Appendix 1
Timaru Stormwater Management Plan

DRAFT - Timaru Stormwater Management Plan

Prepared for Timaru District Council

3 May 2023

FOR LODGEMENT

TIMARU DISTRICT COUNCIL
Te Kaunihera ā-Rohe o Te Tihi o Maru

Quality Control Sheet

Title	DRAFT - Timaru Stormwater Management Plan
Client	Timaru District Council
Version	V1.0 For lodgement
Issue date	May 2023
Job reference	6-TTDA7.00 Contract 2442

Executive Summary

The area of the Timaru stormwater management area (SMA) is approximately 1,900 ha (Figure 5-1) and consists of a mixture of residential, open space, industrial, and commercial land use with some lifestyle blocks and pasture around the western fringes.

Timaru District Council (TDC) has a series of resource consents from Environment Canterbury (ECan) that permits the discharge of stormwater to land and into the Taitarakihi/ Te Ahi Tarakihi Creek, Waimataitai Creek and Ōtipua Creek; this management plan outlines how TDC will manage the activities that operate within the SMA and discharge into TDC's stormwater network, specifically to minimise the effect the stormwater may have on the environment.

This stormwater management plan captures the long-term vision for the management of stormwater within Timaru and outlines how the remedial and improvement programmes are identified and prioritised, and how they will realise the communities' objectives and targets for the management of Timaru's stormwater.

The Vision for Timaru's Stormwater Management is:

Together we value, protect and restore the mauri/lifeforce of the waterways so that it enables Mahinga kai, kī uta kī tai (mountains to the sea).

TDC manages the urban stormwater, whilst ECan has a responsibility for maintaining conveyance/flood carrying capacity of Taitarakihi Creek and Ōtipua/Saltwater Creek under their drainage bylaw. TDC has developed a multi-valued approach to the management of the water bodies and coastal environment within the stormwater management area. This approach follows the principles of Te Mana o Te Wai as set out in the National Policy Statement for Freshwater Management (2020).

TDC have adopted adaptive stormwater management principles to improve the management of stormwater in Timaru. Whilst this document outlines the principles and approach that TDC will apply, the mechanics of the approach are expressed in the "Timaru Stormwater Management Plan - Monitoring Plan", "Timaru Stormwater Implementation Plan" and associated guides; this management plan should be read in conjunction with these documents.

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for Timaru District Council ('**Client**') in relation to existing and future stormwater management in the Stormwater Management Area of Timaru ('**Purpose**') and in accordance with the Timaru District Council Professional Services for Stormwater Management Plan and Consent Applications, Contract Number 2442 dated 13th May 2020. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

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1. Introduction

The purpose of this Stormwater Management Plan (SMP) is to:

- State the vision, goals, and objectives for stormwater management in Timaru
- Provide an overview of the existing stormwater system and the receiving environment
- Outline the current stormwater management issues and challenges in Timaru
- Outline the stormwater management approach
- Introduce the methodology and tools TDC applies to manage the stormwater in Timaru
- Provide guidelines for monitoring the performance of the stormwater system and actions to be undertaken if the system is not meeting the performance standards

This SMP is not a design report, nor does it contain standard procedures for designing stormwater infrastructure. It is intended to provide a framework for implementing stormwater management practices to identify and then prioritise infrastructure or management process improvements.

2. Stormwater Management Vision and Strategy

2.1 Overview

The structure of this SMP applies the planning framework presented in Figure 2-1. Where the vision describes the future and hopes for the management of stormwater for the community Timaru and the environment, and each subsequent component in the hierarchy supports the vision.

Figure 2-1 Stormwater Strategic Hierarchy

2.2 Vision

The vision statement for stormwater management in Timaru is:

Together we value, protect and restore the mauri/lifeforce of the waterways so that it enables Mahinga kai, kī uta kī tai (mountains to the sea).

2.3 Principles

Te Mana o te Wai is the fundamental concept of the National Policy Statement for Freshwater Management 2020 (NPSFM), and "…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."

TDC has decided that the principles that underpin the concept of Te Mana o te Wai will be used as the principles of this management plan. These key principles are:

- Mana whakahaere: the power, authority, and obligations of tangata whenua to make decisions that maintain, protect, and sustain the health and well-being of, and their relationship with, freshwater
- Kaitiakitanga: the obligation of tangata whenua to preserve, restore, enhance, and sustainably use freshwater for the benefit of present and future generations
- Manaakitanga: the process by which tangata whenua show respect, generosity, and care for freshwater and for others
- Governance: the responsibility of those with authority for making decisions about freshwater to do so in a way that prioritises the health and well-being of freshwater now and into the future
- Stewardship: the obligation of all New Zealanders to manage freshwater in a way that ensures it sustains present and future generations
- Care and respect: the responsibility of all New Zealanders to care for freshwater in providing for the health of the nation.

2.4 Goals

TDC has identified four goals in their draft *Stormwater Management Plan and Resource Consent Application Vision and Strategy* document (dated 6 September 2021):

1. Planning and Regulation: Planning and regulatory framework supports and facilitates integrated stormwater management
2. Asset Management: Stormwater assets are managed effectively and efficiently using the industry's best practicable options to meet the adopted level of service of the primary network able to accommodate a 1 in 5-year rain event for residential areas and a 1 in 10-year rain event for commercial/industrial areas without the inundation of habitable floor areas
3. Receiving Environment: The impact of the stormwater systems results in the quality and flow regime of receiving environments being maintained
4. Stakeholder Engagement and Education: Broader community and stakeholder participation and understanding are established, and strong coordination and capability

These goals will be achieved through the objectives which have been developed to align with the NPSFM.

2.5 Objectives and Targets

The NPSFM sets out the hierarchy of obligations for Te Mana o te Wai which prioritises:

(a) first, the health and well-being of water bodies and freshwater ecosystems
(b) second, the health needs of people (such as drinking water)
(c) third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future.

Objectives and targets specific to Timaru have been identified and are expressed in the context of these three priorities, as summarised in Table 2-1.

2.6 Approach

The approach enables the rest of the hierarchy structure to be implemented via targeted monitoring of performance and planning of stormwater management upgrades. The approach is explained in Section 9.0.

Table 2-1 Hierarchy of obligations, objectives, and targets for stormwater management in Timaru

<table>
<tr><th>Te Mana o te Wai Hierarchy of Obligations</th><th>Objectives</th><th>Targets</th></tr>
<tr><td rowspan="3">First, the health and well-being of water bodies and freshwater ecosystems</td><td>1 Progressively reverse the diminished ecosystem health in the Taitarakihi/ Te Ahi Tarakihi Stream</td><td>For Taitarakihi/ Te Ahi Tarakihi Stream by 2040:
Sediment quality ≤ ANZG DGV
MCI scores improved from baseline (62.9) to 90
QMCI scores increased from baseline (2.0) to ≥ 4.
Improvements in riparian margins within the SMA Area where overland flow is an issue
Improvements in F-IBI scores from baseline [to be established) or other agreed fish diversity and abundance targets
Improvements in dry weather water quality from the baseline (to be established after 3 years) and routinely meeting ANZG receiving 90% species level of protection, for stormwater derived toxicants.
A reduction of fine sediment depth and cover over time.
Wet weather flows in Taitarakihi/ Te Ahi Tarakihi Stream are to meet any national acute toxicant guideline values for stormwater derived toxicants within 10 years of the guideline being published, or within 5 years if MCI and QMCI scores are not > 90 and 4 respectively.</td></tr>
<tr><td>2 Progressively reverse the diminished ecosystem health in the Waimātaitai Stream</td><td>For Waimātaitai Stream by 2035:
Sediment quality ≤ ANZG DGV
MCI scores improved from baseline (68 - 71) to 90
QMCI scores increased from baseline (4 - 3) to ≥ 5.
Improvements in riparian margins within the SMA Area where overland flow is an issue
Improvements in F-IBI scores from baseline [to be established) or other agreed fish diversity and abundance targets
Improvements in dry weather water quality from the baseline (to be established after 3 years) and routinely meeting ANZG receiving 90% species level of protection, for stormwater derived toxicants.
A reduction of fine sediment depth and cover over time.

Wet weather flows in Waimātaitai Stream are to meet any national acute toxicant guideline values for stormwater derived toxicants within 10 years of the guideline being published, or within 5 years if MCI and QMCI scores are not > 90 and 5 respectively.</td></tr>
<tr><td>3 Progressively reverse the diminished the ecosystem</td><td>For Ōtipua-Saltwater Creek by 2035:</td></tr>
</table>

Te Mana o te Wai Hierarchy of Obligations	Objectives	Targets
	health of the Ōtipua-Saltwater Creek.	• Sediment quality ≤ ANZG DGV • Upper reaches MCI scores improved from baseline (70 - 77) to 90 • Upper reaches QMCI scores increased from baseline (3.24 – 4.05) to ≥ 5. • Improvements in riparian margins within the SMA Area where overland flow is an issue • Improvements in F-IBI scores from baseline [to be established) or other agreed fish diversity and abundance targets Improvements in dry weather water quality from the baseline (to be established after 3 years) and routinely meeting ANZG receiving 90% species level of protection, for stormwater derived toxicants. A reduction of fine sediment depth and cover over time Wet weather flows in Ōtipua-Saltwater Creek are to meet any national acute toxicant guideline values for stormwater derived toxicants within 10 years of the guideline being published, or within 5 years if MCI and QMCI scores are not > 90 and 5 respectively.
	4 Progressively reduce the cumulative impacts of stormwater discharges on the Te Ahi Tarakihi Mātaitai and Tūhawaiki Mātaitai so the coastal habitat is healthy and suitable for safe mahinga kai harvesting, and the mahinga kai species are safe to eat.	No human source incidents of E.coli concentrations entering waterways or the coast via the stormwater network (e.g. through cross connections or wastewater overflows). Coastal sediment quality within Whales Creek ≤ ANZG DGV Mussel tissue quality ≤ FSANZ Food Standards Code maximum levels or median or 90th percentile GEL Note: Total arsenic results are to be factored by 0.05 (reduced by 95%) to calculate the inorganic arsenic concentration to be compared against FSANZ Food Standards Code inorganic arsenic values Mussels >50 mm shell length have large quantities of flesh outside spawning seasons inclusive of a post spawning period of one month
	5 TDC advocate for kī uta kī ta (from the mountains to the sea) during TDC's involvement stakeholder and regulator in RMA and LGA processes.	None
	6 Where practicable prioritise addressing effects of stormwater quality and quantity	95% of new development buildings or structures do not use materials that contribute to stormwater contamination

Te Mana o te Wai Hierarchy of Obligations	Objectives	Targets
	at or close to their source rather than at the end of pipe into surface water or instream.	90% of new subdivision, use and development is to achieve stormwater neutrality on site or improvements towards stormwater neutrality Council roading and carpark upgrades and redevelopment projects incorporate as far as practicable treatment of stormwater.
Second, the health needs of people (such as drinking water)	7 Stormwater impacted sediment in public areas as is not a risk to human health	Within public parks ephemeral waterways, Whales Creek and the Patiti Point Coast stormwater outfalls and channels, sediment quality ≤ nationally recognised parks/recreational soil contaminant standards (SCS) No human source incidents of E.coli concentrations entering Ōtipua-Saltwater Creek via the stormwater network (e.g. through cross connections or wastewater overflows)
Third, the ability of people and communities to provide for their social, economic, and cultural well-being, now and in the future	8 Recognise and respect mana motuhake – the whakapapa and the relationship Kāti Huirapa have with water ecosystems in their rohe and actively involve them in stormwater management.	Refer to associated consent conditions 8, 10, and 15 that are in relation to Kāti Huirapa contributions to the: • Development of the Implementation Plan to achieve the objectives and targets; and, • The periodic reviews of the Monitoring (Trigger Actions and Response) Plan and Stormwater Management Plan.
	9 When investing in stormwater infrastructure environmental, social and cultural benefits are optimised.	Investment is shown to have prioritised options that achieve environmental, cultural and social benefits.
	10 Stormwater is managed so that run-off from urban areas, the primary stormwater network and overland flow paths, does not exacerbate the flooding, erosion or damage to property or infrastructure or cause risks to human safety.	Zero flooding for rain events up to a 1 in 5 year return for residential zones, and a 1 in 10 year return for commercial and industrial zones Zero deaths and notified injuries from stormwater runoff The significant flood risk identified in the lower parts of the Taitarakihi Stream and Waimātaitai Stream catchments is progressively reduced
	11 Timaru is more resilient to the effects of flooding and the associated impacts of climate change.	The above targets for Objective 10 will be achieved by considering and designing for predicted climate change increases in storm intensities and depths beyond 2031 for the duration of the consent. Water Quantity modelling for predicted climate change increases in storm intensities and depths beyond 2031 is undertaken within 5 years of commencement and periodically reviewed for the duration of the resource consent to ensure Objective 9 is at least meet.

3. Scope

The Timaru SMP covers the stormwater activities and TDC's infrastructure within the Timaru Stormwater Management Area (SMA) that is shown in Figure 3-1.

