average WQI worst water quality. This is partly due to the stricter water quality standards that apply to protect ecological values in Banks Peninsula waterways, compared to the city waterways (Noakes and Marshall 2024).

The CSNDC EMP requires that Council assesses monitoring results against the consent Objectives and Attribute Target Levels (ATLs) for key urban stormwater contaminants, namely total suspended solids (TSS), copper, lead, and zinc[8]. Failure to meet any of the ATLs triggers investigations to determine whether the water quality is due to stormwater inputs. The three Council-monitored waterway sites each failed multiple ATLs.

When compared to sites sampled as part of the Stormwater Monitoring Plan (Green, 2024) 19 of the 21[9] stormwater investigation sites sampled did not meet at least one of the ATLs in 2024. It is noted that the ATLs are specified as the 95th percentile data, therefore comparisons to one-off data are conservative. Most non-compliances with ATLs in Banks Peninsula in 2024 were due to elevated concentrations of the dissolved metals copper and zinc, which are common urban contaminants (Figure 12). A summary of all available data is provided in Figure 12. Dashed lines denote CSNDC ATLs for respective parameters including:

- Total Suspended Solids:
    - 25 mg/L for waterway sites (black line)
    - 13 mg/L for Akaroa Harbour (CW01 and CW04; orange line)
    - 29.7 mg/L for Lyttelton Port (CW02; green line)

[8] ATL's sourced from the EMP dated January 2025.

[9] Note the Walnut Stream upstream site was not included in Green (2024).

- 30.1 mg/L for Cass Bay (CW03; blue line)

- Dissolved Copper (95th %ile):
  - <0.001 mg/L for waterway sites
  - <0.0013 mg/L for coastal sites (black line)
- Dissolved Lead (95th %ile):
  - ≤0.0011 mg/L for Balguerie Stream (green line; AK_4, AK_5)
  - ≤0.00135 mg/L for Aylmers Stream and Stream Reserve Drain (orange line; AK_1, AK_2, GB_2, GB_3)
  - ≤0.0044 mg/L for coastal sites
- Dissolved Zinc (95th %ile):
  - ≤0.0029 mg/L for Stream Reserve Drain and Aylmers Stream (orange line)
  - ≤0.0025mg/L for Balguerie Stream and all other waterways[10] (green line)
  - ≤0.008 mg/L for coastal sites (black line)

Note that for dissolved lead and zinc, where no general waterway ATL is available, the most conservative ATL for Banks Peninsula has been used for comparison purposes. Coastal wet weather data shown in Figure 12 includes a second sampling event not reported on in Green (2024).

[10] No specific triggers available for other waterways.

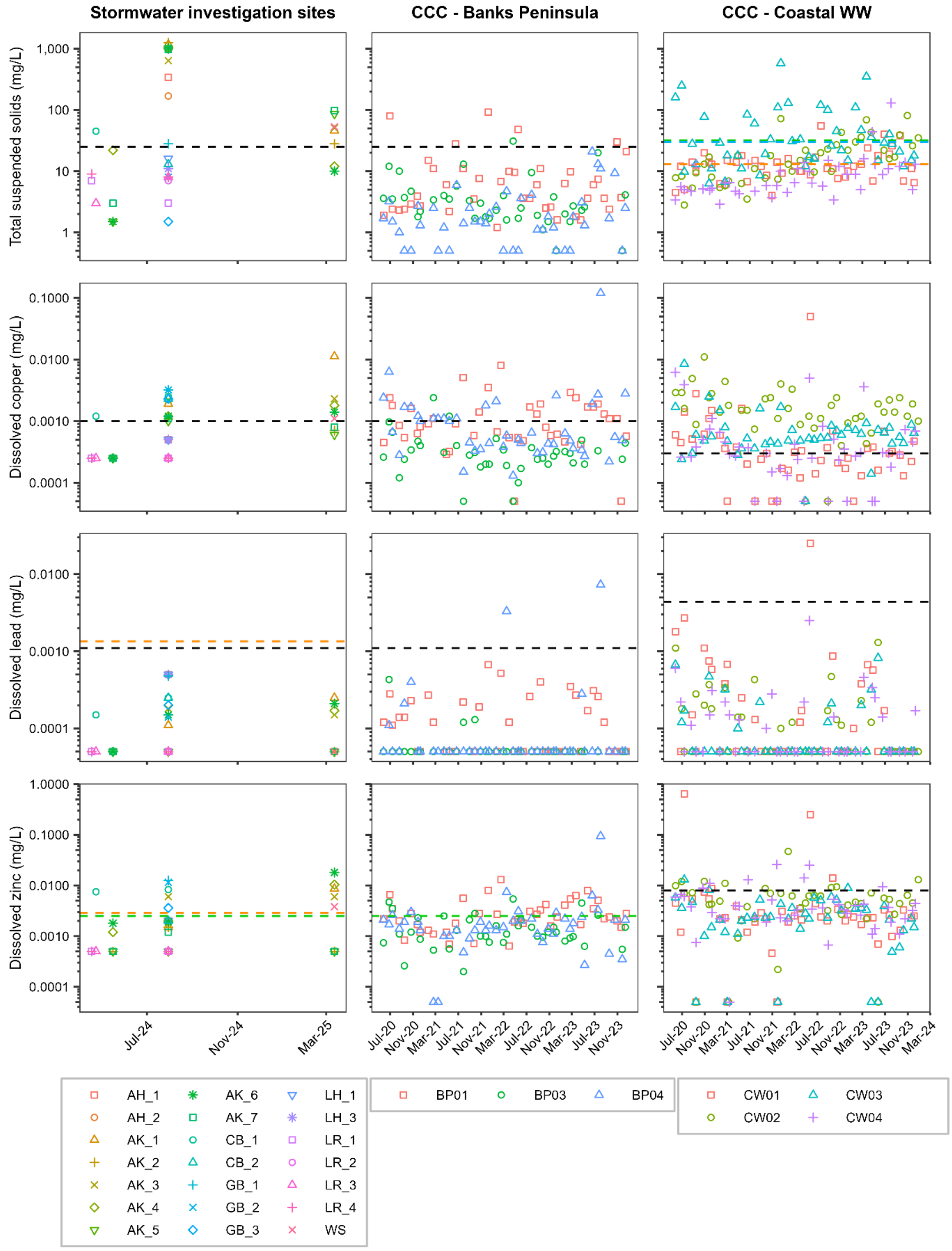

Figure 12: Key urban stormwater contaminants across monitoring sites within Banks Peninsula catchment. Dashed lines denote CSNDC ATLs for respective parameters.

6.3.1 Akaroa Harbour Catchment

Water quality results within the Akaroa Harbour waterway sites are representative of low-intensity agricultural land use and stormwater impacts (Green, 2024). Increased nutrient concentrations were observed in Aylmers Stream and Balguerie Stream during rainfall compared to baseline conditions but were still low. Dissolved inorganic nitrogen (DIN) concentrations were low, below 0.5 mg/L, but dissolved reactive phosphorus (DRP) concentrations were elevated (0.047 mg/L in Aylmers Stream). However, it is noted that phosphorus is naturally elevated in Banks Peninsula streams because of the volcanic geology (Hayward et al 2009). At the long-term Council monitoring sites, DIN concentrations within Balguerie Stream and Aylmers Stream increased 32% and 30%, respectively between 2021-2023 (Noakes and Marshall 2023).

Of the two long term Council monitoring sites in Akaroa Harbour, Aylmers Stream failed to meet the ATLs for each of the three dissolved metals (copper, lead and zinc) and the Balguerie Stream site did not meet the ATL for dissolved zinc, on occasion (Figure 12). When comparing the stormwater investigation sites, the Aylmers Stream downstream site[11] exceeded the ATL for copper, lead and zinc, during baseflow conditions. No metals concentrations were exceeded at the Aylmers upstream site. Grehan Stream had no ATL exceedances during baseflow conditions and TSS was below the ATL at all Akaroa catchment sites during baseflow conditions. It is noted that the stormwater investigation sites are ‘one-off sampling events and more routine monthly sampling will be needed to compare to ATLs in the future.

Wet weather monitoring at the stormwater investigation sites revealed higher exceedances of ATLs. TSS was recorded above the ATL in Aylmers, Balguerie, Walnut and Grehan Streams. All waterway sites except for Balguerie Stream upstream exceeded the dissolved copper ATL and Walnut Creek exceeded the dissolved zinc ATL. The maximum dissolved copper and zinc concentrations measured during rainfall events in Aylmers Stream exceeded acute toxicity and behavioural avoidance thresholds for native freshwater fishes (Green, 2024). It is noted that these concentrations are associated with short term pulses of stormwater and not reflective of baseflow conditions. However, it is noted that metals can become deposited in sediments over time. All stream sites had high levels of turbidity and faecal pathogens associated with agricultural land use, with high levels recorded upstream of Council stormwater outfalls (Green, 2024).

Elevated turbidity and faecal indicator bacteria[12] were recorded at stormwater investigation sites during wet weather monitoring at Akaroa Harbour coastal sites in French Farm and Duvauchelle’s bays (Figure 12). Exceedances for metals ATLs occurred at CW01 (Akaroa Harbour), with this site recording the highest concentrations in stormwater events for copper, zinc and lead. However, when considering all sampling events, metals concentrations at this site was typically below the ATL (Figure 12).

[11] Same as Council site BP04

[12] Data summarised in Green (2024)

6.3.2 Te Roto o Wairewa - Lake Forsyth

Baseline water quality results from the Okana River and Hukahuka Turoa Stream stormwater investigation sites were representative of low-intensity agricultural land use impacts, with slightly elevated nutrients and faecal indicator counts both upstream and downstream from Council stormwater outfalls. No exceedances of heavy metal ATLs were recorded at any of the sites in either the baseline or wet weather monitoring Green (2024). Wet weather monitoring demonstrated that Council stormwater outfalls contribute disproportionately to instream turbidity and faecal pathogens during rainfall events (Green 2024).

6.3.3 Whakaraupō - Lyttelton Harbour

Baseline water quality results for waterways within the Whakaraupō-Lyttleton catchment are limited to intermittently flowing sites within Cass Bay and Governors Bay as many of the streams are ephemeral (only flowing during rainfall events). Both Cass Bay and Stream Reserve Drain downstream sites exceeded the ATLs for dissolved copper and zinc. Cass Bay Stream also exceeded the ATL for TSS (Figure 12), but the cause of this is unknown.

Whakaraupō waterway sites during wet weather events showed ATL exceedances for copper at all sites, and exceedances for zinc at all sites but Cass Bay upstream. These exceedances have the potential to cause chronic toxicity impacts, which may alter stream community composition. It is noted that many streams in these catchments are ephemeral or intermittent.

Wet weather monitoring at coastal sites indicate water quality of Cass Bay and Lyttelton Port are impacted by urban stormwater contaminants. Wet weather monitoring showed TSS was highest at the Cass Bay site, with consistent exceedances of the TSS ATL (Figure 12). The Lyttelton Harbour site had consistently elevated copper and occasional elevated zinc concentrations recorded. It is noted that Lyttelton Port is excluded from meeting ATL's under Schedule 8 of the CSNDC. However, it has been included in this SMP for context and comparison, as it is recognised that the urban waterways contribute urban stormwater contaminants to the harbour, in addition to port activities.

6.4 Instream Sediment

Substrate composition is generally consistent across surveyed Banks Peninsula sites, which consist of a mix of substrate sizes up to large cobbles (Green, 2024). However, there were minor differences between sites, with sites located close to the coast (i.e., AK4, AK6, and CB1) being the only sites with silt/sand present and AK4 having few large cobbles. Despite this, these compositions indicate that there was a weak influence of stream gradient on substrate.

The ATL for fine sediment (<2 mm diameter) percent cover of stream bed was exceeded at all Council sites in 2020. Fine sediment cover was highest in Aylmers Stream and Stream Reserve Drain (Instream 2020). When compared to the updated monitoring in Green (2024) fine sediment cover was not exceeded at any of the Akaroa catchment sites. It is noted that the National Policy Statement – Freshwater Management (updated 2024) recommends monthly monitoring for five years to grade a site, therefore one-off measures should be treated with caution as variation can occur over time The downstream most site on the Okana Stream (LR1) had 100% fine sediment cover (Green 2024), but as this site is non-wadable it does not breach the ATL of 20%.

Stormwater contaminants such as heavy metals can accumulate in stream bed sediments, which can adversely affect the health of invertebrates and fish. Sediments at 21 stormwater investigation sites were analysed for common stormwater contaminants, including copper, lead, zinc, and Polycyclic Aromatic Hydrocarbons (PAHs). Only one ATL exceedance was recorded, this was for lead in the Balguerie Stream downstream site (AK4) (Figure 13). No other sediment ATL exceedances occurred for either waterway or coastal sites.

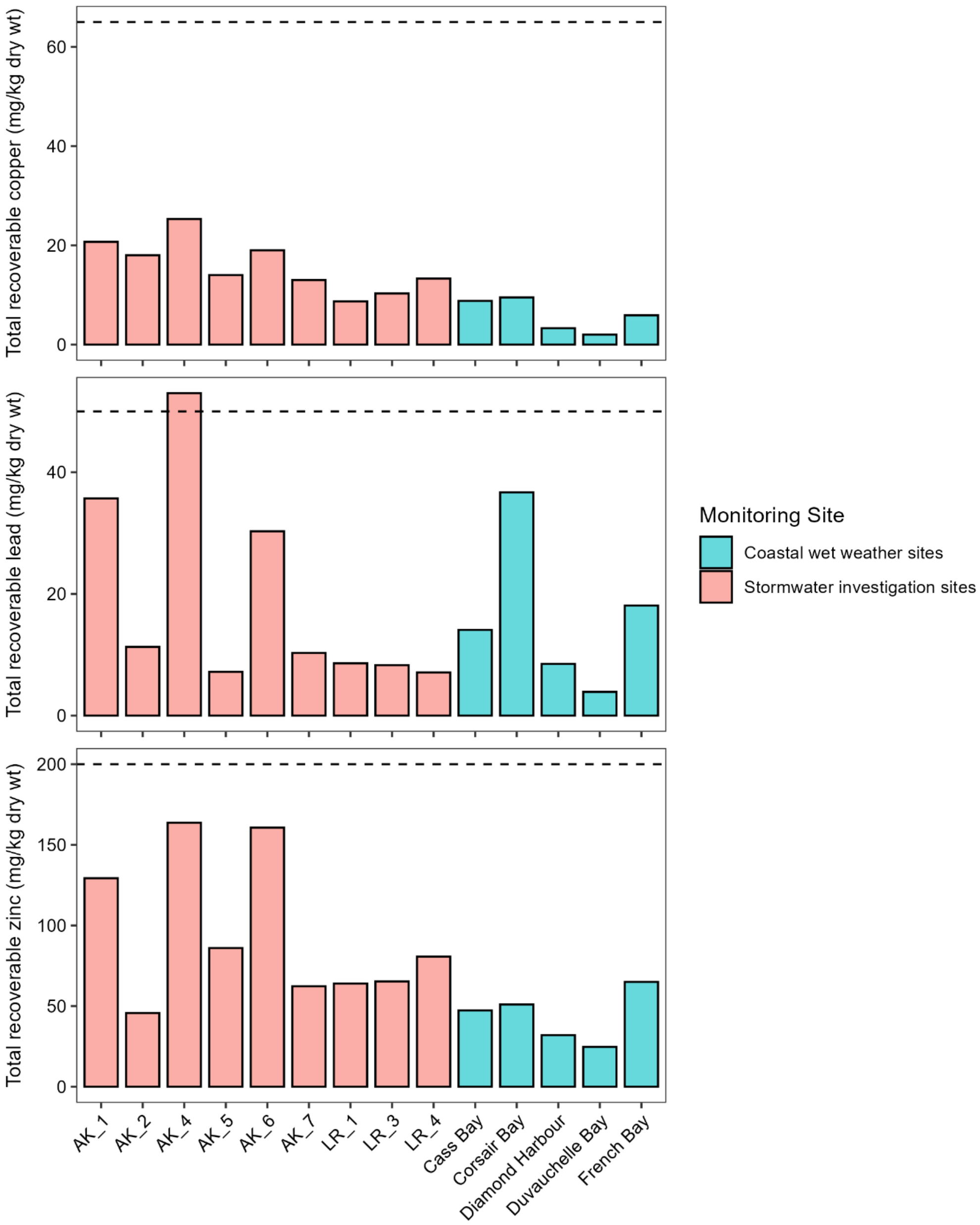

Figure 13: Key urban contaminants in sediment samples taken across monitoring sites within Banks Peninsula catchment. Dashed lines denote CSNDC waterways guideline levels for respective parameters, including the upper concentration for copper (65 mg/kg dry weight).

6.5 Aquatic and Riparian Habitat

The Akaroa catchments of Grehan, Balguerie, Walnut, and Aylmers Streams each flow through areas designated as having ‘Special Wildlife Significance’ and intersect ‘Land of National Significance’. These catchments support valuable aquatic and riparian habitats, including remnant native forest, diverse stream substrates, and steep gradients that promote healthy benthic communities by maintaining shaded, fast-flowing conditions. However, stream conditions vary substantially between urban and rural areas. In urbanised parts of Akaroa township, particularly downstream of stormwater outfalls, aquatic habitats are more degraded. For instance, Balguerie Stream exhibits altered flow regimes and increased modification in its lower reaches. Similarly, instream conditions downstream from stormwater outfalls on other streams show impacts such as reduced habitat quality and altered flow dynamics, indicating urban pressures.

The CSNDC includes consent ATLs for total macrophyte cover, long filamentous algae cover and fine sediment cover. Five-yearly aquatic ecology surveys are undertaken at three stream sites within Banks Peninsula. The last round of Council sampling was completed in 2020. Total macrophyte cover and filamentous algae cover was met at all three Council sites in 2020 (Instream 2020). Low cover with long filamentous algae likely reflects a combination of good shading and regular flushing flows. At the stormwater investigation sites sampled in 2024, both the Balguerie Stream downstream most site (AK4) and Grehan upstream site exceeded the ATL for long filamentous algae of 30% total cover (33 and 35 % cover, respectively). No other sites exceeded the ATLs for habitat metrics.

6.6 Aquatic Invertebrates

Invertebrates are animals that lack backbones, such as worms, snails and insect larvae. Some aquatic invertebrates are sensitive to pollution, so their relative abundance can be used as an indicator of waterway health. Examples of pollution-sensitive invertebrates include the ‘EPT taxa’, which are the larvae of aquatic insects belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). The Quantitative Macroinvertebrate Community Index (QMCI) measures the relative abundance of pollution- sensitive species at a site, with higher QMCI scores reflecting higher dominance of pollution-sensitive species, and therefore better-quality water and habitat. The CSNDC has an ATL of 5 for QMCI scores in Banks Peninsula. QMCI scores for Banks Peninsula sites are shown in Figure 14.

Of the stormwater investigation sites and supplementary State of the Environment sites, four of eleven met the QMCI ATL of 5. When comparing upstream and downstream sites, the upstream sites recorded a higher QMCI value at all streams apart from the Okana River. In the Okana River catchment, the downstream ‘impact’ site met the ATL for QMCI, while the upstream sites were just below (4.9 and 4.8).

When comparing the observed upstream vs downstream effects in Banks Peninsula waterways, there are a range of potential drivers. There are often differences in habitat types, with the upstream sites less impacted by urban effects, such as channelisation and loss of riparian margins. Upstream sites have a lower level of urban stormwater inputs and are closer to source populations of invertebrates from less impacted reaches. On Banks Peninsula, this can include forested valleys with high ecological values. This can result in faster recolonisation to downstream reaches. The higher QMCI values at upstream sites also indicate good 'source' populations to colonise downstream reaches, which is beneficial for restoration success. To improve the linkages between source populations and reaches impacted by urban stormwater, enhancement along the riparian corridor is recommended.

Overall, the Banks Peninsula sites were dominated by pollution-tolerant taxa, but they have a greater range of pollution-sensitive taxa than sites in the Heathcote or Linwood Canal catchments. *Neocurupira chiltoni*, a net-wing midge, which is endemic to Banks Peninsula and has an At Risk – Naturally Uncommon threat status (Andrew et al. 2012) was recorded at Balguerie Stream in 2020 macroinvertebrate surveys (Instream 2020). This species was not identified at any of the updated monitoring (Green, 2024). No other invertebrate taxa with a conservation status were recorded during invertebrate sampling.

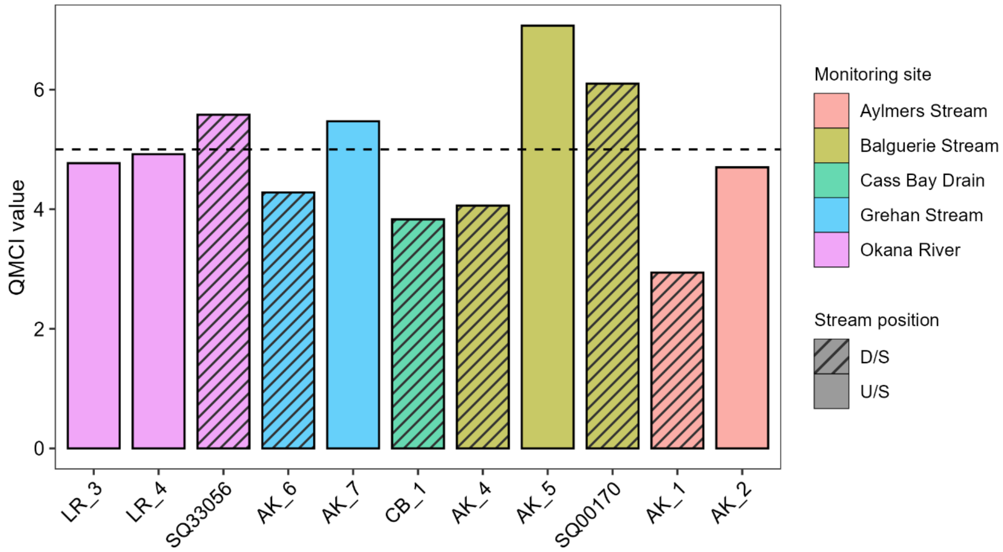

Figure 14: QMCI scores across Banks Peninsula. Dashed horizontal line denotes the Banks Peninsula waterways QMCI CSNDC ATL score of 5. Data collected from Table H1 in Green (2024).

6.6.1 Fish

Banks Peninsula waterways have a high diversity of fish species, which is distinct from most streams in Christchurch City. A total of 12 species across Akaroa Harbour and Little River streams were recorded in April 2024, comprising 11 native species and one introduced species (Green, 2024).

Of the 11 species recorded in the fish survey, one is Threatened – Nationally Vulnerable (pouched lamprey: *Geotria australis*), three At Risk – Declining (longfin eel: *Anguilla dieffenbachii*, īnanga: *Galaxias maculatus* and bluegilled bully: *Gobiomorphus hubbsi*) and one At Risk - Naturally Uncommon (giant bully: *Gobiomorphus gobioides*). The remaining four species are Not Threatened (shortfin eel: *A. australis*, banded kokopu: *G. fasciatus*, Common bully: *G. cotidianus*, common bully: *G. breviceps* and redfin bully: *G. huttoni).* Brown trout (*salmo trutta*) was the only introduced species recorded.

In addition to the fish surveys, environmental DNA results show the presence of kōaro (*G. brevipinnis)*. The New Zealand freshwater fish database also holds records for kōaro and the introduced and naturalised perch (*Perca fluviatilis*), rudd (*Scardinius erythrophthalmus*) and tench (*Tinca tinca*) in the Okana River. The eDNA results for the Wairewa catchment also showed the presence of kākahi (freshwater mussels).

6.7 Closing Ecological Comment

Banks Peninsula waterways are unique environments within Canterbury with high ecological values including distinct native fish populations, compared to other Christchurch District water-ways (such as the Ōtākaro-Avon and Ōpāwaho-Heathcote). Therefore, Banks Peninsula waterways merit a high level of protection from human impacts, including urban stormwater. Because typical stormwater treatment options such as treatment wetlands or increased setbacks may not be feasible a greater focus may need to be placed on on-site stormwater treatment and direct intervention in streams such as:

- Fish passage barrier remediation: eleven Council-owned structures in Banks Peninsula streams were identified as high priority for remediation, including structures in Aylmers Stream, Stream Reserve Drain and Okana River (Instream 2023).
- Daylighting and restoration of stream reaches: naturalising and opening up piped sections of waterway – can provide a considerable educational and ecological benefits in urban waterways.
- Erosion and sediment control: erosion and overland flow areas could be identified and addressed to reduce discharges over time e.g. by stabilising banks. Areas of contaminated sediment (such as in Aylmers Stream) could be removed and other instream sediment control options are possible.
- Riparian planting: planting can improve shading of a stream reach, which can assist to reduce nuisance macrophyte levels, improve riparian and instream habitat conditions, provide fish habitat and improve local biodiversity values. Improved linkages between upstream invertebrate and fish sources populations and reaches impacted by urban stormwater will also assist with restoration potential.
- Identification, protection and enhancement of inanga spawning and lamprey breeding sites. Further investigation into the extents of these high value sites is recommended, as inanga and lamprey are highly valued by local rūnanga as taonga species.

7 Land Use

7.1 Present Situation

Te Pātaka o Rākaihautū - Banks Peninsula catchment land zonings are mostly rural. Residential commercial and industrial zones in this SMP area are less an 1% of the catchment. This information is contained in Table 4 below.

Table 4: Te Pātaka o Rākaihautū / Banks Peninsula catchment District Plan land zonings

Land Use	Area (m2)	Area (Ha)	Percentage of Catchment	District Plan Code
Commercial	152,058	15.2	0.015%	CBP
Industrial	27,623	2.76	0.003%	IG
Open Space	156,337,181	15,633	14.98%	OMF, ON, OCP, OWM, OC
Residential	8,197,819	819.8	0.79%	RSS, RBP, RLL
Rural	849,687,650	84,968.8	81.41%	RuBP, RUPH
Specific Purpose	14,900,558	1,490	1.43%	SPLP, PA, SPC, SPS
Transport (roads)	14,371,028	1,437	1.38%	T

7.2 Vegetation & Wildlife

Rural and Open Space land makes up more then 95% of the Te Pātaka o Rākaihautū - Banks Peninsula.

Before human arrival much of the Christchurch District supported diverse forest and wetland communities. Banks Peninsula was extensively covered in mostly podocarp (totara, matai, kahikatea) forest associations with red and black beech forest dominating the wetter and cooler climate south-eastern areas of the Akaroa Ecological District. Shrublands and sub-alpine plant communities made up relatively minor proportions on the driest, highest, and most exposed sites. Specialist plant communities occupied volcanic rock bluffs and coastal cliffs that are prominent features of the Peninsula's ecological character.

Coastal lagoons and swamps were also prominent features of the area's ecological character, most notably Wairewa and Te Waihora, with the latter extending inland to about Lincoln, forming extensive flax swamps that encircled Banks Peninsula.

Almost all the original ecosystems and associated native vegetation of the Christchurch District have been cleared for human settlement and agricultural development. The exception on the

Peninsula is Kaitorete Spit which remains one of the finest examples of a natural dune ecosystem in New Zealand.

On Banks Peninsula less than 1% of the original old growth forest remains, although the subsequent regeneration of scrub and forest on 'unproductive sites' has increased forest cover to about 15%. Wetlands have been extensively drained and developed. Coastal wetland Te Waihora - Lake Ellesmere, has been substantially reduced in area and severely affected by adjoining land use.

Up to 21 vascular plant species have become extinct on Banks Peninsula since the arrival of humans, with many also lost from the Canterbury Plains. A further 137 are listed as either Threatened or At Risk.

Forested and shrubland areas support a depauperate birdlife due to more local bird species extinctions than in most other parts of New Zealand. Coastal and oceanic birdlife is abundant with a wide diversity of seabirds and shorebirds. Other marine life is abundant in the surrounding waters, with seals, dolphins, and other marine mammals commonly sighted.

Rūnanga, local Community groups and Council Parks staff are working to restore and regenerate native vegetation. Significant planting work is occurring to stabilise stream banks to reduce turbidity and improve land stabilisation.

7.3 Development and Trends

Banks Peninsula's resident population is 9,330 (placeholder; estimated by Statistics NZ from 2018 census information) about half of which is in Lyttelton and Diamond Harbour. Population has increased from 8,916 in 2018. Akaroa and Diamond Harbour are growing at just over 0.4% per year. The population of other settlements is growing by just under 0.4% per year. Most of the growth in settlements is residential.

The location and extent of settlements is mapped for indivicual settlements in Appendix B

7.4 Contaminated Sites and Stormwater

7.4.1 Background

Some amount of contaminants is released from every site that discharges stormwater. Contaminated sites are a greater concern. There are two types of contaminated sites:

- Sites with in-ground contaminants that may be entrained in stormwater, typically when soil is disturbed (during a construction phase) and;
- Sites where on-site activities (during an operational phase), usually industrial in nature, may release chemical or metal contaminants into stormwater (or into the ground).

The National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health Regulations (NES) help to identify potentially hazardous activities and industries which are listed in the Hazardous Activities and Industries List (HAIL), found at https://environment.govt.nz/publications/hazardous-activities-and-industries-list-guidance-identifying-hail-land/

Such sites are listed in a Listed Land Use Register (LLUR) when they become known to the Regional Council either through a consent application (to ECan or the CCC) or through investigations. Sampling, excavation, subdivision, removal of fuel storage tanks and changing land use on these sites may require a resource consent and remedial action.

Lyttleton has a long history of industrial activities (e.g. workshops, factories) and this is reflected in the high number of LLUR sites located in this settlement. While LLUR sites are also present in other Banks Peninsula settlements they are generally limited to service stations and hazardous goods storage. Historic horticulture or farming activities potentially leaving residues of copper and pesticide (e.g. around old sheep dips) are also located on Banks Peninsula given its rural land use, however these tend to be located outside of the settlement areas so beyond the scope of this SMP.

7.4.2 Construction Phase - Low Risk Sites

The Councils "Transition Plan" was released in 2025 and specifies processes for managing sites stormwater dischargers previously excluded from using the CSNDC and Stormwater and Land Drainage Bylaw 2022 due to the environmental risks they posed. The Transition Plan also includes criteria for assessing sites identified as HAIL and on the LLUR and assigning them a "Low" and "High "risk status (section 3.2 and 3.3).

The criteria for low-risk sites include but is not limited to (refer to Transition Plan):

- Sites not listed on the LLUR or only a portion of the site is identified as a HAIL activity and proposed disturbance will not occur on that portion of the property.
- Sites has contaminants 'at or below background concentrations' or 'below guidelines for residential use'.

If a site meets these criteria, then its construction activities will most likely be able to operate under the CSNDC.

7.4.3 Construction Phase - Higher Risk Sites

"High risk" is generally a reference to sites with persistent or hazardous chemicals in the soil (contaminated sites) or sites which regularly store and use hazardous chemicals (industrial sites).

Many contaminants adhere to sediments and can be mobilised into surface or groundwater when soils are disturbed. These contaminants can be managed by using good sediment control during earthworks and taking care with where soil is disposed of. More specific measures, including on-site treatment, may be needed for more mobile contaminants that cannot be controlled by typical sediment control practices.

The Transition Plan specifies that the criteria for assessing high risk sites during construction includes, but is not limited to:

- Sites listed on the LLUR with one of the following classifications: '*contaminated for*', '*significant adverse environmental effects*' and '*managed for*'.

Sites that trigger these criteria are generally excluded from using the CSNDC and so must seek their own discharge consents from ECan.

7.4.4 Other Sites

Any other sites which do not fall into either of the above categories of "low or high risk" (e.g. *not investigate and non-verified HAIL* or are not listed as LLUR but are known to contain HAIL activities) shall be assessed against criteria detailed in Section 3.2 of the Transition Plan. Sites able to pass these criteria will be classed as "low risk" while sites that cannot, are be directed to ECan for a final risk assessment.

7.4.5 Storage or use of hazardous chemicals (Industrial Sites) – Operational Phase

When the storage or use of hazardous chemicals is occurring on an industrial site during the operational phase then the Council shall use the Risk Matrix included in the Transition Plan to assess if shall be permitted to discharge under the CSNDC, or if it needs to be transferred to ECan to undergo a further risk assessment and potentially gain their own stormwater consents from ECan.

7.4.6 Historic Landfills

Historic (closed) landfills could be relevant because stormwater directed toward these landfills could pick up contaminants. Risks arise when stormwater moves through a landfill and entrains dissolved contaminants. Landfills are capped and drained in ways intended to minimise the risk. This is regulated by consents for individual landfills.

The main risk factor associated with stormwater management plans occurs if there will be groundwater mounding associated with infiltration and detention basins. This can cause leaching of contaminants from the landfill into groundwater or directly into the harbour. However, no infiltration basins are proposed on Banks Peninsula and the risk of groundwater mounding does not arise. There are 8 known closed landfills throughout Banks Peninsula, listed below.

Table 5: Closed landfills on Te Pātaka o Rākaihautū

Landfill Location	Remediation and Monitoring	Resource Consent
Gollans Bay, Lyttleton	Annual water quality sampling as part of resource consent conditions.	CRC951237
Allandale Reserve, Governors Bay	A project to raise the height of a seawall is in a planning stage.	n/a
Okains Bay	Seawall repairs currently underway.	n/a

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Le Bons Bay	Landfill was fully excavated and sent to Kate Valley	n/a
Ōnuku, Akaroa	Landfill cap repairs completed. Annual water quality sampling as part of resource consent conditions.	CRC951241
Barry's Bay	Seawall repairs completed. Annual water quality sampling as part of resource consent conditions.	CRC001041
Wainui	No works required	n/a
Birdlings Flat	Landfill cap repairs completed. Annual water quality sampling as part of resource consent conditions.	CRC951244

7.4.7 Facilities Built Near Contaminated Sites

Due to the small size of Banks Peninsula Settlements, their topography and limited available land it is not practicable to build large-scale stormwater treatment facilities such as basins and wetlands in or near settlements. The Council is unlikely to undertake earthworks to build large scale stormwater treatment facilities on or near LLUR sites. As part of this SMP, Council does propose to install smaller stormwater filtration devices in some settlements. These devices have a much smaller footprint than basins and wetlands and require limited earthworks. To manage any risks posed by potential land contamination, earthworks will occur in accordance with the Council's global earthworks consents and the contractor's environmental management plans.

8 Waterway Capacity and Flooding

8.1 CCC Levels of Service

Urban drainage systems are mostly designed to meet expectations of safe vehicle travel and flood-free housing. Stormwater networks comprising side channels, pipes and drains keep properties and traffic lanes free of ponded water in frequent events. In more extreme rainfalls the lower lying parts of roads and private properties store water in excess of system capacity until it can be drained away. New houses are expected to be built sufficiently high to remain dry in all but the most extreme events.

- Road drainage, pipes and minor drains are designed so that the 5 year annual recurrence interval rainfall does not cause a nuisance to traffic.
- Hillside drainage should ensure that a 20 year annual recurrence interval rainfall does not endanger property.
- Finished floor levels are normally set 150mm above the natural ground in non-flood-risk areas to ensure that any local ponding does not wet the floor.

Minimum floor levels are set within Flood Management Areas (FMAs) to 400mm above the 200 year annual recurrence interval flood level. FMAs are District Plan zones which would be inundated by the 200 year ARI flood level plus a 250mm additional freeboard allowance. (The necessary 400 mm floor height above flood level includes the 250 mm freeboard plus an assumed 150 mm minimum foundation height above the natural ground.) On the Peninsula this only applies in Little River.

- Otherwise a 50 year average recurrence interval event is used to set minimum floor levels as has been required since the Building Act 1991.

8.2 Flooding

Flooding in some settlements is documented in reports from various observers including residents, Council staff and contractors. Hydraulic models have been developed to quantify flooding in some settlements. Flooding is generally sourced from hillsides external to a settlement and arrives via the waterways that flow through most settlements. None of the settlements is sufficiently large to generate the amount of rainwater runoff that would cause internal flooding.

Commentary in this section is derived from historical records, file records and flow models developed for Little River and Lyttelton.

As far as is known houses have been built with a knowledge of flood levels and the incidence of house flooding overall is not more frequent than it is in Christchurch City. A small group of houses in Port Levy is flood prone.

8.2.1 Lyttelton Harbour Settlements

Allandale / Teddington

The Council does not have records of flooding other than highway flooding in Allandale and Teddington.

Purau

Water flowing occasionally over Purau Avenue / Camp Bay Road is believed to be the only flooding issue. Water can overflow the stream channel and flow over-land. A wet area between the two streams appears likely to be due to groundwater.

Rapaki

There is no official information about flooding in Rapaki; however, the rūnanga is concerned about the capacity of the culvert on Ōmaru Stream which gives access to the marae. If the culvert capacity is exceeded, flood waters may overtop the culvert and enter the marae building (Andrew Scott, pers. Comm.)

Cass Bay

Houses in Cass Bay are not believed to be under threat, however blocked stormwater inlets on the road can divert hillside runoff through gardens, causing erosion and silt deposition.