Figure 3-1 Timaru Stormwater Management Area

The SMA extent is based on both the existing urban area and most of the anticipated urban Future Development Areas (but still zoned rural) set out in the proposed Timaru District Plan (pTDP). TDC has obtained a series of Resource Consents from Environment Canterbury that permit TDC to manage and discharge stormwater from existing urban areas and future urban growth to groundwater, surface waters, and coastal environments.

- XXX List and summarise these resource consents here if some existing catchment consents are not superseded by the SMA application

As a result, TDC can permit properties within the SMA to discharge stormwater subject to the specific conditions in the consents and ensuring that any stormwater discharges comply with TDC Stormwater Bylaw. Specifically, TDC has consents that permit the following discharge or activities:

- XXX List the activities – reconfirm once the consent is applied for/granted
- Discharges of stormwater generated from urban areas within the SMA that are from the TDC reticulated network. In addition, TDC can permit the discharge of non-connected residential, retail and commercial sites within the SMA that discharge onto land (but not via an engineered soakage system within their site or directly to surface water
- The discharge of construction-phase stormwater from development construction areas

However, several discharges are excluded from the consent, being:

- From engineered soakage systems into land for discharges of construction-phase stormwater or stormwater from a developed site
-

- Land disturbance stormwater discharges into the reticulated stormwater network and onto or into land within the SMA or into surface water that exceeds 4 ha of a disturbance at any one time.
- Where an approved Erosion and Sediment Control Plan has not been implemented for land development construction areas.
- Discharge of stormwater onto or into land or to surface water from any development construction area or mitigation facility that HAIL activities have occurred.
- Sites that have received a written stormwater disconnection notice from TDC.

It is important to note that the SMP and associated resource consents are limited to managing activities within the SMA.

4. Description of the Stormwater System

4.1 Stormwater Network and Infrastructure Description

The Timaru township is made up of several, largely discrete, stormwater networks, owing to the well-defined waterway catchments and gullies that make up the SMA area. In some areas, there are lengths of road several kilometres long without a stormwater pipe as the steep catchments mean kerb and channel has the capacity to convey stormwater a reasonable distance. The network is generally aged and there is limited information on the physical condition of the pipes.

The ownership and subsequent responsibility for the operation and maintenance of stormwater assets is split between TDC departments. Currently, TDC's Land Transport Unit manage the street infrastructure (i.e. sumps in the roads), the Drainage and Water team are generally responsible for all other stormwater infrastructure, while the Parks and Reserves team tend to maintain the planted areas (e.g. raingardens, stormwater basins, swales).

The level of service currently adopted by TDC is that water will not inundate habitable floor spaces in the:

1. 5-year ARI for urban residential areas
2. 10-year ARI for industrial and commercial areas

This means that ponding can be expected to occur in parks, roads, and private properties during the above rainfall events.

Figure 4-1, Table 4-1 and Table 4-2 shows the stormwater infrastructure servicing the Timaru township.

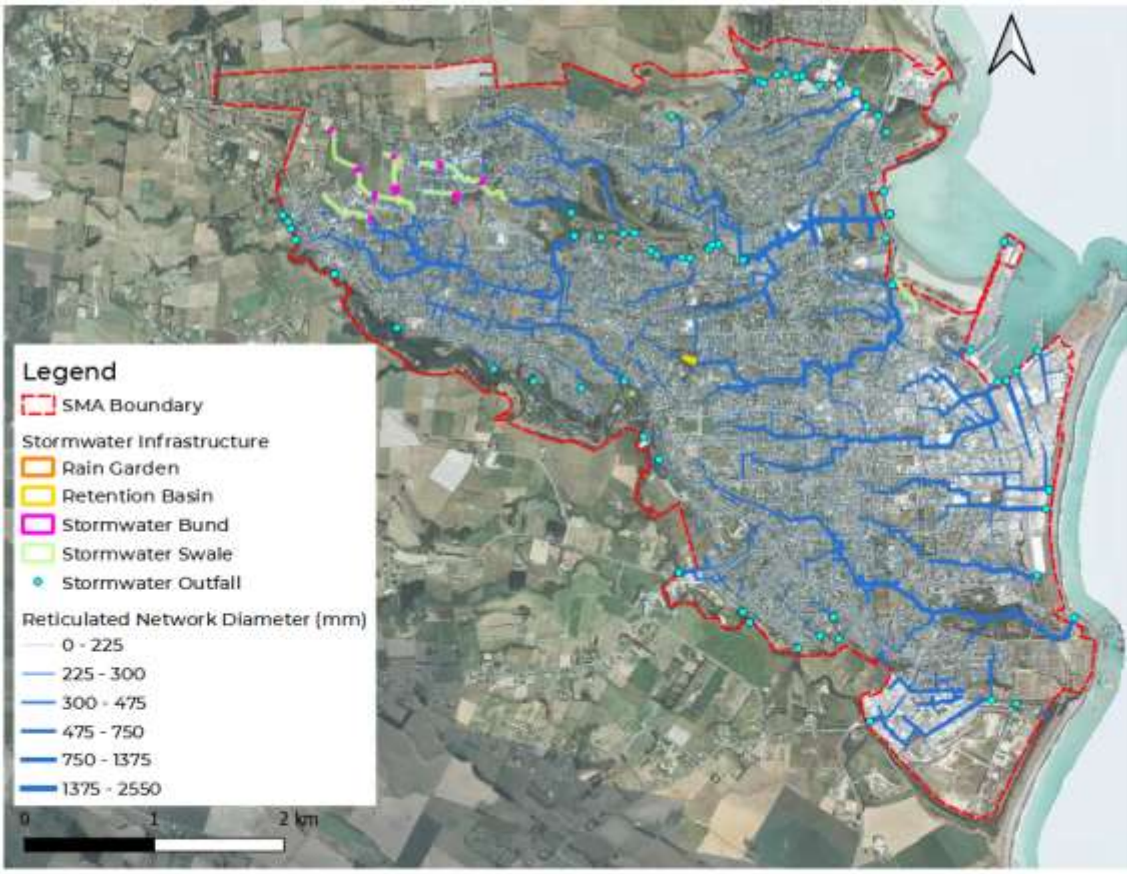


Figure 4-1 Stormwater infrastructure in Timaru

Table 4-1 Stormwater Conveyance Infrastructure Summary

Stormwater Infrastructure	Quantity
Stormwater pipe length	149,933 m total
<300 mm diameter	65,756 m
300 – 500 mm diameter	43,214 m
500 – 1,000 mm diameter	28,463 m
>1,000 mm diameter	12,500 m
Stormwater outfalls	65

Eight of the coastal outfalls, prone to blockage, have been flagged as part of TDC's Stormbeat programme, which involves pre-emptive maintenance of stormwater and wastewater infrastructure before large storm events.

Table 4-2. Summary of the stormwater treatment infrastructure in the Timaru SMA.

Location	Date Constructed	Function	Approximate Catchment (m^2)	Approximate Storage Volume (m^3)	Footprint Area (m^2)	Estimated First Flush Depth (mm)
Hillview Crescent	2016	Rain Garden	4,800	24	80	8
Wai-Iti and Morgans Road	2015	Rain Garden	3,500	18	60	8
West End Park	2009	Retention Basin	67,000	1,400	1760	21

Within Gleniti, there are a series of attenuation bunds within three natural gullies designed to mitigate the effects of development in the Gleniti area in northwest Timaru. The 570 ha area of Geniti was rezoned to residential in 2006, approximately 18% of the wider Waimataitai catchment. Grassed swales convey stormwater through the gullies, connecting the bunds in series and providing some treatment. Figure 4-2 shows the location of the bunds and summarises the progress of bund design and construction.

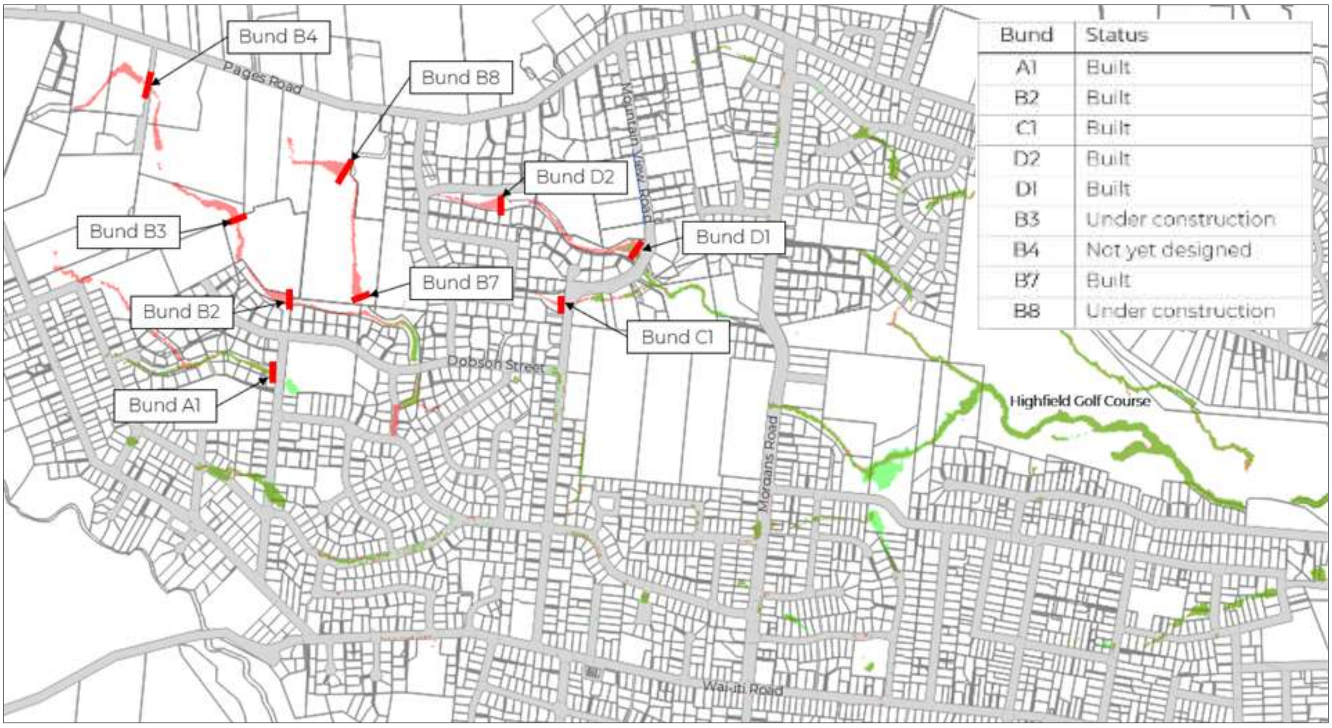


Figure 4-2 Gleniti bunds

4.2 Stormwater Network Capacity

An assessment of the capacity of the stormwater network has been completed (WSP, 2021), as presented in Table 4-3 and Figure 4-3.

The capacity assessment found that most of the pipe network is appropriately sized, with 73% of the network able to convey the 5-year ARI peak flows and 64% able to convey the 10-year ARI peak flows. Only 14% of pipe were unable to meet the 2-year ARI level of service. This assessment highlights that the capacity in the Timaru stormwater network is generally able to meet TDC's level of service requirements, however an increase in capacity could help to alleviate nuisance flooding in affected areas.

Table 4-3 Timaru stormwater pipe network capacity performance (WSP, 2021)

2-Year ARI	5-Year ARI	10-Year ARI	Total Length Assessed	Excluded Length	Total Length of Pipe Network
44,509 m (86%)	37,800 m (73%)	33,098 m (64%)	51,081 m (98%)	944 m (2%)	52,025 m

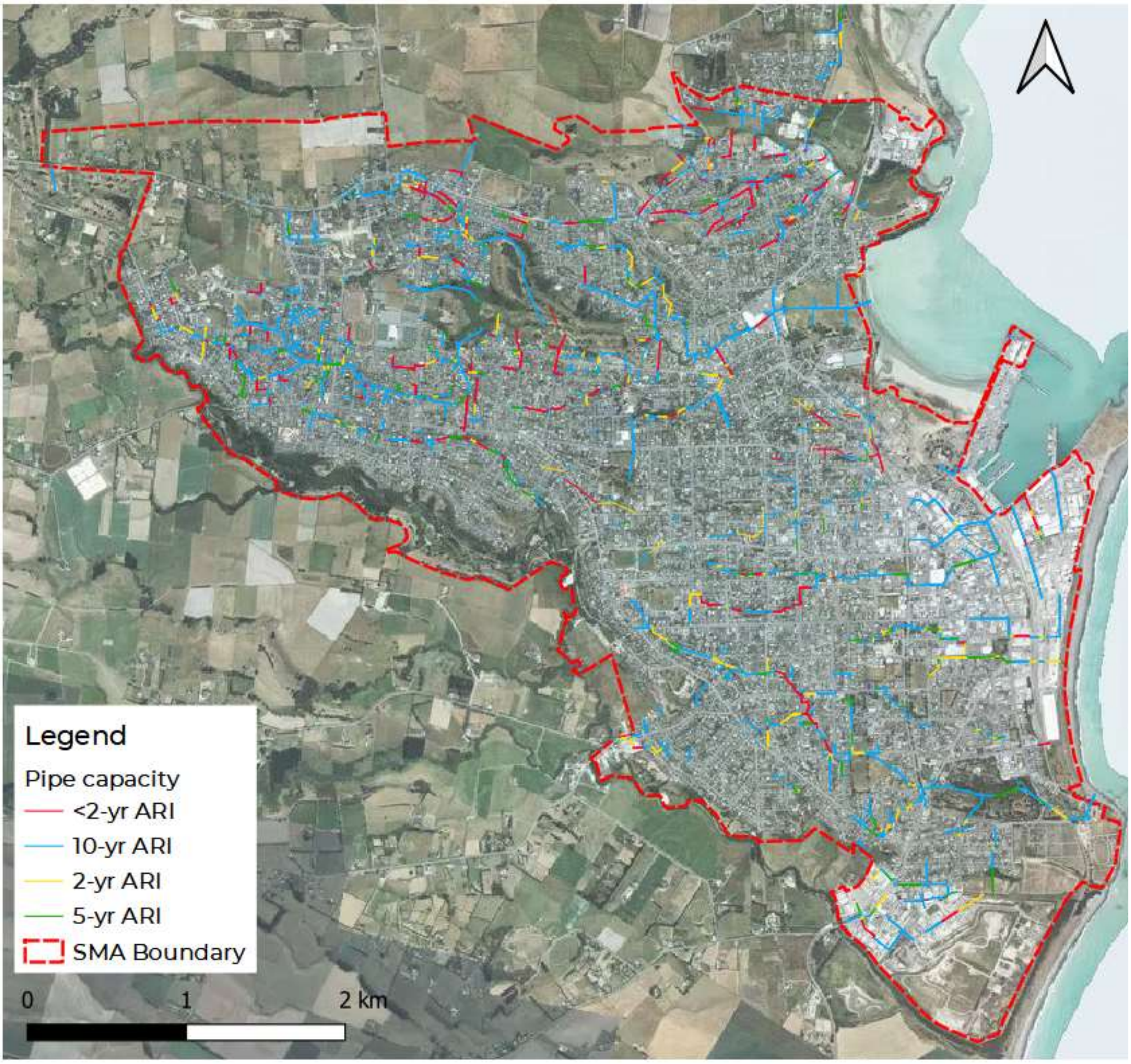


Figure 4-3 Stormwater network pipe capacity.

4.3 Flood Risk Assessment

WSP (2021) flood mapping assessment found that Timaru rolling topography creates well-defined overland flow paths for runoff and flood water exceeding the pipe network capacity. Where obstructions to these flow paths exist, such as roads with undersized culverts, flooding can be deep.

In general, stormwater related issues and actions in the Timaru SMA include blockages of inlets, outfalls, sumps and culverts, as well as flooding. Known problem areas for blockages and flooding have been identified by TDC as part of the “Stormbeat” programme. These locations, as well as the predicted 10-year ARI flood depth and buildings potentially at risk of flooding are shown in Figure 4-4. Approximately 8% of buildings are identified as potentially impacted by flooding, being those where the building footprint intersects flood depth greater than 150mm (NZBC minimum floor level). This assessment was based on the LINZ buildings layer which includes non-habitable buildings such as sheds and garages.

Figure 4-5 graphically depicts the 10-year ARI flood information to a flood hazard and Figure 4-6 shows the predicted 200-year ARI flood depth.