Charteris Bay, Church Bay, Diamond Harbour

The hilly topography of these settlements makes flooding unlikely. In the one instance of flooding on record, a garage floor sat against the hillside allowing hill runoff to enter the building.

Governors Bay

Streams in Governors Bay are incised and most have relatively small catchments. Flooding may affect some parts of properties but is not known to affect houses in Governors Bay.

Lyttelton

Lyttelton occupies the lower flanks of spurs on Tauhinukorokio-Mt Pleasant and Mt Cavendish. Three major and some minor waterways flow in valleys between the spurs. Soon after European settlement these waterways were first timber lined and then enclosed in large brick pipes at the turn of the 20th century for reasons of hygiene and land stability. The major pipes are generously sized and have adequate capacity. Lyttelton's stormwater network now consists of large 7 large brick stormwater mains (brick barrels) which drain the hillsides above the town, and branches of mostly minor pipes. The network is sparse and relies to a significant extent on conveyance within street side channels. In many places this works where side channels are steep and can carry a lot of water. In other places the network would perform more effectively with more catchpits and more drainage pipes. Streets that collect direct hillside runoff (e.g. Cressy Terrace, Ross Terrace, Reserve Terrace) can carry runoff from large areas of hillside in excess of their drainage capacity.

Occasional overflows have occurred at the brick barrel entries when debris grilles become blocked with hillside trash. This has caused house and property flooding. The inlets are progressively being reconstructed with larger entry structures and larger debris grilles, making them resistant to blocking.

In some properties private stormwater is discharged onto the ground and runs over-land causing wetness problems and potential instability, particularly on steeper areas and nearby road cuttings.

8.2.2 Northern Bays Settlements

Koukourārata-Port Levy

The rūnanga reports flooding from Oiri Stream affecting a group of houses in Pa Road at the south end of Koukourārata. The Oiri Stream channel is small and flood waters from the hillside can spill out and spread across a fairly level flood plain. Approximately five houses on Pa Road near the shoreline are on the flood plain. Some of these houses have only a small clearance above ground level and are reportedly flood prone. Flood waters are impeded at the beach edge by Pa Road which is elevated to be above high tide level. A culvert at that location is sufficient for ordinary drainage but does not pass flood flows. The Council is installing a triple culvert to reduce the risk of it filling with beach sand.

Pigeon Bay

The Council has repaired roads, road culverts and bridges affected by flooding in this bay. House or property flooding is not recorded.

Kukupa

There are no known flooding problems.

Little Akaloa

Flooding or excess stormwater in Little Akaloa is likely to arise from hillside stormwater exceeding capture capacity or the Little Akaloa Stream over-topping its banks. As is typical of natural streams the banks-full capacity can be exceeded approximately every 2 years.

8.2.3 Eastern Bays Settlements

Okains Bay

Two long-time residents were interviewed about historical flooding. It appears that houses are elevated above known flood levels and problems experienced by locals relate to drainage and tidal inundation. Drain maintenance is now privately undertaken since the loss of a drainage rating scheme under the previous Akaroa County Council. The residents would prefer the Council to revert to the previous arrangement, which they think would be more efficient. Since 2011 salt water intrudes onto some paddocks during king tides. It is suggested that the 2011 earthquakes may have caused river flats to subside and become more prone to tidal flooding. The effectiveness of some Council reinstatement work on stream culverts on flooding was questioned by residents.

Le Bons Bay

There are notes and photographs about house flooding in Le Bons Bay. Photographs taken after the damaging December 2021 storm show that some baches were flooded or nearly flooded in that storm, meaning that they could be at risk in other storms. An informal approach to 2 long term residents provided the information that 7 dwellings and 5 garages were flooded in the 2021 event. The source of flood water was hillside runoff. Flood water was held up by the high tide. A residents' meeting was held in October 2022 to discuss the December 2021 storm. (Meeting notes in TRIM 23/1051174). Issues raised included:

- Keeping the Hughes Drain beach outfall open.
- Sediment runoff from forestry operations.
- Road grading is said to fill culverts.
- Stream erosion damage to two properties
- (Property inundation was not raised as an issue in that meeting.)

It is important that the beach outfall for Hughes Drain remains open. Houses would potentially flood if beach sand blocked the drain. Drain water levels are measured behind the beach and sent via mobile coverage to the Council offices.

The recurrence interval of the December 2021 event is not known.

8.2.4 Southern Settlements

Birdlings Flat

There are no known flooding problems.

Little River

The older part of Little River was established around a railway station which, along with the railway line appears to have been built high to elevate it above the flood plain of the nearby Okana River. According to present day knowledge the railway line and associated buildings sit above all but extreme flood levels. The state highway, which is also the town's main thoroughfare is not elevated and sits on the floodplain of the Okana River and is subject to relatively frequent flooding. Businesses serving the town are also on the floodplain and are at risk when the river floods. Newer houses appear to have been sited appropriately with a knowledge of the risks and appear to be elevated above all but extreme floods.

A reasonably good understanding of the frequency, extent and depth of flooding is obtained from a hydraulic model by Environment Canterbury and an extension of the model into the town area by the Christchurch City Council (c2020). The models indicate that at perhaps somewhat less than a 5-year average recurrence interval (ARI) the highway is closed by deep water and at approximately a 10 year ARI flood water flows into the town from the Okana River and flows the length of the main street.

Historical records indicate that in a larger flood the Okana River can overflow its banks upstream of Awa-iti Domain and flow through the Domain. In such an event the tennis and rugby clubs and Coronation Library are at risk, and the state highway is likely to be blocked by flowing water. Other streams flowing from the western hills can contribute to highway flooding.

8.2.5 Akaroa Harbour Settlements

Akaroa

Much of what is recorded about flooding in Akaroa has been collated in *Historical Flooding Research and Mapping Project, 2008* by Suky Thompson for an Akaroa Harbour settlements study. The project reports five notable flood events between 1936 and 2002. A subsequent flood occurred in 2014. The following is from Thompson, 2008.

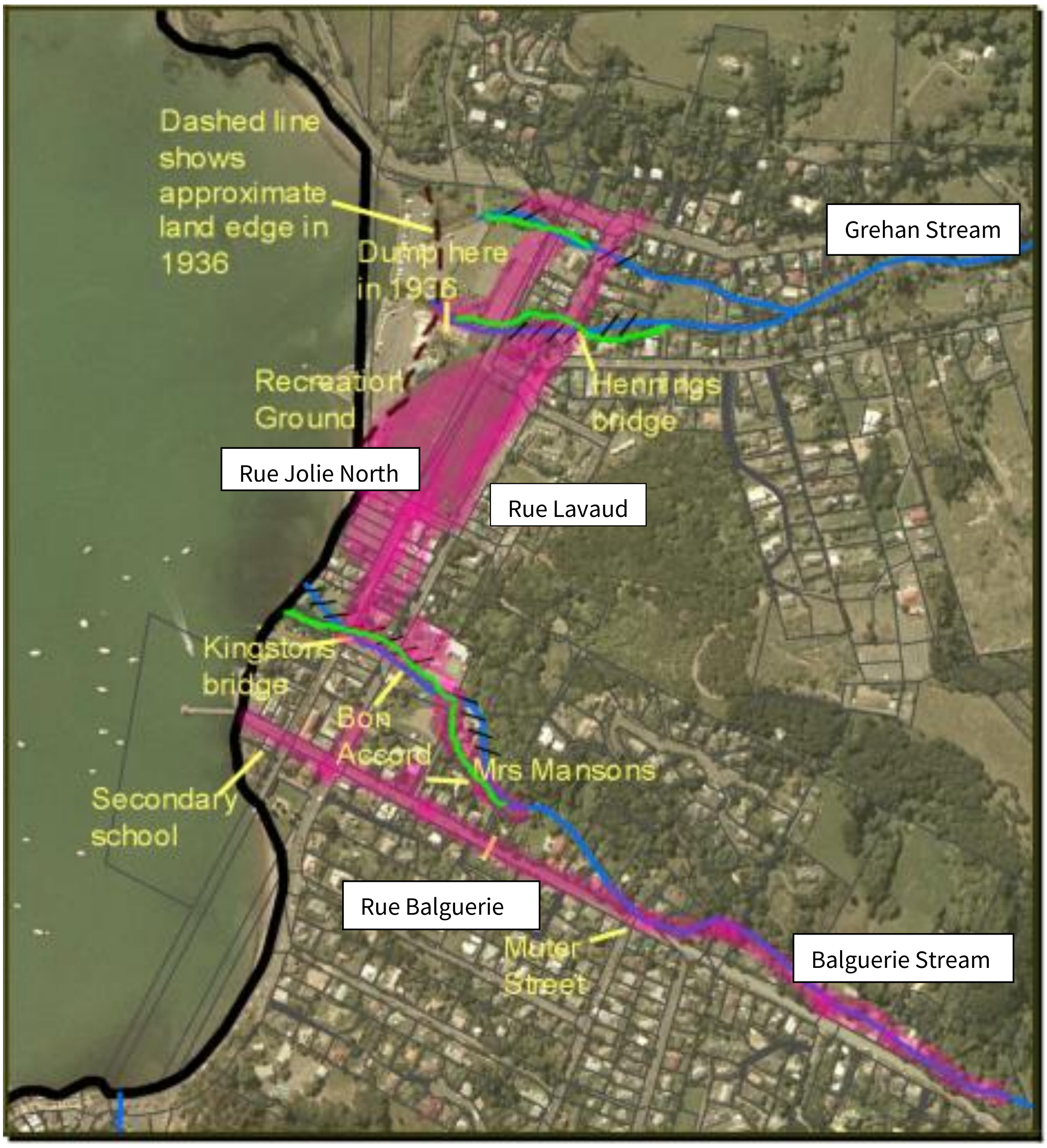

Figure 15: Areas in the north part of Akaroa flooded in February 1936

All but the largest floods are generally contained in or near stream channels east of the main street, Rue Lavaud. “Hennings Bridge” (now Waeckerle Bridge) over Grehan Stream and “Kingstons Bridge” (Figure 15) on Balguerie Stream over Rue Jolie are constrictions to large flows.

Spillage of flood waters occurs at these bridges in large events. In the largest event on record, in 1936, water spilled at these points, and upstream, and flooded a number of houses. It also exited from Balguerie Stream onto Rue Balguerie uphill (east) from Rue Lavaud and flowed down Rue Balguerie and into the shopping precinct. In that event Thompson records "…lots of houses being flooded in Rue Jolie North and Rue Balguerie, shops being protected by sandbags in Rue Lavaud and a big lake from the Rue Jolie North bridge (Balguerie Stream) to the Recreation ground." The accumulation of debris such as trees at bridges is cited as a factor in bridge flooding. The Recreation Ground is reclaimed land and is flat and poorly draining. The ground and adjacent historic Yew Cottage can flood to a depth of up to a metre. Club Lavaud on Woodills Road can be affected by Grehan Stream. Thompson states that Figure 15 is "based on a very comprehensive writeup in the Akaroa Mail" and is accurate. Figure 15 is likely to be representative of a bad present-day flooding scenario in north Akaroa.

Flooding from Aylmers and Walnut Streams appears not to have affected houses or the southern business area, presumably because the streams and bridges are of adequate size. One building in William Street was recorded as flooded in 1936.

Barrys Bay

"The parts of Barrys Bay … prone to flooding are all on the valley floor" (Thompson, 2008). Thompson comments that the cheese factory has flooded twice. A stopbank built up-valley from the cheese factory, possibly in the 1970s, may have saved the factory in the October 2000 storm. However, the factory is low lying and could flood in future.

Duvauchelle

"The state highway has flooded on a number of occasions at low points between the hotel and (Pawsons Valley Road). This has usually been caused by a combination of extreme rain and high tide and wind. Keeping the culverts that drain to the sea along the Duvauchelle waterfront clear is a major problem (at such times), and blocked culverts have been blamed for flooding problems." (Thompson, 2008)

Large flood flows can be expected to break out from streams on some occasions and flow over-land, exiting to sea across the state highway. Houses need to be elevated above anticipated flood levels.

French Farm

"Records and memories only record French Farm being flooded by the Christmas 1963 storm and the Wahine storm, the strongest the Peninsula has experienced since European settlement began" (Thompson, 2008). Areas indicated by Thompson as affected by flooding are pastoral land.

Robinsons Bay

Robinsons Bay is taken to mean Robinsons Bay valley and housing on the hill between Robinsons Bay and Duvauchelle.

Thompson (2008) comments that "The main problem in Robinsons Bay is caused by poor outflow to the sea." A map in Thompson's study does not indicate houses threatened by flooding. Locals commented to Thompson that houses near the shore are not at risk of flooding, however they are low lying and could be at increasing risk in future.

Takamatua

Reports after flooding in 1994 and 2002 suggest that houses on Takamatua Valley Road have not been flooded and are at low risk. Limited drainage in Old French Road obstructs hillside runoff on some occasions and appears to cause property flooding which could threaten low-lying floors in lower Old French Road (A Baird pers comm).

Tikao Bay

"Very steep Tikao Bay is not prone to flooding except for one property … on the waterfront. However, the narrow (shore-front) does make it particularly susceptible to sea surges." (Thompson, 2008)

Wainui

"Flooding at Wainui is mainly due to (wind-driven) sea surges" (Thompson, 2008). Thompson's information was gained from a long term resident and two informed District Council employees.

8.3 Flood Models

Water flow models referred to in this section	Potential use of model data
Hydrology and hydraulics flood assessment for proposed Okains Bay Water Treatment Plant, Beca, 2023.	Estimated flood flows
Koukourarata / Port Levy Area Drinking Water Scheme Flooding and Coastal Hazards Risk Assessment, Tonkin & Taylor, 2023.	Estimated flood flows Indicated land inundation areas
Hydraulic model of Okana River (adjacent to Little River), ECan, 2019	Estimated flood flows Indicated land inundation areas
Hydraulic model of Little River, supplementary to the Ecan model, 2019 (19/505433)	Indicated land inundation
Akaroa – Grehan Stream Flood Modelling, GHD, 2015	Estimated flood flows Flood levels at Rue Balguerie
GIS-based estimation of 5, 50 yr ARI flows in main stormwater network	Estimated sub-catchment discharges

8.4 Floodplain Management

River and stream flooding is a risk in some areas. The flooding risk in internal waterways and drains is dealt with by:

- Avoidance: built-up areas are located on high ground.
- Rules under the Building Act 2004
- District Plan rules.
- Outside the Fixed Minimum Floor Level Overlay all new builds are required to have a floor level that is above the 50-year ARI flood level plus 400 mm.
- An appropriately designed and managed stormwater network where pipes and drains should have capacity to convey a 20% annual exceedance probability rain event.

8.5 Coastal Effects and Sea Level Rise

8.5.1 Effects of Sea Level Rise on the Stormwater Network

Rising sea levels are expected to impact some near-coastal stormwater networks in time but beyond the term of this SMP.

- The SMP will allow for sea level rise and coastal inundation and erosion by keeping long-lived new infrastructure outside of hazard zones.
- The effects of sea level rise on existing infrastructure will be anticipated in stormwater renewals planning, informed by the Council's Coastal Hazard Adaptation Plan(s).
- The effects of sea level rise on communities will be provide for through Coastal Hazard Adaptation Plans.

Networks may be affected in low lying parts of Akaroa, Purau and Little Akaloa. In time land drainage ditches and swales in areas such as Le Bons Bay and Okains Bay will be compromised. Many settlements have coastal roads that will be could experience inundation in time.

Engineering solutions such as sea walls and pumping are likely to be expensive and not without residual risks. These solutions may be possible if there is space to temporarily store excess stormwater.

8.5.2 National Guidance

The most recent guidance from the Ministry for the Environment (MfE, 2022) updates guidance from 2017 with advice to allow for anticipated vertical land movement, especially subsidence, and to consider the the importance level of 'activities' (assets) at risk. Planning horizons are extended to 2130 (or to 2090 for non-habitable, short term 'activities'). Recommendations for planning new development or redevelopment are to allow for approximately 1.7 m of sea level rise (SLR) plus vertical land movement (VLM), which around the Banks Peninsula coastline is subsidence of 2 to 3 mm per year. VLM adds to effective sea level rise, bringing the recommended SLR allowance in new development and redevelopment to 1.9 to 2.0 metres by 2130.

Note: The 1.7 m SLR planning scenario is SSP5-8.5H+ which is the most conservative of a number of shared socio-economic pathways (SSPs, i.e. climate change drivers) modelled by the International

Panel on Climate Change. Four other pathways represent less severe climate change predictions and may be used in some planning.

MfE advice recommends a risk-based approach considering adaptation pathways over time. The risk-based approach is being followed in Coastal Hazard Adaptation Planning.

Sea level rise trends and post-earthquake land settlement trends are monitored nationally and locally.

8.5.3 Council's Coastal Hazards Adaptation Programme

The Council's Coastal Hazards Adaptation Planning Programme involves planning for the effects of sea level rise and coastal hazards, including coastal flooding, rising groundwater and coastal erosion. In 2022, adaptation planning began in the Whakaraupō – Koukourarata area. Since that time the Coastal Panel (rūnanga and community representatives) has considered coastal hazard risks to various public assets and have made recommendations for how risks might be managed. The Adaptation Plan was released for public consultation in October 2024. The final Coastal Hazards Adaptation Plan for Whakaraupō and Koukourarata was approved by the Council in March 2025. Funds are likely to be sought through the 2027-30 Long Term Plan for Adaptation Plans.

Part Three: Objectives and Principles

9 Developing a Waterway Health Approach

9.1 Introduction

Metals, likely to be of urban origin and sediment, likely to be of rural origin can exceed water quality targets in some streams during and after rainfall. Mitigation options have been considered, particularly for monitored streams that are showing stormwater impacts where stormwater contaminants exceed targets.

9.2 Role of Monitoring and Tangata Whenua Values in Setting Targets

9.2.1 Environmental Monitoring

Waterway monitoring has assisted development of this SMP. Exceedances of CSNDC ATL guidelines for copper and zinc indicate urban sourced contaminants. However, exceedances of other ATLs such as QMCI, indicate a holistic waterbody health approach is desirable.

Before installing treatment devices across Te Pātaka o Rākaihautū - Banks Peninsula the Council will undertake additional wet weather monitoring and stormwater characterisation to better understand the stormwater inputs. From the monitoring results, the areas we would like to investigate further include: Aylmers Stream, Walnut Stream, Cass Bay Stream and Lyttelton.

9.2.2 Mahaanui Iwi Management Plan Objectives

This plan recognises and is intended to help support the policies and objectives for water and the environment from the Mahaanui Iwi Management Plan 2013 as detailed in Section 2.12. Existing protection and some potential issues to be addressed for this SMP are proposed in Table 6 below.

9.2.3 Consultation with Rūnanga

Initial engagement with four Papatipu Rūnanga regarding mana whenua environmental values, environmental monitoring results and options for stormwater treatment had been undertaken. The Council has received the position statements from Ōnuku Rūnanga, Te Rūnanga o Koukourārata, Wairewa Rūnanga and Te Hapū o Ngāti Wheke (Rāpaki). During the delivery of the SMP, Council will partner with the four rūnanga to determine how and where enhancement should occur.

9.2.4 Cultural Health Monitoring

Cultural health monitoring has been undertaken in some areas of Te Pātaka o Rākaihautū by some of the Papatipu Rūnanga. This monitoring has helped to inform the position statements and identify more specific areas of concern or values that are important to protect e.g. stream habitats that should be prioritised for riparian planting and/or bank stabilisation and focus areas for education programmes. Cultural Health monitoring will be undertaken again over the SMP term as per the EMP.

Table 6: Maahanui Iwi Management Plan Issues

Iwi Management Plan Issues	**How the CCC is addressing Iwi Management Plan issues**
Whakaraupō **Issue WH1:** The cultural health of the harbour is at risk as a result of: Sedimentation; Stormwater run off; and Inflow from streams carrying increased sediment and nutrient loads. **Issue WH3:** The protection and enhancement of waterways and waipuna is essential to improving the cultural health of the catchment.	Capital programme outside the SMP includes a stabilisation programme to reduce the amount of sediment being eroded from the Port Hills and washed into Ihūtai-Estuary and Whakaraupō-Lyttleton Harbour. Waipuna are recognised and receive some protection from District Plan processes and the WWDG. Identifying waipuna and riparian margins that can be planted and stabilised. Help to educate landowners of the importance of stock management and riparian buffers (in conjunction with ECan).
Koukourarata to Pōhatu **Issue KP 7 and 8:** Protection of waipuna as a wāhi taonga, and loss of indigenous biodiversity and implications for the health of the land, water and communities	Waipuna are recognised and receive some protection from District Plan processes and the WWDG. Council to support and initiate protection, enhancement and restoration activities for indigenous biodiversity for waterways and waipuna identified by tāngata whenua.
Akaroa Harbour **Issue A5:** Effects on waterways and waipuna as a result of: Stormwater run-off; Indigenous riparian vegetation removal; Stock access; Sedimentation from earthworks and vegetation clearance activities.	Waipuna are recognised and receive some protection from District Plan processes and the WWDG. District Plan waterway setbacks (15 m). Identifying waipuna and riparian margins that can be protected through planting indigenous buffers. There is a project in the Capital Programme – Duvauchelle Waterways which seeks to stabilise the banks of Pawsons Valley Stream, Pipers Stream and Showground Drain with indigenous planting and more robust engineering methods, where necessary. Help to educate landowners of the importance of stock management and protection and enhancement of riparian buffers (in conjunction with ECan).

Poranui to Timutimu **Issue PT4:** Protecting the mauri of waterways in the southern bays catchments.	District Plan waterway setbacks (15 m). Identifying waipuna and riparian margins that can be planted and stabilised. Help to educate landowners of the importance of stock management and riparian buffers (in conjunction with ECan).
Te Roto o Wairewa **Issue W1 and W3** (Degradation of riparian areas; Sewage and stormwater disposal; and Soil erosion and sedimentation)	Treating stormwater from urban areas (looking for appropriate locations in Little River). District Plan waterway setbacks 15 m. Identifying riparian habitats that can be planted and stabilised. Help to educate landowners of the importance of stock management and riparian buffers (in conjunction with ECan).

9.3 Potential Controls

Table 7: Contaminant Sources, Significance and Possible Mitigation Methods.
Colours indicate the effectiveness of mitigation methods.
Green = Likely to be effective, Yellow = Sometimes effective, Red = Difficult or slow to get effects.

Source	Contribution	Possible Mitigation Methods
Sediment		
Hillside sediment Slips, under-runners, bank erosion	High	Mostly rural sources outside the scope of the SMP. Proposing trial under-runner remediation at Diamond Harbour.
Construction sites	Unknown, mitigated to some extent	Sediment & erosion controls Conditions on subdivision, resource or building consents Minimum Requirements for Developed Sites
Road works	Low; usually adequately controlled	On-site sediment controls
Plants (leaves, etc.)	Low (seasonal)	Undertake riparian planting to substitute natives for exotic species with high leaf fall
Vehicle emissions	Low	Treat road runoff
Deposition on roads via vehicles,		Treat runoff from busiest roads, carparks and manoeuvring areas using filtration such as:

Source	Contribution	Possible Mitigation Methods
pedestrians, private property runoff and wind.		Rain Garden (generic in-ground bio-filter) Cartridge filter (Stormfilter by Stormwater 360) Filterra (proprietary in-ground bio-filter)
		Catchpit filter (e.g. Litta Trap) Street sweeping
Bank erosion	Low-moderate	Stream bank stabilisation
Zinc		
Bare galvanised roofs	Significant in Lyttelton. Few elsewhere.	Replace with alternative roofing material (clay tile, non-metal roofs or pre-coated Zn-Al or paint with low zinc paint)
		Downpipe filters (e.g. Storminator™ by University of Canterbury)
		Divert first flush to the wastewater network
Ageing painted roofs	Some in most areas. Could be a developing issue as pre-coated roofs get older.	Replace with alternative roofing material (clay tile, non-metal roofs or pre-coated Zn-Al or paint with low zinc paint)
		Treat roof runoff through downpipe filters
		Install rainwater tanks to divert roof runoff from network
Bare Zn-Al[1] roofs	Few in settlements. Usually associated with industrial areas.	Paint roofs and maintain paint in good condition
Vehicle tyres	Significant district-wide.	Treat runoff from busiest roads, carparks and manoeuvring areas using filtration such as: Rain Garden (generic in-ground bio-filter) Cartridge filter (Stormfilter by Stormwater 360) Filterra (proprietary in-ground bio-filter)
		Catchpit filter (e.g. Litta Trap) Street sweeping
Copper		
Brake pads	High district-wide	Copper content of brake pads anticipated to reduce from 2025 following USA legislation.
		Educate local auto industry and residents about the value of low/no copper brake pads, noting

Source	Contribution	Possible Mitigation Methods
		some low-Cu pads are currently available in NZ market.
		Riparian planting to buffer overland flows
Particulate deposition on roads	Moderate	Treat runoff from busiest roads, carparks and manoeuvring areas using filtration such as: Rain Garden (generic in-ground bio-filter) Cartridge filter (Stormfilter by Stormwater 360) Filterra (proprietary in-ground bio-filter)
		Catchpit filter (e.g. Litta Trap)
		Street sweeping
		Riparian planting to buffer overland flows
Roofs, cladding, spouting, downpipes	Low but may increase	Advocate with NZ Government for legislation on copper cladding.
		Investigate the feasibility of a District Plan rule to discourage the use of copper claddings.
		Educate residents
		Onsite treatment of the copper stormwater runoff (e.g. copper sculpture filters thought grass prior to entering SW system, or retrofit planter box to treat runoff)
		Transparent sealer applied to copper surfaces
Lead		
Paint flakes/chips from old buildings	Unknown but more likely to contaminate soil than water	Site remediation during development
Lead flashings on roofing	Low, becoming less common	Education
Building material in older homes (pipes, roofing)	Low, and as homes are renovated, demolished and maintained, the quality of lead is reducing.	Wait until lead is no longer present
Historic lead from leaded petrol	Low but noted in sediment monitoring	Undertake instream sediment remediation

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Source	Contribution	Possible Mitigation Methods
Pathogens/ bacteria		
Sheep and cattle	Believed to be the largest bacteria source	Unlikely to change unless catchments become forested.
Wastewater overflows	Occasional	CCC Wastewater team are actively reducing wastewater overflow with controls such as renewals, capacity upgrades, reduction of vented manhole and code of practice guidelines.
Dogs	Unknown	Signage and education
		Riparian planting to buffer overland flows
Other Organic Material		
Leaf Litter and Grass Clipping	Minor	Education
		Riparian planting to buffer overland flows and replace exotic trees with natives over time
Polynuclear aromatic hydrocarbons		
(Old) coal tar street surfaces.	Unknown	Encapsulation. Removal.
Combustion	Likely low	Monitor
Nutrients		
Soil erosion	Unknown	Investigate sources
		Stablise stream banks through riparian planting
		Plant native forest in catchment
Probable agricultural sources (via runoff)	Unknown	Education
Phosphate		
Industrial sources	Moderate	Enforcement
Fertiliser	Believed to be a minor source	Education
Leaf Litter and Grass Clipping	Unknown contribution	Education

Table 8: Assessing options as potential Best Practicable Options

Mitigation Option	Contaminants Treated	Assessment as a Best Practicable Option
First flush basins and Wetlands	TSS, Cu, Zn	Limited space and hilly topography rule out basins and wetlands in settlements.
Methods above this line more suitable for developments where land is readily available. Methods below this line have smaller footprints and are more suitable for use within redevelopments		
Rain Garden (generic in-ground bio-filter)	TSS, Cu, Zn, hydrocarbons	Good TSS and metals removal. Appears to be a more expensive means of removing metals than basin + wetland
Cartridge filters (e.g. Stormfilter by Stormwater 360)	TSS, Cu, Zn, hydrocarbons	Good TSS and reasonable metals removal. More expensive means of removing metals than basin + wetland Similar metals removal cost to rain garden
Filterra (proprietary in-ground bio-filter)	TSS, Cu, Zn, hydrocarbons	Good TSS and metals removal. More expensive than basin + wetland Better suited to new or re-development.
Catchpit filter (e.g. Litta Trap)	TSS, some Cu & Zn, litter, organic material	Good removal of particles larger than 100 µm (sand size). Some metals removal. Not suited to shallow catchpits on Banks Peninsula.
Street sweeping	TSS, particulate Cu & Zn	Good removal of particles larger than 100 µm (sand size). Some metals removal.
Downpipe filters (e.g. Storminator™ by University of Canterbury)	Zn, roof-sourced TSS	Very good zinc removal. Council can require downpipe treatment in a few cases.
Roof replacement with non-steel materials	Zn	Very effective but likely a far-future solution. Council does not have powers to require this.
New roofs required to be non-steel	Zn	Very effective but likely a far-future solution. Council does not have powers to require this. There is scope for both Councils to promote the benefits of this source control.
Roof painting	Zn	Good barrier to zinc discharge. Not a permanent solution. Council does not have powers to require roof painting.
Low-copper brake pads	Cu	Potentially the most effective and efficient copper mitigation. Appears to be happening due to legislation overseas. Government support may speed uptake.

9.4 Contaminant Model

9.4.1 Contaminant Load Model

Annual loads of total suspended solids, copper and zinc have been estimated by a model developed for Te Pātaka o Rākaihautū by DHI Ltd and Dr Tom Cochrane (University of Canterbury). Urban loads are estimated by the contaminant load model MEDUSA[13] Version 2.0 (CLM). MEDUSA is an event-based pollutant load process model used to predict amount of TSS, Cu and Zn contributed by individual impermeable surfaces during rain events. Rural sediment loads are developed from tables of sediment yields for rural areas published by NIWA[14].

The Peninsula is divided into urban areas and rural catchments (Figure 16) that are modelled separately. Urban areas are represented at settlement scale and rural catchments are aggregated into groups that discharge into separate receiving waters, as shown in Figure 16. Contaminant information for individual rural waterways was not obtained. The total amount of rural contaminants entering enclosed water bodies that also receive urban inputs, (i.e. the two harbours and Wairewa – Lake Forsyth) is more useful.

Urban model parameters are the area, material type and length of antecedent dry period for individual surfaces, and average rainfall intensity, pH and duration for rainfall events (Charters et al. 2020). Parameter values are derived from sampling stormwater discharged from Christchurch roofs, roads and car parks. The CLM estimates the annual load of three contaminants, total suspended solids (TSS), total copper and total zinc for each urban sub-catchment.

Rural contaminant load estimates are based on sediment yields obtained from stream gauging. A sediment yield estimate (kg/m^2/yr) by Hicks et al. (2019) was assigned to each rural catchment from the River Environmental Classification[15] reach nearest to each identified rural land parcel. Total sediment load for each rural catchment was then derived by summing the yield estimate across each catchment and the area associated with each land parcel (DHI, 2025). Background estimates of soil zinc and copper concentrations (in mg metal/kg sediment) from Cavanagh et al. (2015) were mapped onto each of the rural catchments and an area-weighted average value was calculated (DHI, 2025).

[13] Modelled Estimates of Discharges for Urban Stormwater Assessments

[14] National Institute of Water and Atmosphere

[15] River Environment Classification (REC), version 5.

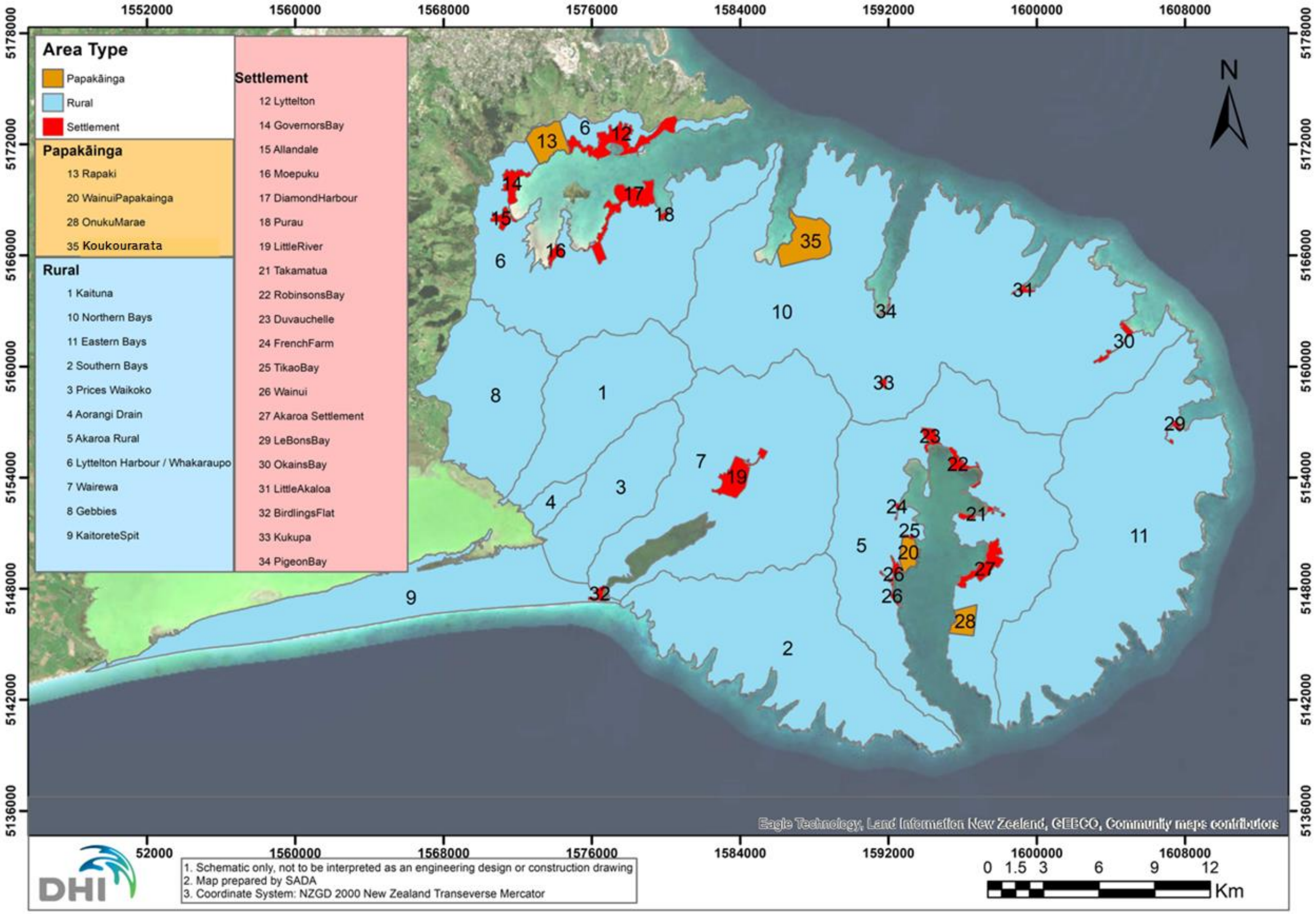

Figure 16: Urban, rural and papakainga sub-catchments

9.4.2 Contaminant Load Model Results

Rural sediment yields are much greater in total than urban yields due to the large relative size of rural areas. Rural areas generate almost two orders of magnitude more TSS (assumed to be sediment) than settlements. It is frequently commented that sediment is the major contaminant of the two harbours and Wairewa – Lake Forsyth. The model suggests that green spaces within settlements contribute significantly more TSS than impervious surfaces.

The model indicates that annual loads of metals from the smaller settlements are minor but that the largest five settlements Lyttelton (population 3,180), Diamond Harbour (1,650), Governors Bay (940), Akaroa (770) and Little River (280) discharge a significant proportion of the total settlement zinc load into their receiving environments. Half as much zinc is modelled from impervious surfaces in the Whakaraupō – Lyttelton Harbour catchment as from rural and undeveloped surfaces: the proportion is one quarter from the less populated Akaroa Harbour settlements. The model indicates that approximately 80% of the urban zinc is discharged from roofs. The percentage could be higher in Lyttelton where approximately 10% of roofs (based on a manual count from aerial photography) are in poor condition. The model calculates significant contributions of zinc from rural roads and the many rural buildings. It is likely that some zinc from rural roads and buildings is absorbed into the soil, but that detail is not modelled.

The model indicates that settlements discharge a small percentage of total copper. Settlements around Whakaraupō are indicated to discharge 5% of the copper in that catchment and settlements around Akaroa Harbour are indicated to discharge 3% of the total copper in that catchment. Roads contribute more copper than soils in most settlements. Road copper is sourced from vehicle brake pads and is more bioavailable than copper in soils.

Significant amounts of contaminants are discharged from the 5 largest settlements Lyttelton, Governors Bay, Diamond Harbour, Little River and Akaroa. Minor amounts of contaminants are discharged from the smaller settlements. Estimated contaminant loads before and after treatment are in Appendix C.

9.4.3 Modelling Stormwater Treatment

The CLM was used to help estimate the value of installing stormwater treatment devices in the larger settlements. Forty locations where it could be possible to install devices were considered. The area potentially contributing to each device contains a relatively busy road. Device catchments range in area from 0.12 to 10 ha. The CLM uses a theoretical treatment efficiency to estimate contaminant load removal by facilities. Estimated contaminant loads in sub-catchments proposed for treatment are in Appendix E.