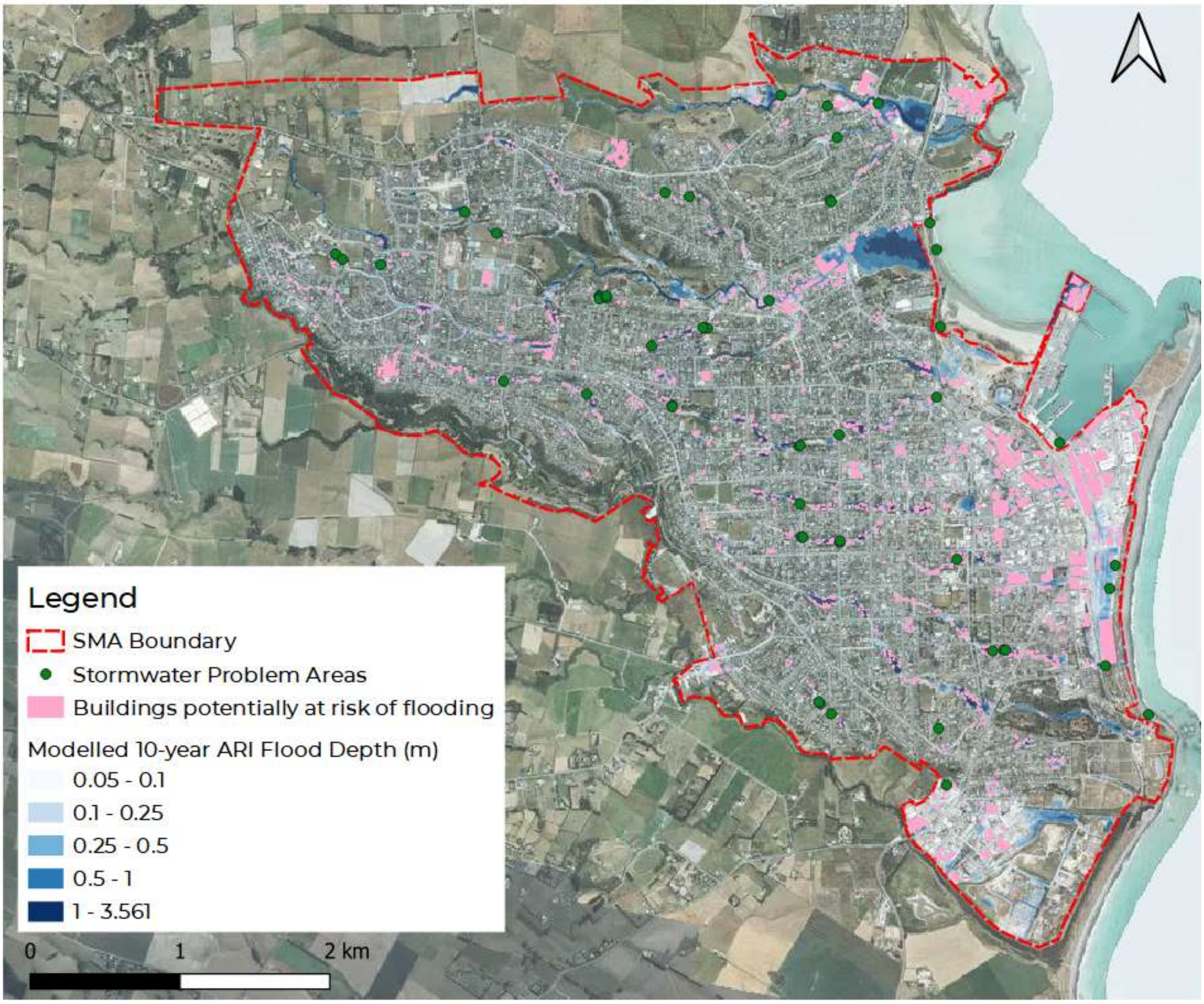


Figure 4-4 10-year ARI Flood Depth and Stormwater Problem Areas

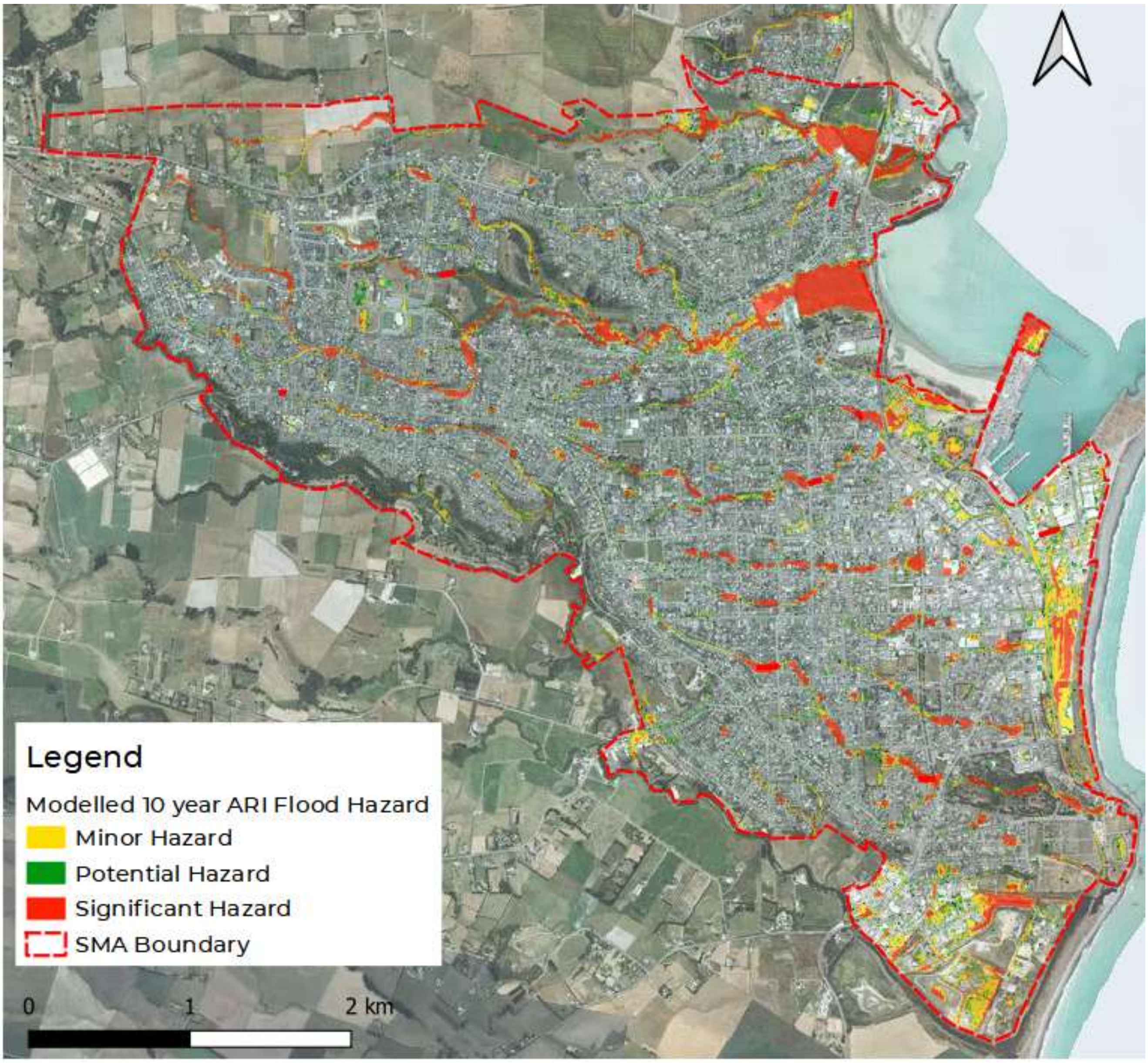


Figure 4-5. Modelled 10-year ARI Flood hazard class

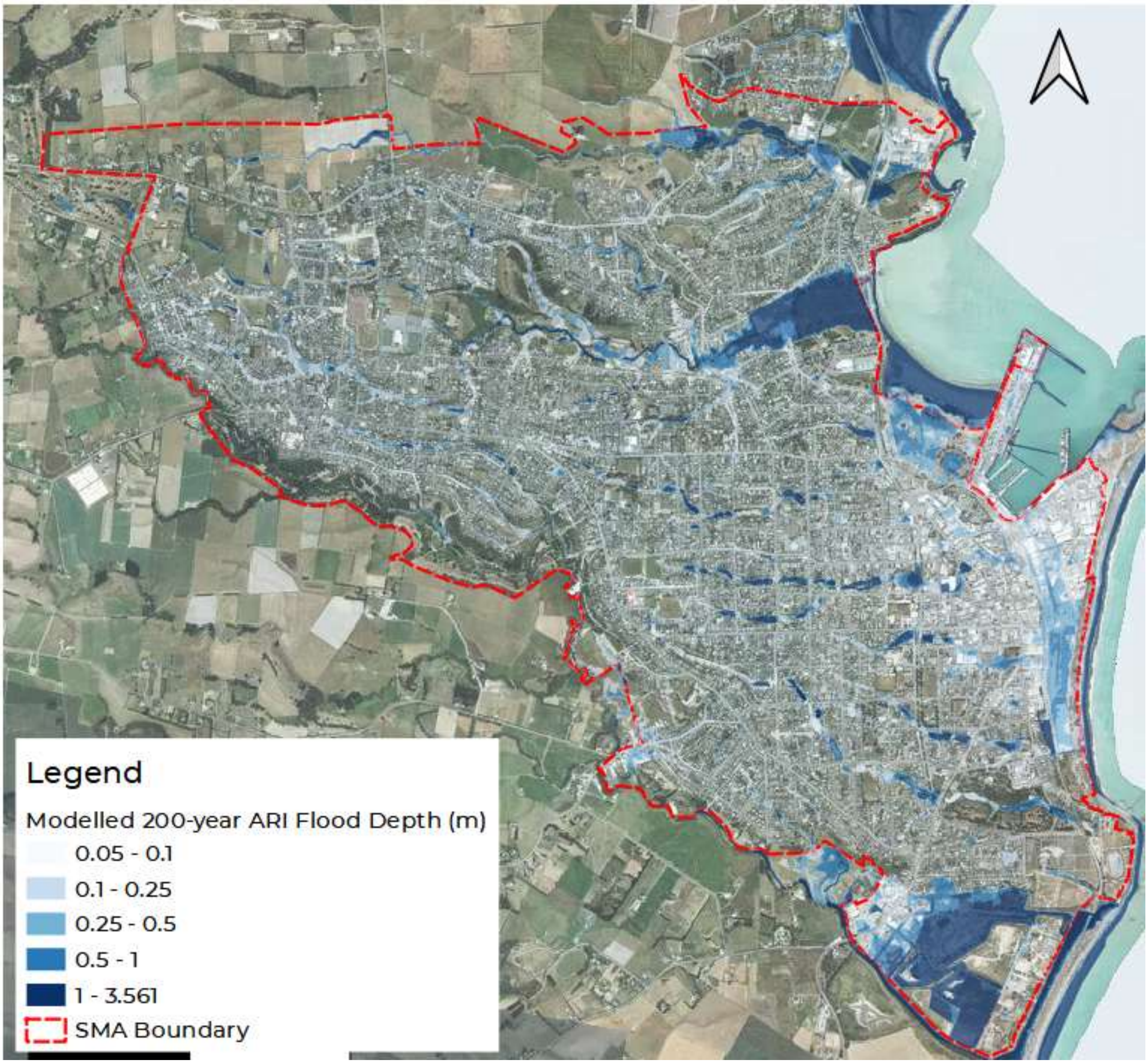
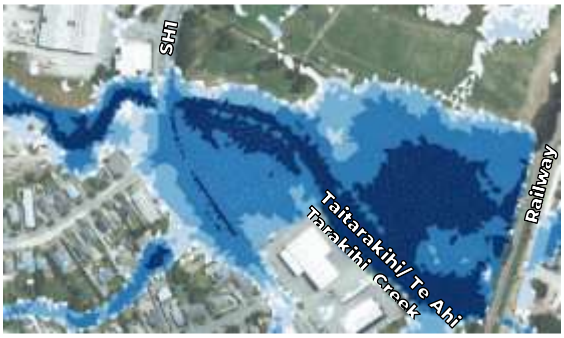


Figure 4-6 Modelled 200-year ARI (with climate change) flood depth

Table 4-4 outlines the key flooding issue areas in Timaru, that are a focus for TDC given community interest and the significance and frequency of complaints.

Table 4-4 Key flooding issue areas, including issues recently addressed

Location	Description
1. Taitarakihi/ Te Ahi Tarakihi Creek 	The area around State Highway One (SH1) near the bottom of the Taitarakihi/ Te Ahi Tarakihi Creek catchment is arguably the highest flood risk area in Timaru, with multiple instances or property and businesses flooding in recent years and flooding of SH1. Upgrades to increase the culvert capacity beneath the railway was completed in 2022 and Waka Kotahi have plans to also upgrade the culverts beneath SH1. These two major upgrade projects will greatly increase the capacity of the Creek but a wider catchment-scale option (e.g. attenuation of the upper catchment and creek widening) will be required to lower the flood risk in this area to an acceptable level.
2. Waimataiati Stream 	There are known flooding issues in the lower parts of the Waimataitai Creek catchment, particularly around the commercial area including Pak-n-Save. However, the modelled flood extents may be overstating the flood risk as downstream of the Highfield Golf Course, the stormwater network has not yet been added to the stormwater model. Results are based on rain-on-grid modelling and areas like Ashbury Park show as flooded because the railway embankment acts as a dam. TDC have a current model build project for the Waimataitai and Whales Creek catchments which is scheduled for completion mid-2023, from which the flood risk can be better understood, and solutions investigated.
3. June Street 	The June Street issue is with a vertical stormwater pipe that was installed to convey stormwater from June Street over a 20m high cliff to the property below. In this high energy environment, surcharging of the downstream manhole caused flooding in the shared driveway and adjacent properties. A grated manhole lid was installed on the manhole to release air pressure which has helped, however overland flow from June Street continues to be an issue in heavy rainfall. TDC's Land Transport unit are investigating a solution to improve inlet capacity in June Street

4. Caroline Bay 	Caroline Bay is an area well known for flooding of the roads, playground and paddling pool following heavy rainfall, caused by a combination of overflows from an undersized stormwater main (servicing the large Whales Creek catchment) and inadequate localised drainage to clear excess water after the event. Works are underway to seal the main stormwater line which will increase capacity by allowing the pipeline to surcharge without spilling. Combined with this are improvements to the local drainage system, including a small pump station to drain low lying areas.
5. Kauri Street 	Properties either side of Kauri Street, that are located in the overland flow path, are lower than the road, with the road an obstruction to the overland flow. Recent works have been undertaken to increase inlet capacity in Kauri Street along with some entranceway modifications to prevent surface flow from Kauri Street spilling down the driveway and into the garage/downstairs rooms at 9 Kauri Street. These works improved the situation for small frequent events, but extensive network upgrades and/or major overland flow path modifications would likely be required to make any significant improvements to level of service.
6. Canada Street 	This area of Canada Street, in the Gardens Gully catchment, is a low point in the topography with no overland flow path (until ponding has risen over 2m deep to overtop Woodland Road). Some work to clear root intrusion in 2017 helped to improve the level of service in small events. Hydraulic modelling indicates that the area would benefit from both improvements in inlet capacity and pipe network capacity, along with consideration of overland flow path management.

4.4 Contaminant Sources and Loads

The majority of Timaru SMA's discharge stormwater to a waterbody via 70 outfalls. Consequently, any activities or urban buildings and infrastructure within the SMA have the potential to discharge contaminants into these urban streams and creeks passing through Timaru, or directly to the coastal environment.

To understand the risks that commercial and industrial properties pose to the water quality in the stormwater, a desktop evaluation has been completed which will be followed up by detailed inspections based on a desktop assessment of the risk posed by the property. In addition, an evaluation of the likely contaminant load from the outfalls has been completed.

4.4.1 Contaminant Load Model

To establish a better understanding of the likely contaminant loads within the SMA, a contaminant load modelling (CLM) assessment tool was developed for Timaru(PDP, 2021c). The CLM allows TDC to identify areas that contribute the highest contaminant loads and would therefore likely benefit the most from stormwater treatment.

There are 87 sub-catchments in the Timaru CLM which are presented in Figure 4-7 along with the catchment boundaries of the receiving environments, those being Taitarakihi/ Te Ahi Tarakihi Creek, Waimataitai Stream, Whales Creek, Ōtipua-Saltwater Creek and direct discharges to the coastal environment, including the harbour (the Pacific Ocean catchment).

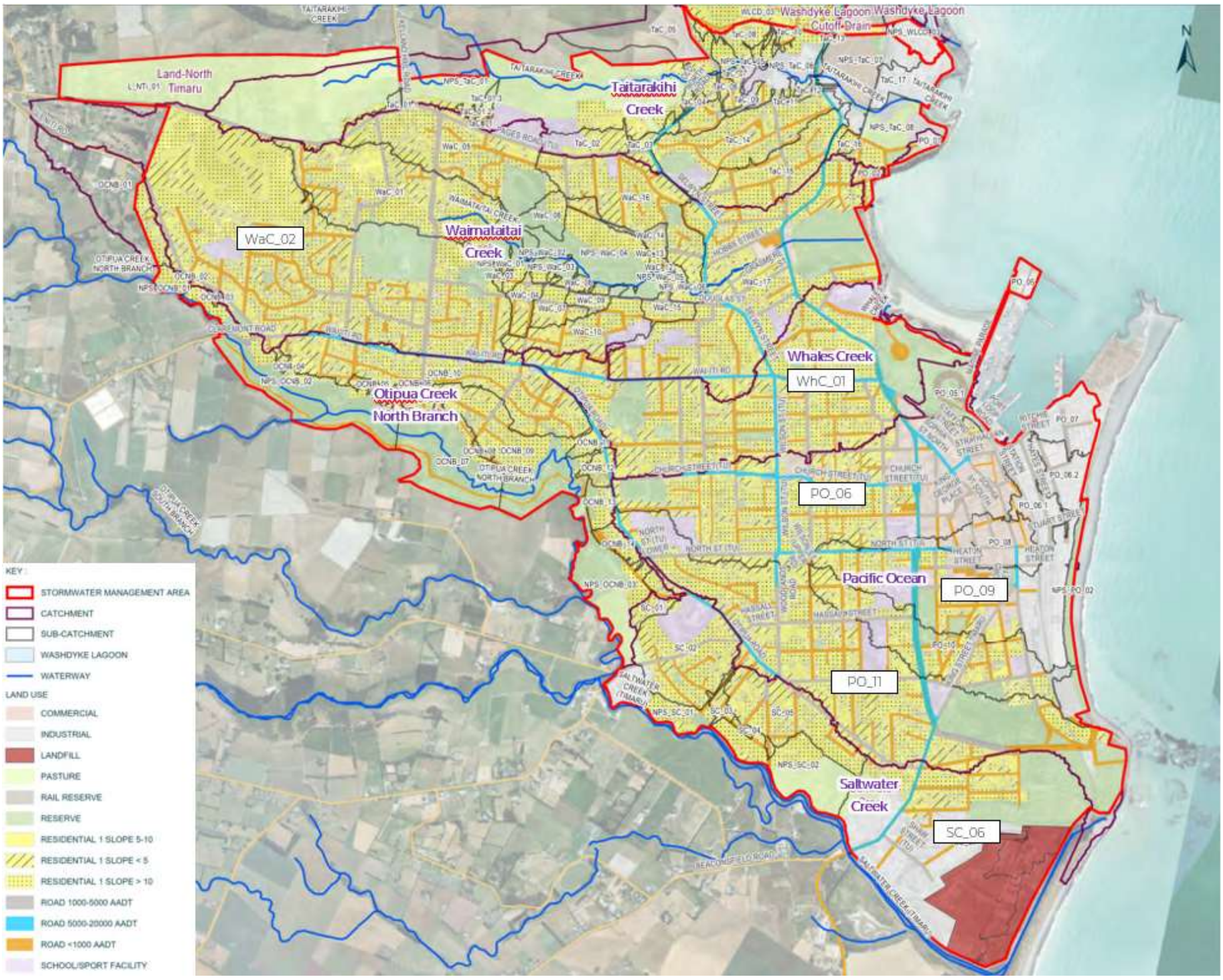


Figure 4-7 CLM sub-catchments draining to each outfall (grey outline), with multiple sub-catchments grouped together for each main receiving environment (purple outline/labels). White text boxes label the six most significant contributing catchments

A summary of the contaminant load predictions, on a receiving environment basis, is presented in Table 4-5. The 21 sub-catchments flowing to Waimataitai Creek are collectively expected to discharge the greatest mass of TSS within the SMA of Timaru. This reflects the significant proportion of pasture and reserve land use in this catchment. A large proportion of the stormwater network in Timaru discharges directly to the Ocean. As presented in Figure 4-7, the Pacific Ocean catchment has been created to include all 12 sub-catchments which, via multiple outfalls discharge to the harbour or the Timaru foreshore. As this is the largest urban catchment, the model predicts this catchment will discharge the greatest mass of TCU, TZn and TPH. This is expected due to the extensive industrial and commercial activities occurring in this catchment.

Analysing the CLM results by land use (PDP, 2021c) demonstrates that the residential land use areas are predicted to contribute the majority of TSS loading. Industrial areas contribute the majority of TZn, while the roads are the highest contributors of TCu and TPH.

Table 4-5 Environments Distribution of Contaminant Loadings in Timaru According to Receiving environments

Receiving Environment	Area (ha) % SMA	TSS (t/year) % SMA	TZn (kg/year) % SMA	TCu (kg/year) % SMA	TPH (kg/year) % SMA
Land - North Timaru	42.5 2.10%	63.1 6.70%	2.5 0.20%	0.6 0.60%	2.5 0.40%
Ōtipua Creek North Branch	206.4 10.40%	98.4 10.50%	32.2 3%	4.7 5.30%	43 7%
Pacific Ocean	514 25.80%	163.4 17.40%	459.2 43.10%	34.9 39.20%	265.9 43%
Saltwater Creek	242.3 12.20%	105.1 11.20%	232.3 21.80%	13.1 14.70%	32.9 5.30%
Taitarakihi/ Te Ahi Tarakihi Creek	273.8 13.70%	197.7 21.10%	185.5 17.40%	12.9 14.40%	52.3 8.50%
Waimataitai Creek	557.8 28%	243.7 25.90%	117.2 11%	16.6 18.70%	139.7 22.60%
Whales Creek	156.6 7.90%	67.9 7.20%	36.9 3.50%	6.4 7.20%	81.7 13.20%
Total SMA	**1993.4**	**939.3**	**1065.8**	**89.2**	**618**

The CLM analysis also identified six sub-catchments, as labelled in Figure 4-7, that are predicted to contribute a disproportional mass of stormwater contaminants. Focusing on only six of the 87 sub-catchments would cover 44.1% of the SMA area and which, combined, contribute between 35.8% to 55.0% of the total contaminant load. The key advantage of focusing on these six sub-catchments is that whilst they each cover a large area and contribute a high proportion of contaminant load, they discharge to one point. This means that stormwater from these large sub-catchments can be treated by focusing on a small number of locations making a significant improvement to the stormwater exiting the SMA. Further priority could be given to WaC_02, WhC_01 and SC_06 as Waimataitai Creek, Caroline Bay and Saltwater Creek are likely more sensitive to contaminant discharges than the harbour or the Timaru foreshore.

Contaminant loads for certain pollutants are expected to decrease over time as new materials and regulations limit previous high contaminant yield materials/practices. For example, it is expected that new builds and replacement roofs within the SMA will utilise materials which have a reduced risk of leaching zinc into the stormwater runoff. Education campaigns, such as the effects of copper disk brakes on environment, at a local and national level have the potential to significantly speed up this process.

4.4.1 Non-residential Assessments

It is important to note that in addition to the contaminants predicted by the CLM, other hazardous contaminants can be transported from industrial and commercial sites with poor stormwater management.

The non-residential assessments conducted by PDP (2021b) identified 93 commercial or industrial properties that present a potential risk to the quality of stormwater within Timaru. A desktop assessment was carried out to determine the risk level of commercial and industrial sites in the Timaru District by the activities occurring at the sites. In Timaru, nineteen sites were deemed to be high-risk due to the type of activity occurring at the site. Following the desktop assessment, high-risk sites were identified for detailed site assessments which involved a site walkover using a GIS-based survey to record areas of interest and notes from the site. The purpose of these assessments was to ensure compliance with TDC's stormwater bylaw and to identify opportunities for progressive improvement in water quality from potential high-risk sites. Seven sites in Timaru were audited in person by PDP during the assessments, and recommendations have been made for improving stormwater management and reducing potential environmental impacts at these sites. TDC have been working through assessments of the remaining high-risk sites in conjunction with ECan compliance officers.

In general, the site assessments found a lack of understanding of stormwater contaminants and their effects on the aquatic environment. Education for business owners on good stormwater management practices, combined with more frequent auditing and enforcement, were determined to be key actions that would aid in improving stormwater management, and subsequently stormwater quality, at private sites.

4.4.1 Wastewater Overflow Risk into the Stormwater Network

Across Timaru, there are known locations where wastewater overflows can occur following significant rainfall. When assessing the location of these overflows, it is likely in these instances that diluted wastewater enters the stormwater system and discharges to receiving waterways and Caroline Bay. This is cause for concern due to this occurring in areas of high mahinga kai, recreational and amenity values.

There have been seven instances in the past five years where Caroline Bay has tested elevated levels of bacterial contamination, making it unsuitable for swimming[1]. Further analysis of this monitoring data did not show consistent correlation between rain events and elevated level of Enterococci[2]. However, wastewater overflows (wet weather) and/or unauthorised cross-connections from the sewer system (dry weather) into the stormwater system could be occurring and contributing to the contamination issues in Caroline Bay. Source tracing is required to confirm the source of bacteria, be that human or animal sources (e.g. dogs/birds/livestock).

To visualise the potential interaction between the stormwater and wastewater network, the following is mapped on *Figure 4-8*:

- Known storm event problem areas TDC is actively actioning for Wastewater (Stormbeat Locations)
- Modelled manhole overflows during a wet weather peak flow 24-hour event
- Modelled 10-year 24-hr flood depth

[1] Information sourced from Land Air Water Aotearoa (LAWA). Caroline Bay is monitored weekly for recreational water quality from November to March by ECan.

[2] Enterococci are various types of bacteria that naturally occur in the gut of humans and animals as well as birds, fish and reptiles. These are the preferred biological indicator for faecal contamination of coastal swimming sites.

- Reported wastewater wet weather maintenance call outs and wastewater complaints.

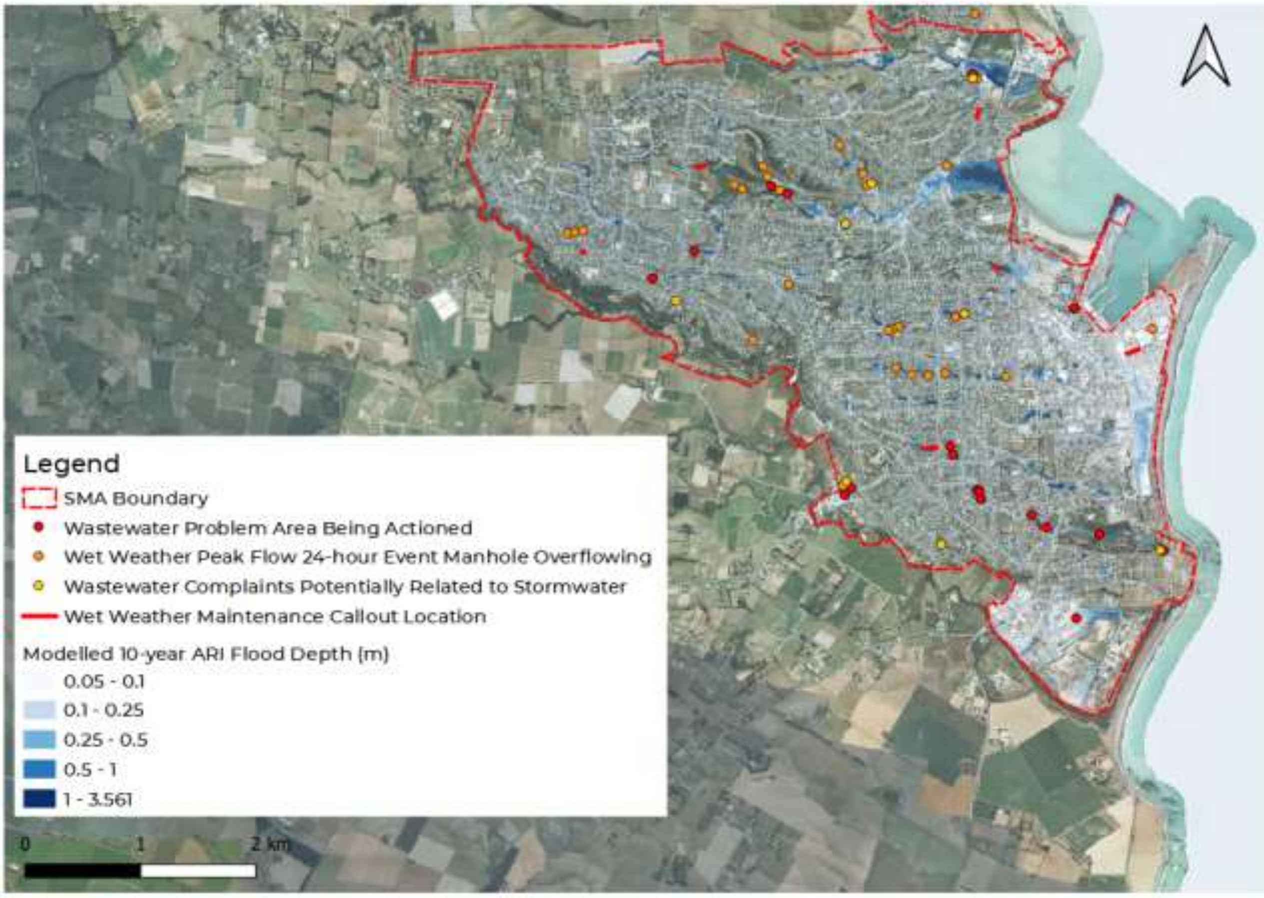


Figure 4-8. Summary Map of Wastewater issues related to wet weather, including the modelled 10-year flood depth.

The problem areas, maintenance callouts and manhole overflows are shown to overlap predominantly in the areas of modelled flood depth and major overland flow paths. Indicating that there may be an interaction between modelled stormwater flooding, and wastewater problem areas/ overflows. Management of stormwater flooding/overland flow may be able to alleviate the wastewater inflow and infiltration issues.

Throughout Timaru there are widespread reports of wastewater related issues across the Timaru SMA, with 465 customer complaints recorded since 2017. However, there were only 17 instances of these that were potentially related to rainfall events.

TDC have scheduled wastewater upgrades and investigations to address the following overflow issue areas:

- Highfield Golf Course – ongoing issues over many years; the pipe installed in the course is shallow in depth, limiting the capacity of the downstream section of the pipe. Stage one includes upgrades to the Douglas Street sewer pipeline (2023). Stage two includes upgrades within the Highfield Golf Course.
- O'Neill Place – Part one completed, upgrading 543 m of the Saltwater Creek downstream sewer pipe. Approximately 1.5 km of further pipe upgrades for the 2022/2023 financial year.
- Botanic Gardens (by Band Rotunda) – ongoing issue during periods of heavy rainfall; inflow and infiltration is a big contributor; also deteriorating concrete pipe. Project identification/investigation stage.
- Evans St by BP fuel station – two sewer overflows in winter 2022, approximately 25 metres apart (from different catchments) during a storm event, likely due to inflow

and infiltration. However, there is no prior history/problems in this area. Project identification/investigation stage.

5. Description of the Environment

5.1 The Township and Wider Catchment

Timaru is a port city located in the Canterbury Region on the east coast of the South Island, with a resident population of 46,296 (NZ Census, 2018). It lies between the Ōpihi River to the north and the Parerora River to the south. Both State Highway 1 and Main South Railway Line pass through the city, making it a critical link in the distribution of freight from the port to the rest of the South Island.

The Timaru SMA is 1,900 ha and is bordered by Ōtipua - Saltwater Creek in the south and Taitarakihi/ Te Ahi Tarakihi Creek to the north. The area of the wider hydrological catchment of both these rivers and including the SMA is 6,456 ha, shown in Figure 5-1.

Figure 5-1. Timaru SMA, Catchments and Waterways.

Most of the waterways within the Timaru catchment are hill-fed, with short lengths and low flows. The mid to lower reaches remain flowing year-round. The key waterways within the Timaru SMA are addressed in Section 4.7.

5.2 Catchment History

Prior to urbanisation, herbaceous grasslands and flax ground predominated the hilly landscape of Timaru. Figure 5-2 depicts the Timaru catchment area in its pre-European, largely natural state as digitised from the original 19th Century 'Black Maps.'

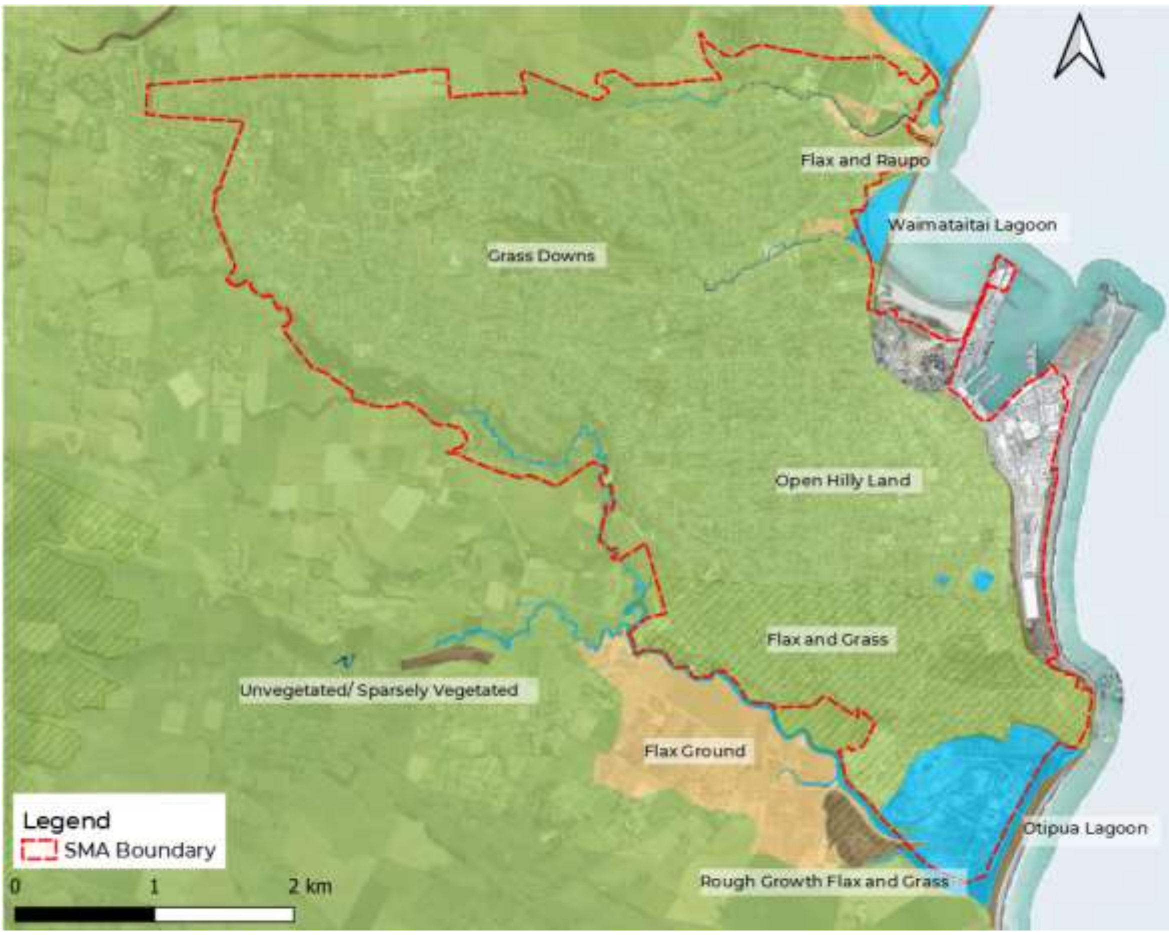


Figure 5-2 Digitisation 19th Century Black Maps for Timaru.