Treatment efficiencies are in Table 18, Appendix D based on findings from international research. Reported treatment efficiencies indicate that facilities are typically effective in removing particles (TSS) but are likely to remove a moderate percentage of dissolved metals. Dissolved metals, which form a significant part of the contaminant load tend to be sourced from roofs and roads.

10 Mitigation Plan

10.1 Factors Affecting Option Selection

Stormwater and stormwater contaminants are generated at smaller scales in Peninsula settlements than in Christchurch City but monitoring sometimes detects contaminants above guideline levels. Current monitoring gives limited information about the distribution of contaminants but does provide enough basis to conclude that stormwater is impacting waterway health.

Streams or watercourses run through most settlements. Most settlements are close to the coast and relatively short sections of streams are affected by contaminants. Urban stormwater catchments are typically small, with short pipe runs. Near the coast there is little available space for basins and wetlands which are a preferred treatment type in the City. Treatment, if it is to occur, would need to be at multiple locations rather than aggregated in large-scale treatment facilities.

Some street sweeping is done to pick up litter, stones and sand but is less effective at removing fine particles that contain most metal contaminants (Depree, 2011). Side channels in larger settlements are often not suitable for sweeping being partly dished (Akaroa, parts of Lyttelton) and grass swales (Governors Bay, Diamond Harbour).

Sump filters can trap litter and stones but have variable, generally lower, effectiveness in trapping fine contaminants. Most sumps in the larger settlements (Lyttelton, Akaroa and Diamond Harbour) are too shallow for filter inserts to be installed.

Some contaminant discharges can be reduced voluntarily through education. Through its Community Waterways Partnership the Council has an education programme focussed on what the community can do at home. The education programme discusses the environmental benefits of installing rainwater tanks and maintaining roofs. Benefits are long term and could be strengthened if there was a means for Council to incentivise this behaviour change.

As an alternative to treatment contaminants can be eliminated at source by substitution of non-contaminating materials. This could involve substituting inert building materials for those with zinc coatings, substitution for zinc oxide in tyres, or low-copper brake pads. Contaminants could be reduced at or near source by, for example, painting or repainting roofs, or treating roof runoff in downpipe filters. The Council does not have powers under the Local Government Act to require these measures (PCE, 2022), meaning they are not a practicable option at this time. New legislation is expected to be needed before such powers are available to the Council.

Although contaminants are partly responsible for degraded stream conditions they are not the only influences. Deforestation, farming practices and land instability in upper catchments delivers sediment and nutrients that degrade stream habitats. Reduced riparian cover can remove habitat for aquatic biota and allow the sun to warm and de-oxygenate water.

Current monitoring shows that waterways within the Peninsula have high ecological values, particularly when compared to other parts of Christchurch District. Given the limitations of the standard stormwater treatment methods as mentioned above, it is thought that enhancement methods may benefit the environment more than treatment. Identification and protection of spawning habitat and stream enhancement (through riparian planting and bank stabilisation) are options.

10.2 Source Controls

Despite the desirability of eliminating contaminants at source it is not easy to do. As the discussion above indicates the Christchurch City Council cannot impose obvious measures such as prohibiting the use of certain building materials or requiring roofs to be painted. However, both the CCC and Environment Canterbury could advocate for, investigate and promote non-contaminating materials. Since the same issue is experienced nation-wide it would be desirable for a lead to be shown by the Ministry for the Environment.

10.3 Treatment Devices - Considerations

There are few suitable stormwater treatment options for Banks Peninsula urban areas other than filtration devices and devices are practicable in only a limited number of places. Devices would need to be retrofitted into urban areas and suitable sites have been difficult to find. Pumping can be needed to allow a device to operate. Contributing areas often include rural hillside whose runoff can overload a filter causing bypassing and reduced performance.

Practicable filter sites were sought in areas containing a commercial centre or busy road (each of which typically produces a significant contaminant load). A practicable site is on public or vacant land, preferably flat and without other utilities. Filters at pipe outfalls on stream banks were considered but these sites are less practicable, often being in private land with limited access. About 30 sites in Lyttelton, Governors Bay, Little River and Akaroa appear to be possibilities, subject to confirmation. A further 10 on-road sites in Lyttelton are possible but installation would be significantly more difficult. Installations at the 40 sites were modelled and costed to aid evaluation; the cost is estimated to be of the order of $20 million.

The contaminant load model showed that even a significant number of filters (40) would have a minor effect in relation to overall contaminant loads (even when only impervious (built-up) area loads are considered).

Table 9: Contaminant load reduction by 40 filters compared to settlement impervious area loads

Contaminant	Modelled annual load impervious areas, all settlements, (kg/yr)	Modelled annual load impervious areas, 4 settlements with proposed filters (kg/yr)	Modelled annual load reduction if 40 filters installed (kg/yr)
TSS	27,000	15,400	1,840
Total Zinc	352	216	10.4
Total Copper	12.8	7.4	0.7

Notes: The modelled annual TSS load reduction through 40 filters (1,840 kg/yr) includes some sediment load from rural hillsides.

Devices might be sited elsewhere in residential parts of Lyttelton and other settlements. However, lower residential contaminant loads, surcharging from rural hillside stormwater and higher installation costs would limit their effectiveness.

10.4 Environmental Improvement as an Option

The Council considered whether environmental enhancement measures such as those in Table 10 would be more beneficial than contaminant removal alone and discussed this option with rūnanga.

Table 10: Possible environmental improvements

Improvement option	Target/measure	Justification
Stream bank planting, riparian and/or shade trees	Metres of stream planted per year. Improve Rapid Habitat Assessment (RHA) Improve macrophyte and QMCI ATLs[16]	Healthy water bodies Reduce sediment from bank erosion
Stabilise eroding stream banks	Metres of stream bank protected per year. Improve fine sediment and TSS concentration ATL Protect Coastal Water TSS ATL	Reduce sediment from bank erosion
Enhance spawning habitat	Metres of habitat protected/created per year	Healthy water bodies Mahinga kai
Fund Rūnanga-initiated projects	Improve mana whenua values ATLs	Healthy water bodies Mahinga kai
Industrial Site Audits	10 highest-risk sites to be audited by 2028.	Very little information about industrial stormwater quality on the Peninsula.
Education / Engagement Plan	Holistic freshwater and stormwater communication strategy to be rolled alongside with consultation of SMP.	Raise awareness to the public about what they can do in their own homes to improve stormwater quality/quantity.
Partnership with ECan and Papatipu Rūnanga	Advocate for Banks Peninsula Catchment Management Plans (e.g. Kaituna Valley and Akaroa Harbour).	Most of BP is within ECan jurisdiction, and urban areas are CCC jurisdiction. Collaboration between both councils and rūnanga will improve stormwater outcomes

A range of treatment and environmental improvements were developed in three mitigation options in Table 11 below.

[16] Attribute Target Levels: measures of stream health from the Canterbury Land and Water Regional Plan which form Schedule 7 and 8 of the CSNDC.

Table 11: Mitigation options considered

	Option 1: ~3 devices $1.6 million Stream enhancement $7 million		**Option 2: ~12-14 devices ~$4.7 million Stream enhancement ~$3.9 million**		**Option 3: ~22 devices $8.6 million No stream enhancement**	
Option Objective	**Maximise enhancement**		**Treat the worst streams**		**Maximise treatment**	
Mitigation	Mitigation quantity	*Value measure*	Mitigation quantity	*Value measure*	Mitigation quantity	*Value measure*
Contaminant load reduction Treatment devices	About 3 devices	*Removes estd. 0.77 kg zinc p.a. 0.1 kg copper p.a.*	About 12-14 devices	*Removes estd. 2.9 kg zinc p.a. 0.22 kg copper p.a.*	About 22 devices	*Removes estd. 7.5 kg zinc p.a. 0.53 kg copper p.a.*
Improve QMCI and RHA scores Enhance riparian planting Enhance spawning habitat	15 km riparian planting 1 km spawning habitat enhancement	*Most biodiversity assistance* *Most instream habitat improvement.*	9 km riparian planting 0.3 km spawning habitat enhancement	*Biodiversity assistance* *Instream habitat improvement.*	0	*No biodiversity assistance*
Improve instream sediment cover and quality Sediment removal, trapping Stabilise stream bank	$1 million sediment removal, 1 km stabilised stream banks	*Most instream habitat improvement.*	$0.35 million sediment removal, 0.6 km stabilised stream banks	*Instream habitat improvement.*	0	*Some sediment removal*
Improve Cultural Health Index score Rūnanga projects	$1.3 million for biodiversity projects	*Cultural Health Index improves*	$1.0 million for biodiversity projects	*Cultural Health Index improves*	0	*No biodiversity assistance*
Consent ATLs[17] addressed		*8*		*8*		*3*

[17] Attribute Target Levels. Measures of stream health from the Canterbury Land and Water Regional Plan.

10.5 Choosing a Mitigation Strategy

The Council's preferred option is to install 9 – 12 stormwater filters on the worst practicably accessible sites and carry out some instream environmental improvement. Option A is an amalgam of the Options 1 and 2 released for public consultation.

With a maximum number of treatment devices not more than approximately 9-12 the proportion of settlement area treated will be small. Consequential environmental improvements are expected to be small also. There are benefits to be gained from additional environmental enhancements such as riparian planting.

It is noted that:

a. Contaminants exceed guidelines in places, but typically only at the coastal end of catchments.

b. Devices in the most effective locations – commercial areas and busy roads – are at best moderately difficult to install due to construction requirements, utilities clashes and access. Devices at more than 10-15 sites are expected to become increasingly difficult and expensive to install and maintain. There would seem to be a limited number of practicable treatment device sites.

c. A practicable number of devices will remove a very small percentage of the total metals load from settlements.

d. The difference in contaminant capture between the options is small in relation to total contaminants catchment wide.

e. In the Council's view the BP SMP budget can provide more environmental benefits if a proportion is spent on environmental enhancements.

f. In the long-term source controls are expected to be more effective and more efficient than treatment options.

The locations of treatment devices for the Options 1, 2 and 3 consulted on are shown in Appendix E.

10.6 Responses to Reviews and Submissions

10.6.1 Engagement with Ngāi Tahu Papatipu Rūnanga

Four Ngāi Tahu Papatipu Rūnanga hold tino rangatiratanga (sovereignty) over the area of Te Pātaka o Rākaihautū - Banks Peninsula covered as part of this SMP; Te Hapū o Ngāti Wheke, Te Rūnanga o Koukourarata, Wairewa Rūnanga and Ōnuku Rūnanga. Council staff engaged with Papatipu Rūnanga throughout the development of this SMP, this included:

- In April 2025, Council staff met with Papatipu Rūnanga via a series of hui at each marae.
- At the MKT offices in November 2024
- At the MKT offices in late 2021

By agreement, Mahaanui Kurataiao Ltd. facilitated the development of Position Statements with all four Papatipu Rūnanga. Each Position Statement clearly defines the takiwā of each Papatipu

Rūnanga and provides high-level cultural context information that acknowledges their rangatiratanga and mana whenua/mana moana (territorial rights over land and water) over Te Pātaka o Rākaihautū / Banks Peninsula. These Position Statements assert their role as kaitiaki and identify issues/concerns and priorities for their takiwā that relate to stormwater management. Each Papatipu Rūnanga concludes their Position Statement with recommendations to Council, consistent themes include:

- **Engagement and collaboration:** rūnanga seek a collaborative and integrated approach to stormwater management including recognition of the concept of Ki Uta Ki Tai.
- **Identity:** acknowledgement and protection of ancestral relationship to the natural environment is required.
- **Mahinga kai:** the Council is to work with Papatipu Rūnanga to protect and enhance areas of mahinga kai value in the long term, including the protection and enhancement of known springs.
- **Native planting:** establish native riparian buffer zones along waterways and drains in line with catchment scale planting plans developed jointly by Papatipu Rūnanga, CCC and ECan, as well as considering the control of exotic pest and weed species.
- **Monitoring:** increase monitoring frequency of water quality in harbours and streams to help address contaminant sources and issues, utilising the State of the Takiwā methodology.
- **Contaminants and sedimentation:** should be dealt with by investigating direct discharges, stabilising sediment sources on hillsides and construction sites and capturing or eliminating urban contaminants.
- **Stream enhancement:** is advocated for through riparian planting, fencing and bank stabilisation to increase indigenous habitat, as well as implementing appropriate setbacks.
- **All Papatipu Rūnanga recommended that Council implement Mitigation Option 2.**

In addition to the above commonalities, each Papatipu Rūnanga raised a matter of specific interest:

- Te Hapū o Ngati Wheke advocate for improvement of the cultural health of the harbour by investigating marine pests and pollution.
- Te Rūnanga o Koukourarata recommend all stormwater is to be discharged to land as opposed to drain outlets to the sea/harbour.
- Wairewa Rūnanga is concerned with the water quantity and quality issues faced by Te Roto o Wairewa / Lake Forsyth, as well as the risk of flooding to their takiwā.
- Ōnuku Rūnanga seeks the investigation of sources of *E. coli* where guidelines above the recreational standard have consistently been exceeded.

10.6.2 Responses to Technical Reviewers

The Reviewer for contaminant modelling and contaminant mitigation thought the SMP provides an appropriate description of contaminant modelling and a pragmatic approach to contaminant capture options. The Reviewer suggested that contaminant load model output could be mapped to aid understanding. The CCC agrees in principle but feels that too many maps would be needed to convey the relatively simple result that the five largest settlements generate most contaminants.

The Ecology Reviewer suggested helpful corrections and improvements which were made. Some Reviewer comments were to the effect that more monitoring would be desirable and this is acknowledged to be correct. Some additional monitoring will be carried out by both ECan and the CCC in 2025/26. The Reviewer agreed that restoration including removal of fish passage barriers is likely to better support aquatic ecology than stormwater treatment.

10.6.3 Responses to Public S

10.6.4 Submissions

Fifty-eight persons or organisations made a submission on the SMP. Forty-five persons answered the Quick Poll with 58% preferring Option 1, 24% preferring Option 2 and 11% preferring Option 3. Thirteen persons or organisations provided a written response with Option 2 being the most popular option. The following summarises the 13 written submissions.

While some submissions were neutral, the more substantial submissions were critical of the SMP going only a small way toward preventing the release of sediment and contaminants, treating stormwater and thus protecting the environment, particularly the harbours. Submitters noted numerous sources of sediment, although many sources such as road-side cuttings and hillsides are predominantly rural and outside the scope of the SMP. All submissions note the necessity of managing stormwater runoff to minimise environmental harm. Submitters want the Council to find ways to address all sources of contaminants, both urban and rural, that affect streams and the harbours. Organisations want to engage with the Council and the wider community to find ways to address contaminant (including sediment) discharges and avoid environmental harm.

10.6.5 SMP Targets

The preferred option is intermediate between Options 1 and 2 and contains some treatment devices and some environmental enhancement. The number of devices will vary depending on where devices can be most effective and practicability of installation. A review of costs indicates that installation costs may be higher than was estimated at first. Proposed SMP targets are:

- Install 9-12 filters to treat approximately 5 impervious hectares leading to streams where contaminant exceedances have been recorded. See Table 20 in Appendix F.

- Enhance 8 km of streambank over 10 years with native vegetation planting for shade and to reduce bank erosion.

In addition to the funding under the SMP, there is funding under other programmes that can achieve enhancement along another 9 km of waterway length: Duvauchelle Waterways Project (1.8km) and Urban Forest Banks Peninsula (3.6km of waterway in Akaroa Parks and 4km in Lyttelton Parks).

- Stabilise 500 m of stream bank over 10 years with rock and native vegetation planting to reduce sediment generation and provide shade.

Similarly the Duvauchelle Waterways Project will seek to stabilise approximately 580 m of streambanks and reduce the amount of sediment entering the Harbour from this area.

- Enhance or introduce spawning habitat in 200 m of stream over 10 years.
- Remove sediment contaminated with lead from Balguerie Stream (priority) and sediment contaminated with metals in other places.
- Carry out sediment trapping where this can be effective.
- Audit high-risk industrial sites and work with occupiers to remediate contaminated stormwater discharges, (Section 11 Goals 5.2 and 5.3). Ten industrial site audits will be carried out on the Peninsula over the first three years of the SMP. Three sites were completed in 2025.
- Develop an information pack about the environmental benefits of non-steel roofs. Provide the information to the industry and to persons who will be installing a new roof.
- Develop an information pack about the environmental benefits of installing rainwater tanks. Provide the information to the public and to persons who will be building or installing a new roof.
- Investigate the degree to which the Council can promote non-steel roofing without an adverse response from the industry and promote that roofing type through educational material and publicity.
- Seek for new industrial roofs to be coated (painted).
- Erosion and sediment control on development and construction sites, (Section 11 Goal 1.1).
- Work with community groups and the public to educate the community about the effects of and mitigation of stormwater contaminants, (Section 11 Goal 6.1).

Annual load reduction targets are taken from contaminant load reductions estimated for treatment devices in Table 19, Appendix E.

Table 12: Contaminated Load Reduction Targets for Te Pātaka o Rākaihautū - Banks Peninsula Settlements.

Contaminant	Modelled Settlement contaminant loads in 2025 without treatment (kg)	Modelled Settlement contaminant loads in 2035 without treatment (kg)	Reduction target through treatment by 9-12 devices (kg/yr)
Total suspended solids	626,000	623,000	450
Total zinc	378	389	4.1
Total copper	20	20	0.18

Notes:
1. Contaminant loads from settlements come from impervious and pervious areas. Papakainga zone contaminants are not included.
2. The likely reason for TSS loads reducing 2025-2035 is the modelled conversion of greenspace to built land.

10.7 Beyond the Stormwater Management Plan

Other measures for consideration by Council to protect the environment have arisen during public consultation and engagement with Papatipu Rūnanga. Because Te Pātaka o Rākaihautū / Banks Peninsula is largely rural it is understandable that both mana whenua and the local community would like a management plan that achieves more in rural areas. Common themes emerging is the management of rural sediment and protection and enhancement of mahinga kai; such work would require initiating and funding outside of this stormwater management plan, however we see value in capturing the major themes, as listed below inTable 13.

Table 13: Water management measures recommended by public and rūnanga submissions

Major Themes	Theme raised by
Reduce sediment discharges into Whakaraupo – Lyttelton Harbour to protect mahinga kai. Many rural hillsides are steep, lack forest cover and are slip-prone and erodible. Large sediment flows enter the harbour and harm marine life. Forest cover and stabilisation of under-runners, tracks and road cuttings would reduce sediment discharges into the harbours.	Te Hapū o Ngāti Wheke
Better notification about and reduction of *E. Coli* (pathogens) in Whakaraupo. Pathogens affect swimming and shellfish gathering. Reliable notification is needed. Reduction of pathogens where possible.	Te Hapū o Ngāti Wheke
Councils to work collaboratively with Papatipu Rūnanga Acknowledge the relationship of mana whenua with the harbours, provide for te taiao decision-making processes, provide for mahinga kai.	Te Rūnanga o Koukourarata Ōnuku Rūnanga Wairewa Rūnanga
Improve coastal water quality Papatipu Rūnanga and councils develop plans and rules to limit *E. Coli*, discharge stormwater into land, fencing and planting to protect streams, best practice septic tank design.	Te Rūnanga o Koukourarata

A catchment management plan for Te Roto o Wairewa. Wairewa catchment is erosion-prone. Sediment brings phosphate into Te Roto o Wairewa-Lake Forsyth where it causes toxic algal blooms. The Rūnanga wants a plan to stabilise unstable parts of the catchment.	Wairewa Rūnanga
Collaborative approach to enhance mahinga kai value and stream health Manage stormwater, eliminate contaminants, protect streams, waipuna, salt marsh and sea grass, plant riparian buffers.	Ōnuku Rūnanga
Flooding mitigation plan for Little River. State Highway 74 through Little River is blocked every 2-5 years by flooding. Businesses can be flooded. The community would like a solution.	Little River Wairewa Community Trust
Non-contaminating roof materials. CCC and ECan to take an active role in discovering and promoting acceptable, non-contaminating roof materials that will reduce zinc and copper discharges into rivers and reduce stormwater treatment costs.	SMP Team
Deal with contaminant sources Council is asked to increase funding to protect the environment. Request more actions to keep contaminants out of harbours. Benefits of hillside and stream planting promoted. Roadside cuttings can be sediment sources.	Public consultation Ōnuku Runanga

Progressive improvement could be achieved through further measures such as those in Table 14.

Table 14: Areas for improvement outside of the Stormwater Management Plan

Activity	Motivation for the Activity
The Council regulating and acting under regulations to stop the discharge of contaminants.	As required by conditions of CRC252424 (CSNDC)
The Council investigating new means of controlling contaminants at source (e.g by materials substitution or innovative means of treatment).	As required by conditions of CRC252424 (CSNDC)

The Council and others implementing new or improved contaminant mitigation practices.	Through the proposed Surface Water Implementation Plan 2021 (referred to in section 2.1)
The Council and others making progressive environmental improvements such as restoring waterways and their corridors to a natural state.	Healthy Environment Community Outcome
Citizen-based awareness and advocacy for clean water and improved biodiversity.	Kaitiakitanga
Advocacy by Ngāi Tahu for the mana of water and waterways.	Kaitiakitanga. Kawanatanga. Mahaanui Iwi Management Plan
Catchment management plans for Te Pātaka o Rākaihautū (erosion and sediment management)	Reduce erosion, increase tree cover Advocacy by rūnanga Treaty partnership

10.8 Industries and High-risk Site Discharges

The Council will manage industrial sites through its Stormwater and Land Drainage Bylaw 2022. The bylaw requires industrial contaminants to be controlled to meet best practice. The Christchurch City Council's expectation is that stormwater entering its network is managed according to best practice, especially where the discharge occurs directly into a waterway. On-site pre-treatment may be required unless contaminant levels are less than LWRP Schedule 5 standards.

Where industrial site occupiers do not meet the required standards for discharge into the network, the site will be removed from the CSNDC and will require a separate resource consent from ECan for its discharge. A condition is included in the CSNDC for this process and all industrial sites excluded from the resource consent will be listed on Schedule 1 attached to the consent.

In managing high-risk sites the Council will:

1. Audit at least 15 high-risk sites per year;
2. Inform audited industries of the results of audits and work closely with these industries to achieve outcomes in line with the Stormwater Bylaw;
3. Communicate with industries about stormwater discharge standards and the means of meeting these standards.

Change will be sought through a combination of education and enforcement.

1. Education will be carried out through an industry liaison group.

2. Introduction of the Industrial Stormwater Discharge Licence to ensure that new buildings or developments can gain advice on stormwater treatment in the design and consenting process. Existing industrial sites, may be audited to ensure that the site is operating with adequate controls and good management practices in place to mitigate risks to the waterways.

3. Enforcement will happen as pollution prevention officers identify and visit high-risk industrial sites and work with industries to improve site management.

Contamination risks are limited to a degree by acceptance of trade wastes into the wastewater system. This is authorised through Trade Waste Consents and the monitoring of consents permits a degree of oversight and site control.

Future needs include:

1. More interaction with industries by the Council; communication, awareness and education;

2. Improved knowledge of the environmental effects of compounds discharged by industrial sites;

3. Ongoing site checks until the Council is confident that all risky sites are controlled adequately;

4. Upgrades on non-compliant sites.

10.9 Measures for New Developments

In general, new developments on sites less than 5,000m^2 in size will be required to provide onsite stormwater mitigation in accordance with the Council's Onsite Stormwater Mitigation Guide.

Sites larger than 5,000m^2 in size will generally be required to:

1) Provide sufficient onsite stormwater storage to mitigate peak flows back to pre-developed flow rates for all storms up to and including the 2% AEP critical event.

2) Provide first flush treatment for new hardstand areas (roads, car parking, driveways, etc).

Table 15: Minimum Requirements for New Development Sites.

Source of Stormwater Discharge(s)	Total area of disturbance does not exceed 1,000m^2	Total area of disturbance equals or is greater than 1,000 m^2
From/during land disturbance activities	An approved Erosion and Sediment Control Plan is required	An approved Erosion and Sediment Control Plan is required
From new / re-development **residential** roof and hardstand areas	No discharge onto or into land where the slope exceeds 5 degrees. Sumps collecting runoff from new hardstand areas shall be fitted with submerged or trapped outlets wherever practicable. Sites increasing impervious by 150m^2 or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide. An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat (2). On-site rainwater storage is required for new and redevelopment sites on the hills.	No discharge onto or into land where the slope exceeds 5 degrees. First flush treatment is required for stormwater runoff from new hardstand areas in excess of 150m2 and buildings with copper or uncoated galvanised metal roofs or guttering/spouting (1). Sites increasing impervious by 150m2 or more to a total coverage in excess of 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide. An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required for sites in the flat (2). On-site rainwater storage is required for new and redevelopment sites on the hills.
From new / re-development **non-residential** roof and hardstand areas	No discharge onto or into land where the slope exceeds 5 degrees First flush treatment is required for stormwater runoff from new hardstand areas exceeding 150m^2, buildings with copper or uncoated galvanised roofs or guttering/spouting and high-use sites	No discharge onto or into land where the slope exceeds 5 degrees First flush treatment is required for stormwater runoff from new hardstand areas exceeding 150m^2, buildings with copper or uncoated (3) galvanised roofs or guttering/spouting and high-use sites

Source of Stormwater Discharge(s)	Total area of disturbance does not exceed 1,000m^2	Total area of disturbance equals or is greater than 1,000 m^2
	Sites increasing impervious by 150m^2 or more to a total coverage exceeding 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide. An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required (4) Site management and spill procedures required for sites that engage in hazardous activities (5)	Sites increasing impervious by 150m^2 or more to a total coverage exceeding 70% are required to mitigate water quantity effects according to the Christchurch City Council On-site Mitigation Guide. An assessment of water quantity effects and provision of on-site stormwater storage or network upgrade may be required (4) Site management and spill procedures required for sites that engage in hazardous activities (5)
Any land use with Canterbury Land and Water Regional Plan Schedule 3 activities.	An application for approval under the Stormwater and Land Drainage Bylaw 2022 must be made to authorise connection and discharge into the Council network.	An application for approval under the Stormwater and Land Drainage Bylaw 2022 must be made to authorise connection and discharge into the Council network.

Explanatory notes:

1. *The first flush is the first 25 mm of runoff.*
2. *The Council has discretion to waive the requirement for first-flush treatment of hardstand areas on large residential sites with a low impervious percentage where the amount of pollution-generating hardstand being added is considered to have less than minor effect.*
3. *"Uncoated" means without a painted or enamelled coating. Council has discretion to waive the requirement for first flush treatment of hardstand areas on large residential sites where the amount and type of pollution-generating hardstand being added is considered to have a less than minor effect.*
4. *Quantity assessment and mitigation: the effects of the discharge on the stormwater network capacity and/or the extent or duration of flooding on downstream properties are to be assessed. Where Council considers an increase (including cumulative increases) has a more than minor effect, on-site stormwater attenuation or stormwater network upgrade shall be provided. The details of storage volume and peak discharges or network capacity required to mitigate effects on flooding or network capacity constraints shall be determined by the Christchurch City Council planning engineer.*
5. *Site management and spill procedures: procedures are to be implemented to prevent the discharge of hazardous substances or spilled contaminants discharging into any land or surface waters via any conveyance path.*

10.10 Operational Controls on Stormwater and Sediment

The management of sites which may experience erosion and/or discharge sediment during development works is controlled by conditions of either resource consents or building consents, as applicable, for earthworks and building. The Stormwater and Land Drainage Bylaw 2022 specifies some standards for activities not controlled by consents.

Standards for sediment discharges are set by the Sediment Discharge Management Plan 2021 (SDMP). The sediment discharge management process should work as follows:

1. Allowable TSS (total suspended solids) concentration trigger levels for discharges to the stormwater network are set by the SDMP.
2. An erosion and sediment control plan (ESCP) is prepared by a 'suitably qualified and experienced professional' as determined is necessary by a site risk assessment.
3. The TSS concentration trigger levels for the site are included in authorisations or conditions where possible.
4. The ESC measures are implemented on site and monitored.

10.11 Effects of Stormwater on Groundwater

Some stormwater is discharged onto the ground surface including hillsides, particularly in smaller settlements but the majority flows onto and along roads in side-channels or swales. The hilly or rolling nature of most settlements means that there are multiple connections to waterways. Relatively low infiltration rates in loess subsoils over most of the peninsula do not encourage infiltration into the ground as a means of stormwater disposal.

'Groundwater' typically refers to water stored underground in permeable strata (aquifers). Aquifers in Banks Peninsula are likely to be associated with alluvial valleys. Only a few small settlements (e.g. Le Bons Bay, Okains Bay) are in that type of location. Overall the stormwater discharged from settlements is expected to enter streams or to add to the store of soil moisture if discharged onto or into the ground. Its influence on groundwater is believed to be minor. Groundwater is not needed for drinking. Groundwater is not considered further in this SMP.

Rainwater soakage into the ground from greenspace is defined as "not stormwater" by the discharge consent.

10.12 Changes to springs and base-flow

Schedule 2(l) to the CSNDC (CRC252424) requires consideration of the diversion and discharge of stormwater on baseflow and springs.

A springs database obtained from Environment Canterbury locates numerous springs, generally on hillsides outside settlement boundaries. A few exceptions include a spring on the Cass Bay foreshore. Many other, unmapped, minor springs and water seeps occur on hillsides (PDP, 2023), mostly outside settlements. Pattle Delamore (PDP, 2023) considers that "the location of most settlements near the base of catchments, downgradient of most springs, means that further urban development in areas zoned residential and commercial … is not expected to result in adverse effects on baseflow in streams." Nine recorded springs in settlements marked as green triangles in Appendix B maps will not be affected by activities carried out under this SMP.

11 Plan Objectives

These objectives address the issues arising from Sections 3 and 5 through 11.

11.1 Objective 1. Control Sediment Discharges

Our goals are:

1.1 Ensure the quality of stormwater from all new development sites or re-development sites is treated to best practice (with Table 15 being the minimum standard);

1.2 Stormwater treatment devices to be installed on any large-scale developments;

1.3 Sediment from 95% of consented construction activities on the flat is treated to best practice by 2027;

1.4 Sediment from 90% consented construction activities on the Hills is treated to best practice by 2027;

1.5 Stabilise 500m (outlined in Table 11) of riparian margin within Settlements each year where there is an erosion and sediment discharge.

Action Plan for Urban Sediment				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Sediment (urban)				
1.1 New developments	Plan and oversee installation of treatment facilities	District Plan (Development contributions) and Long Term Plan	Normal planning processes.	Ongoing
1.2 New treatment facilities	Ensure new facilities are built to best practice	Designs should conform to the Infrastructure Design Standard	Normal Council planning, design and procurement process.	Ongoing
1.3 & 1.4 Construction & excavation sites	On-site sediment and erosion control effected through Erosion and Sediment Control Plans	Council enforcement powers under the Building Act 2004.	Train Building Inspectors. Implement an enforcement process. Contractor(s) on standby for clean-up when breaches occur.	ESC now part of resource consents for earthworks and building

Action Plan for Urban Sediment				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
1.5 Reduce sediment discharges from waterways	Stabilise 500m *(*Table *11)* of eroding waterway bank per year.	Stabilise with planting where planting is effective	Survey waterway margins, design new bank, install	Starting 2026

Recommended for further consideration:

1.6 Road cutting remediation trial where areas are contributing large volumes of sediment.

1.7 Instream sediment remediation trial at Balguerie Stream.

1.8 Sediment trap instream in Wairewa – Little River.

1.9 Work with Parks and Transport on areas that become de-stabilised.

11.2 Objective 2. Control Zinc Contaminants

Our goals are:

2.1 [repeats Goal 1.2] To have all stormwater treatment facilities constructed and confirming to best practice.

2.2 The CCC collaborates with local and regional government in a joint submission to central government seeking national measures and industry standards to reduce the discharge of building and vehicle contaminants.

Action Plan for Zinc				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Zinc				
2.1 Same as 1.1				
2.2 National measures and industry standards	National measures and industry standards to reduce the discharge of building and vehicle contaminants.	Represent Council position to Ministry for the Environment	Regular meetings with MfE staff	ongoing
2.3 On-site zinc capture	Evaluate downpipe-mounted zinc filters.	Trial Storminator™ downpipe inserts on CCC buildings	Fit Storminators to CCC buildings with rusty/old roofs	Start in 2025

Recommended for consideration through the Surface Water Implementation Plan:

2.4 The Council continues research and trials into means of trapping roof-sourced zinc on site.

2.5 The Council adopts a zinc limitation strategy based on identified best practicable options.

2.6 The Council continues to explore means and incentives for limiting source-discharge of zinc from building materials.

11.3 Objective 3. Control Copper Contaminants

Our goals are:

3.1 The Council consults with the government, through the Ministry for the Environment, about legislation to limit the copper content in vehicle brake pads.

3.2 The Council does not permit stormwater discharges into the network from unprotected copper cladding, spouting or downpipes.

3.3 The Council will investigate the feasibility of a district plan rule to discourage the use of copper claddings.

Action Plan for Copper				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
Copper				
3.1 Vehicle brake pads	Request legislation requiring low/no copper in brake pads	Combined regional and local authority approach to government re legislation to apply nation-wide.	Liaison between local and regional councils. Representation to government via NZTA, MfE	Unknown
3.2 & 3.3 Architectural copper (roofs, spouting, downpipes)	Prohibit the use of unprotected architectural copper. Seek to limit or eliminated the use of architectural copper.	District Plan rule; NZ-wide legislation; and possible District Plan rule; other-wise investigate Regional Rule	Liaise with government thru MfE. Investigate and consult.	Unknown
3.2 On-site copper capture	Evaluate downpipe-mounted copper filters.	Trial Storminator™ downpipe inserts on CCC buildings	Fit Storminators to CCC buildings with copper roofs and spouting	Start in 2025

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11.4 Objective 4. Improve Waterway Health

Our goals are:

4.1 Improve Quantitative Macroinvertebrate Community Index and Rapid Habitat Assessment scores by planting and enhancing 8 km of riparian margins.

4.2 Enhance spawning habitat by protecting and enhancing 500 m riparian margins within spawning reaches.

4.3 Improve Cultural Health Index scores by working with Papatipu Rūnanga to determine priority projects and sites to prioritize.

4.4. Improve instream sediment cover and quality.

Action Plan for Improving Waterway Health				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
4.1 Improve Quantitative Macroinvertebrate Community Index and Rapid Habitat Assessment scores	Enhance 8 km of riparian margin in Settlements	Enhance 8km of riparian margin in Settlements	Desktop analysis, priority waterways, delivery	Ongoing
4.2 Improve spawning habitat	Enhance 500 m of riparian margin in Settlements within spawning reaches	Enhance 500 m of riparian margin in Settlements	Inspect sites for spawning habitat. Delivery	Spawning surveys 2025 onwards
4.3 Improve Cultural Health Index scores	Work with Papatipu Rūnanga to identify priority sites	To be determined with Papatipu Rūnanga	Work with Papatipu Rūnanga to improve mana whenua values at priority sites	Ongoing
4.4 Improve instream sediment cover and quality	Trial instream remediation methods 50-100 m of instream habitat (Balguerie Stream)	Determine site-specific method based on NIWA feasibility study	Determine sites with Papatipu Rūnanga Generate improvement plan.	Ongoing

11.5 Objective 5. Control Industrial Site Contaminants

Our goals are:

5.1 A database of industrial sites considered to be medium or high risk is compiled, based on the best available information by 2026.

5.2 Educate industries about the effects of stormwater discharges

5.3 10 Highest-risk industrial sites are audited by the approved procedure under the CSNDC by 2027

Action Plan for Industrial Sites				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
5.1 Hold good information about industrial sites.	Continue to improve database of industrial site information.	Desktop analysis, questionnaires, Chamber of Commerce	Desktop analysis, mailouts, questionnaires, industry liaison	Ongoing
5.2 Industries aware of effects of discharges to stormwater	Develop awareness among all industries of the harmful effects of contaminated discharges.	Educate via mail-outs. Educate during site audits.	Inspect sites in risk order. Communicate results and expectations	Ongoing
5.3 Industries able to control harmful substances	Ensure that harmful substances are contained, tracked, and disposed of safely	Audit sites and follow up with education and enforcement.	Protocols for site controls developed jointly by CCC, ECan and industry. Site audits.	Ongoing
5.3 Non-compliant discharges remedied	Trace and eliminate discharges	Audit sites and follow up with education and enforcement.	Communicate the issue to industry & visit industries. Generate improvement plan. Engage and obtain compliance.	Ongoing

11.6 Objective 6. Engagement and Education

Our goals are:

6.1 By 2025 the Council will be working with community groups to engage with the public to educate participants about current stormwater practice and enable the public to take action to stop contaminants at source.

6.2 By 2026 the Council will be engaging regularly with the Ministry for the Environment to collaborate on contaminant reduction initiatives.

Action Plan for Engagement and Education				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
6.1 Valuing Water Resources	Education and engagement to empower community groups Each new generation values waterways	Joint partnership prog to effectively co-ordinate existing education and engagement of community groups	Partner delivery (Council, ECan, Ngāi Tahu, CWMS) with stream care and other community groups	Ongoing
6.1 Communication strategy	Develop a long term communication strategy	Holistic freshwater and stormwater communication strategy to be rolled alongside with consultation of SMP.	Raise awareness to the public about what they can do in their own homes to improve stormwater quality/quantity. E.g. rainwater tanks and roof maintenance.	Ongoing
6.1 Promote community action	Encourage supportive community groups	More direct support for active groups. Provide information and involve in planning	Assist groups to develop goals and action plans. Share Council planning. Fund and track funding. Monitor results.	Ongoing
6.2 CCC and MfE engaged re heavy metals reduction.	CCC to seek regular contact with relevant MfE planning team(s).	The anticipated mechanism is regulation or national education campaign.	Council to contact MfE, starting at executive level, progressing to staff level contacts	Ongoing

11.7 Objective 7. Manage Stormwater Quantity

Our goals are

7.1 The quantity of stormwater from all new development sites or re-development sites will be attenuated to at least the minimum standard of section 11.5

7.2 Protection for property will continue to be achieved through controls on development and controls on new floor levels.

7.3 Improve knowledge about flooding by consulting with communities, gathering information and carrying out surveys.

Action Plan for Flooding				
Goal	**Action**	**Mechanism**	**Action Components**	**Timing**
7.1 & 7.2 Control extra stormwater from new development	Limit the increase in peak stormwater runoff.	Stormwater from new subdivisions is controlled through full storm detention. Stormwater from larger individual sites attenuated on site.	Normal planning processes	Ongoing
7.3 Manage the effects of flooding.	Improve institutional understanding of flood frequencies and effects.	Gather and process flooding information.	Plan for flood mitigation as necessary. Seek to create/improve computer models.	Ongoing

Part Four: Stormwater Outcomes

12 Conclusion

The purpose of the Comprehensive Stormwater Network Discharge Consent is to drive planning and actions that will progressively improve the quality of stormwater discharges.

Actions the Council can take through the stormwater management plan must be accompanied by other actions if the Council's Community Outcome (Healthy Environment) and the Mahaanui Iwi Management Plan objectives are to be realised. Further actions, by the Council and others, include:

- Raise awareness and educate citizens on how to stop contaminants from entering stormwater at source.
- Eliminate or reduce contaminants at source (e.g. by choosing or specifying non-contaminating building materials).
- Remove contaminants from stormwater before they enter natural water.
- Restore waterway corridors to a natural state.
- Restore and plant riparian margins.
- Improve instream habitat by sediment removal, riparian tree planting (for temperature control, bank stability and shelter).
- Improve biodiversity to improve food sources for instream life.
- Performance monitoring of treatment facilities and ecological/environmental improvements.

Information gained while developing the SMP suggests that controlling contaminants at source is more sensible than removing them from stormwater through treatment systems. However, the control or elimination of contaminants at source will affect our buildings, means of transport, household products and the ways we do things. Source control is a journey we will need to travel together to protect the environment; tangata whenua, community groups, regulators, researchers, and local, regional and central government.

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Appendix A Schedule 2 Matters

Table 16: Schedule 2 matters to be included in SMPs: CRC252424 Condition 7

No.	Matters for inclusion in SMPs	Addressed in which Section of the SMP
a	Specific guidelines for implementation of stormwater management to achieve the purpose of SMPs;	The SMP is the guideline
b	A definition of the extent of the stormwater infrastructure, that forms the stormwater network within the SMP area for the purposes of this consent;	4.4, Appendix B
c	A contaminant load reduction target(s) for each catchment within that SMP area and a description of the process and considerations used in setting the contaminant load reduction target(s) required by Condition 6(b) using the best reasonably practicable model or method and input data;	11.1 to 11.5
d	A description of statutory and non-statutory planning mechanisms being used by the Consent Holder to achieve compliance with the conditions of this consent including the requirement to improve discharge water quality. These mechanisms shall include: Relevant objectives, policies, standards and rules in the Christchurch District Plan; Relevant bylaws; and Relevant strategies, codes, standards and guidelines;	2.3 through 2.11
e	Mitigation methods to achieve compliance with the conditions of this resource consent including the requirement to improve discharge water quality under Condition 23, and to meet the contaminant load reduction targets for each catchment as determined through the SMPs and the standards for the whole of Christchurch set in Condition 19. These methods shall include: Stormwater mitigation facilities and devices; Erosion and sediment control guidelines;	11.5

No.	Matters for inclusion in SMPs	Addressed in which Section of the SMP
	Education and awareness initiatives on source control systems and site management programmes; Support for third party initiatives on source control reduction methods; Prioritising stormwater treatment in catchments: that discharge in proximity to areas of high ecological or cultural value, such as habitat for threatened species or Areas of Significant Natural Value under the Regional Coastal Environment Plan (Canterbury Regional Council, 2012); and areas with high contaminant loads;	
f	Locations and identification of Christchurch City Council water quality and water quantity mitigation facilities and devices; including a description and justification for separation distances between mitigation facilities or devices and any contaminated land;	Appendix B (small number of devices)
g	Identification of areas planned for future development and a description of the Consent Holder's consideration to retrofit water quality and quantity mitigation for existing catchments through these developments where reasonably practicable;	7
h	Identification of areas subject to known flood hazards;	9.2
i	A description of how environmental monitoring and assessment of tangata whenua values have been used to develop water quality mitigation methods and practices;	10.2
j	Results from and interpretation of water quantity and quality modelling, including identification of sub-catchments with high levels of contaminants;	10.4 and Appendices C to F
k	Mapping of existing information from Canterbury Regional Council and the Consent Holder showing locations where discrete spring vents occur;	Appendix B
l	Consideration of any effects of the diversion and discharge of stormwater on base-flow in waterways and springs and details of monitoring that will be undertaken of any waterways and	11.11

No.	Matters for inclusion in SMPs	Addressed in which Section of the SMP
	springs that could be affected by stormwater management changes anticipated within the life of the SMP;	
m	A cultural impact assessment;	10.2.3
n	A summary of outcomes resulting from any collaboration with Papatipu Rūnanga on SMP development;	11.6.1
o	An assessment of the effectiveness of water quality or quantity mitigation methods established under previous SMPs and identification of any changes in methods or designs resulting from the assessment;	10.4
p	Assessment and description of any additional or new modelling, monitoring and mitigation methods being implemented by the Consent Holder;	10.2
q	A summary of feedback obtained in accordance with Condition 8 and if / how that feedback has been incorporated into the SMP;	11.6.3
r	If the Consent Holder intends to use land not owned or managed by the Consent Holder for stormwater management, a description of the specific consultation undertaken with the affected land owner;	Not applicable; no non-Council land to be used for stormwater management.
s	Identification of key monitoring locations in addition to those identified in Schedule 10 where modelled assessments of water levels and/or volumes shall be made. For all monitoring locations, water level reductions or tolerances for increases shall be set for the critical 2% and 10% AEP events in accordance with the objective and ATLs in Schedule 10 and shall be reported with the model update results required under Condition 55;	No key locations. No flooding targets for this catchment in consent conditions. Flooding is to be addressed outside the SMP .
t	Procedures, to be developed in consultation with Christchurch International Airport Limited, for the management of the risk of bird strike for any facility owned or managed by the Christchurch City Council within 3 kilometres of the airport;	No facilities of concern to Christchurch International Airport Limited

No.	Matters for inclusion in SMPs	Addressed in which Section of the SMP
u	A description of any relevant options assessments undertaken to identify the drivers behind mitigation measures selected; and	11.1 to 11.5
v	An assessment of the potential change to the overall water balance for the SMP area arising from the change in pervious area and the stormwater management systems proposed.	11.12

Appendix B Location and Extent of Settlements

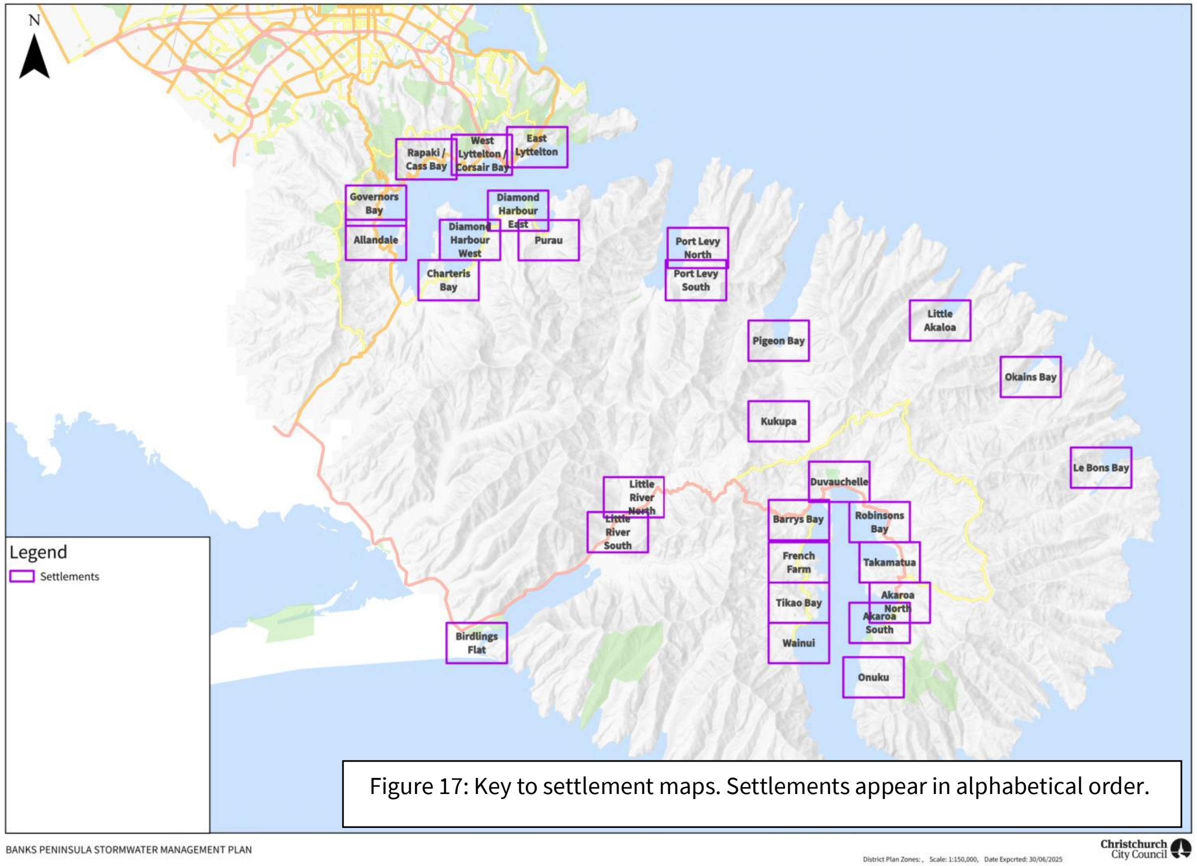

Figure 17: Key to settlement maps. Settlements appear in alphabetical order.

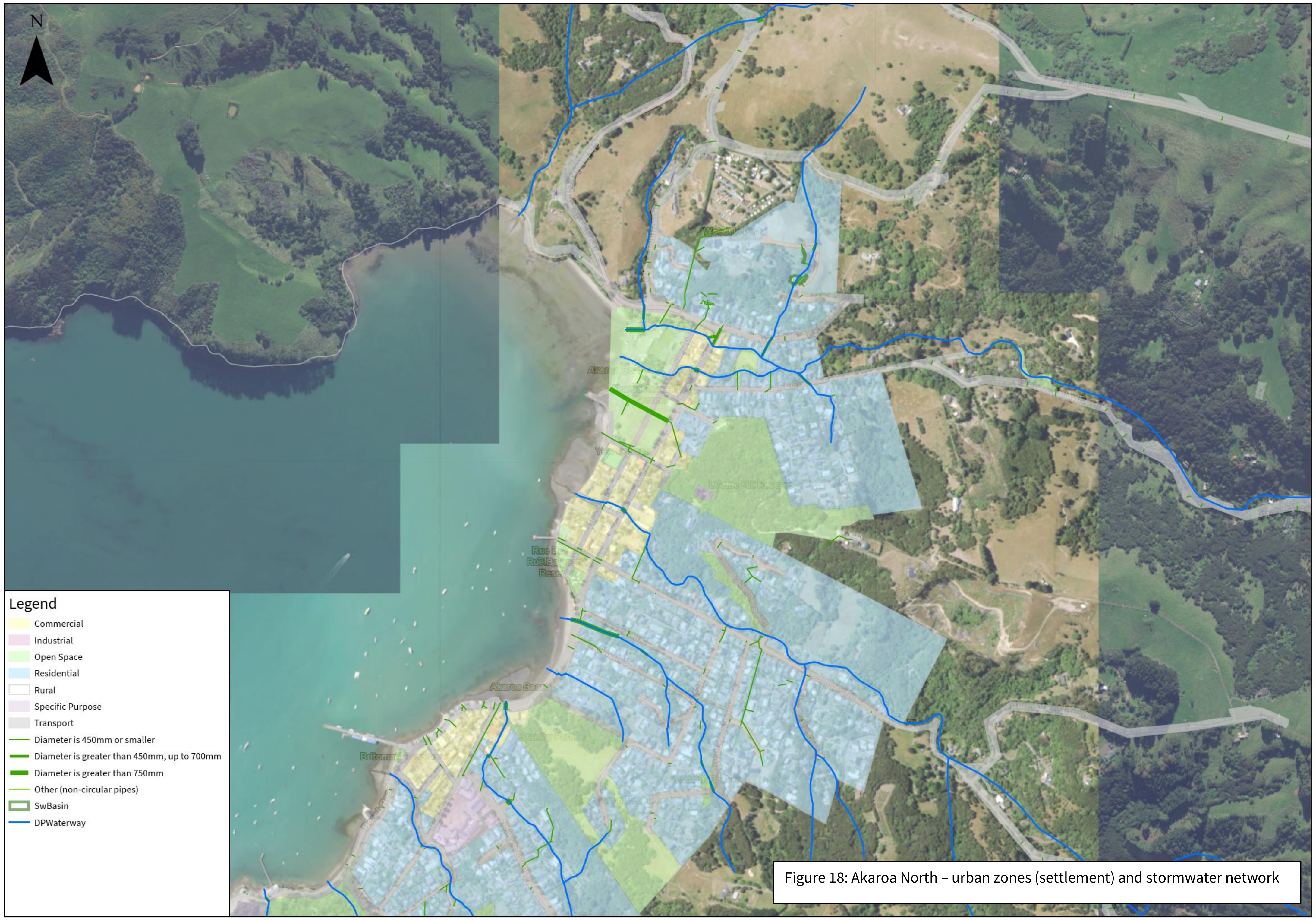

Figure 18: Akaroa North – urban zones (settlement) and stormwater network

District Plan Zones: Akaroa North, Scale: 1:8,000, Date Exported: 11/04/2025

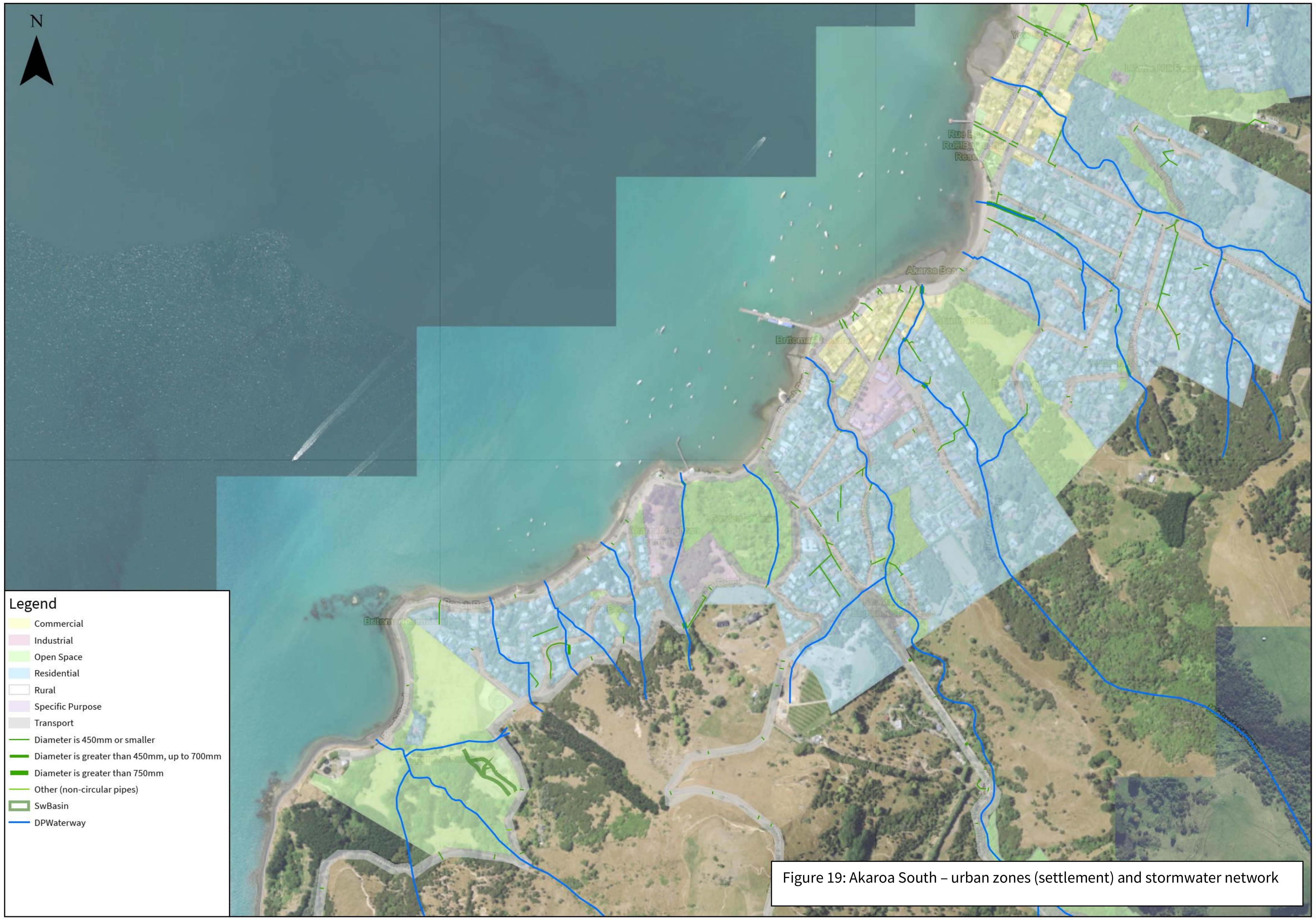

Figure 19: Akaroa South – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Akaroa South, Scale: 1:8,000, Date Exported: 11/04/2025

Figure 20: Allandale – urban zones (settlement) and stormwater network

District Plan Zones: Allandale, Scale: 1:8,000, Date Exported: 30/06/2025

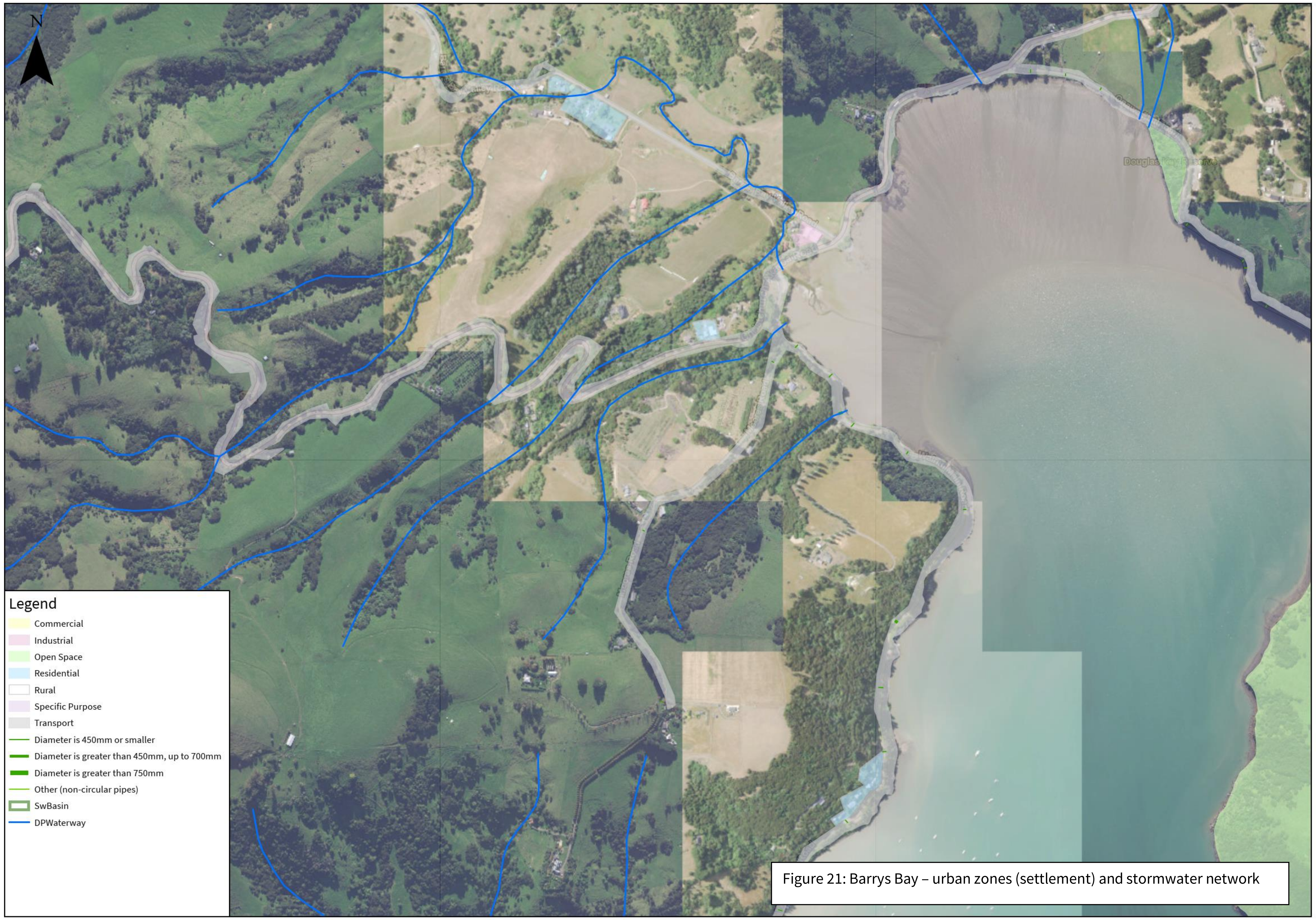

Figure 21: Barrys Bay – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Barrys Bay, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

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Figure 22: Birdlings Flat – urban zones (settlement) and stormwater network

District Plan Zones: Birdlings Flat, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

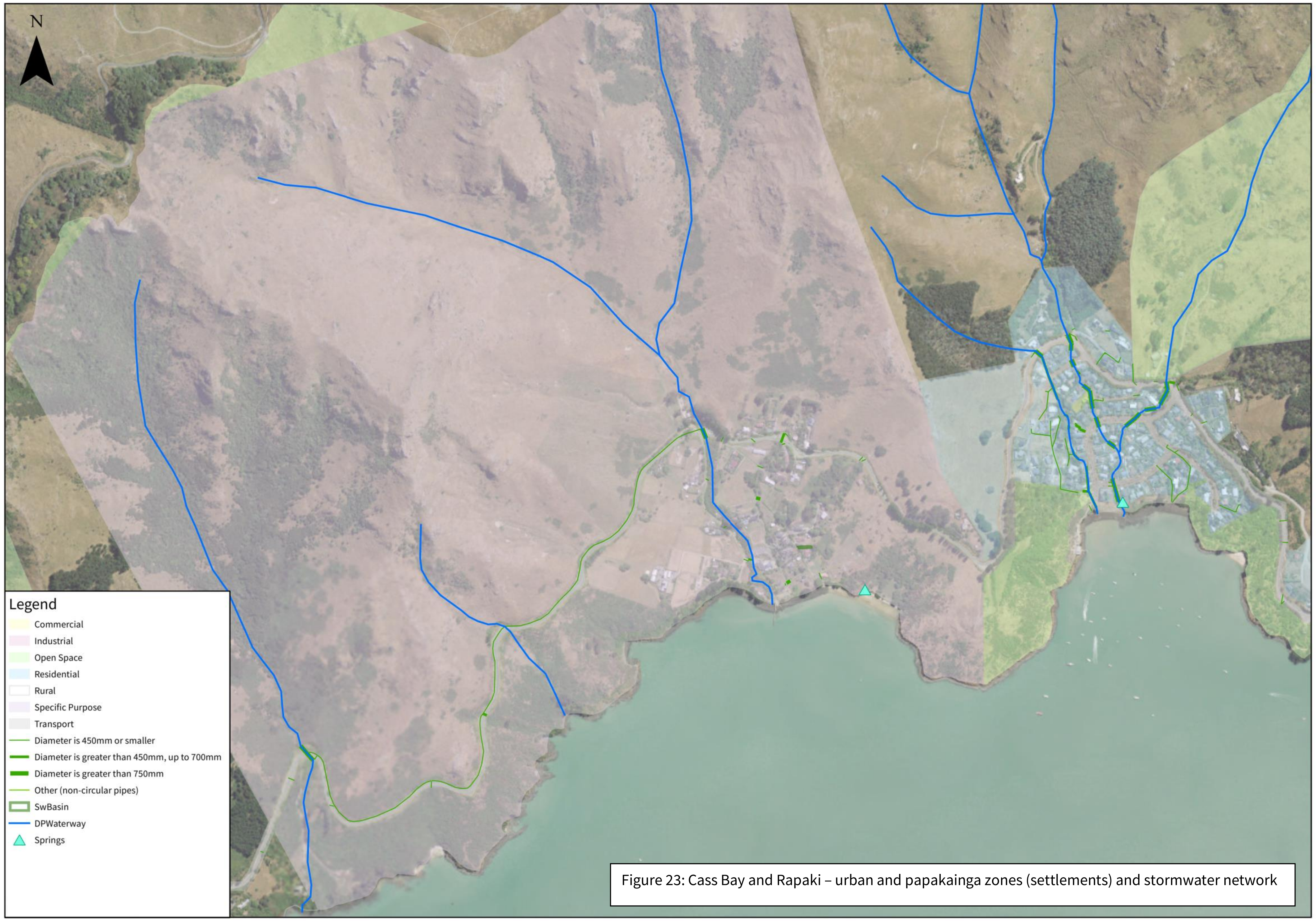

Figure 23: Cass Bay and Rapaki – urban and papakainga zones (settlements) and stormwater network

District Plan Zones: Rapaki / Cass Bay, Scale: 1:8,000, Date Exported: 30/06/2025

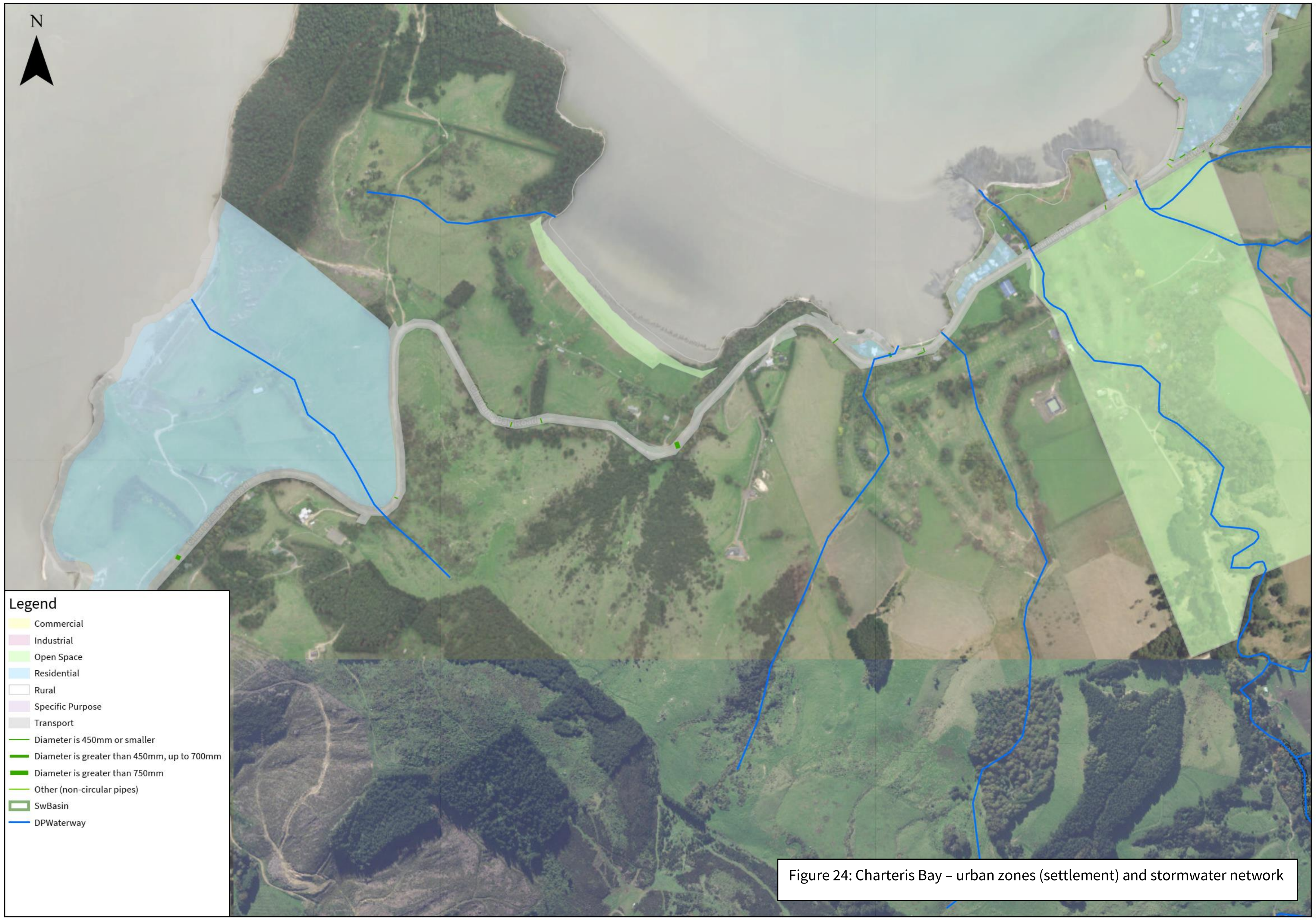

Figure 24: Charteris Bay – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Charteris Bay, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

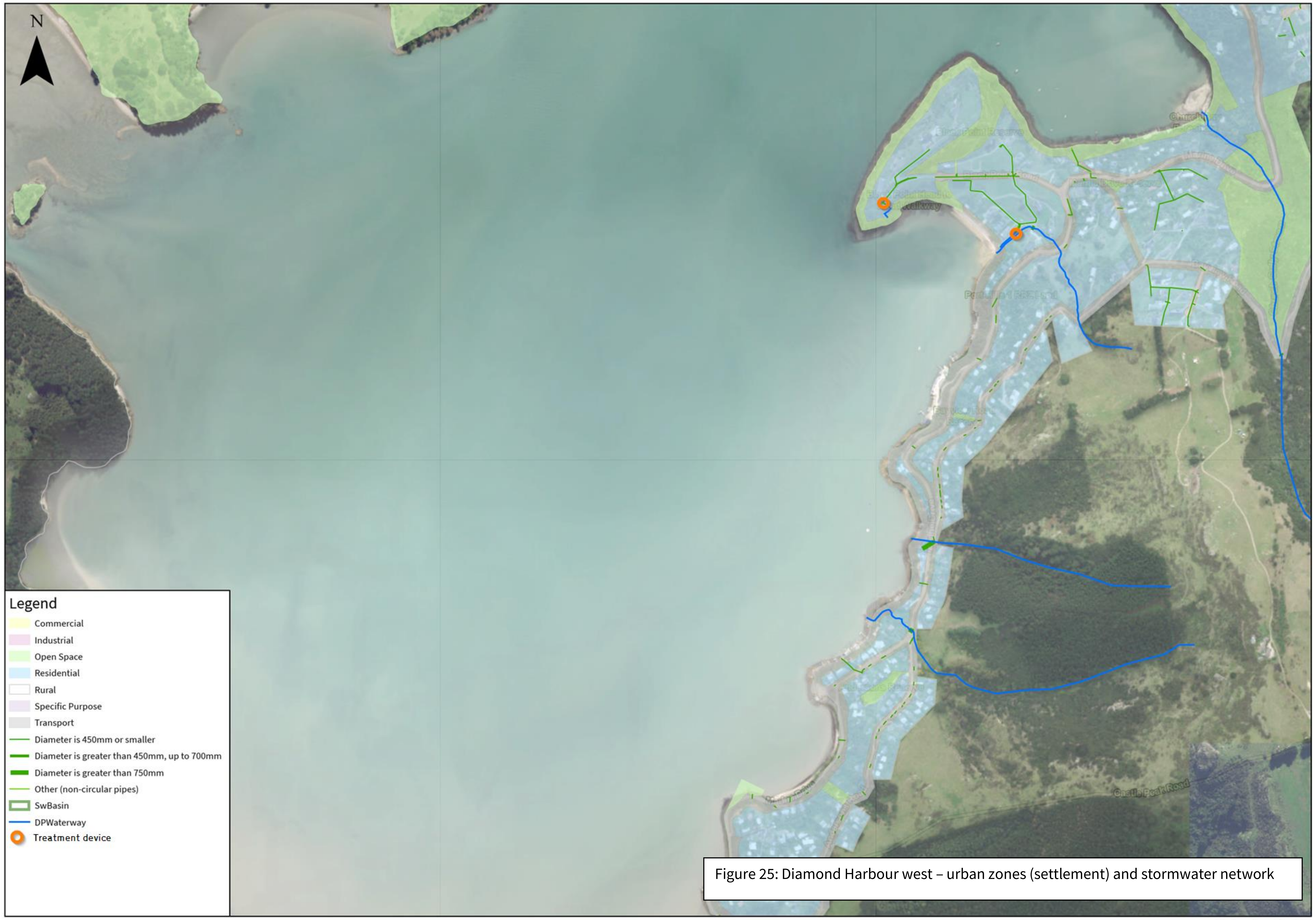

Figure 25: Diamond Harbour west – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Diamond Harbour East, Scale: 1:8,000, Date Exported: 11/04/2025

Figure 26: Diamond Harbour east – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Diamond Harbour West, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

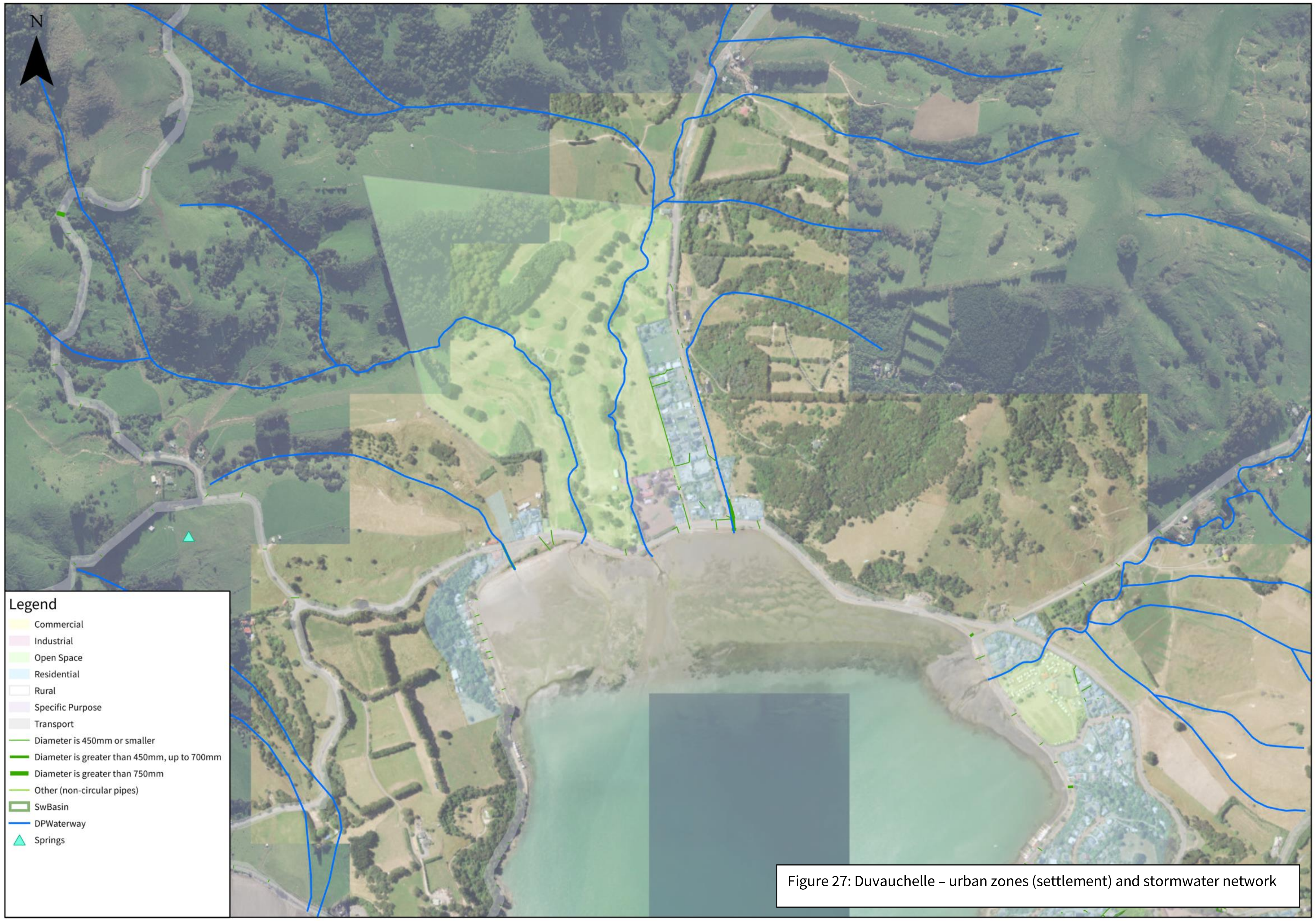

Figure 27: Duvauchelle – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Duvauchelle, Scale: 1:8,000, Date Exported: 30/06/2025