Following urbanisation, drastic land use changes have occurred in Timaru. One of the most significant losses is Waimātaitai hapua (lagoon), which was lost through changes to coastal processes following construction of the port. This area is now known as Waimātaitai Beach.

Urban growth since the 1970s has predominantly been in the northwestern suburb of Gleniti as depicted in Figure 5-3. Whilst Redruth in the southeast has been the focus of industrial and commercial growth since the 1940s. Currently, Timaru District Council operate the Redruth Landfill and resource recovery park at the south-eastern extent of the SMA. As presented in Figure 5-3, the Ōtipua-Saltwater Creek has been realigned around the landfill, and the outlet to the creek now occurs to the north of the landfill.

Figure 5-3. Historic imagery (1935 – 1939) and Current LINZ aerial imagery in the Timaru SMA.

5.3 Current and Future Land Use

The land use zoning in the operative Timaru District Plan (TDP) includes Rural, Recreational, Residential, Commercial, and Industrial Light and Industrial Heavy zone types. The land use zones from the District Plan do not separate roads from land. The current district plan provides an indication of the current land use in the SMA, shown in Figure 5-4.

Figure 5-4 Current land use zoning from the operative Timaru District Plan

In line with the Proposed District Plan, further urban development is envisaged in the fringes of the Timaru SMA, as indicated in Figure 5-5. In addition, some rezoning of inner residential land to commercial and industrial zones is proposed.

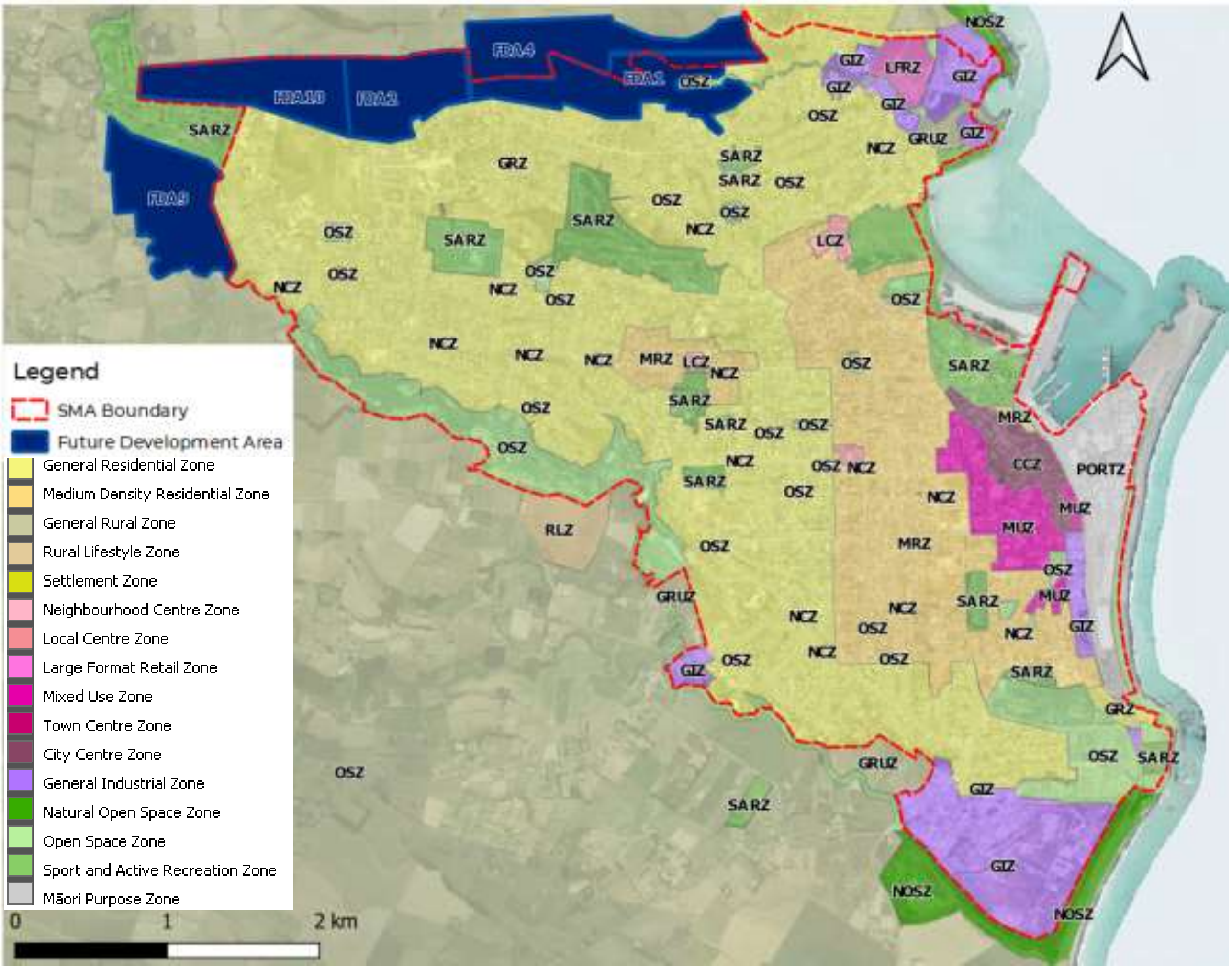


Figure 5-5 Proposed land use zones (TDC Proposed District Plan) and Development Areas

Table 5-1 provides a summary of the areas of current urban land-use and a fully developed scenario within the SMA. Within the SMA a 95.3 ha increase in residential land-use is envisaged, similarly, commercial and industrial land-use will increase by 12.1 ha and 6.6 ha respectively. A full assessment of the assumptions and breakdown of the existing and future zoning areas can be found in The Contaminant Load Model Report (PDP, 2021).

Table 5-1 Comparison of Area for Current and Proposed Changes to Land Use in Timaru (PDP)

Land-Use Zone	Current Area (ha)	Future Area (ha)	Area Δ (ha)
Commercial	57.4	69.5	12.1
Industrial	131.4	138.0	6.6
Pasture	251.9	152.6	-99.3
Reserve	277.7	263	-14.7
School/Sport Facility	67.4	67.4	0.0
Residential	881.9	977.2	95.3
Roads	277.4	277.4	0.0
Rail Reserve	5.0	5.0	0.0
Landfill	43.4	43.4	0.0

5.4 Mana Whenua Context

5.4.1 Cultural Setting

Ngāi Tahu whānui are the iwi (Māori tribe) who hold mana whenua over a large proportion of Te Waipounamu – the South Island. Today, Ngāi Tahu are organised around eighteen marae-based communities (Papatipu Marae), each recognised under the Te Rūnanga o Ngai Tahu Act 1996 and is represented by a Papatipu Rūnanga (assembly, Council); of which Te Rūnanga o Arowhenua is the local Papatipu Rūnanga, and asserts ancestral rights and responsibilities of local Arowhenua families and individuals to mahinga kai as guaranteed under the Treaty of Waitangi/Te Tiriti o Waitangi (1840) and reserved under Sales and Purchase Agreement for Canterbury (Kemp's Deed, 1848).

Arowhenua has been the main centre of Māori life in South Canterbury since the mid-19th century when the Māori people of the area moved from nearby Te Waiateruati. While Arowhenua marae was not the first pā for Arowhenua Māori, it has been the main settlement area for the iwi since the mid-1800s.

Timaru and Waitarakao are rich cultural landscapes. The Mana Whenua Impact Assessment – Timaru Stormwater Management Plan (Hall, 2020) evidences mahinga kai/taonga species, culturally significant waterways, settlements (kāinga, Pa, nohoanga), wāhi Tapu, wāhi Taonga, Mātaitai reserves, Māori Land and Te Ara Tawhito (traditional trails). The culturally significant waterways Taitarakihi/Te Ahi Tarakihi and Saltwater/Ōtipua Creeks as well as the city of Timaru all lie within the takiwā of Arowhenua, which "centres on Arowhenua and extends from the Rakaia River in the north to the Waitaki River in the south and inland to the Main Divide."

Mātaitai Reserves

There are three Mātaitai reserves on the coast: Tuhawaiki, Te Ahi Tarakihi and Waitarakao (Figure 5-6). These reserves were established in 2019 with the purpose to protect and enhance the fishery resources and marine environment for present and future generations. A survey conducted by Te Tiaki Mahinga Kai in 2018 showed that only 12% of pāua in the mātaitai were at or above the minimum legal size for recreational fishing. Other important mahinga kai shellfish species were present in low densities also. To address issues such as this, Tāngata Tiaki/Kaitiaki have made six bylaws for the Tuhawaiki, Te Ahi Tarakihi and Waitarakao Mātaitai Reserves to manage recreational shellfish and flatfish fishing within these mātaitai reserve areas. The objectives for these Mātaitai reserves bylaws are:

- To ensure whanau have access to an abundant supply of healthy mahinga kai in order to sustain their cultural practices (including sustaining the functions of the marae); and
- To protect the long-term sustainability of the fisheries resources and recreational fishing experience within Mātaitai for present and future generations to use and enjoy.

Figure 5-6 Tuhawaiki, Te Ahi Tarakihi and Waitarakao Mātaitai Reserves

5.4.2 Arowhenua concerns and expectations

The concerns to whanau for Timaru and Waitarakao were identified by cultural experts during site visits in September 2020 as the following:

- Lack of biodiversity, riparian habitat, and cultural materials
- Loss of the extent and condition of wetlands and springs
- The poor condition of mahinga kai in the area and how that impacts the desire to undertake mahinga kai
- Significant waterways have been piped e.g. Waimatatai and Wai iti
- Industrial waste and overflows (the industrial area is still expanding at the expense of the important mahinga kai areas and Mātaitai reserves)
- Mahinga kai are too contaminated to harvest.
- The loss of extent of Waitarakao
- Absence of any interpretation or recognition of the cultural significance of the sites.
- Neglect by management of these areas e.g. cattle in Taitarakihi/ Te Ahi Tarakihi Creek.
- Inhibited fish passage.

A summary of the assessment of the Timaru SMA in terms of the thresholds set by Arowhenua for cultural use is presented in Table 5-2. The waterways in Timaru are not meeting the thresholds for cultural use in their current condition.

Table 5-2 Timaru assessment of thresholds for cultural use (Kitson Consulting, 2022)

Threshold	Condition
Mahinga kai resources being present	Poor
Mahinga kai species in sufficient numbers and in good condition	Poor
The ecosystem supports mahinga kai species and resources	Poor
Human health safety for gathering and consuming kai	Poor
Access to mahinga kai is available	N/A
Nitrate and ammonia toxicity in NPSFM National Objective 'A' band	Fail
E. coli contamination in NPSFM National Objective 'A' band	Fail

In addition, Arowhenua seek that the following matters are addressed in stormwater management for Timaru. Kitson Consulting (2022) summarises the needs of the waterways connected to TDC stormwater networks from the iwi management plan as the following:

- The responsibility of the Crown and other agents with authority delegated by the Crown is to actively protect Treaty rights, including mahinga kai and other taonga.
- The need for environmental management to consider the rights and needs of future generations.
- Arowhenua whānau must be involved in matters that impact their values and interests.
- Provision for cultural and spiritual values, customs, and traditions
- Protection and enhancement of waterways, including stopping discharges of contaminants, diffuse and point-source
- All mahinga kai taken from waterways to be fit for human consumption
- Exercise of traditional rights and customary uses is enabled, and opportunities increased, including protection and restoration of:
  - *Sufficient water quality and quantity*
  - *Natural habitat (instream and riparian)*
  - *Wetlands*
  - *Fish passage*
  - *Mahinga kai and taonga species*
  - *Traditional cultural materials (eg. Flax and other native plant species)*

Additionally, the following expectations from the cultural impact assessments directly relate to the SMA (Kitson Consulting, 2022):

- Meaningful participation in decision making
- TDC takes a ki uta ki tai approach to Stormwater Management and planning
- Stormwater Management and planning include continuous environmental improvement
- Avoidance of impacts on Mātaitai and waterbodies feeding into them.
- Avoidance of degradation of water quality and loss of taonga species
- Opportunities to improve mahinga kai values (including water quality, water quantity and habitat) over time.
- Mahinga kai outcomes are monitored and include cultural monitoring/Kaupapa Māori methods and mātauranga Māori.