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Figure 28: French Farm – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: French Farm, Scale: 1:8,000, Date Exported: 30/06/2025

Christchurch City Council

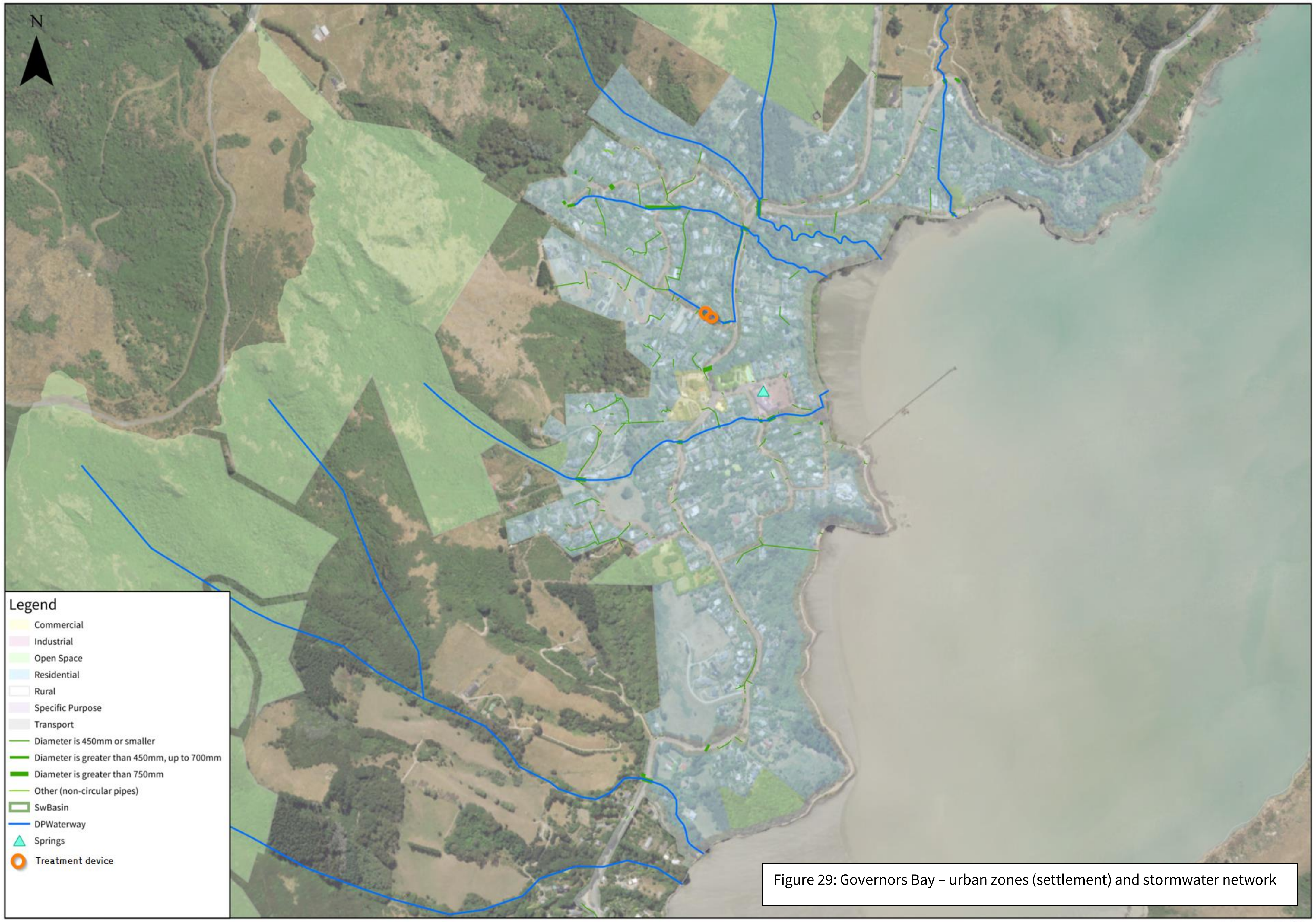

Figure 29: Governors Bay – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Governors Bay, Scale: 1:8,000, Date Exported: 30/06/2025

Christchurch City Council

Christchurch City Council

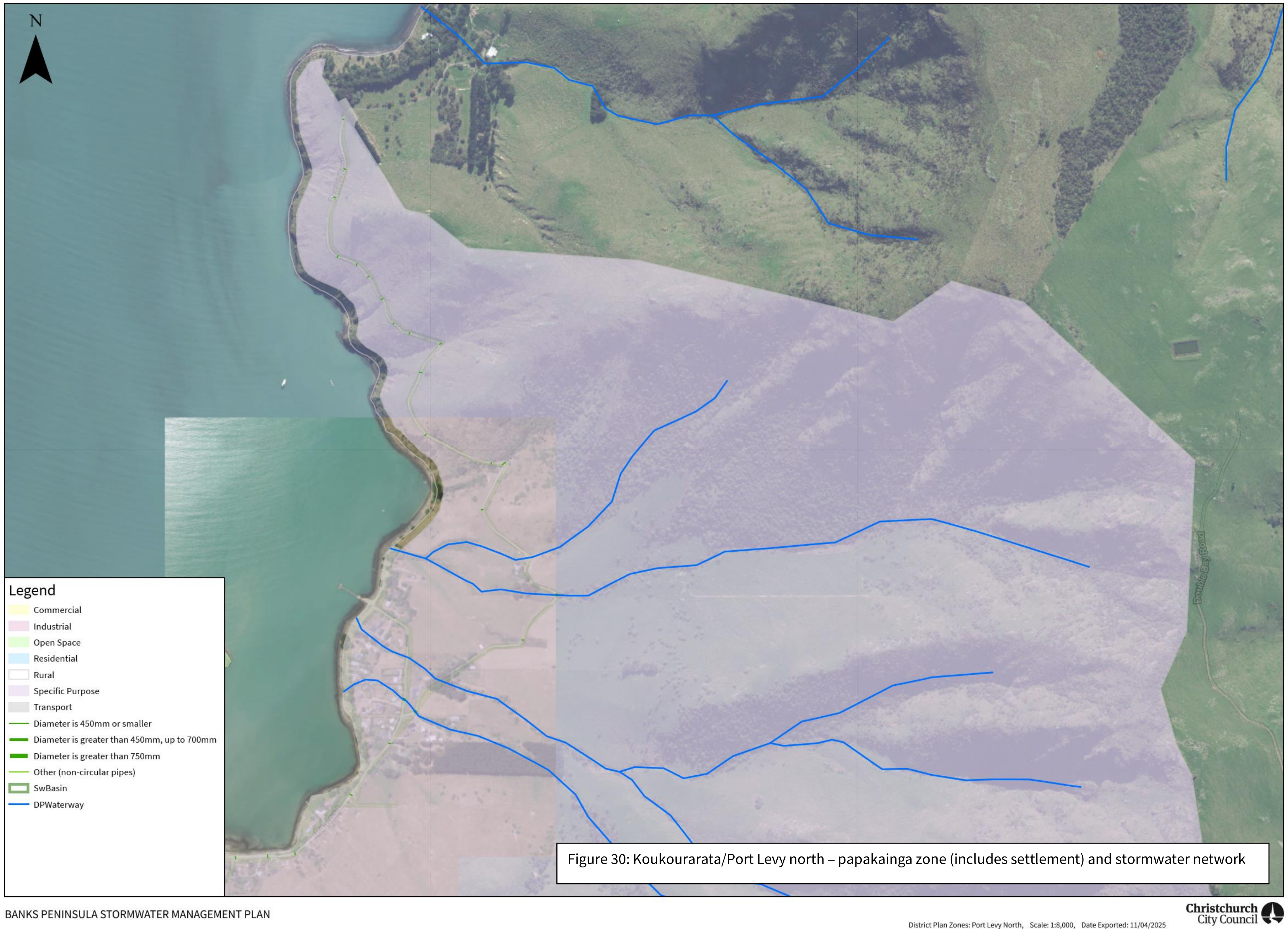

Figure 30: Koukourarata/Port Levy north – papakainga zone (includes settlement) and stormwater network

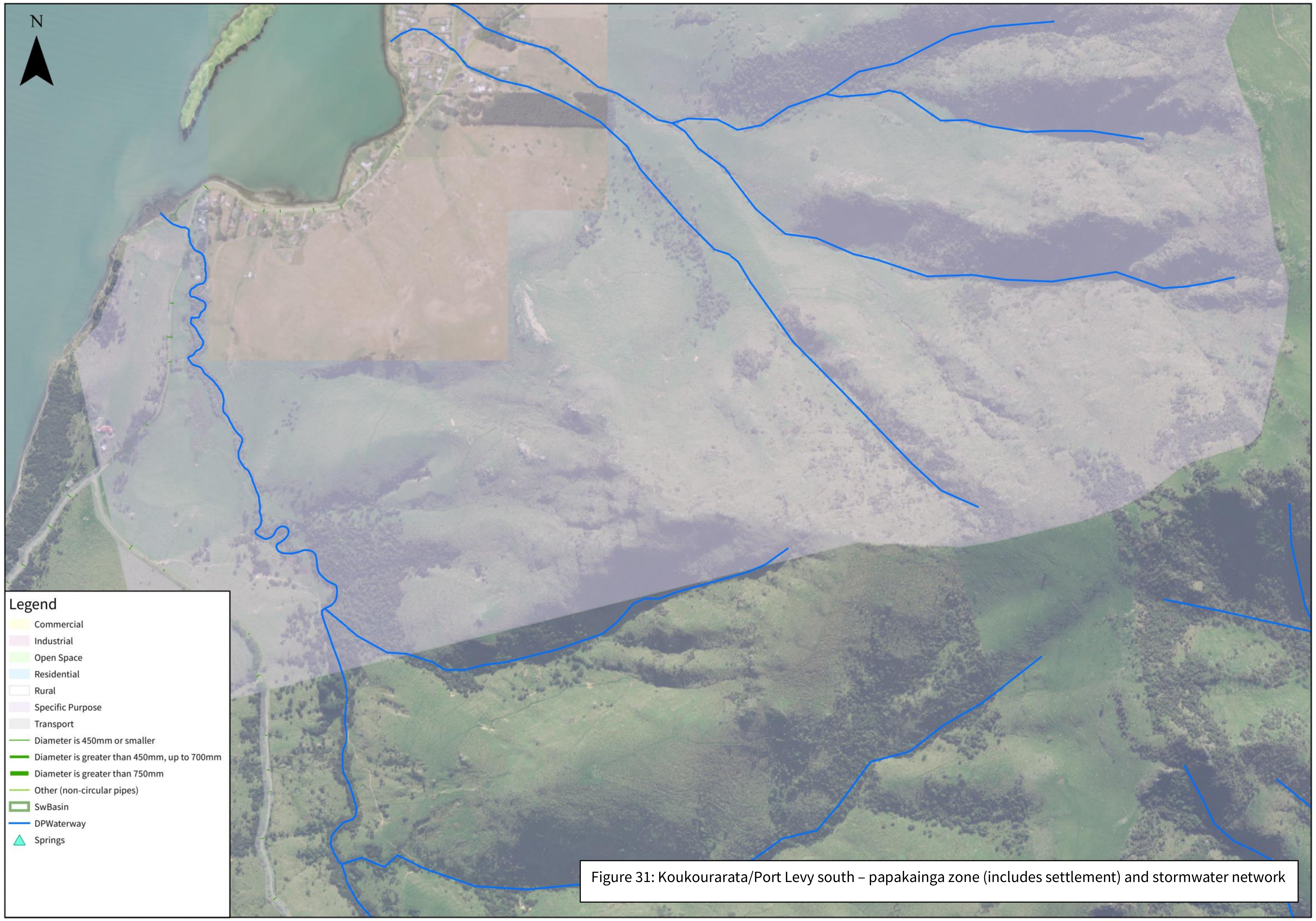

Figure 31: Koukourarata/Port Levy south – papakainga zone (includes settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Port Levy South, Scale: 1:8,000, Date Exported: 30/06/2025

Christchurch City Council

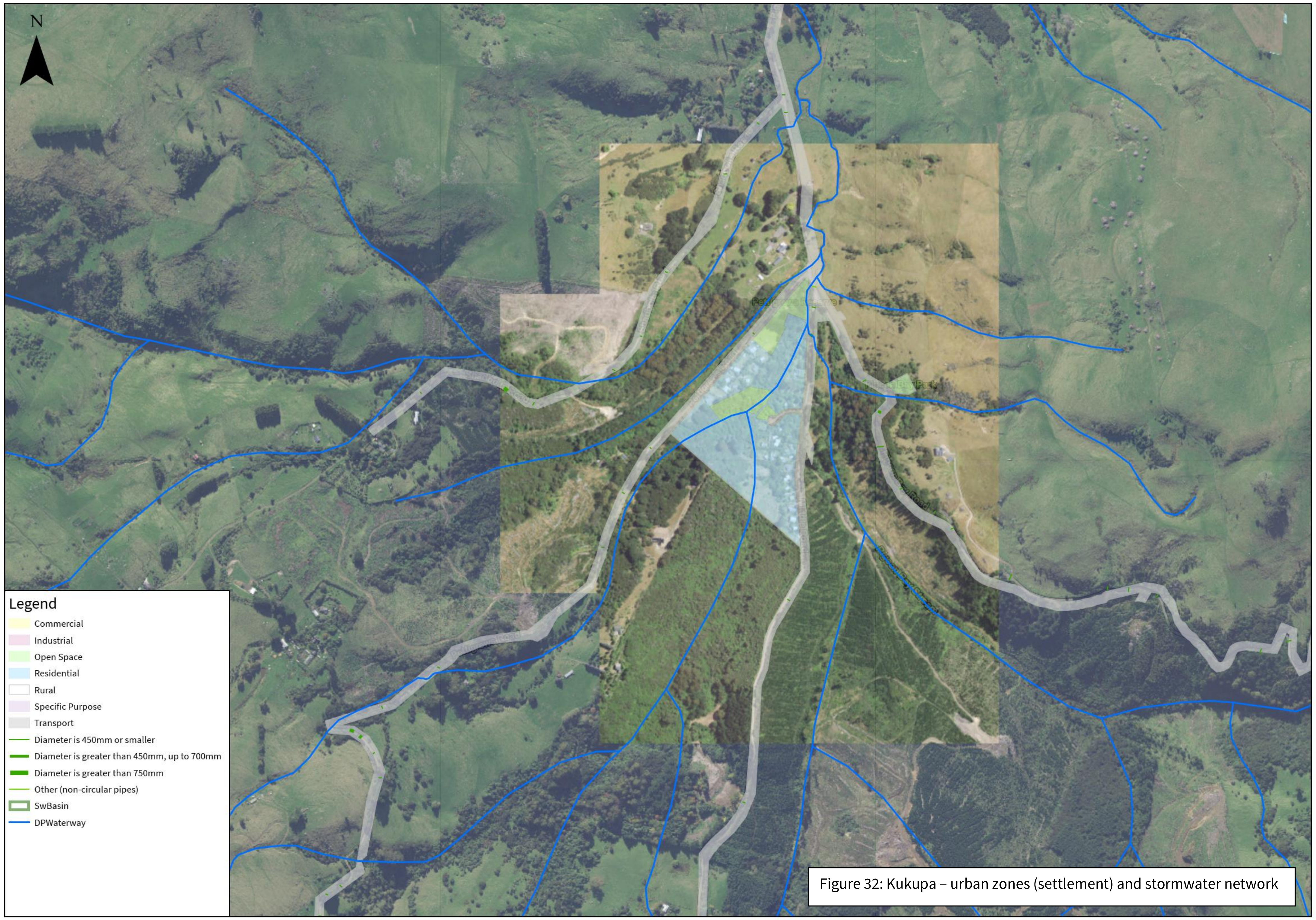

Figure 32: Kukupa – urban zones (settlement) and stormwater network

District Plan Zones: Kukupa, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

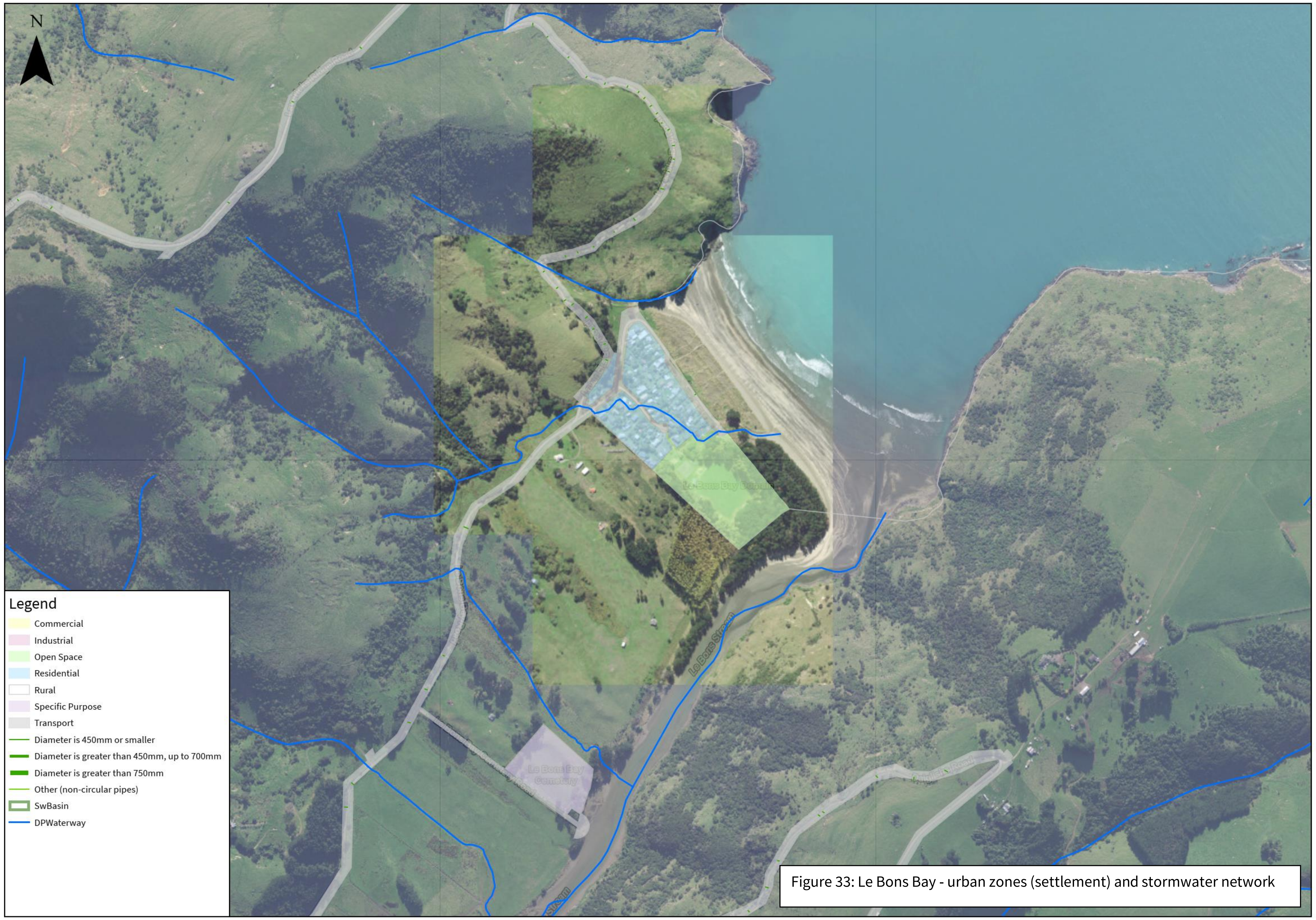

Figure 33: Le Bons Bay - urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Le Bons Bay, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

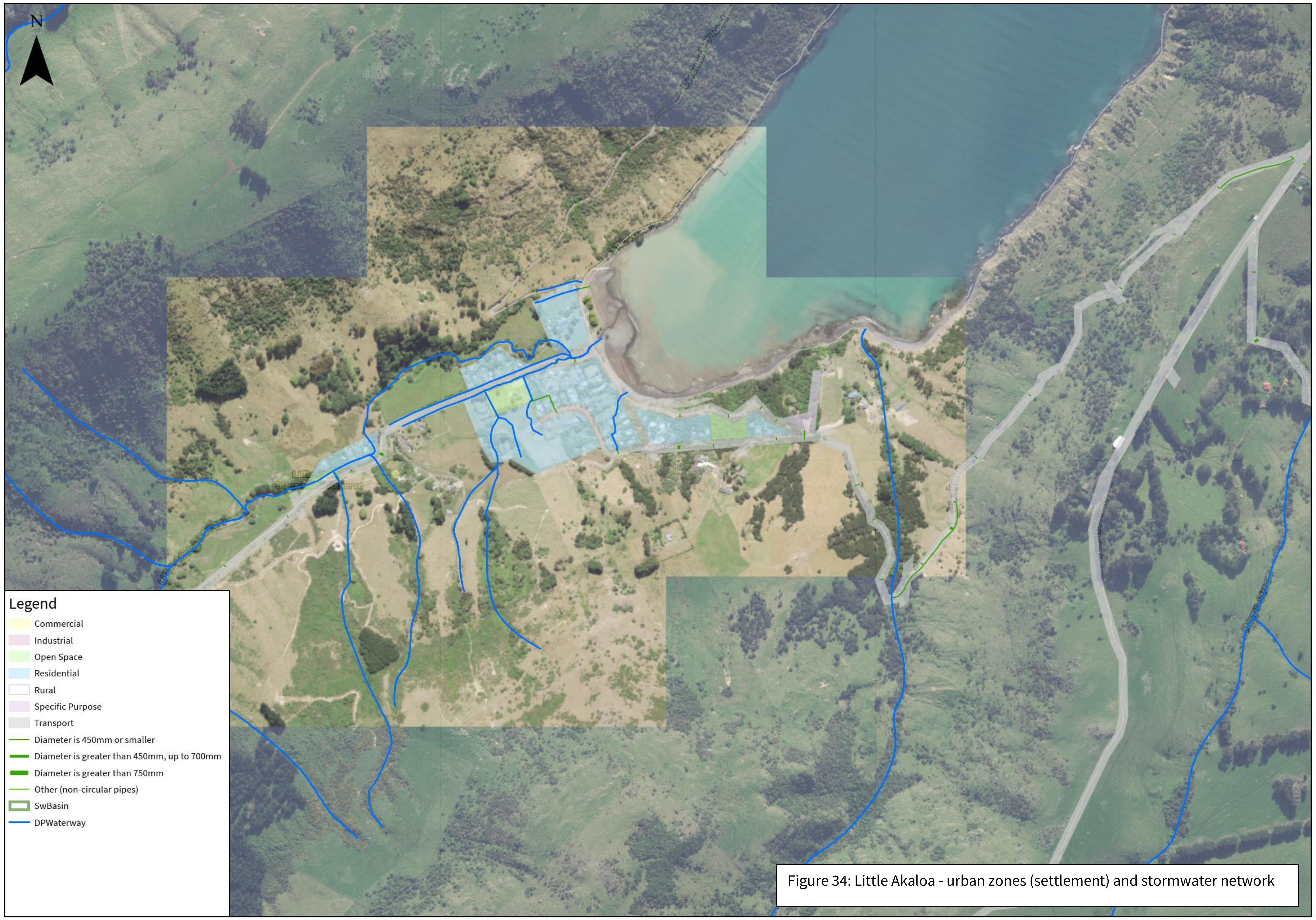

Figure 34: Little Akaloa - urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Little Akaloa, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

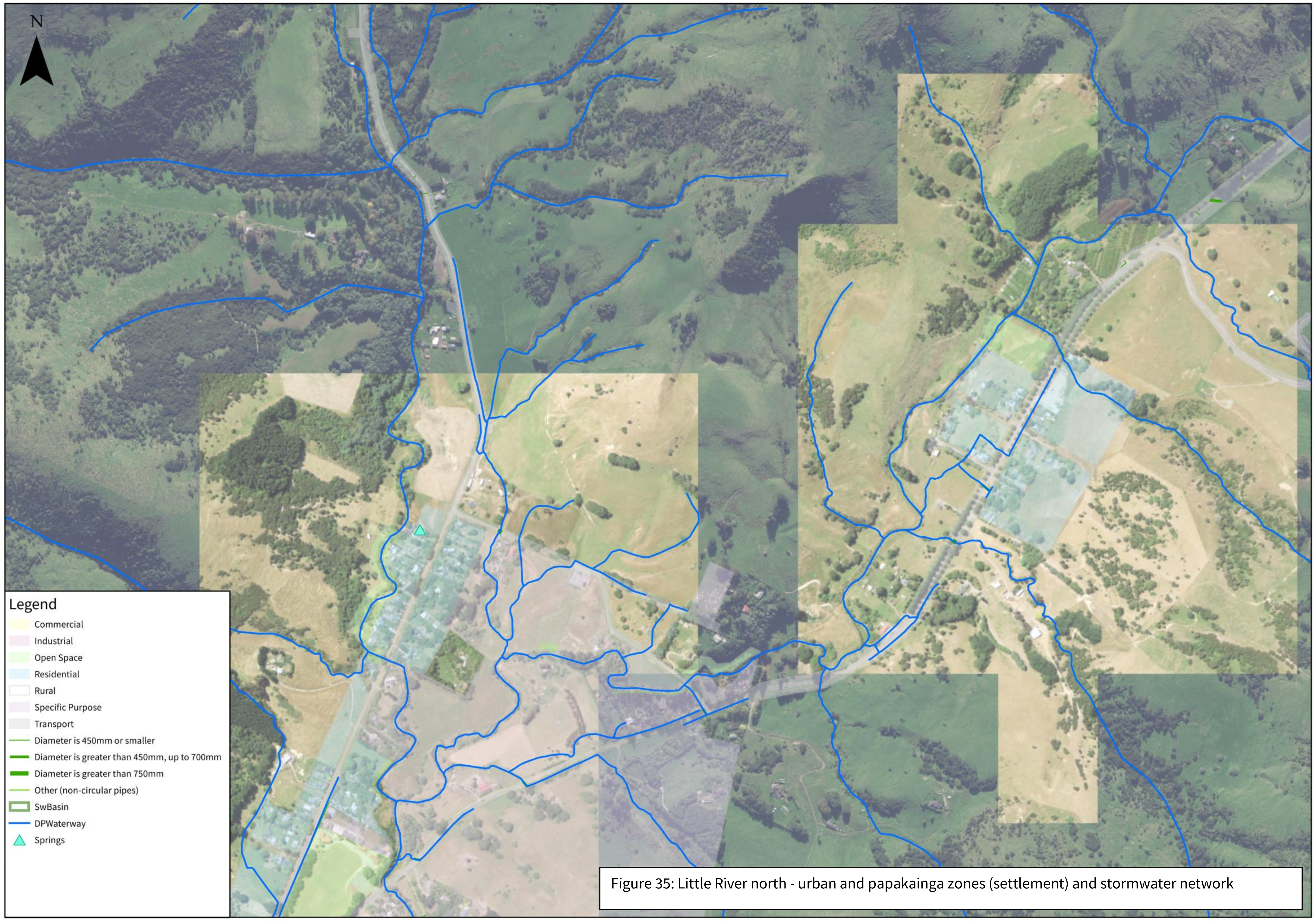

Figure 35: Little River north - urban and papakainga zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Little River North, Scale: 1:8,000, Dzte Exported: 30/06/2025

Christchurch City Council

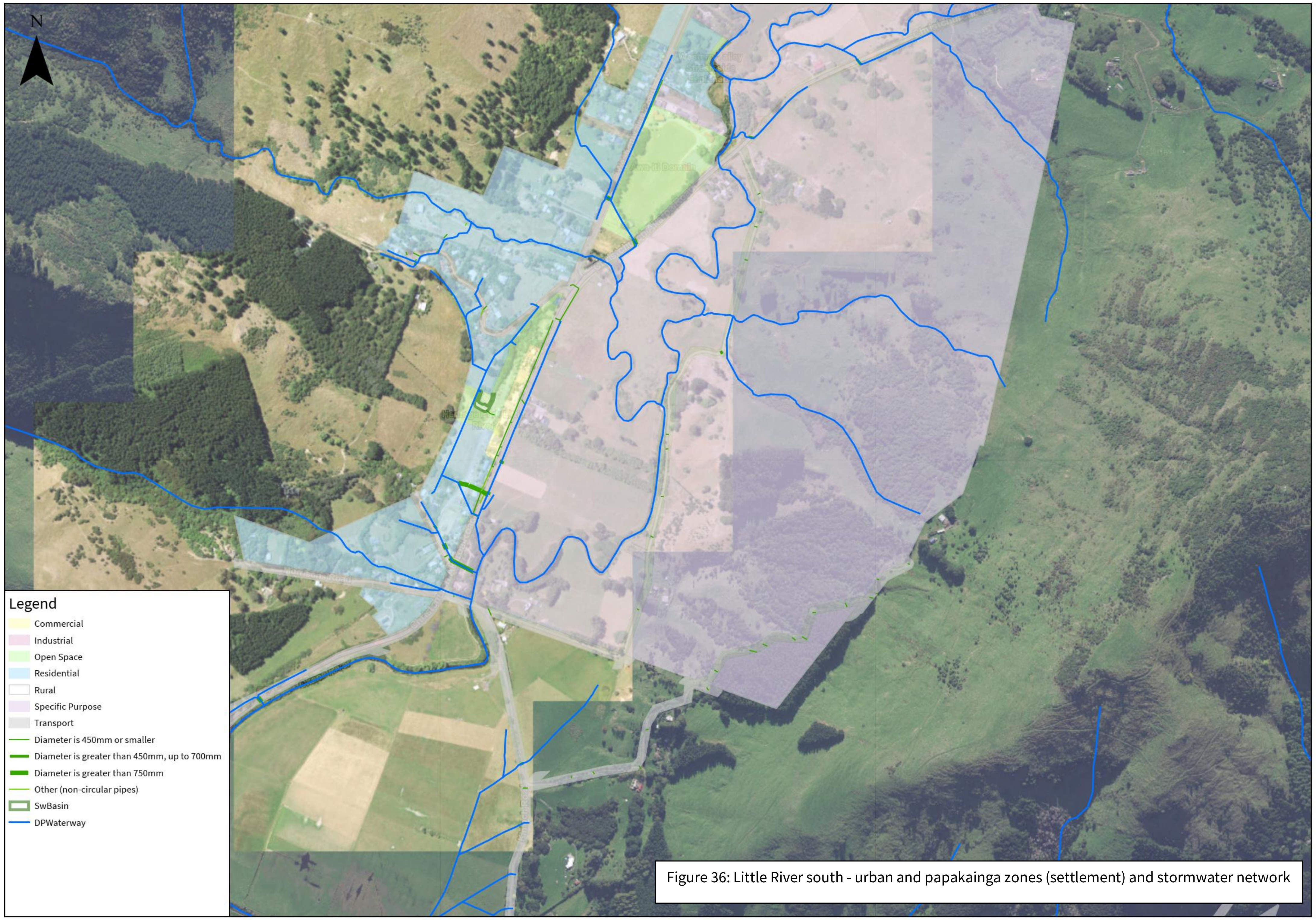

Figure 36: Little River south - urban and papakainga zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Little River South, Scale: 1:8,000, Date Exported: 11/04/2025

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Christchurch City Council

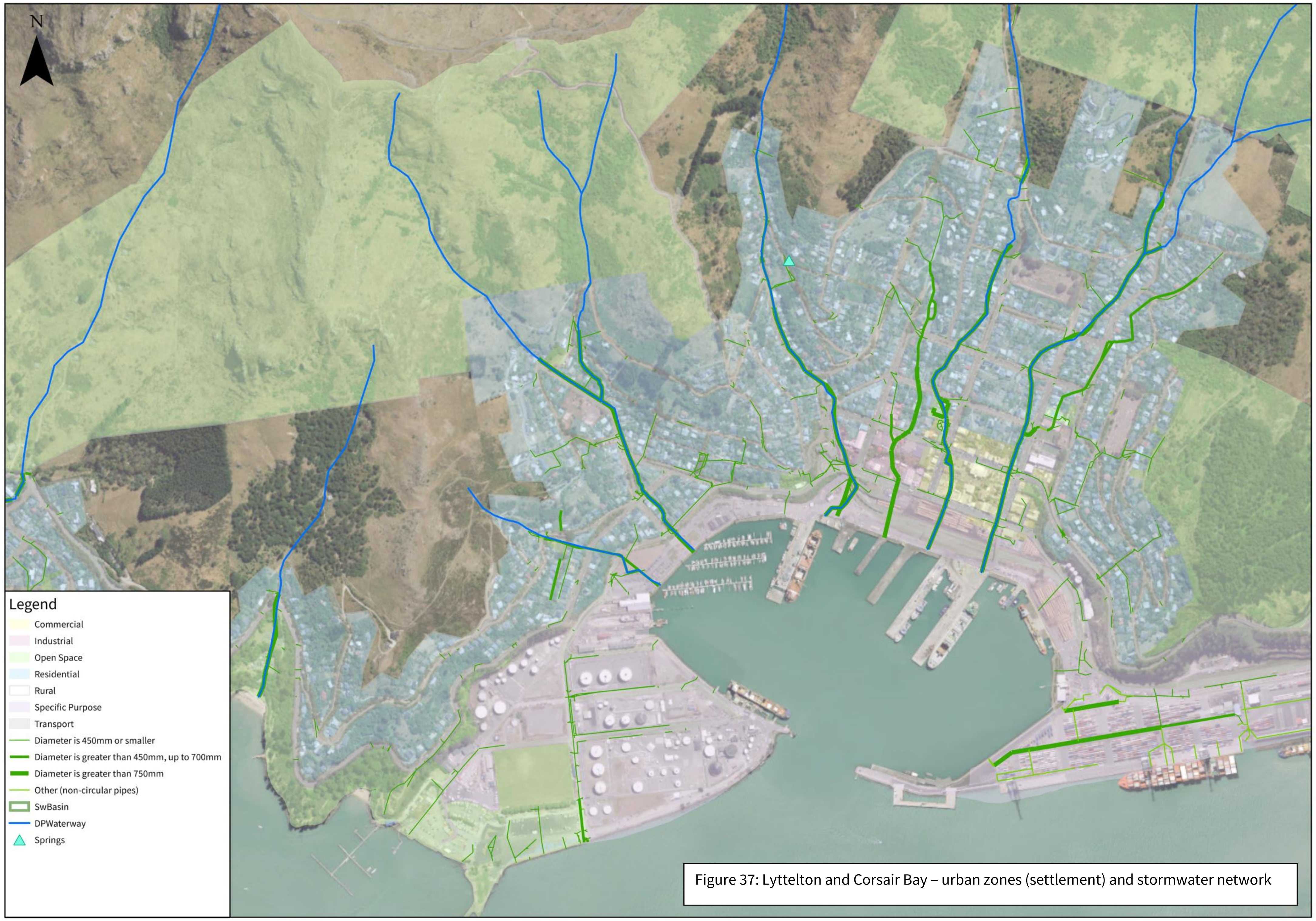

Figure 37: Lyttelton and Corsair Bay – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: West Lyttelton / Corsair Bay, Scale: 1:8,000, Date Exported: 30/06/2025