5.5 Climate

Due to its coastal location, Timaruhas a relatively dry temperate oceanic climate. As summarised in *Table 5-3*, based on a weather station at the botanic gardens, the average monthly temperature varies from 5.8 °C in winter to 15.9 °C in summer. The monthly rainfall fluctuates between 27 mm/ month to 60 mm/month, with the most rainfall occurring between October and April.

Table 5-3 Timaru Average Climate (2000 - 2022) at Timaru EWS (NIWA Network# H41425) via Niwa-Cliflo

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Daily Temperature (°C)	15.9	15.5	14.1	11.6	8.9	6.4	5.8	7.1	9.1	11.1	13.1	14.8	11.1
Average Monthly Rainfall (mm)	57.6	50.0	42.4	59.8	35.7	42.5	48.1	50.7	27.4	50.8	59.6	51.6	576
Average Wet Days (no.)	8	6	6	7	5	6	6	6	5	8	8	7	78

5.6 Topography

Timaru is built among the hills formed by lava flow from the extinct Mount Horrible, resulting in steep and winding streets, and providing the distinct bluestone rock from which many of the town's buildings are constructed. Timaru's rolling topography is in clear contrast to the flat landscape of the Canterbury Plains to the north. As presented in Figure 5-7, the substantial gullies between the lava flows correspond to the major watercourses in the township, being Taitarakihi/ Te Ahi Tarakihi, Waimataitai, and Ōtipua-Saltwater Creek.

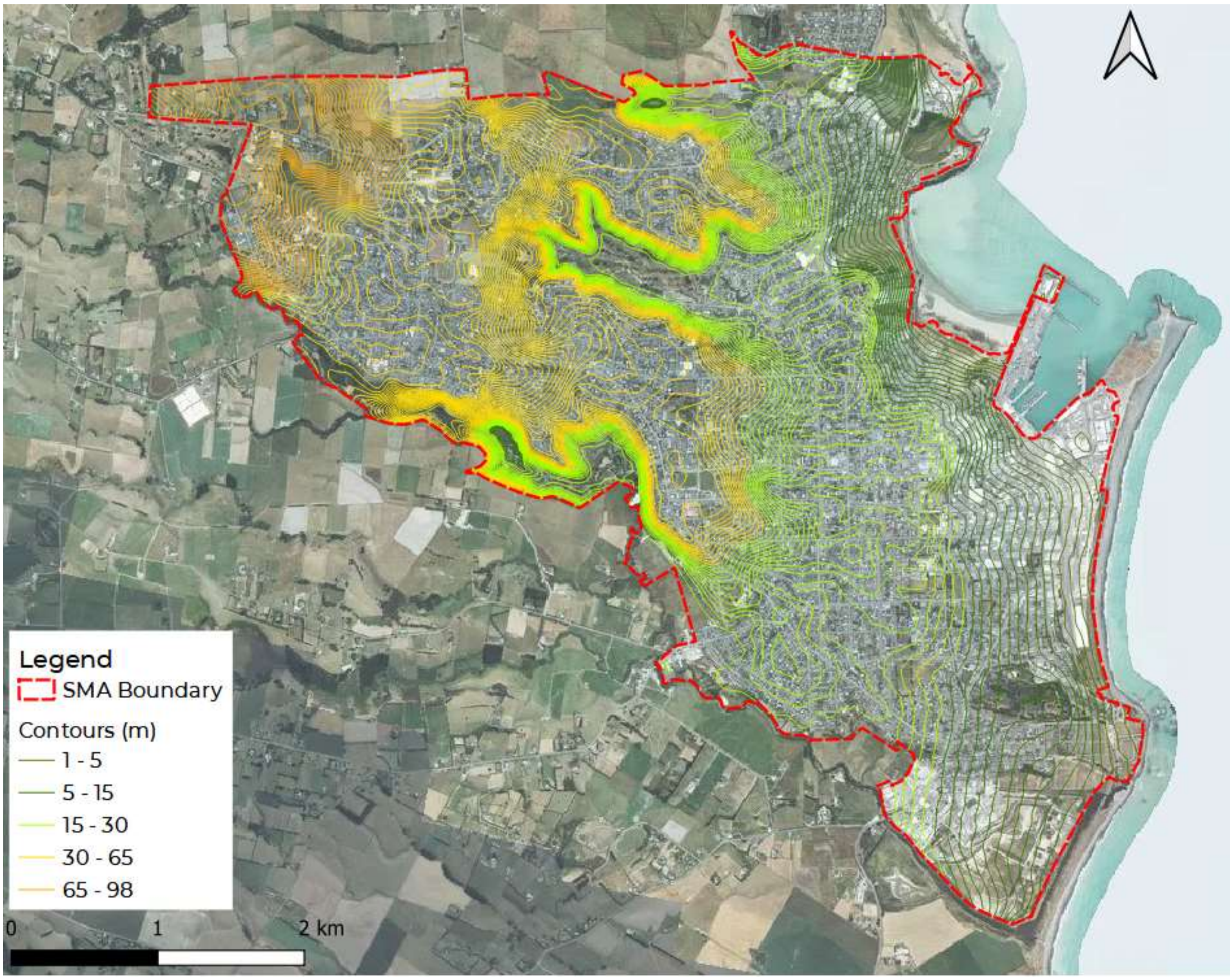


Figure 5-7 1 m Contours Generated from LINZ 8 m DEM

5.7 Geology, Soils and Groundwater

The 1:250,000 scale geological map of the Timaru area indicates the surficial geology consists mostly of Mid Pleistocene loess deposits (windblown silt and sand), with interbedded paleosols and occasional peat lenses (Figure 5-8). The loess deposits are up to tens of metres thick and overlie the Timaru Basalt Formation (TBF). The TBF outcrops, shown in Figure 5-8, occur where creeks have eroded through the loess deposits and on the coast at Smithfield and Patiti Point. The TBF overlies the Kowai Formation which is an older alluvial deposit formed during the Pilocene age (note outcropping in Figure 5-8) consisting primarily of gravels, with intercalated sand and mud. These gravels are commonly cemented by clay and iron oxides.

Holocene river deposits (unweathered loose gravel, sand and silt) occur where the Taitarakihi/ Te Ahi Tarakihi Creek, Waimataitai Creek and Ōtipua-Saltwater Creek have eroded the loess deposits and deposited gravels, sands and muds downstream. Near the coast the Holocene deposits are described as uncemented marine sand and gravel. The thickness of the Holocene layers is difficult to constrain using available bore logs. The area around the port is mapped as fill.

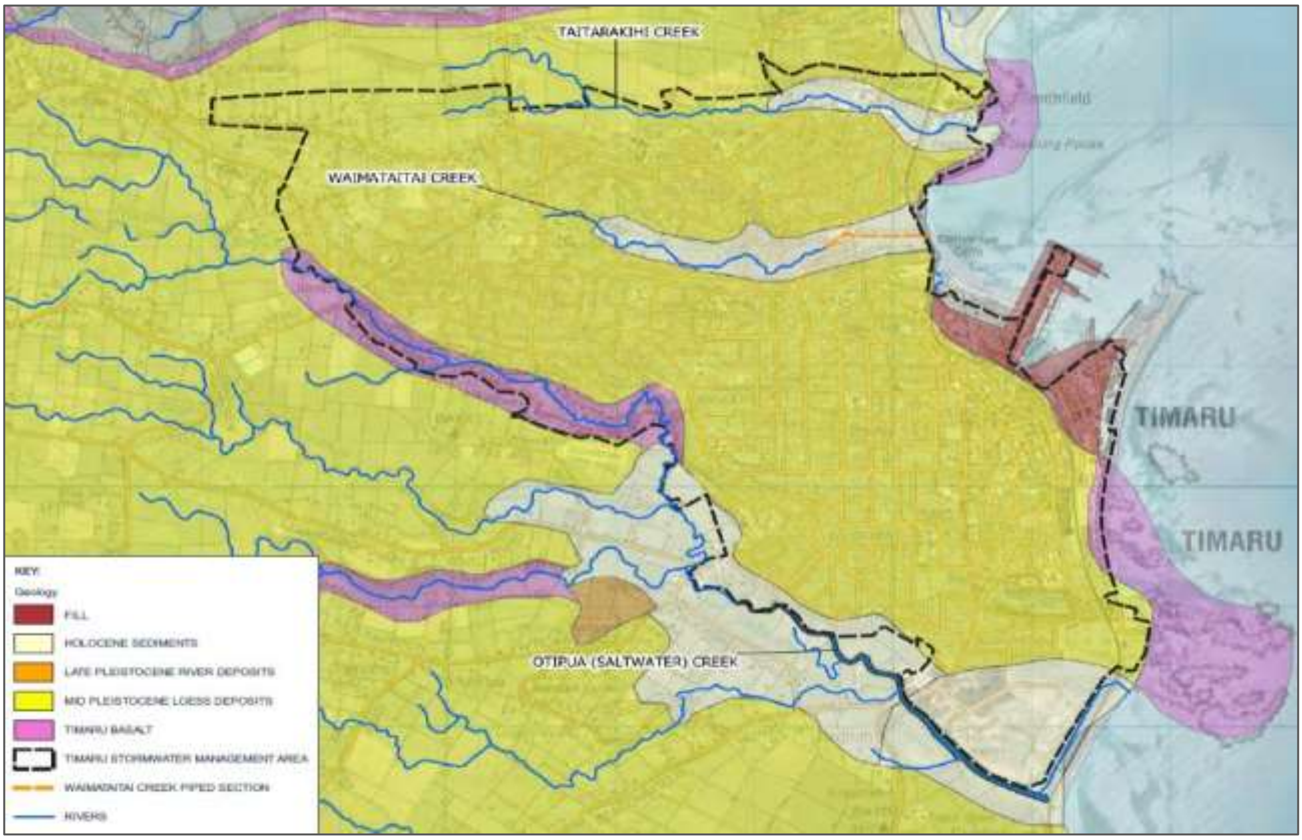


Figure 5-8 Timaru Geology (GNS, 2018)

S-Map Online summarises most of the soils in the Timaru SMA as poorly drained (Figure 5-9) and moderately deep. The soil clay content within Timaru typically ranges from 15 to 35% and all soils in the Timaru SMA tend to have a high-water logging vulnerability.