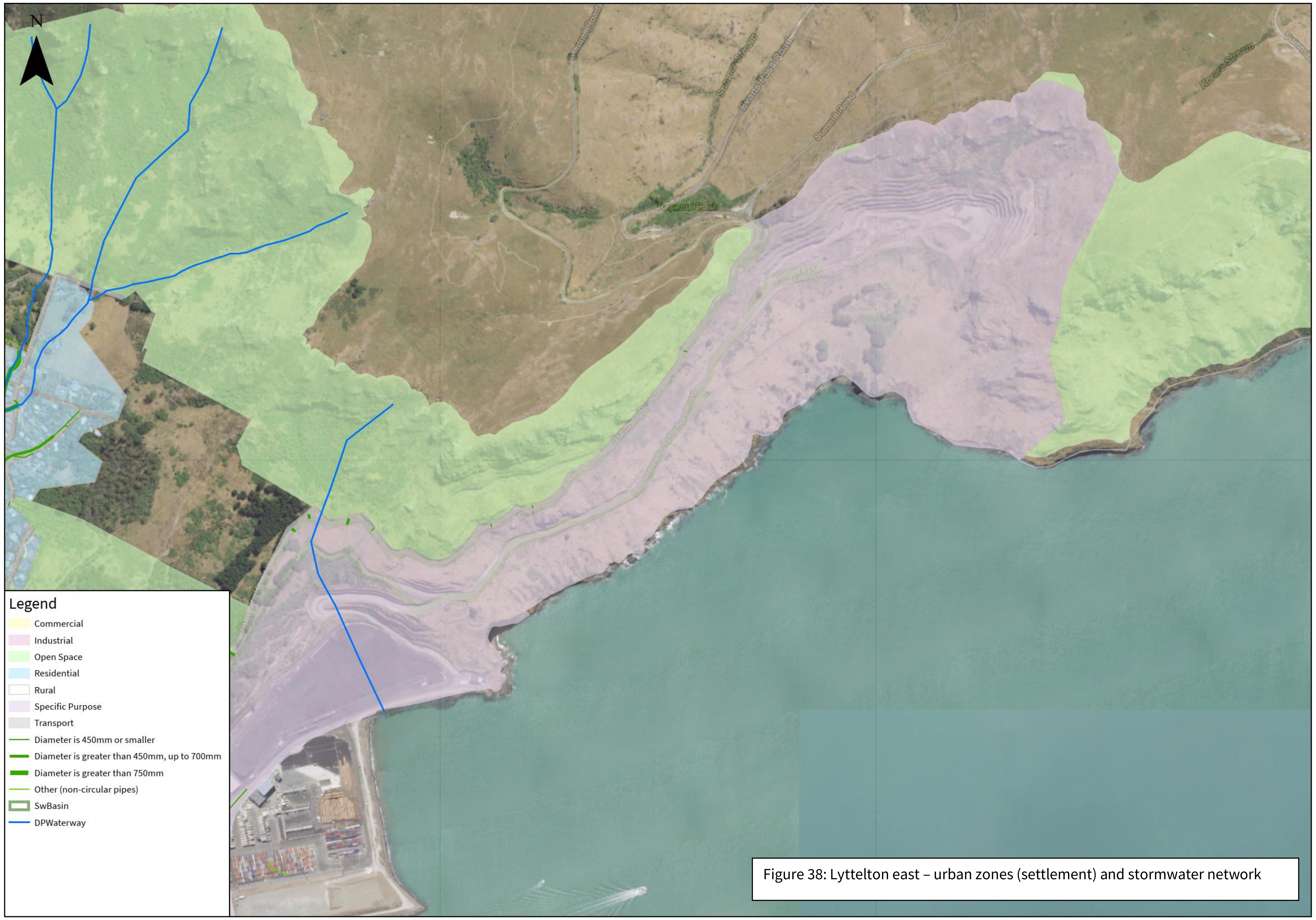

Figure 38: Lyttelton east – urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: East Lyttelton, Scale: 1:8,000, Date Exported: 11/04/2025

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Figure 39: Okains Bay - urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Okains Bay, Scale: 1:8,000, Date Exported: 11/04/2025

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Christchurch City Council

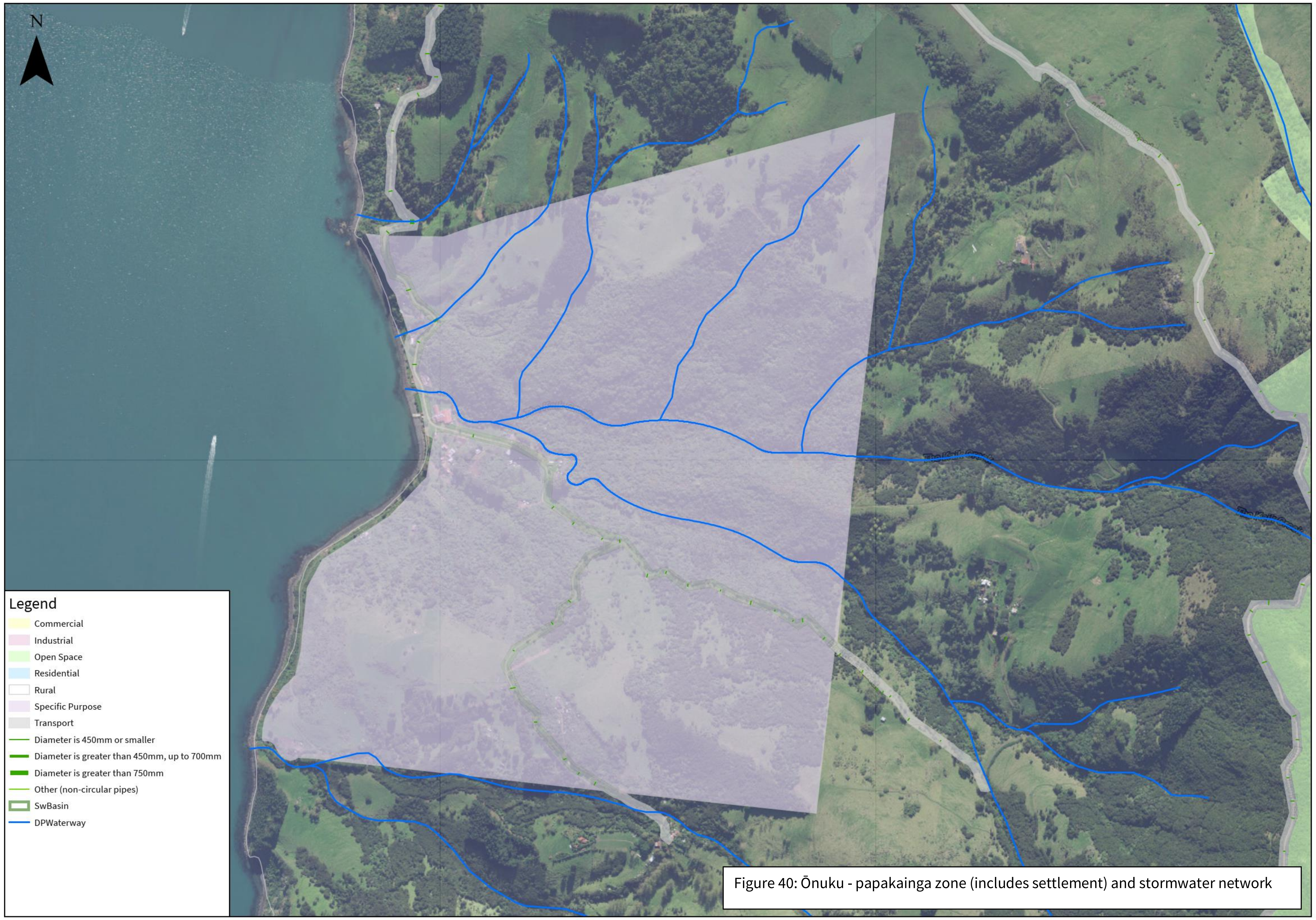

Figure 40: Ōnuku - papakainga zone (includes settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Onuku, Scale: 1:8,000, Date Exported: 11/04/2025

Figure 41: Pigeon Bay - urban zones (settlement) and stormwater network

District Plan Zones: Pigeon Bay, Scale: 1:8,000, Date Exported: 30/06/2025

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Figure 42: Purau - urban zones (settlement) and stormwater network

District Plan Zones: Purau, Scale: 1:8,000, Date Exported: 30/06/2025

Figure 43: Robinsons Bay - urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Robinsons Bay, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

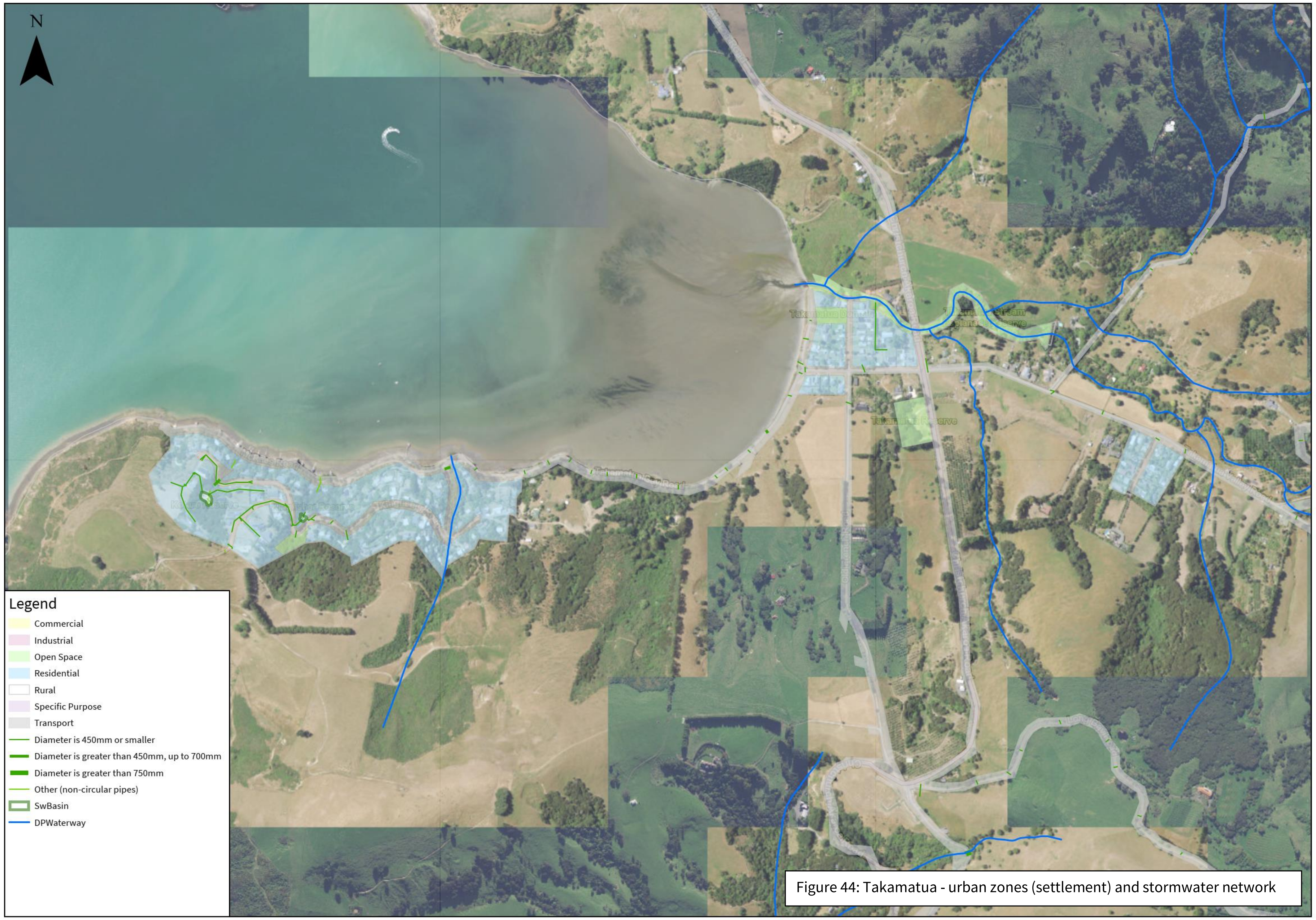

Figure 44: Takamatua - urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Takamatua, Scale: 1:8,000, Date Exported: 11/04/2025

Christchurch City Council

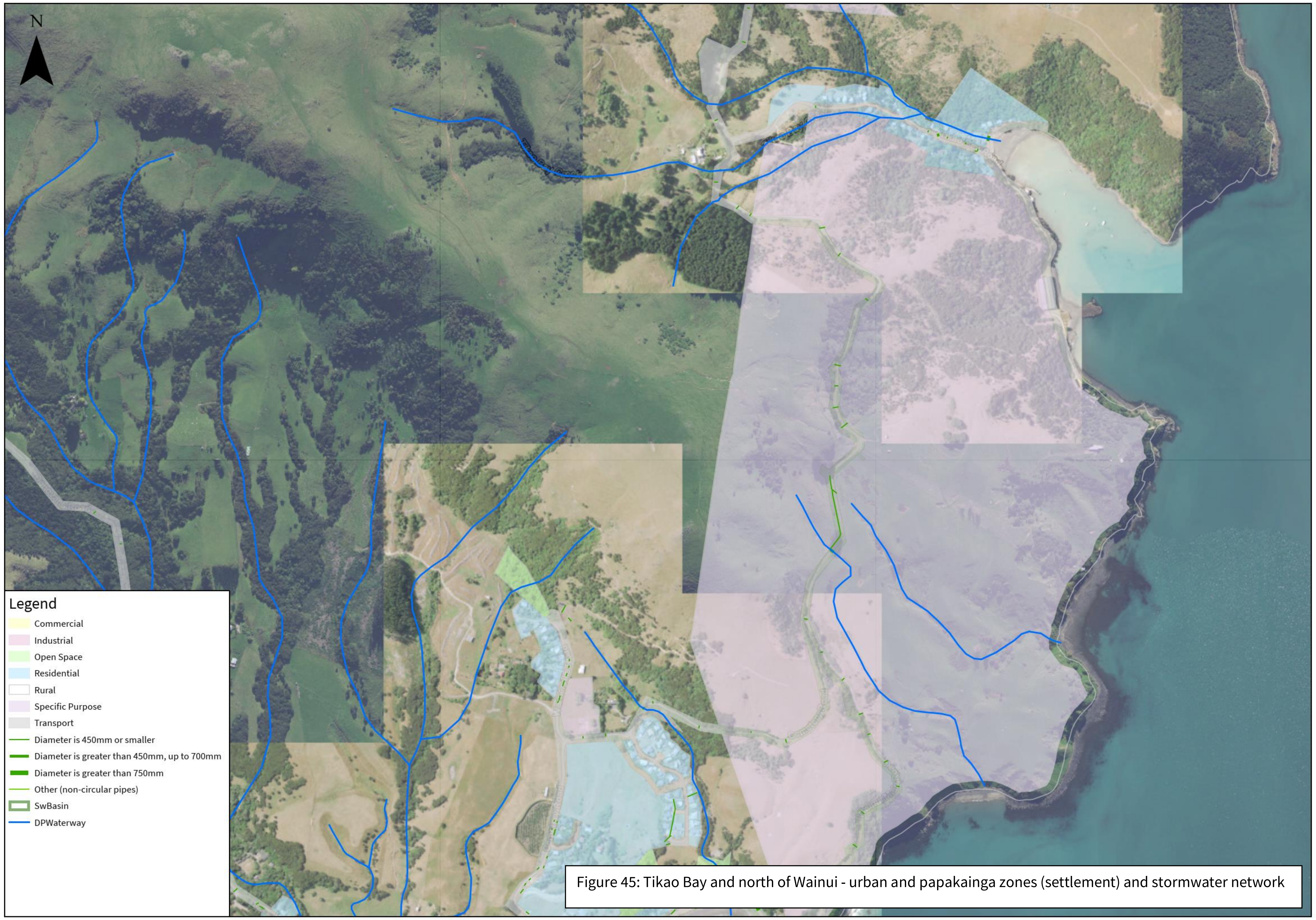

Figure 45: Tikao Bay and north of Wainui - urban and papakainga zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Tikao Bay, Scale: 1:8,000, Date Exported: 11/04/2025

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Figure 46: Wainui - urban zones (settlement) and stormwater network

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

District Plan Zones: Wainui, Scale: 1:8,000, Date Exported: 11/04/2025

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Appendix C Contaminant Load Model Results

Next page

Table 17: Contaminant Loads – Banks Peninsula Contaminant Load Model – development as at 2023, normal rainfall year.

Banks Peninsula CLM		**Impervious Areas**												**Pervious Areas**		
		Roof (Kg/year)			Road (Kg/year)			Carpark (Kg/year)			Total (Kg/year)			(Kg/year)		
Sub-Catchment Name		**TSS**	**TZn**	**TCu**	**TSS**	**TZn**	**TCu**	**TSS**	**TZn**	**TCu**	**TSS**	**TZn**	**TCu**	**TSS**	**TZn**	**TCu**
Whakaraupō/Lyttn Hbr	Rural	45.7	20.6	0.07	5455	10.7	2.41	0	0.0	0.00	5500	31.3	2.47	5,039,746	295.9	101.73
Rapaki	Papakainga	5.7	2.6	0.01	726	1.4	0.32	0	0.0	0.00	732	4.0	0.33	118,415	6.8	2.18
Lyttelton	Settlement	262.5	80.1	0.27	6388	12.9	2.84	312	1.2	0.14	6962	94.2	3.25	94,905	5.1	1.44
Governors Bay	Settlement	41.7	18.8	0.06	932	1.8	0.41	0	0.0	0.00	974	20.6	0.47	33,740	1.4	0.34
Diamond Harbour	Settlement	101.1	45.6	0.15	4139	8.1	1.83	0	0.0	0.00	4240	53.7	1.97	83,633	4.6	1.48
Purau	Settlement	7.1	3.2	0.01	45	0.1	0.02	0	0.0	0.00	52	3.3	0.03	2,877	0.1	0.03
Wairewa	Rural	51.1	28.3	0.09	15581	32.4	6.96	0	0.0	0.00	15632	60.7	7.06	6,625,617	420.0	141.69
Little River	Settlement	26.6	14.7	0.05	2433	5.2	1.09	0	0.0	0.00	2459	19.9	1.14	141,553	4.5	1.42
Akaroa Rural	Rural	97.9	54.2	0.18	20861	42.9	9.30	0	0.0	0.00	20959	97.1	9.48	6,707,336	412.0	135.34
Wainui Papakainga	Papakainga	2.9	1.6	0.01	655	1.3	0.29	0	0.0	0.00	658	2.9	0.29	85,427	3.7	0.91
Ōnuku Marae	Papakainga	2.3	1.3	0.00	415	0.8	0.18	0	0.0	0.00	417	2.1	0.18	90,447	4.8	1.42
Akaroa Settlement	Settlement	124.3	68.2	0.22	4677	12.7	2.24	227	0.9	0.10	5029	81.8	2.57	63,886	2.7	0.59
RobinsonsBay	Settlement	30.0	16.6	0.05	2321	4.6	1.03	0	0.0	0.00	2351	21.2	1.08	32,028	1.3	0.29
Duvauchelle	Settlement	8.6	4.8	0.02	523	1.0	0.23	0	0.0	0.00	531	5.8	0.25	17,352	0.7	0.17
Takamatua	Settlement	15.8	8.7	0.03	744	1.5	0.33	0	0.0	0.00	760	10.2	0.36	8,822	0.3	0.08
Wainui	Settlement	15.4	8.5	0.03	503	1.0	0.22	0	0.0	0.00	518	9.5	0.25	14,783	0.7	0.23
Tikao Bay	Settlement	2.9	1.6	0.01	103	0.2	0.05	0	0.0	0.00	105	1.8	0.05	2,779	0.2	0.06
French Farm	Settlement	1.6	0.9	0.00	188	0.4	0.08	0	0.0	0.00	190	1.3	0.09	2,933	0.1	0.03
Northern Bays	Rural	61.9	34.3	0.11	19307	37.8	8.51	0	0.0	0.00	19369	72.1	8.63	14,638,665	972.9	333.31
Eastern Bays	Rural	29.9	16.6	0.05	12822	25.1	5.65	0	0.0	0.00	12852	41.7	5.71	7,213,555	489.2	173.13
Southern Bays	Rural	10.9	6.0	0.02	9225	18.1	4.07	0	0.0	0.00	9236	24.1	4.09	4,966,344	345.9	121.59
Okains Bay	Settlement	5.7	3.2	0.01	831	1.6	0.37	0	0.0	0.00	837	4.8	0.38	18,648	0.5	0.19
Le Bons Bay	Settlement	6.2	3.4	0.01	579	1.1	0.26	0	0.0	0.00	585	4.5	0.27	7,077	0.2	0.07
Birdlings Flat	Settlement	18.1	10.0	0.03	411	0.8	0.18	0	0.0	0.00	429	10.8	0.21	6,438	0.3	0.06
Allandale	Settlement	3.2	1.5	0.00	339	0.7	0.15	0	0.0	0.00	342	2.1	0.15	25,373	1.0	0.23
Pigeon Bay	Settlement	1.8	1.0	0.00	295	0.6	0.13	0	0.0	0.00	297	1.6	0.13	2,702	0.1	0.02
Kukupa	Settlement	2.6	1.4	0.00	223	0.4	0.10	0	0.0	0.00	226	1.9	0.10	6,644	0.3	0.06
Little Akaloa	Settlement	5.6	3.1	0.01	128	0.3	0.06	0	0.0	0.00	133	3.4	0.07	9,014	0.4	0.17
Moepuku	Settlement	0.5	0.2	0.00	0	0.0	0.00	0	0.0	0.00	0	0.2	0.00	24,162	0.9	0.25
Koukourarata	Papakainga	5.1	2.3	0.01	271	0.5	0.12	0	0.0	0.00	276	2.8	0.13	317,670	21.8	7.54
Gebbies	Rural	21.7	9.8	0.03	4453	10.7	2.07	0	0.0	0.00	4475	20.5	2.10	1,643,664	80.8	25.11
Kaitorete Spit	Rural	1.7	0.8	0.00	2513	4.9	1.11	0	0.0	0.00	2515	5.7	1.11	115,502	5.0	1.10
Prices/Waikoko	Rural	5.4	2.4	0.01	2086	4.3	0.93	0	0.0	0.00	2091	6.8	0.94	2,076,041	129.2	43.17
Kaituna	Rural	9.7	4.4	0.01	1853	3.6	0.82	0	0.0	0.00	1863	8.0	0.83	3,421,561	226.9	78.74
Aorangi Drain	Rural	1.6	0.7	0.00	555	1.9	0.29	0	0.0	0.00	557	2.6	0.29	239,327	14.1	4.50

Appendix D Contaminant Model Treatment Efficiencies

Table 18: Treatment efficiencies used in the BP-CLM[18]

Treatment system	TSS treatment efficiency (% removal)				Zinc treatment efficiency (% removal)				Copper treatment efficiency (% removal)			
	Roofs	Roads	Paved Surface	Grassland	Roofs	Roads	Paved Surface	Grassland	Roofs	Roads	Paved Surface	Grassland
Single treatment systems												
Basin & wetland	50.0	80.0	80.0	80.0	25.0	60.0	60.0	60.0	30.0	70.0	70.0	70.0
Rain garden	70.0	80.0	80.0	80.0	60.0	70.0	70.0	70.0	70.0	75.0	75.0	75.0
Stormfilter	50.0	75.0	75.0	75.0	15.0	40.0	40.0	40.0	20.0	65.0	65.0	65.0
Wet pond	10.0	75.0	75.0	75.0	5.0	30.0	30.0	30.0	5.0	40.0	40.0	40.0
Basin	10.0	60.0	60.0	60.0	5.0	20.0	20.0	20.0	5.0	30.0	30.0	30.0
First flush Basin	10.0	60.0	60.0	60.0	5.0	20.0	20.0	20.0	5.0	30.0	30.0	30.0
Wetland	50.0	80.0	80.0	80.0	25.0	60.0	60.0	60.0	30.0	70.0	70.0	70.0
Soil adsorption basin	89.0	89.0	89.0	89.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0
Swale	30.0	75.0	75.0	75.0	15.0	40.0	40.0	40.0	20.0	50.0	50.0	50.0
Combined treatment systems												
Basin and basin & wetland	55.0	92.0	92.0	92.0	28.8	68.0	68.0	68.0	33.5	79.0	79.0	79.0
Basin and First flush basin	19.0	84.0	84.0	84.0	9.8	36.0	36.0	36.0	9.8	51.0	51.0	51.0
Rain garden and basin and wetland	85.0	96.0	96.0	96.0	70.0	88.0	88.0	88.0	79.0	92.5	92.5	92.5
Swale and basin and wetland	65.0	95.0	95.0	95.0	36.3	76.0	76.0	76.0	44.0	85.0	85.0	85.0
Swale and first flush Basin	37.0	90.0	90.0	90.0	19.3	52.0	52.0	52.0	24.0	65.0	65.0	65.0

[18] From Auckland Regional Council Contaminant Load Model User Manual Appendix C Table C.1.

Appendix E Treatment Devices Proposed in the SMP

Table 19: Treatment devices proposed for the SMP. Location and performance.

Device ID	Harbour receiving environment	Sub-catchment	Sub-catchment Area (Ha)	Treatment device name/location	Treatment device type	Consultation Option(s) having this device	Contaminant load before treatment (2035)			Contaminant Load After treatment (2035)			Estimated contaminant Load reduction after treatment		
							TSS (kg/yr)	Zinc (g/yr)	Copper (g/yr)	TSS (kg/yr)	Zinc (g/yr)	Copper (g/yr)	ΔTSS (kg/yr)	ΔZinc (g/yr)	ΔCopper (g/yr)
First choice treatment sites															
2	Whakaraupo/ Lyttelton Hbr	Lyttelton	1.29	6 Norwich Quay	Stormfilter	3	131	3391	52	48	2872	23	83	519	29
9	Whakaraupo/ Lyttelton Hbr	Stream Reserve Drain, Gov. Bay	4.61	911 Governors Bay Rd	Filterra	1, 2, 3	101	678	46	20	252	12	81	426	35
47	Whakaraupo/ Lyttelton Hbr	Stream Reserve Drain, Gov. Bay	0.75	903 Governors Bay Rd	Filterra	2	64	271	28	15	146	12	48	124	16
22	Whakaraupo/ Lyttelton Hbr	Lyttelton Tunnel Roundabout	0.55	25 Norwich Quay	Filterra	1, 3	63	183	28	13	61	7	50	122	21
14	Akaroa Harbour	Aylmers Stream	0.85	Percy/William Sts	Stormfilter	2, 3	15	678	8	5	580	4	10	97	4
15	Akaroa Harbour	Aylmers Stream	0.7	19/21 Percy St	Filterra	1, 2, 3	43	359	20	9	136	5	34	224	15
11	Akaroa Harbour	Balguerie Stream	1.61	4 Rue Balguerie	Filterra	3	123	2084	55	25	781	14	98	1303	41
13	Akaroa Harbour	Balguerie Stream	0.66	60 Rue Jolie	Filterra	3	61	848	28	12	321	7	49	528	21
BPM	Akaroa Harbour	Balguerie Stream	0.9	Rue Lavaud Developmt (BP Meats)	Filterra	3	123	2084	55	25	781	14	98	1303	41
Backup treatment sites															
21	Whakaraupo/ Lyttelton Hbr	Governors Bay	5.6	197 Main Rd, Gov Bay	Filterra	3	148	1285	69	30	485	18	118	799	52
41	Akaroa Harbour	Aylmers Stream	1.33	2 William St Akaroa	Filterra	2	48	1182	20	16	1002	9	32	180	12
43	Akaroa Harbour	Aylmers Stream	2.22	Kowhai Grove	Filterra	2	25	753	10	6	521	4	19	232	6
44	Akaroa Harbour	Aylmers Stream	0.75	145A Rue Jolie	Filterra	2	31	634	13	8	431	6	24	203	8
45	Akaroa Harbour	Aylmers Stream	0.57	144 Rue Jolie	Filterra	2	37	548	16	9	365	7	28	183	9

Appendix F Treatment Devices in Options 1, 2 and 3

Table 20: Treatment devices in Options 1, 2 and 3 put out for public consultation

Id	Name (device location street address)	Catchment Area (Ha)	Impervious Catchment Area (Ha)	Treatment device type	Option 1 (~ 3 devices)	Option 2 (~12-14 devices)	Option 3 (~22 devices)
2	6 Norwich Quay	1.29	1.10	Stormfilter			Y
9	911 Governors Bay Rd	4.61	0.50	Filterra	Y	Y	Y
10	36 Main Rd, Gov Bay	15.49	1.00	Stormfilter			Y
11	4 Rue Balguerie	1.61	0.60	Filterra			Y
12	Rec Ground Rue Brittan	3.21	0.60	Filterra			Y
13	60 Rue Jolie	0.66	0.75	Filterra			Y
14	Percy/William	0.85	0.30	Stormfilter		Y	Y
15	19/21 Percy St	0.70	0.25	Filterra	Y	Y	Y
16	Service Stn Little River	1.13	0.75	Stormfilter			Y
17	4207 Chch-Akaroa Rd	1.48	0.80	Stormfilter			Y
18	4230R Chch-Akaroa Rd	1.25	0.75	Stormfilter			Y
19	9 Main Rd, Gov Bay	0.15	0.15	Filterra			Y
20	90 Main Rd, Gov Bay	2.50	0.38	Filterra			Y
21	197 Main Rd, Gov Bay	5.60	0.50	Filterra			Y
22	25 Norwich Quay	0.55	0.55	Filterra	Y		Y
23	17 Gladstone Quay	1.88	0.80	Stormfilter			Y
24	6 Norwich Q south side	0.21	0.21	Stormfilter			Y
25	1 Beach Rd west	0.09	0.12	Filterra			Y
26	1 Beach Rd east	0.23	0.12	Filterra			Y
27	cnr Beach Rd - Rue Jolie	0.06	0.06	Filterra			Y
28	2A Julius Tc west	0.14	0.12	Filterra			Y
29	2A Julius Tc east	0.12	0.12	Filterra			Y
30	29 Oxford St -X	0.58	0.8	Stormfilter			
31	5 London St -X	0.36	0.43	Stormfilter			
32	2 London St -X	0.79	0.36	Stormfilter			
33	17 Dublin St -X	0.75	0.35	Stormfilter			
34	62 London St -X	0.51	0.57	Stormfilter			
35	47 London St -X	0.26	0.39	Stormfilter			

36	28 Norwich Quay -X	0.77	0.26	Stormfilter			
37	40 London St -X	0.56	0.26	Stormfilter			
38	44 London St (London) -X	0.33	0.4	Stormfilter			
39	44 London St (Canterbury) -X	0.52	0.23	Stormfilter			
40	25 Percy St Akaroa	0.2	0.2	Stormfilter		Y	
41	2 William St Akaroa	1.33	0.64	Stormfilter		Y	
42	Bruce/Rue Jolie	0.83	0.23	Filterra		Y	
43	Kowhai Grove	2.22	0.45	Filterra		Y	
44	145A Rue Jolie	0.75	0.31	Filterra		Y	
45	144 Rue Jolie	0.57	0.32	Filterra		Y	
46	9 Bruce Tc Akaroa	0.24	0.15	Filterra		Y	
47	903 Governors Bay Rd	0.75	0.34	Filterra		Y	

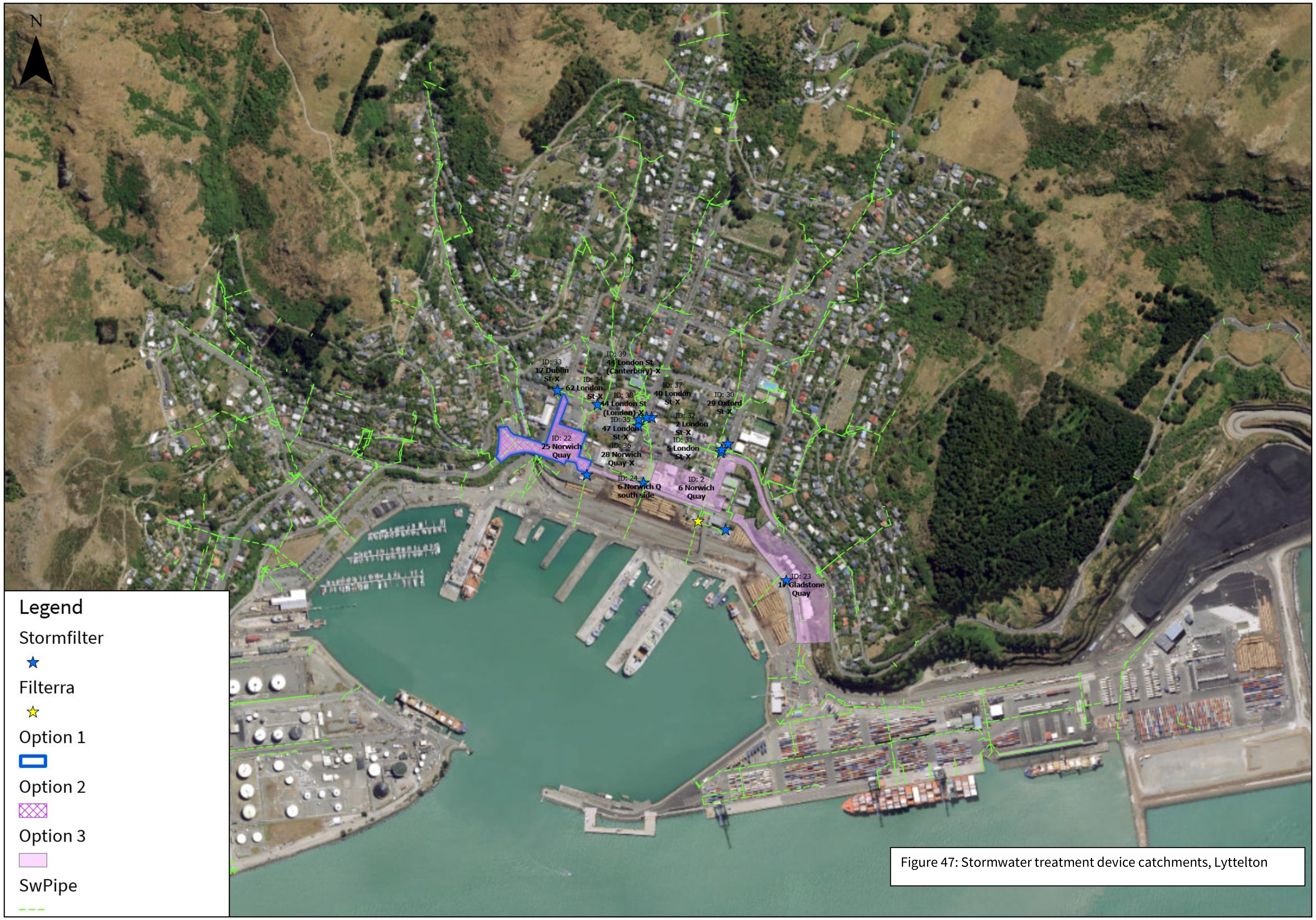

Figure 47: Stormwater treatment device catchments, Lyttelton

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

Treatment Catchment Area: Lyttelton, Scale: 1:7,000, Date Exported: 10/04/2025

Christchurch City Council

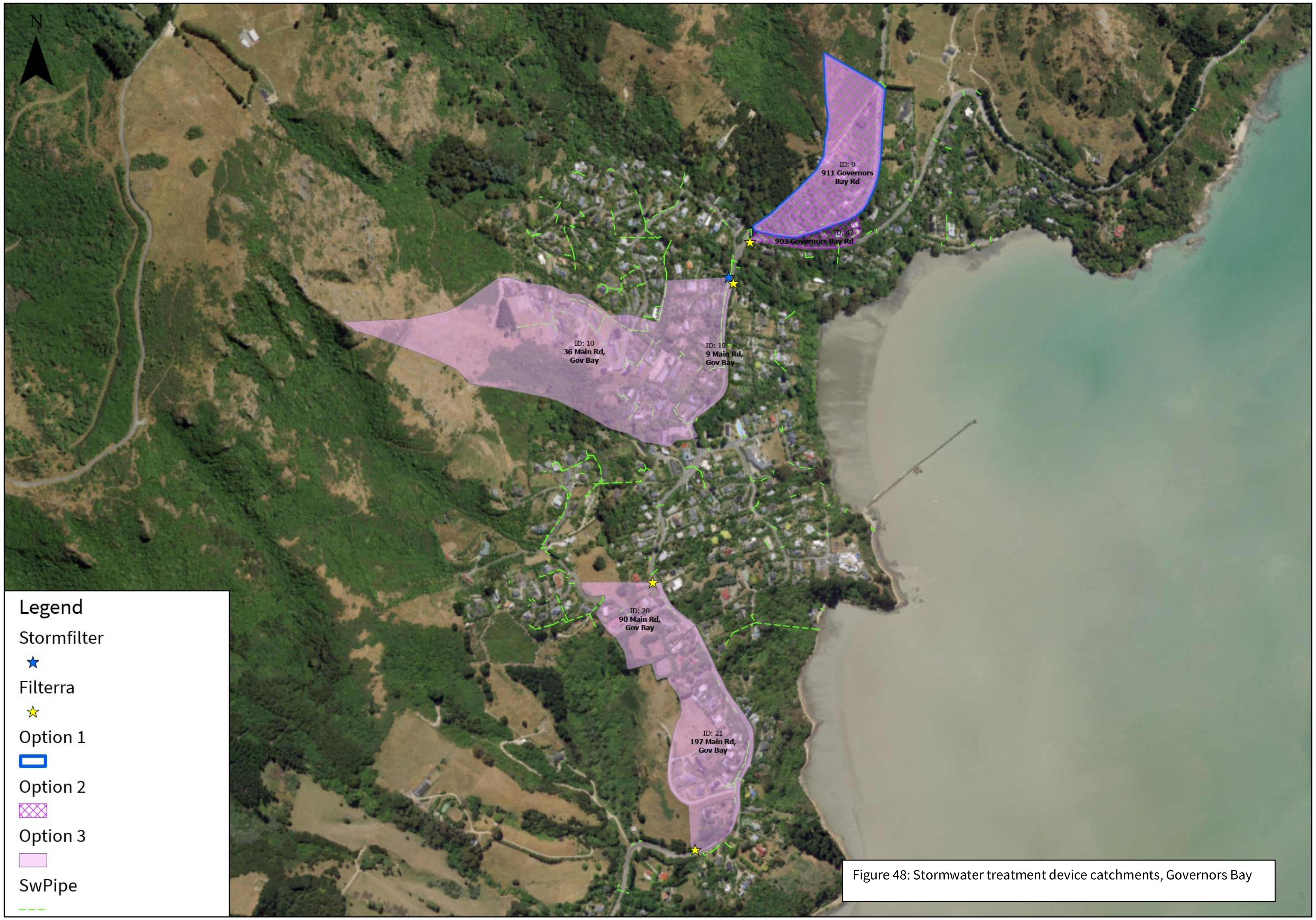

Figure 48: Stormwater treatment device catchments, Governors Bay

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

Treatment Catchment Area: Governors Bay, Scale: 1:7,000, Date Exported: 10/04/2025

Christchurch City Council

Figure 49: Stormwater treatment device catchments, Little River

BANKS PENINSULA STORMWATER MANAGEMENT PLAN

Treatment Catchment Area: Little River, Scale: 1:7,000, Date Exported: 10/04/2025

Christchurch City Council

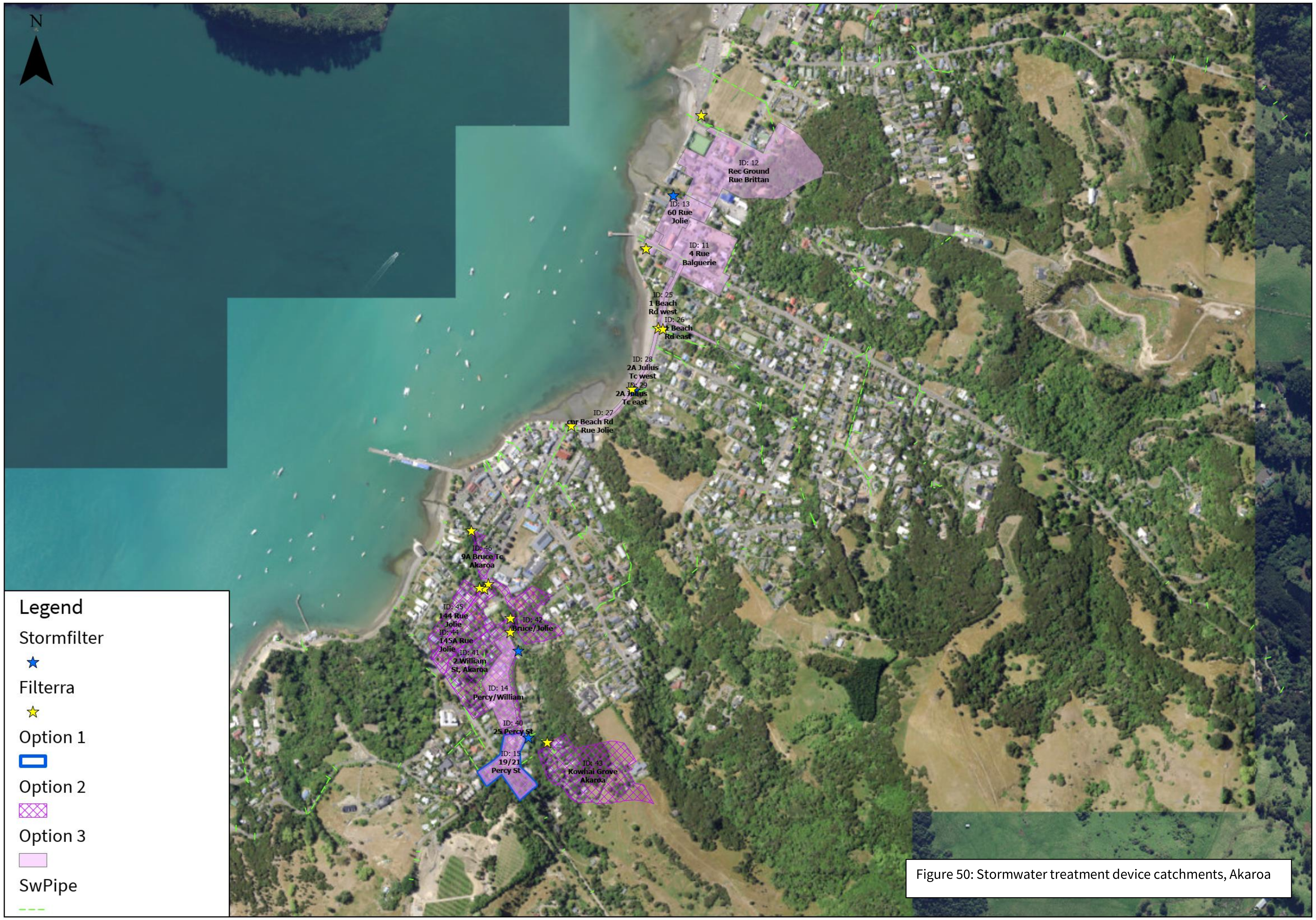

Figure 50: Stormwater treatment device catchments, Akaroa

Appendix G Attribute Target Levels, Schedules 7 to 10

Waterways, Coastal and Groundwater Receiving Environment Attribute Target Levels in Schedules 7 to 10 from Condition 23, Consent CRC252424.

Schedule 7: Receiving Environment Objectives and Attribute Target Levels for Waterways

The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels.

TBC-A = To Be Confirmed once a full year of monitoring allows hardness modified values to be calculated, in accordance with Condition 52.

TBC-B = To Be Confirmed following engagement with Papatipu Rūnanga, through an update to the EMP, in accordance with Condition 54.

Table 21: Waterways, Coastal and Groundwater Receiving Environment Attribute Target Levels

Objective	Attribute	Attribute Target Level	Basis for Target
Adverse effects on ecological values do not occur due to stormwater inputs	QMCI	Lower limit QMCI scores: • Spring-fed – plains – urban waterways: 3.5 • Spring-fed – plains waterways: 5 • Banks Peninsula waterways: 5	QMCI is an indicator of aquatic ecological health, with higher numbers indicative of better quality habitats, due to a higher abundance of more sensitive species. QMCI scores are taken from the guidelines in Table 1a of the LWRP (Canterbury Regional Council, 2018). This metric is designed for wade able sites and should therefore be used with caution for non-wade able sites. These targets can be achieved through reducing contaminant loads and waterway restoration.

Objective	Attribute	Attribute Target Level	Basis for Target
Adverse effects on water clarity and aquatic biota do not occur due to sediment inputs	Fine sediment (<2 mm diameter) percent cover of stream bed TSS concentrations in surface water	Upper limit fine sediment percent cover of stream bed: • Spring-fed – plains – urban waterways: 30% • Spring-fed – plains waterways: 20% • Banks Peninsula waterways: 20% Upper limit concentration of TSS in surface water: 25 mg/L No statistically significant increase in TSS concentrations in surface water	Sediment (particularly from construction) can decrease the clarity of the water, and can negatively affect the photosynthesis of plants and therefore primary productivity within streams, interfere with feeding through the smothering of food supply, and can clog suitable habitat for species. The sediment cover Target Levels are taken from the standards for the original Styx and South-West Stormwater Management Plan consents, and are based on Table 1a of the LWRP (Canterbury Regional Council, 2018). These targets should be used with caution at sites that likely naturally have soft-bottom channels. These targets can be achieved through reducing contaminant loads (particularly using erosion and sediment control) and instream sediment removal.
Adverse effects on aquatic biota do not occur due to copper, lead and zinc inputs in surface water	Zinc, copper and lead concentrations in surface water	Upper limit concentration of dissolved zinc: • Ōtākaro/ Avon River catchment: 0.0297 mg/L • Ōpāwaho/ Heathcote River catchment: 0.04526 mg/L • Cashmere Stream: 0.00724 mg/L • Huritīni / Halswell River catchment: 0.01919 mg/L • Pūharakekenui/ Styx River catchment: 0.01214 mg/L • Ōtūkaikino River catchment: 0.00868 mg/L	These metals can be toxic to aquatic organisms, negatively affecting such things as fecundity, maturation, respiration, physical structure and behavior. The Council has developed these hardness modified trigger values in accordance with the methodology in the 'Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand' (ANZG, 2018) guidelines, and the species protection level relevant to each waterway in the LWRP (Canterbury Regional Council, 2017). This calculation document can be provided on request. These targets can be achieved primarily through reducing contaminant loads.

Objective	Attribute	Attribute Target Level	Basis for Target
		• Linwood Canal: 0.146 mg/L • Banks Peninsula catchments: TBC-A Upper limit concentration of dissolved copper: • Ōtākaro/ Avon River catchment: 0.00356 mg/L • Ōpāwaho/ Heathcote River catchment: 0.00543 mg/L • Cashmere Stream: 0.00302 mg/L • Huritīni / Halswell River catchment: 0.00336 mg/L • Pūharakekenui/ Styx River catchment: 0.00212 mg/L • Ōtūkaikino River catchment: 0.00152 mg/L • Linwood Canal: 0.0175 mg/L • Banks Peninsula catchments: TBC-A Upper limit concentration of dissolved lead: • Ōtākaro/ Avon River catchment: 0.01554 mg/L • Ōpāwaho/ Heathcote River catchment: 0.02916 mg/L • Cashmere Stream: 0.00521 mg/L	

Objective	Attribute	Attribute Target Level	Basis for Target
		• Huritīni / Halswell River catchment: 0.01257 mg/L • Pūharakekenui/ Styx River catchment: 0.00634 mg/L • Ōtūkaikino River catchment: 0.00384 mg/L • Linwood Canal: 0.167 mg/L • Banks Peninsula catchments: TBC-A No statistically significant increase in copper, lead and zinc concentrations	
Excessive growth of macrophytes and filamentous algae does not occur due to nutrient inputs	Total macrophyte and filamentous algae (>20 mm length) cover of stream bed	Upper limit total macrophyte cover of the stream bed: j. Spring-fed – plains – urban waterways: 60% k. Spring-fed – plains waterways: 50% l. Banks Peninsula waterways: 30% Upper limit filamentous algae cover of the stream bed: • Spring-fed – plains – urban waterways: 30%	Macrophyte and algae cover are indicators of the quality of aquatic habitat. Targets are taken from Table 1a of the LWRP (Canterbury Regional Council, 2018). Improvement towards these targets can be achieved by reduction in nutrient concentrations and riparian planting to shade the waterways.

Objective	Attribute	Attribute Target Level	Basis for Target
		• Spring-fed – plains waterways: 30% Banks Peninsula waterways: 20%	
Adverse effects on aquatic biota do not occur due to zinc, copper, lead and PAHs in instream sediment	Zinc, copper, lead and PAHs concentrations in instream sediment	Upper limit concentration of total recoverable metals for all classifications: • Copper = 65 mg/kg dry weight • Lead = 50 mg/kg dry weight • Zinc = 200 mg/kg dry weight • Total PAHs = 10 mg/kg dry weight No statistically significant increase in copper, lead, zinc and Total PAHs	Meta Metals can bind to sediment and remain in waterways, potentially negatively affecting biota. These trigger values are based on the ANZG guidelines (ANZG, 2018). These targets can be achieved through reducing contaminant loads and instream sediment removal.
Adverse effects on Mana Whenua values do not occur due to stormwater inputs	Waterway Cultural Health Index and State of Takiwā scores	Lower limit averaged Waterway Cultural Health Index and State of Takiwā scores for all classifications: • Spring-fed – plains – urban waterways: TBC-B • Spring-fed – plains waterways: TBC-B Banks Peninsula waterways: TBC-B	The Waterway Cultural Health Index assesses cultural values and indicators of environmental health, such as mahinga kai (food gathering). These indices are on a scale of 1 - 5, with higher scores indicative of greater cultural values. No guidelines are available currently for the different types of waterways, so these targets will be developed specifically for this consent, with higher targets for waterways with higher values. These targets can be achieved through reducing contaminant loads and habitat restoration.

Schedule 9: Receiving Environment Objectives and Attribute Target Levels for Groundwater and Springs

The EMP outlines the methodology for the monitoring of Attributes and how these will be compared against Attribute Target Levels

Table 22: Attribute Target Levels for Groundwater and Springs

Objective	Attribute	Attribute Target Level	Basis for Target
Protect drinking water quality	Copper, lead, zinc and *Escherichia coli* concentrations in drinking water	Concentration to not exceed: • Dissolved Copper: 0.5 mg/L • Dissolved Lead: 0.0025 mg/L • Dissolved Zinc:0.375 mg/L No statistically significant increase in the concentration of *Escherichia coli* at drinking water supply wells	The most important use of Christchurch groundwater is the supply of the urban reticulated drinking water supply. Contaminants in stormwater that infiltrate into the ground could impact on the quality of water supply wells and/or springs. The compliance criteria for a potable and wholesome water supply are specified in the Drinking Water Standards for New Zealand 2005 (Revised 2008). Metals and *E. coli* were chosen for these targets, as these are contaminants present in stormwater. The target values for copper and lead are a quarter of the Maximum Acceptable Value (MAV) or Guideline Value (GV) taken from the Drinking Water Standards for New Zealand 2005 (revised 2008). This is to ensure investigations occur before the water quality limits in the LWRP are exceeded, which are that concentrations are not to exceed 50% of the MAV. An equivalent criteria has also been applied to the zinc target, which is not included in the LWRP water quality limits, but has a guideline in the drinking water standards.
Avoid widespread adverse effects on shallow groundwater quality	Electrical conductivity in groundwater	• No statistically significant increase in electrical conductivity	Contaminants in stormwater that infiltrate into the ground could impact on groundwater quality. Long term groundwater quality at monitoring wells is undertaken by Canterbury Regional Council. Those monitoring points that occur within the urban area could be impacted by Council stormwater management activities. Electrical conductivity is to be used as an indicator for identifying any general changes in groundwater quality related to recharge.

Te Hapū o Ngāti Wheke Rūnanga Position Statement: Te Pātaka o Rākaihautū Banks Peninsula
Reviewed and updated: 12/06/2025
Approved:

Introduction

Christchurch City Council (CCC) are required to prepare a Stormwater Management Plan (SMP) for Settlements of Te Pātaka o Rākaihautū / Banks Peninsula as part of the Comprehensive Stormwater Network Discharge Consent (CSNDC). This consent authorises the discharge of water and contaminants to land and water from the CCC stormwater network. The SMP only applies within the 24 urban settlements throughout the catchment where stormwater network infrastructure is located. These settlements are defined by CCC in the District Plan.

Within the takiwā of Te Hapū o Ngāti Wheke Rūnanga, Te Rūnanga hold tino rangatiratanga over the following urban settlements within Te Pātaka o Rākaihautū / Banks Peninsula:

- Lyttelton
- Governors Bay
- Cass Bay
- Rāpaki
- Allandale
- Teddington
- Te Wharau / Charteris Bay
- Diamond Harbour
- Purau

Condition 4 of the CSNDC (CRC214226) requires that CCC consult with Papatipu Rūnanga to develop and update Stormwater Management Plans. This statement responds to Te Pātaka o Rakaihautū / Banks Peninsula Stormwater Management Plan, which is the final SMP in development across the Christchurch District.

The purpose of Te Pātaka o Rakaihautū SMP includes the following:

- Contribute to meeting contaminant load reduction standards.
- Setting (and meeting) additional contaminant load reduction targets.
- Demonstrate the means by which Receiving Environment Objectives and Attribute Target Levels will be met.

It is important to note that Lyttelton Port has its own stormwater network and is excluded from the CSNDC. Rural stormwater runoff including runoff from roads is also not included in this SMP.

Recent State of Takiwā monitoring undertaken in March 2025 found that Whakaraupō catchment health was in a ‘poor to moderate’ state of cultural health. The average score from all cultural monitor surveys was 2.0, indicating ‘poor to moderate’ cultural health. Site access for mahinga kai scored the best on average across all sites, with a score of 2.4. Despite this, willingness to harvest mahinga kai harvest was scored the worst on average amongst all categories, with an average score of 1.7 across all sites. The Attribute Target Level for Mana Whenua Valus of 5 (very good) was not met by the survey results.

Te Hapū o Ngāti Wheke Rūnanga Position Statement: Te Pātaka o Rākaihautū Banks Peninsula
Reviewed and updated: 12/06/2025
Approved:

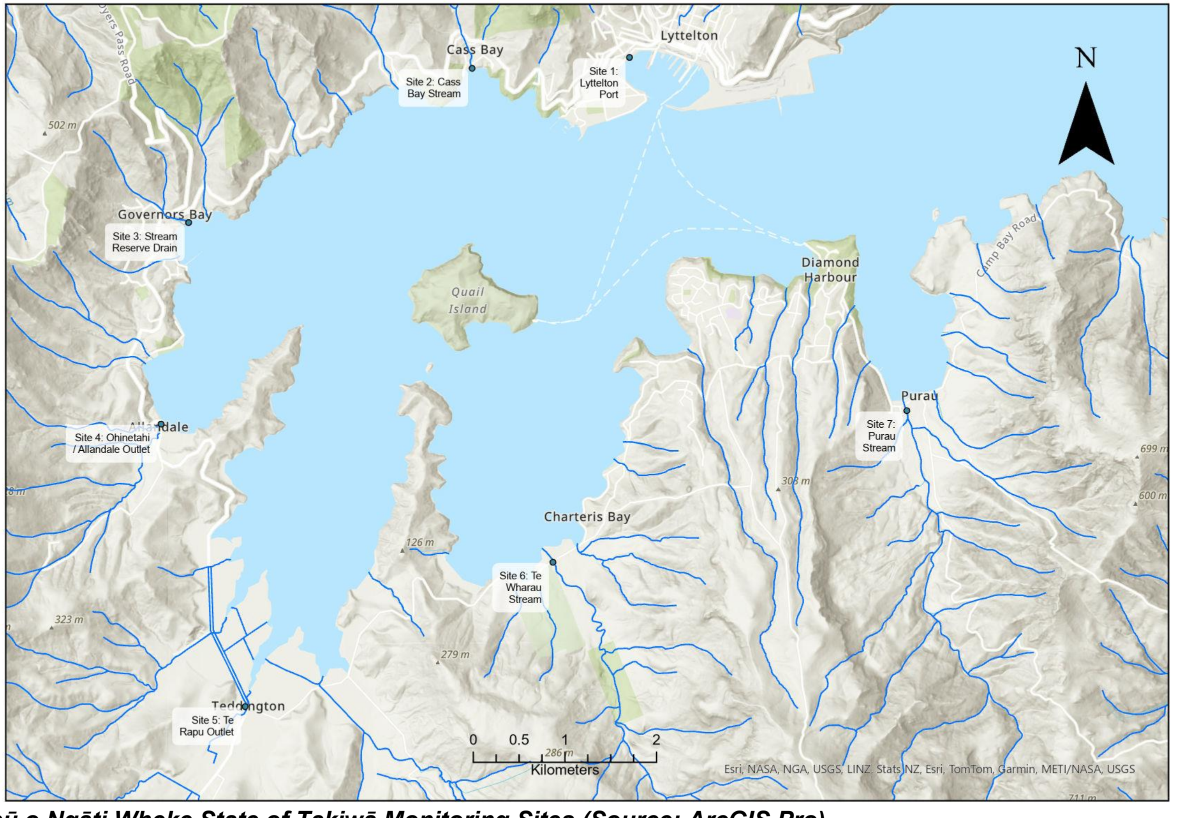

Figure 1: Te Hapū o Ngāti Wheke State of Takiwā Monitoring Sites (Source: ArcGIS Pro)

Te Hapū o Ngāti Wheke Rūnanga Position Statement: Te Pātaka o Rākaihautū Banks Peninsula
Reviewed and updated: 12/06/2025
Approved:

Position of mana whenua

Whakaraupō has a rich history of Ngāi Tahu land use and occupancy, and a strong tradition of mahinga kai. The harbour was named after the raupō needs that were once plentiful at Ōhinetahi at the head of the harbour. Kaimoana such as pātiki, pātiki rori, pīoki, hoka, aua, pāpaki, koiro and hokarari provided an abundant and reliable supply of mahinga kai for tāngata whenua and their manuhiri.

The restoration of kaimoana values and cultural health of Whakaraupō is a priority objective for tāngata whenua. The cultural impact of pollution and sedimentation on the harbour and its mahinga kai resources is significant. Restoring cultural health is about restoring the mauri of the harbour and the mana of the people. Decline in the available quantities and quality of kaimoana because of the deteriorating marine environment have prevented tāngata whenua from exercising their cultural values such as manaakitanga.

Heavy metals, in particular, copper, lead and zinc are key stormwater contaminants that can be toxic to aquatic habitat at high concentrations. Although copper and zinc are the most prominent contaminants throughout the catchment, there are still many potential sources of lead contamination in waterways. Many of the older homes and infrastructure in Lyttelton and nearby settlements used lead-based paints historically on building products such as timber weather boards. As these older products deteriorate over time they can release lead particles into the environment. These sources of lead are concerning for Rūnanga.

Whakaraupō is characterised by steep hills and valleys with numerous permanent and ephemeral streams. The soils of Te Pātaka o Rākaihautū are particularly sensitive to land use and vegetation clearance, and local streams can carry high sediment and contaminant loads. As a result, sedimentation is one of the key contributors to the poor cultural health of Whakaraupō. Catchment erosion is recognised a significant external source of sediment to the harbour and the source of the infilling of intertidal mudflat areas.

The Lyttelton township and other areas within the Whakaraupō catchment have an extensive history of various industrial activities and landfill sites, including an historic gasworks site in Lyttelton. Various by-products were produced during the gas manufacturing process, with many of these being refined and used in other industrial operations. Coal tar was one key by-product from the gas manufacturing process and was typically either sold as produced or refined on-site for alternative uses. In Lyttelton it was known to be used for constructing roads and stabilising old retaining walls. This contaminant is only one example of the many that are historically recorded throughout the catchment. These contaminants are extremely concerning for Rūnanga as they can become reactivated and mobilized during construction activities which can result in them being discharged into streams and the harbour. It is critical that appropriate erosion and sediment control processes are implemented for any construction activities that occur within contaminated sites. Any contaminated soils or materials must be managed and contained on-site to help mitigate the risk to further stormwater contamination.

A community-based approach based on the principle of Ki Uta Ki Tai is required to address the impacts of land use and other activities on the cultural health of the harbour. Tāngata whenua firmly believe that managing the harbour for mahinga kai can recognise and provide for multiple uses and values, while protecting and restoring this tribal taonga. Te Hapū o Ngāti Wheke support mitigation measures such as indigenous vegetation planting in highly erodible areas, rain gardens, filtration, and low impact design methods such as installing rainwater tanks to help mitigate the impacts of stormwater runoff.

There is an increasing demand for development in the catchment, but a lack of appropriate wastewater and stormwater infrastructure to support this. Tāngata whenua want to see a limit on development until wastewater discharges to the harbour cease. Populations continue to increase as more land is developed into new residential housing. This creates more wastewater and stormwater discharged into land and waterways. Subdivision consents continue to be granted without the appropriate infrastructure in place to support the increased population. Sedimentation is a further concern with regard to subdivision and development activities. Vegetation clearance and earthworks increases the risk of sediment and contaminants entering local waterways and the harbour.

Appropriate management tools are required to protect and enhance the marine environment. The Rāpaki Mātaitai Reserve was established in 1998 to protect and enhance the traditional fishing ground at Rāpaki Bay for Te Hapū o Ngāti Wheke Rūnanga. During the lifetime of Rāpaki tāua and pōua, pollution of Whakaraupō has resulted in the inability of Rāpaki residents and their visitors to eat kaimoana gathered from the area. Historically there were abundant supplies of ika to provide regular food for those living at Rāpaki, however this I no longer the case. Although the primary emphasis for tāngata whenua regarding the relationship with Whakaraupō is kaimoana, the catchment also holds significant recreational value for the community. Ngāi Tahu use of Whakaraupō also includes waka, including waka ama (outrigger canoes), waka taua (traditional canoes), and waka unua (sailing canoes). Ngāi Tahu have used waka on Whakaraupō for generations, for mahinga kai, travel and trade. Long term monitoring data trends for Whakaraupō show that most recreational sites are unsuitable for recreational activities such as swimming due to the elevated risk to public health from contact with the water. High *E. coli* is often recorded in the Whakaraupō catchment, particularly after heavy rainfall. Contaminants are flushed from urban and rural land into the many hill waterways and eventually discharge into Whakaraupō. Elevated *E. coli* has also been sampled in Lyttelton pipes which suggests possible wastewater contamination. More mitigation measures must be in place to address contaminant issues like *E. coli* at source.

CCC have proposed three mitigation options for consideration to help address contaminant issues associated with stormwater runoff and achieve their Attribute Target Levels as part of the Consent requirements. The three options include a combination of contaminant capture by way of treatment devices and environmental enhancement works. Te Hapū o Ngāti Wheke Rūnanga support Option 2 as the preferred mitigation option to address contaminants from stormwater runoff throughout Te Pātaka o Rākaihautū settlements. This option appropriately balances the number of treatment devices to directly capture contaminants in key waterways, as well as enhancing the natural environment and restoring indigenous habitat. The difference in contaminant capture between all three options is also small relative to total contaminants throughout the catchment, which does not justify installing more treatment devices at the expense of stream enhancement. Te Hapū o Ngāti Wheke Rūnanga do not support Option 3 or any mitigation option that does not incorporate any stream enhancement measures.

Te Hapū o Ngāti Wheke Rūnanga Position Statement: Te Pātaka o Rākaihautū Banks Peninsula
Reviewed and updated: 12/06/2025
Approved:

Te Hapū o Ngāti Wheke do not oppose the Te Pātaka o Rākaihautū SMP, but have the following issues/concerns relating to stormwater and freshwater management within the Whakaraupō catchment:

Ngā Wai/Wai Māori – Freshwater

- The protection and enhancement of waterways and waipuna is essential to improving the cultural health of the catchment.
- Rūnanga have concerns with the high abundance of exotic vegetation (e.g. willow) in some areas of the catchment.
- During recent State of Takiwā monitoring monitors observed a large amount of slash and debris built up within Te Wharau Stream next to the culvert underneath Marine Drive.
- Rūnanga have concerns with the contaminated land and historic landfill site near Allandale Reserve, Governors Bay and the associated risk from sea level rise and climate change.
- Other common issues identified by cultural monitors during State of Takiwā monitoring included foamy and discoloured water in some streams indicating possible contamination, high volumes of sedimentation in some streams, and modified stream banks.

Taonga Species and Mahinga Kai

- The lack of riparian planting and native habitats throughout the catchment limits the ability for taonga species to thrive within the catchment, and the ability for mana whenua to undertake mahinga kai practices.

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Te Hapū o Ngāti Wheke Rūnanga Position Statement: Te Pātaka o Rākaihautū Banks Peninsula
Reviewed and updated: 12/06/2025
Approved:

Recommendations

To mitigate the concerns listed above, CCC will:

1) Investigate the feasibility of and implement (if necessary) a marine pest removal programme for Whakaraupō to help improve the cultural health of the harbour.
2) Increase monitoring frequency of water quality in Whakaraupō, particularly within the working port area to help address contaminant sources and issues.
3) Implement enforceable controls for vessel owners to prevent biofouling accumulating within Whakaraupō.
4) A catchment-based planting plan must be developed for streams that have been identified as key contributors of contaminant discharge into Whakaraupō. The planting plan must ensure that riparian margins are protected and provide sufficient habitat for taonga species. This plan should also include the removal of exotic pest species (i.e., willow) to encourage native vegetation growth and enhance indigenous biodiversity.
5) Investigate direct discharges into streams located in urbanised areas such as Governors Bay and assess the feasibility of treatment devices to target contaminants.
6) Develop and implement planting plans for upper catchment areas to reduce sedimentation in the lower catchment and Whakaraupō.
7) Enhance and naturalise streams throughout Whakaraupō catchment, where possible, to increase indigenous habitat and enhance mahinga kai values.
8) Work with Papatipu Rūnanga to protect and enhance existing mahinga kai areas (i.e., īnanga spawning areas).
9) Restore access to traditional mahinga kai sites for mana whenua.
10) Work with appropriate regulating authorities to improve fencing of waterways in upper catchment areas to prevent stock accessing and further contaminating the awa.
11) Ensure any new development throughout Whakaraupō catchment implements appropriate setbacks from waterways and adheres to the policies and guidelines relating to stormwater as per the Ngai Tahu Subdivision and Development Guidelines document in the Mahaanui Iwi Management Plan.
12) Ensure any construction activities within known contaminated sites adhere to stringent erosion and sediment control measures, to protect waterways and Whakaraupō from further contamination. Contaminated soils and materials must be captured and managed on-site.
13) Implement Mitigation Option 2 to address concerns relating to contaminants from stormwater runoff in Te Pātaka o Rākaihautū settlements, focussing on treating the worst streams and stream enhancement works throughout the catchment.

Te Hapū o Ngāti Wheke Rūnanga reserve the right to oppose the proposal or pursue avoidance or mitigation of any subsequent impacts that are identified as a result of further site visits or further discussions with CCC.

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Te Hapū o Ngāti Wheke Rūnanga Position Statement: Te Pātaka o Rākaihautū Banks Peninsula
Reviewed and updated: 12/06/2025
Approved:

[redacted]

Date: 13 June 2025 Paul Dahl

Mahaanui Kurataiao Ltd

Te Rūnanga o Koukourarata Position statement: Te Pātaka o Rākaihautū / Banks Peninsula
Reviewed and updated: 28/05/2025
Approved: 12/06/2025

Introduction

Christchurch City Council (CCC) are required to prepare a Stormwater Management Plan (SMP) for the Settlements of Te Pātaka o Rākaihautū / Banks Peninsula as part of the Comprehensive Stormwater Network Discharge Consent (CSNDC). This consent authorises the discharge of water and contaminants to land and water from the CCC stormwater network. The SMP only applies within the catchment's 24 urban settlements where stormwater network infrastructure is located. These settlements are defined by CCC in the District Plan.

Within the takiwā of Te Rūnanga o Koukourarata, Te Rūnanga hold tino rangatiratanga over the following urban settlements within Te Pātaka o Rākaihautū / Banks Peninsula SMP catchment (Figure 1):

- Koukourarata / Port Levy
- Pigeon Bay
- Little Akaloa
- Okains Bay
- Le Bons Bay
- Kukupa

Condition 4 of the CSNDC (CRC214226) requires that CCC are to consult with Papatipu Rūnanga to develop and update stormwater management plans (SMP). This statement responds to Te Pātaka o Rakaihautū / Banks Peninsula Stormwater Management Plan, which is the final SMP in development across the Christchurch District.

The purpose of the Te Pātaka o Rakaihautū SMP includes the following:

- Contribute to meeting contaminant load reduction standards.
- Setting (and meeting) additional contaminant load reduction targets.
- Demonstrate the means by which Receiving Environment Objectives and Attribute Target levels will be met.

It is important to note that stormwater runoff originating from rural areas (including runoff from roads) is not included in this SMP.

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Te Rūnanga o Koukourarata Position statement: Te Pātaka o Rākaihautū / Banks Peninsula
Reviewed and updated: 28/05/2025
Approved: 12/06/2025

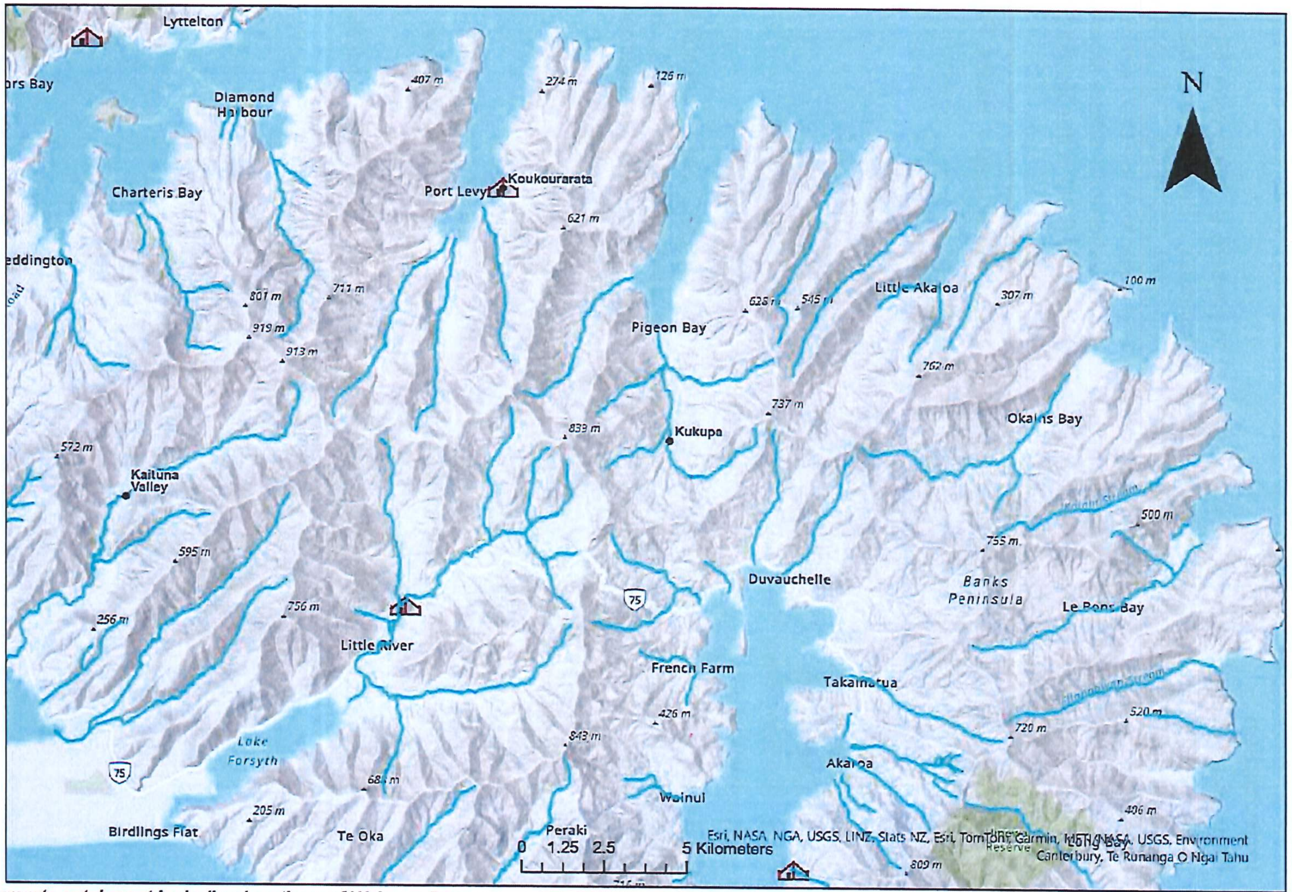

Figure 1: Koukourarata catchment including locations of Wairewa Rūnanga and Te Rūnanga o Koukourarata marae (source: ArcGIS Pro)

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Te Rūnanga o Koukourarata Position statement: Te Pātaka o Rākaihautū / Banks Peninsula
Reviewed and updated: 28/05/2025
Approved: 12/06/2025

Position of mana whenua

The catchment of Te Ara Whānui o Makawhiua (Koukourarata) has an extensive history of Ngāi Tahu settlement. Three pā once existed around the bay: Kaitara, Koukourarata, and Puāri. After the fall of Kaiapoi Pā, Koukourarata and Puāri became the main centres of Ngāi Tahu activity in the Canterbury region. Today, Koukourarata remains a place to settle, reunite and meet. The geography of the catchment is a good reflection of the Ngāi Tahu resource management principle Ki Uta Ki Tai: from mountains to sea. Steep hills form the outer ridge line of numerous small catchments that extend into lowland valleys and open into coastal bays. Prominent ridge lines extend from summit to sea, forming isolated coastal headlands. Waterways draining the upper slopes meander through bushed stream gullies and across valley floors and into the sea.

Koukourarata and the surrounding catchment is a rich mahinga kai resource and increasing pressures on these resources is an ongoing management challenge for tāngata whenua. The health of kaimoana is integral to Ngāi Tahu culture and identity. Stormwater run-off from roads and surrounding land can negatively impact the coastal water quality, contributing to adverse effects on the health and abundance of kaimoana resources in the bays and surrounding areas of the Koukourarata catchment. An issue of particular significance is how surrounding land use is affecting marae and community drinking water supplies, and water quality in streams used for mahinga kai. Stock access to waterways is a key contributor to adverse effects on drinking water quality throughout the catchment, and on mahinga kai sites such as watercress and mint gathering sites and īnanga spawning areas.

As climate change becomes more prominent, the catchment will become increasingly impacted by coastal flooding and rising groundwater. Flooding will affect areas further inland more frequently and will result in increased flood depths. Land drainage will also be slower and water ponding will remain in place longer as a result of higher groundwater levels. Local residents homes and public infrastructure, including roads and the stormwater network, will be impacted by flooding. Places of cultural significance, including wāhi tapu, wāhi taonga and silent file areas may also be increasingly impacted by flooding and coastal erosion.

The eastern bays landscape has experienced extensive change over time. Densely forested hills and valleys have been replaced by pastoral farmland, with a number of small coastal settlements. The protection and restoration of indigenous biodiversity is an important kaupapa, and there are numerous examples of community-led native bush protection, riparian planting, and species recovery projects in the takiwā. In addition, the Kaituna Valley and its environment is a significant cultural landscape with regards to the association and relationship Ngāi Tahu has with it. The name Kaituna refers to the abundance of tuna in the area, and was a key ara tawhito (traditional travel route) for the Ngāi Tahu hapū of Ngāti Huikai travelling between both Koukourarata and Whakaraupō to the rich mahinga kai of Te Waihora, and contains numerous sites of significance such as mahinga kai. The ridge leading from Te Ahu Pātiki towards Te Waihora at Kūhakawariwari (near Ataahua) is the traditional boundary between Ngāti Huikai at Koukourarata and Ngāti Wheke at Rāpaki.

There is little protection for Te Waihora and the many tributaries that feed into it from surrounding land use and contaminant run-off. Te Rūnanga o Koukourarata have concerns this SMP does not do enough to protect Kaituna River and other tributaries throughout Kaituna Valley from stormwater run-off contaminating the awa and degrading the mauri further. The

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Te Rūnanga o Koukourarata Position statement: Te Pātaka o Rākaihautū / Banks Peninsula
Reviewed and updated: 28/05/2025
Approved: 12/06/2025

existing community in Kaituna Valley are strong advocates for maintaining and enhancing the natural character of the area, which includes preserving the significant waterways in the valley such as Kaituna River. Contaminant load model results presented in the draft Te Pātaka o Rākaihautū – Banks Peninsula SMP show the Kaituna sub-catchment produces more contaminants from impervious areas annually than many other sub-catchments defined as settlements. It is crucial that stormwater contaminants generated in Kaituna Valley are also addressed alongside others throughout Te Pātaka o Rākaihautū – Banks Peninsula.CCC have proposed three mitigation options for consideration to help address contaminant issues associated with stormwater runoff and achieve the Attribute Target Levels as part of the Consent requirements. The three options include a combination of contaminant capture by way of treatment devices and environmental enhancement works. Te Rūnanga o Koukourarata support Option 2 as the preferred mitigation option to address contaminants from stormwater runoff throughout Te Pātaka o Rākaihautū settlements. This option appropriately balances the number of treatment devices to directly capture contaminants in key waterways, as well as enhancing the natural environment and restoring indigenous habitat. The difference in contaminant capture between all three options is also small relative to total contaminants throughout the catchment, which does not justify installing more treatment devices at the expense of stream enhancement.

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Te Rūnanga o Koukourarata Position statement: Te Pātaka o Rākaihautū / Banks Peninsula
Reviewed and updated: 28/05/2025
Approved: 12/06/2025

Te Rūnanga o Koukourarata do not oppose Te Pātaka o Rakaihautū Banks Peninsula SMP, but have outlined a number of issues/concerns throughout the catchment of Te Ara Whanui o Makawhiua (Koukourarata) in relation to stormwater and freshwater management:

Ngā Wai/Wai Māori – Freshwater

- Te Rūnanga o Koukourarata have concerns that waterway enhancement plans associated with stormwater contaminant control are only focussed on downstream and coastal areas within the lower catchment. More work needs to be done in upper catchment areas at the source to capture sediment and other contaminants before it reaches the coast.
- The widespread loss of indigenous habitat and ecosystems is an issue of immense importance for tāngata whenua. Rūnanga are committed to conducting restoration projects in the eastern bays, targeting riparian planting on key waterways to help mitigate the adverse effects of stormwater contaminants.
- It is critical that waipuna associated with Koukourarata and the eastern bay catchments are protected and restored as part of maintaining and enhancing the cultural health of the takiwā.
- Te Rūnanga o Koukourarata have concerns that not enough is being done by authorities to protect, enhance and restore remnant wetland areas. The *Canterbury Water Management Strategy* highlights that less than 10% of the region's previously extensive wetlands remain. Cultural health assessments in the takiwā highlight that one of the greatest issues facing waterways is the absence of sufficient riparian margins to buffer those waterways from intensive land use and provide habitat for mahinga kai and indigenous species.
- Te Rūnanga o Koukourarata advocate for the inclusion of Kaituna Valley and the awa associated with it in Te Pātaka o Rākaihautū Banks Peninsula SMP.

Taonga Species and Mahinga Kai

- Poor water quality throughout the takiwā creates risks for tangata whenua when harvest mahinga kai and kaimoana within coastal areas. Te Rūnanga o Koukourarata have many kaumātua that still practice mahinga kai harvest therefore improving water quality is of vital importance for the health of tangata whenua.
- There are increasing pressures on kaimoana resources of Te Ara Whānui o Makawhiua as a result of contaminant discharges to the coastal marine area and harbour. Stormwater runoff can contribute significantly to this.

Recommendations

To mitigate the concerns listed above, CCC will:

1) Investigate sources of *E. coli* and mitigate appropriately.
2) Discharge stormwater to land and remove drain outlets to the coast and on the beach where practicable.

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3) Ensure any development that occurs within the takiwā of Te Rūnanga o Koukourarata must be consistent with the existing character and not adversely affect tāngata whenua aspirations. With regards to stormwater, this must be treated and discharged to land and cannot enter waterways or coastal waters.

4) Support Te Rūnanga o Koukourarata Rūnanga with community engagement projects which incorporate education surveying and monitoring within the environment.

5) Implement requirements for on-site solutions to stormwater management for all new developments (rural and within existing urban settlements throughout Te Pātaka o Rākaihautū). This should be based on a multi-tiered approach to stormwater management:

    a) Education – engaging rural communities awareness of stormwater and how it affects the natural environment, encouraging them to take steps to protect the local environment and how stormwater can be re-used where appropriate;
    b) Reducing volume entering system – implementing measures such as rainwater collection tanks;
    c) Reduce contaminants and sediments entering system – i.e., native vegetation planting upstream and in upper catchment areas to help trap sediment before it gets to the coast; and
    d) Discharge to land-based methods – using appropriate native plant species, recognising the ability of particular species to absorb water and filter waste.

6) Work with Te Rūnanga o Koukourarata and other local authorities to develop appropriate policies and rules to implement and enforce measures to improve coastal water quality, including:

    a) Fencing of waterways that flow into the harbour to prevent stock access;
    b) Establishment of riparian margins and buffers between farmland and waterways;
    c) Best practice septic tank design and maintenance, and prohibit longdrops;
    d) Stormwater discharge to land as opposed to drain outlets on the beach;
    e) Prohibiting the discharge of sewage, bilge water or rubbish from boats while in or adjacent to Te Ara Whānui o Makawhiua.

7) Support Te Rūnanga o Koukourarata with ongoing freshwater and coastal water quality monitoring throughout the catchment, to help ensure mahinga kai and kaimoana are safe to harvest.

8) Implement Mitigation Option 2 to address concerns relating to contaminants from stormwater runoff in Te Pātaka o Rākaihautū settlements, focussing on treating the worst streams and stream enhancement works throughout the catchment.

Te Rūnanga o Koukourarata Rūnanga reserve the right to oppose the proposal or pursue avoidance or mitigation of any subsequent impacts that are identified as a result of further site visits or further discussions with CCC.

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Te Rūnanga o Koukourarata Position statement: Te Pātaka o Rākaihautū / Banks Peninsula
Reviewed and updated: 28/05/2025
Approved: 12/06/2025

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Wairewa Rūnanga Position statement: Te Pātaka o Rākaihautu Banks Peninsula
Reviewed and updated: 09/06/2025
Approved: 11/06/2025

Introduction

Christchurch City Council (CCC) are required to prepare a Stormwater Management Plan (SMP) for Settlements of Te Pātaka o Rākaihautū / Banks Peninsula as part of the Comprehensive Stormwater Network Discharge Consent (CSNDC). This consent authorises the discharge of water and contaminants to land and water from the CCC stormwater network. The SMP only applies within the 24 urban settlements throughout the catchment where stormwater network infrastructure is located. These settlements are defined by CCC in the District Plan.

Within the takiwā of Wairewa Rūnanga, Te Rūnanga hold tino rangatiratanga over the following settlements within Te Pātaka o Rākaihautu / Banks Peninsula catchment (**Figure 1**)

- Little River
- Birdlings Flat

Condition 4 of the CSNDC (CRC214226) requires that CCC consult with Papatipu Rūnanga to develop and update Stormwater Management Plans. This statement responds to Te Pātaka o Rakaihautū / Banks Peninsula Stormwater Management Plan, which is the final SMP in development across the Christchurch District.

The purpose of Te Pātaka o Rakaihautū SMP includes the following:

- Contribute to meeting contaminant load reduction standards.
- Setting (and meeting) additional contaminant load reduction targets.
- Demonstrate the means by which Receiving Environment Objectives and Attribute Target Levels will be met.

Rural stormwater runoff including runoff from roads is not included in this SMP.

Recent State of Takiwā monitoring undertaken in April 2025 found that the catchment health was in a ‘poor to moderate’ state of cultural health. The average score from all cultural monitor surveys was 2.4, indicating ‘poor to moderate’ cultural health. Degree of modification was scored the worst in the survey with an average score of 1.7 across all sites. Site access for mahinga kai scored the best on average with 3.7. The Attribute Target Level for Mana Whenua Values of 5 (very good health) was therefore not met by the survey results. Common issues and concerns throughout the catchment outlined by monitors included an overabundance of invasive and exotic species such as willows and gorse, significant modification including the installation of culverts and other man-made structures within waterways which may be contributing to flooding issues, river quality issues such as sedimentation, bank erosion, and algal blooms, and other historic issues that have contributed to poor water quality in Te Roto o Wairewa and its tributaries (i.e., deforestation and farming).

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Wairewa Rūnanga Position statement: Te Pātaka o Rākaihautu Banks Peninsula
Reviewed and updated: 09/06/2025
Approved: 11/06/2025

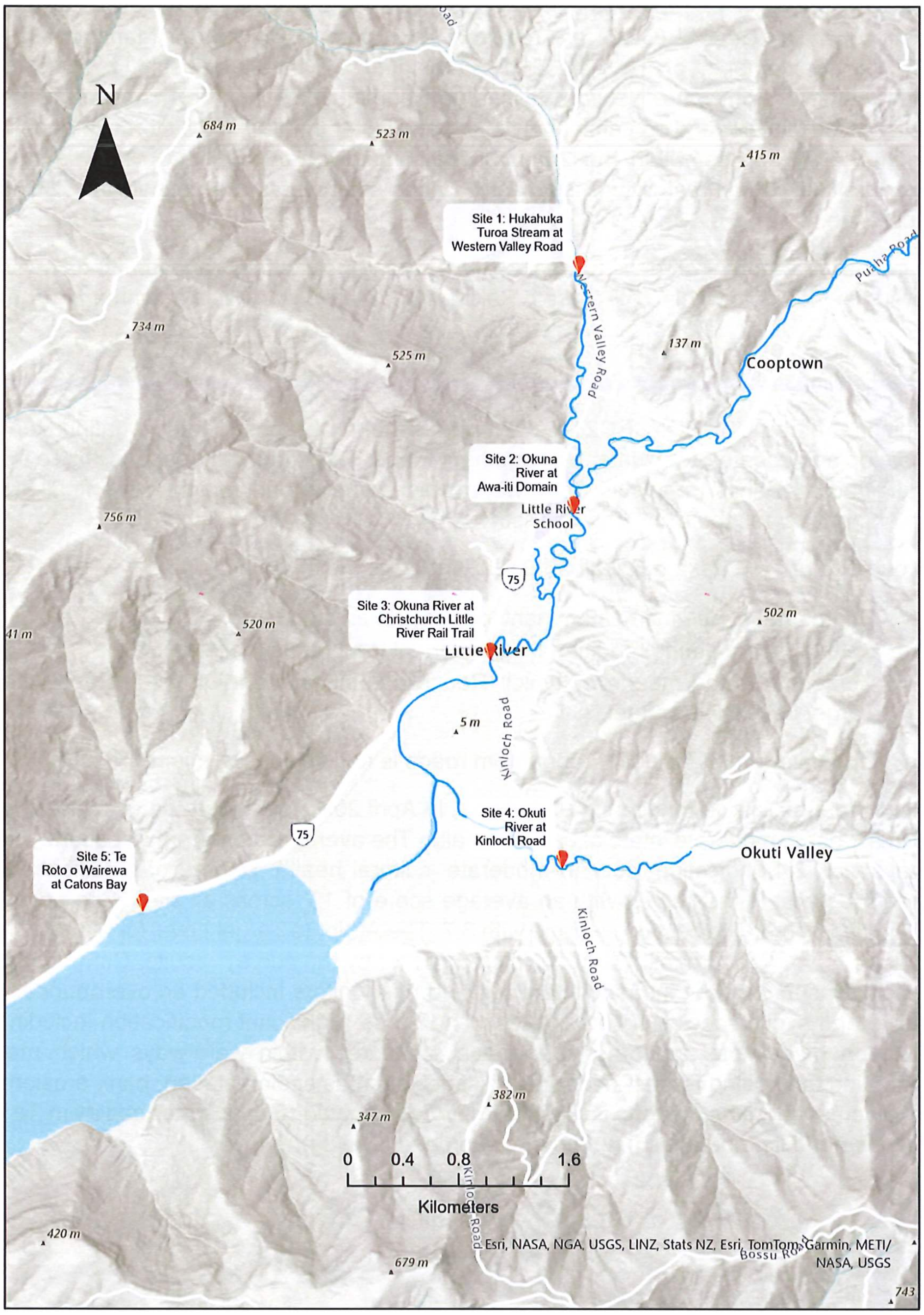

Figure 1: Wairewa State of Takiwā Monitoring Sites (Source: ArcGIS Pro)

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Wairewa Rūnanga Position statement: Te Pātaka o Rākaihautu Banks Peninsula
Reviewed and updated: 09/06/2025
Approved: 11/06/2025

Position of mana whenua

Te Roto o Wairewa / Lake Forsyth is a culturally significant mahinga kai site for Wairewa Rūnanga and Ngāi Tahu. Tangata whenua all have cultural, spiritual, historic, and traditional associations to the lake. The degraded cultural health of Te Roto o Wairewa and its tributaries is one the most significant issues throughout this catchment. State of Takiwā assessments have shown that catchment land use is having a significant impact on the cultural health of the lake. The assessments have all outlined the loss of cultural health as you move from upper to lower catchment: source to sink. Sedimentation and the concentration of nutrients in the sediment of the lakebed are also key issues. There is over 1 metre of sedimentation in the lake, equating to approximately 5,000,000m^3 of topsoil which has eroded from the catchment.

The waterways in the Te Roto o Wairewa catchment flow from maunga to lake, Ki Uta Ki Tai. This means that the cultural health of the lake is directly related to the cultural health of waterways. Water quality and quantity in the catchment's waterways has decreased significantly in the memory of tangata whenua of Wairewa. Land use change has reduced the catchments water yield and increased the presence of contaminants in surface water.

CCC have proposed three mitigation options for consideration to help address contaminant issues associated with stormwater runoff and achieve their Attribute Target Levels as part of the Consent requirements. The three options include a combination of contaminant capture by way of treatment devices and environmental enhancement works. Wairewa Rūnanga support Option 2 as the preferred mitigation option to address contaminants from stormwater runoff throughout Te Pātaka o Rākaihautū settlements. This option appropriately balances the number of treatment devices to directly capture contaminants in key waterways, as well as enhancing the natural environment and restoring indigenous habitat. The difference in contaminant capture between all three options is also small relative to total contaminants throughout the catchment, which does not justify installing more treatment devices at the expense of stream enhancement.

Wairewa Rūnanga do not oppose Te Pātaka o Rākaihautu Banks Peninsula SMP, but have the following issues/concerns relating to stormwater management within their takiwā:

<u>Ngā Wai/Wai Māori – Freshwater</u>

- Te Roto o Wairewa has little protection from the effects of land use on its margins. Historically, lake margin wetlands acted as a nutrient and sediment filter and played an important role in maintaining water quality. However, very few wetlands remain on the landscape today.

- Phosphorus is a critical nutrient input into Te Roto o Wairewa. As the soils of the catchment are naturally high in phosphorus, bank erosion on degraded waterways and lack of vegetation cover on land results in high inputs of contaminants into the lake during storm events.

- One of the most significant concerns for tāngata whenua is the clearing of vegetation in the upper catchments which has resulted in the loss of slope stability, and the erosion and sedimentation of waterways.

- Water quality and quantity in Te Roto o Wairewa catchment's waterways has decreased significantly in the memory of tāngata whenua. Land use change has

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reduced the catchment's water yield and increased the presence of contaminants in water. Land clearance, planting and harvesting of plantations can result in sedimentation and contamination of waterways. Plantations can also negatively affect catchment water yield, as pine trees absorb a significant quantity of water, including stormwater, that would otherwise contribute to the catchment's water yield.

<u>Taonga Species and Mahinga Kai</u>

- The cultural impact of pollution and sedimentation on Te Roto o Wairewa (and its tributaries) and mahinga kai resources is significant. Mitigation options outlined in this SMP must include methods to remove sediment and prevent further sedimentation.
- Maintaining and enhancing indigenous biodiversity within the takiwā is an important Kaupapa for the kaitiaki Rūnanga, as healthy biodiversity ensures the ongoing availability of mahinga kai, both food and cultural materials. Healthy biodiversity can also offset many adverse effects of stormwater contaminants.

Recommendations

To mitigate the concerns listed above, CCC will:

1) Protect and enhance mahinga kai habitats, in collaboration with mana whenua, to enable mahinga kai to thrive, and desired species are plentiful enough for long-term harvest and present across all life stages.
2) Ensure the protection and enhancement of known spring sites.
3) Support regular State of Takiwā monitoring throughout the catchment.
4) Develop a catchment-based indigenous vegetation planting plan that ensures riparian margins are protected and enhanced while also providing for sufficient habitat for taonga species.
5) Ensure that stringent and enforceable controls are implemented on any land-use and earthworks activities to avoid further sedimentation of waterways and improve overall water quality throughout the catchment.
6) Establish a suitable pest and weed control programme to maintain overgrown weeds in and alongside rivers and streams. This should include the removal of exotic vegetation such as pine to help restore the cultural health throughout the takiwā.
7) Ensure the management of natural resources in the takiwā of Wairewa Rūnanga embraces ki uta ki tai, recognising and providing for te taiao interconnectivity in all decision-making processes.
8) Investigate additional mitigation measures that address the water quality issues for Te Roto o Wairewa which may sit outside the scope for this SMP.
9) Explore more effective flood mitigation measures for areas prone to flooding. This includes flood prone areas of Okana River and the Little River township where flooding has occurred consistently.

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10) Investigate options to improve instream habitats throughout Te Roto o Wairewa catchment. Measures to improve instream habitat must be discussed with Wairewa Rūnanga through appropriate channels.

11) Ensure access to traditional mahinga kai sites are restored for mana whenua.

12) Investigate methods to address bank erosion issues throughout the catchment.

13) Ensure all future development takes into account Ngāi Tahu Subdivision and Development Guidelines, with particular focus on stormwater management policies.

14) Improve lake level management to protect and enhance mahinga kai values and the customary relationship of tāngata whenua with Te Roto o Wairewa, and to improve flood management throughout the catchment.

15) Engage with mana whenua prior to any proposed changes, enhancements, translocations and/or diversions rather than consult retrospectively.

16) Ensure that all waterways in the catchment are treated to the same standard and managed for mahinga kai collection in the future.

17) Implement Mitigation Option 2 to address concerns relating to contaminants from stormwater runoff in Te Pātaka o Rākaihautū settlements, focussing on treating the worst streams and stream enhancement works throughout the catchment.

Wairewa Rūnanga reserve the right to oppose the proposal or pursue avoidance or mitigation of any subsequent impacts that are identified as a result of further site visits or further discussions with CCC.

[redacted] Wairewa Kaitiaki Rep.

Date: 11.06.25.

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Introduction

Christchurch City Council (CCC) are required to prepare a Stormwater Management Plan (SMP) for Settlements of Te Pātaka o Rākaihautū / Banks Peninsula as part of the Comprehensive Stormwater Network Discharge Consent (CSNDC). This consent authorises the discharge of water and contaminants to land and water from the CCC stormwater network. The SMP only applies within the 24 urban settlements throughout the catchment where stormwater network infrastructure is located. These settlements are defined by CCC in the District Plan.

Within the takiwā of Ōnuku Rūnanga, Te Rūnanga hold tino rangatiratanga over the following urban settlements within Te Pātaka o Rakaihautū / Banks Peninsula:

- Ōnuku
- Akaroa
- Takamatua
- Robinsons Bay
- Duvauchelle
- Barrys Bay
- French Farm
- Tikao Bay
- Wainui

Condition 4 of the CSNDC (CRC214226) requires that CCC consult with Papatipu Rūnanga to develop and update Stormwater Management Plans. This statement responds to Te Pātaka o Rakaihautū / Banks Peninsula Stormwater Management Plan, which is the final SMP in development across the Christchurch District.

The purpose of Te Pātaka o Rakaihautū SMP includes the following:

- Contribute to meeting contaminant load reduction standards.
- Setting (and meeting) additional contaminant load reduction targets.
- Demonstrate the means by which Receiving Environment Objectives and Attribute Target Levels will be met.

It is important to note that stormwater originating from rural areas (including runoff from roads) is not included in this SMP.

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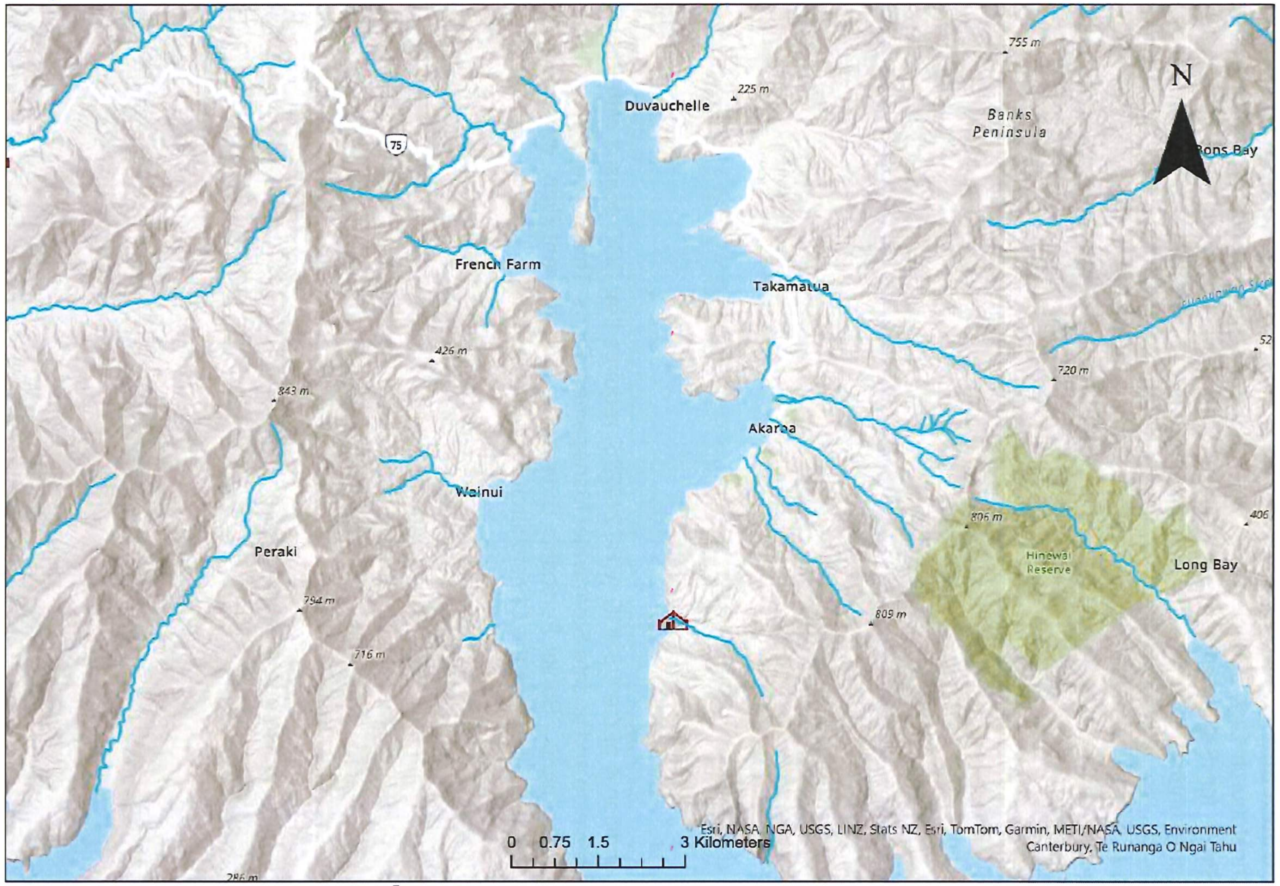

Figure 1: Akaroa Harbour Catchment including the location of Ōnuku marae (Source: ArcGIS Pro)

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Position of mana whenua

Ōnuku Rūnanga is the modern-day representative of the hapū Ngāi Tarewa and Ngāti Irakēhu. Irakēhu was the mother of many of the hapū and pā in the Te Pātaka o Rākaihautū (Banks Peninsula). Ōnuku is located on the shores of Akaroa Harbour. The takiwā of Ōnuku Rūnanga, as defined by the Ngāi Tahu Claims Settlement Act 1998, is centred on Ōnuku and the hills and coasts of Akaroa Harbour to the adjoining takiwā of Te Rūnanga o Koukourārata and Wairewa Rūnanga.

Ngāi Tarewa and Ngāti Irakēhu, hold kaitiaki responsibilities to ensure sustainable management of Akaroa Harbour, including protection of taonga and mahinga kai for future generations. Today, mana whenua-led social and environmental projects, businesses, mana whenua-managed taiāpure, co-governance of Takapūneke Reserve, and other activities and contributions to the wider community continue to build the contemporary story of Ngāi Tarawa and Ngāti Irakēhu within their takiwā. All of this is guided by the tribal whakatauākī:

Mō tātou, ā, mō kā uri a muri ake nei (for us and our children after us).

Akaroa Harbour is a significant cultural landscape with many cultural values associated with it. Natural features of the harbour and its coastline, streams, and ridgelines embed within them Ngāi Tahu history and identity. Freshwater streams of the inner harbour influenced the positioning of early kāinga/temporary campsites used by Ngāi Tahu tupuna. Other cultural values associated with Akaroa Harbour include kai moana, Wāhi Tapu sites, taonga species, native vegetation, culturally significant landscapes, and many traditional Ngāi Tahu place names within cultural memory that warrant acknowledgement, protection and management.

While wastewater discharge to Akaroa Harbour is one of the most significant issues for Ngāi Tahu and Ōnuku Rūnanga, coastal water quality is also significantly affected by non-point source or diffuse pollution and land use. Contaminants from stormwater enter waterways throughout the Akaora Harbour catchment which then all discharge into the harbour. The coastal environment is the meeting place between Papatūānuku and Tangaroa – with coastal processes and influences often extending a considerable distance inland, and inland activities often having a direct impact on the coastal environment.

Improving stormwater management requires on-site, land-based solutions to stormwater disposal, alongside initiatives to reduce the presence of sediments and contaminants in stormwater and reduce the volume of stormwater requiring treatment. Low-impact development and low-impact urban design are fundamental features of sustainable stormwater management. The Ngāi Tahu Subdivision and Development Guidelines outline a number of important issues for Ngāi Tahu in the takiwā relating to stormwater. They provide a framework for Papatipu Rūnanga to positively and proactively influence urban growth while also enabling Council and developers to identify issues of importance and desired outcomes for protecting tāngata whenua interests on the environment.

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Ōnuku Rūnanga has identified several priorities for their takiwā that relate to stormwater management:

1. Elimination of discharges of contaminants to Akaroa Harbour.
2. To scale up with urgency the active regeneration of our ecological systems, enhancement of mauri, and climate change preparedness of Akaroa Harbour.
3. To centre ecological regeneration and climate change planning and adaptation efforts on mahinga kai.
4. For abundance in mahinga kai to be the key objective and measure of success.
5. For the status of Ngāi Tarewa and Ngāti Irakēhu as mana whenua and a Treaty Partner manifests in partnership and shared decision-making between Council and Ōnuku Rūnanga for the active protection of valued resources and restoration of the mauri of the environment.
6. Integrated approach to the management and development of Akaroa Harbour, based on the principle of Ki Uta Ki Tai and recognising the relationship between land use and coastal waters.

CCC have proposed three mitigation options for consideration to help address contaminant issues associated with stormwater runoff and achieve their Attribute Target Levels as part of the Consent requirements. The three options include a combination of contaminant capture by way of treatment devices and environmental enhancement works. Ōnuku Rūnanga support Option 2 as the preferred mitigation option to address contaminants from stormwater runoff throughout Te Pātaka o Rākaihautū settlements. This option appropriately balances the number of treatment devices to directly capture contaminants in key waterways, as well as enhancing the natural environment and restoring indigenous habitat. The difference in contaminant capture between all three options is also small relative to total contaminants throughout the catchment, which does not justify installing more treatment devices at the expense of stream enhancement. Ōnuku Rūnanga do not support Option 3 or any mitigation option that does not incorporate any stream enhancement measures.

Ōnuku Rūnanga does not oppose Te Pātaka o Rākaihautū Banks Peninsula SMP but has outlined several issues/concerns relating to stormwater and freshwater management within the takiwā of Ōnuku Rūnanga.

<u>Ngā Wai/Wai Māori – Freshwater</u>

- **Climate change:** Climate change is the largest, most pervasive threat to the natural environment and societies the world has ever experienced (United Nations 2022). The impact of climate change is a key concern for Ōnuku Rūnanga, in particular as it relates to Wai Māori:

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- Flooding in low-lying areas - Several waterways flow through developed urban areas, which makes them highly vulnerable to the impacts of flooding and stormwater contaminants. These waterways have many point sources of stormwater, such as from road sumps and individual dwellings. The number of point sources, structural intrusions, and lack of sufficient riparian planting in places contribute to the degraded cultural values of these streams.
- Changes in rainfall - NIWA predicts 5 to 15% less rainfall on the peninsular over summer and an increase of 10% rainfall over winter. Dryer summer soils and wetter soils during winter will exacerbate erosion and loss of topsoil (along with increased flooding and drought) and impact terrestrial ecosystems.
- Drinking water - Availability of fresh drinking water is a significant issue. Akaroa is already under pressure. CCC predicts that water availability will be reduced during drought. By 2090 there will be 20% less water in rivers. Reduced flow in streams will also have a significant impact on stream health, coastal ecosystems, and mahinga kai value.

- **Sedimentation:** Increased sedimentation run-off via the many short, steep streams due to storm events and land use, exacerbates phosphates and other contaminants entering the harbour, accelerating the risk of algae bloom, ocean acidification, loss of sea grass habitat, and loss of mahinga kai value. Sedimentation is a significant issue for Ōnuku Rūnanga. Sedimentation is exacerbated within urban areas where the streams are more modified, have stormwater discharging into them, and lack of sufficient riparian planting in places

- **Contaminants from direct discharge and land use:** Land use practices, in particular deforestation for the purpose of urbanisation and farming, have significantly impacted the health of streams, coastal ecosystems, and the mahinga kai value of Akaroa Harbour. Contaminants from stormwater discharge into these waterways degrade the cultural values associated with them. The decline in freshwater quality is especially evident in urban streams. Rūnanga are especially concerned with the recent Water Quality Index results, which show Aylmer's Stream has the worst score in the catchment (55.3), indicating 'poor' water quality.

- **Urban growth:** Urban growth and development throughout the Akaroa Harbour catchment are putting more strain on existing infrastructure and natural resources, in particular fresh water. Future development throughout the takiwā must consider future conditions and adopt measures to ensure homes are resilient to our changing climate. It is critical that tāngata whenua are recognised in the decision-making process relating to future development.

- **Lack of integration:** CCC and ECan are engaged in multiple projects within Akaroa harbour. Many of these projects include native revegetation, research, or ecological enhancement in some form. There is a lack of co-ordination between these projects and a missed opportunity to form clear priorities to maximise outcomes.

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Taonga Species and Mahinga Kai

- **Manaakitanga:** Ōnuku whānau are renowned for the way in which they manaaki their manuhiri. The kai that comes out of the Ōnuku whare kai is second to none. Platters of kaimoana, tuna (eel), and whitebait patties are typical at hui or events held at Ōnuku marae. This practice provides a great sense of pride and whanaungatanga for the whānau who have gathered the kai, and the whānau who have cooked and served it. The whata in front of Ōnuku marae is a visual reminder of the significance of Akaroa harbour and kaimoana to the identity, traditional practices, and means of passing values and knowledge on to current and future generations.

- **Mahinga kai:** The practice of manaakitanga relies on an abundant mahinga kai and is intimately connected to the moana and the interconnected system of streams and hills that surround the harbour. The ability to harvest kaimoana such as paua, pātiki (flounder), kōura (crayfish), kutai (mussels), and many other delicacies from the realms of Tangaroa and Tanē Mahuta is very much dependent on the health and integrity of the functionality of this interconnected ecosystem.

- **Loss of cultural identity:** Direct discharge of contaminants through treated wastewater, stormwater discharge, and from industrial and farming practices continues to negatively impact on mahinga kai and recreational qualities of the coastal environment. Loss of mahinga kai value impacts on cultural practices, mātauranga Māori, and cultural identity.

Recommendations

To mitigate the concerns listed above, CCC will:

1. **Increase collaboration and coordination of ecological enhancement efforts:** Ōnuku Rūnanga wants to implement a collaborative approach to stormwater management. Many adaptation goals from Te Kori a te Kō (Ōnuku Rūnanga Climate Change Adaptation) are interconnected with stormwater management goals. Planning around future stormwater management must involve a collective approach integrating mātauranga Māori and locally based knowledge.
2. **Acknowledgment and protection:** Acknowledge and protect the ancestral relationship of mana whenua to Akaroa Harbour, and that the relationship is ongoing and enduring, and that the Council will provide for that relationship, acknowledging Ngāti Irakehu and Ngāi Tarewa as holding rangatiratanga and mana whenua/mana moana and as kaitiaki.
3. **Ki Uta Ki Kai:** Ensure an integrated approach to the management and development of Akaroa Harbour, based on the principle of Ki Uta Ki Tai and recognising the relationship between land use and coastal waters.

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4. **Enhance mahinga kai value and stream health:** Implement measures to improve water quality and mahinga kai value in the Akaroa Harbour with particular focus on:
   a) Eliminating existing discharges of pollutants;
   b) Establishing native riparian buffer zones along all waterways and drains;
   c) Restoring degraded waipuna, salt marsh and sea grass beds;
   d) Installing sediment traps and other measures to reduce sedimentation and implementing appropriate controls on land use to control sedimentation;
   e) Investigate sources of *E. coli* where guidelines above the recreational standard have consistently been exceeded;
   f) Ensure that all waterways throughout the Akaroa Harbour catchment are treated to the same standard and managed for mahinga kai practice in the future; and
   g) Ensure the protection and enhancement of known spring sites.

5. **Stream naturalisation and preferred approach:** Stream naturalisation methods are the preferred approach to mitigate contaminant exceedances such as heavy metals and Total Suspended Solids (TSS) as opposed to treatment devices installed downstream of waterways.

6. **Future development:** Ensure development with regards to stormwater discharges throughout the Akaroa Harbour catchment is appropriate to the takiwā and avoids effects on cultural, environmental and community values.

7. **Mitigation:** Implement Mitigation Option 2 to address concerns relating to contaminants from stormwater runoff in Te Pātaka o Rākaihautū settlements, focussing on treating the worst streams and stream enhancement works throughout the catchment.

Ōnuku Rūnanga reserve the right to oppose the proposal or pursue avoidance or mitigation of any subsequent impacts that are identified as a result of further site visits or further discussions with CCC.

[redacted]

X

Signed:

Debbie Tikao

Ōnuku Rūnanga Te Taiao Portfolio Manager

Date: 16/06/2025

Date: 11/06/2025