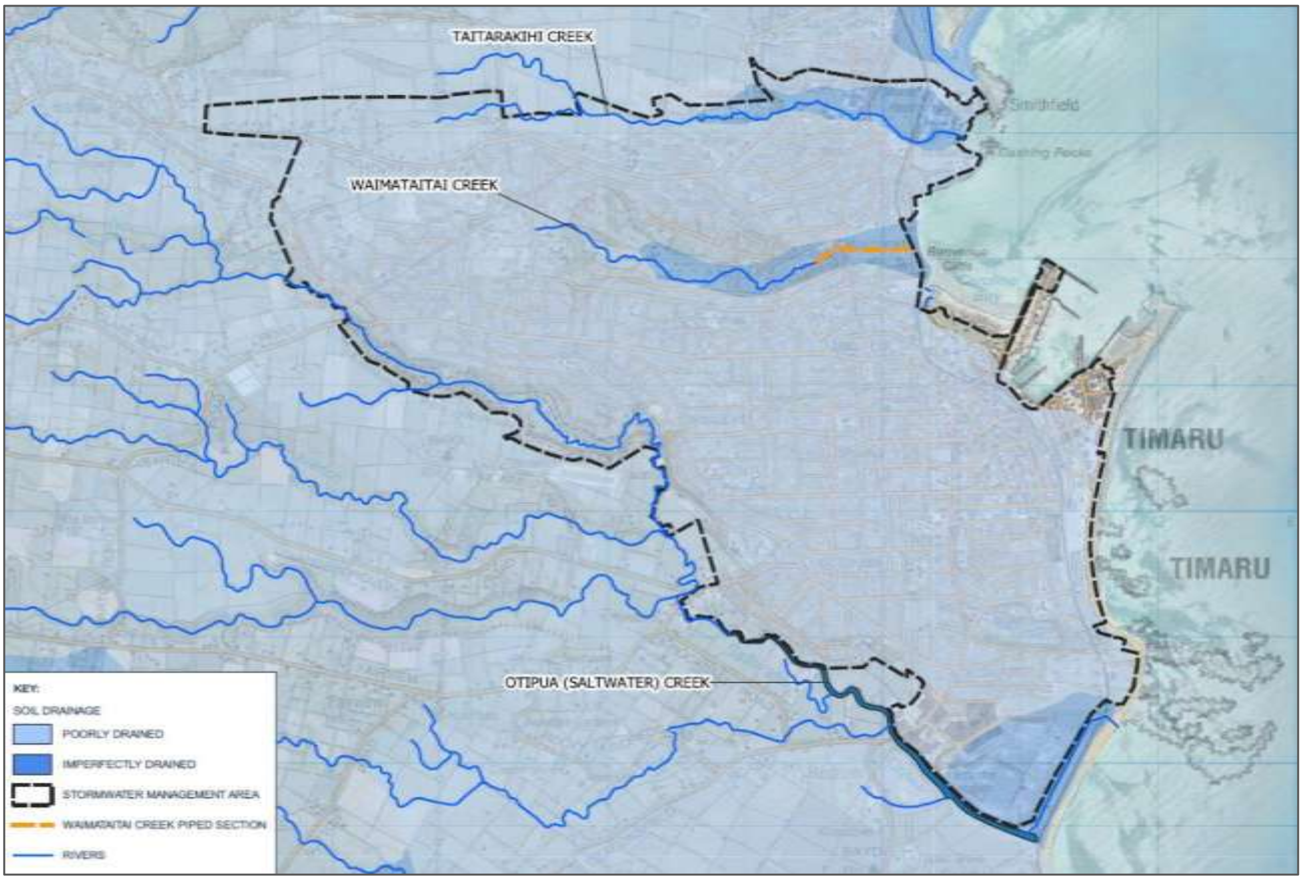


Figure 5-9 Timaru Soil Drainage

In Timaru, the groundwater level varies throughout the SMA, likely a reflection of the city's undulating topography. Figure 5-10 shows depth to groundwater in metres below ground level (m bgl) measured within shallow bores (< 30 m deep) in Timaru (sourced from ECan).

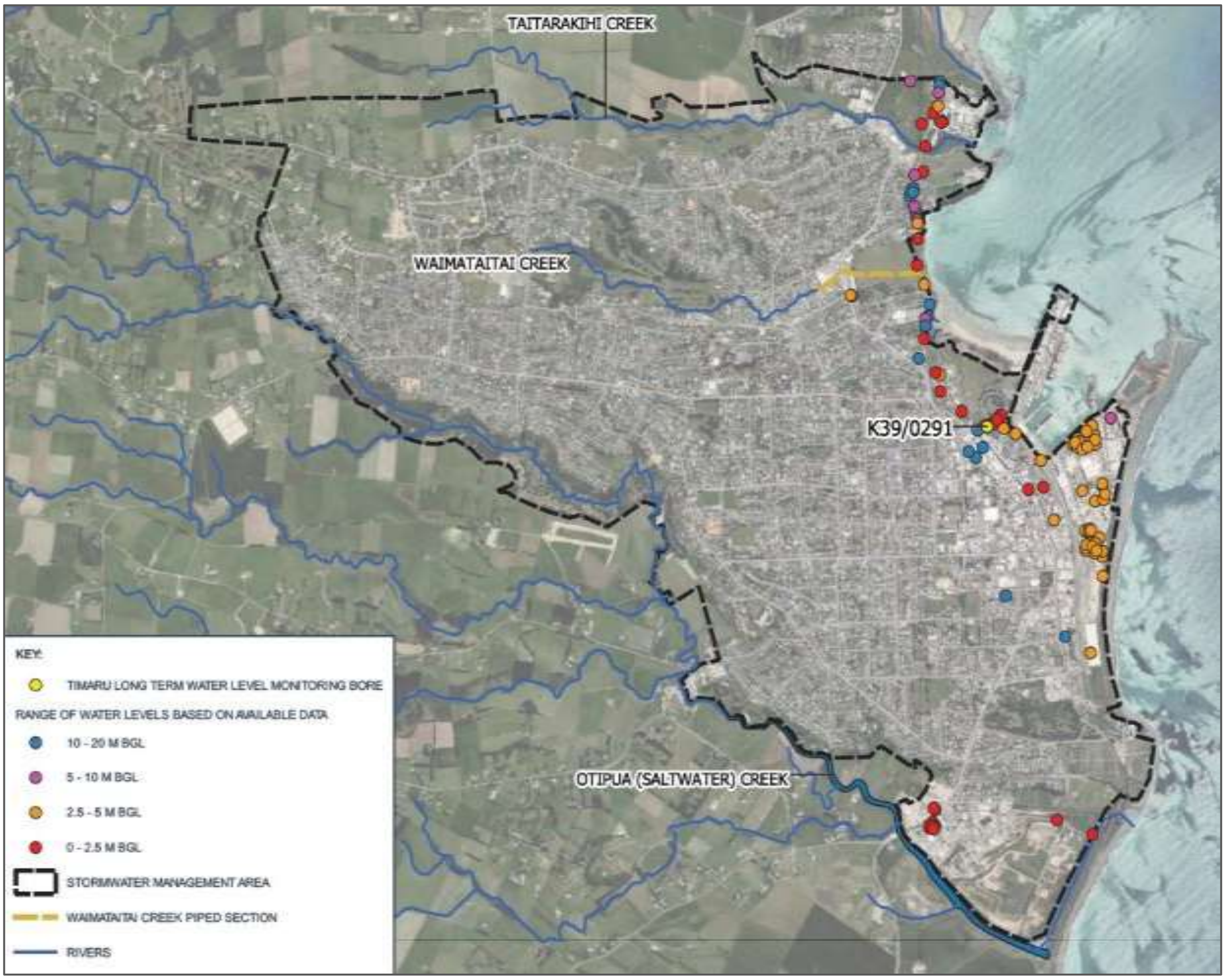


Figure 5-10 Depth to groundwater

The depth to groundwater appears to be shallow (0 to 5 m bgl) in areas of low elevation at the coast near the eastern boundary of the SMA. Larger depths (5 to 20 m bgl) are expected in areas of higher elevations near the eastern boundary of the SMA. The available step-drawdown testing information (bore testing data) indicates the shallow strata within the SMA is of relatively low permeability. This is supported by the lack of abstraction bores, which is an indicator of low permeability strata, especially given Timaru is a substantial settlement and many industrial activities could benefit from a groundwater supply. The bores present within the SMA are predominantly geotechnical/geological investigation bores or observation wells. There is a distinct lack of groundwater level readings in the western portion of the Timaru SMA.

The geology, soils and groundwater implications on the stormwater management at Timaru are summarised as:

- The available information suggests that infiltration of stormwater is unlikely to be a feasible option for stormwater disposal, and hence use of engineered soakage systems is excluded from the SMA discharge permit.
- Based on the lack of stormwater discharges to ground other than passive infiltration, groundwater is not a significant receiving waterbody in terms of considering the effects of stormwater discharges.

- If detention basins are considered as an option to manage stormwater it will be important to consider the effects of slaking of loess soils and the potential for tunnel gully erosion.
- Due to the limited groundwater level, any potential sites where detention of stormwater was being considered would benefit from site specific investigation and monitoring of groundwater levels prior to confirming suitability.

Refer to *Desktop Groundwater Assessment to Support Stormwater Management Plans for Timaru, Washdyke, Pleasant Point and Temuka* (PDP, 2021a) for full details of the comprehensive desktop assessment undertaken as part of a suite of baseline studies.

5.8 Surface Water

There are three key waterways that pass through the Timaru SMA, these are Taitarakihi/ Te Ahi Tarakihi Creek, Waimataitai Creek and Ōtipua Creek. These waterways all receive stormwater run-off from urban areas within the Timaru SMA.

5.8.1 Taitarakihi/ Te Ahi Tarakihi Creek

Taitarakihi/ Te Ahi Tarakihi Creek is a 4.5 km long waterway along the northern boundary of the Timaru SMA. The headwaters of the Taitarakihi/ Te Ahi Tarakihi Creek catchment are situated in the coastal downlands near Hadlow, with Taitarakihi/ Te Ahi Tarakihi Creek flowing in an easterly direction, meeting the sea at Smithfield, 500 m south of Washdyke Lagoon. There is one small pond at the head of Taitarakihi/ Te Ahi Tarakihi Creek, and a small lagoon at the coastal end of the creek. Taitarakihi/ Te Ahi Tarakihi Creek has a near permanent connection to the sea via a small channel that flows over the narrow beach know as Shark Bay, near to Dashing Rocks. The catchment area of Taitarakihi/ Te Ahi Tarakihi Creek covers 5.25 km^2.

5.8.2 Waimataitai Creek and Whales Creek Description, Aquatic Ecology and Fish Passage

Waimataitai Creek is a characteristic small, urban, 'hard-bottomed' watercourse, that passes through the Highfield Golf Course. In the suburb of Waimataitai the creek enters TDC's piped stormwater network that passes from Selwyn Street, under Ashbury Park; ultimately discharging into Caroline Bay via a coastal outfall structure. Waimataitai Creek is known to provide habitat for īnanga and tuna (eels) upstream of the piped section.

Whales/ Pohatu-koko Creek is formed at a coastal stormwater outfall on the northern end of Caroline Bay, where the site has been enhanced with native planting and a boardwalk along the waterway. The stream includes an area of pooled water downstream of the stormwater outfall, which drains to the nearby coast via a small channel and field observations indicate that this site is tidally influenced. Whales Creek provides suitable spawning habitat for the native inanga freshwater fish (i.e., whitebait).

5.8.3 Ōtipua/Saltwater Creek Description, Aquatic Ecology and Fish Passage

Ōtipua - Saltwater Creek flows in a mostly east-southeast direction for 15.5 km, from its headwaters in the Claremont downlands, to its mouth on the southern margin of Timaru city (near Patiti Point). The main tributary channels flow for approximately 19 km in a northwest/southeast direction and meet Ōtipua - Saltwater Creek approximately 3.7 km upstream from the coast. The Saltwater Creek catchment extends to the top of Mt Horrible, Claremont, Rosebrook, and Fairview. At the mouth of the creek lies Ōtipua Wetland and the Redruth Resource Recover Park landfill.

At the lower reach, below State Highway 1 (SH1), the creek is highly modified by stop banks. This is because this site was formerly Ōtipua Lagoon which was converted by local council to the Redruth Landfill site on the true left bank and a restored wetland, including a 4-hectare lake, on the true right bank. The remaining lagoon contains brackish water, and the level is controlled by a mechanical opening which is operated multiple times a year to discharge the lagoon to the ocean. There is also a weir upstream, which is used by the rowing club to maintain a training space. Water from the lagoon naturally seeps to the sea through the shingle ridge; however, this is not a major control on the lagoon's level. On rare occasions water from the lagoon can burst through the natural gravel beach.

5.8.4 Aquatic Environmental Baseline Conditions

Table 5-4 describes the surface water characteristics, including water and sediment quality, aquatic ecology and fish passage.

The environmental baseline for each of the above three creeks is summarised figuratively in Figure 5-11 and Figure 5-12 based on the data from PDP's *Baseline Receiving Assessment of the Timaru, Washdyke, Temuka and Pleasant Point Stormwater Management Plans* (PDP, 2021). Each parameter grouping presented represents data for several contaminants/indicators. The colour of the fish is determined by any exceedances within the group of contaminants/indicators specified, across any of the monitoring rounds.

The following notes about water quality standards and guideline values provides some useful context to help with interpreting the coloured fish ratings in the figures.

- The National Policy Statement for Freshwater Management (NPS-FM) classifies the expected impact of stormwater contaminants (water quality attributes) based on their recorded values (attribute states) dependent on the freshwater body type being assessed. It provides a 'National Bottom Line' for these contaminants indicating threshold values at which exceedance will result in a high risk of significant ecological impact.
- The Australian New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) provides default guideline values (GVs) dependent on the river environment classification (e.g., cool-dry low elevation) or GVs based on a level of species protection (i.e., 80, 90, 95, 99%). The higher the level of species protection sought, the lower the guideline value.
- The Canterbury Land and Water Regional Plan (LWRP) sets water quality limits dependent on the water quality class (e.g., Waimataitai, Taitarakihi/ Te Ahi Tarakihi and Saltwater Creek were considered hill-fed lower urban while Ōtipua Creek was considered hill-fed lower). The LWRP references the ANZG (2018) guidelines for the toxicants, e.g., toxicants shall not exceed the ANZG 90% GV for hill-fed lower urban and 95% for hill-fed lower.

There were four additional monitoring sites covered in the PDP Baseline Receiving Assessment that have not been reported on here as they were located outside of the three key waterways (either Waimataitai, Taitarakihi/ Te Ahi Tarakihi , Saltwater or Ōtipua Creek).

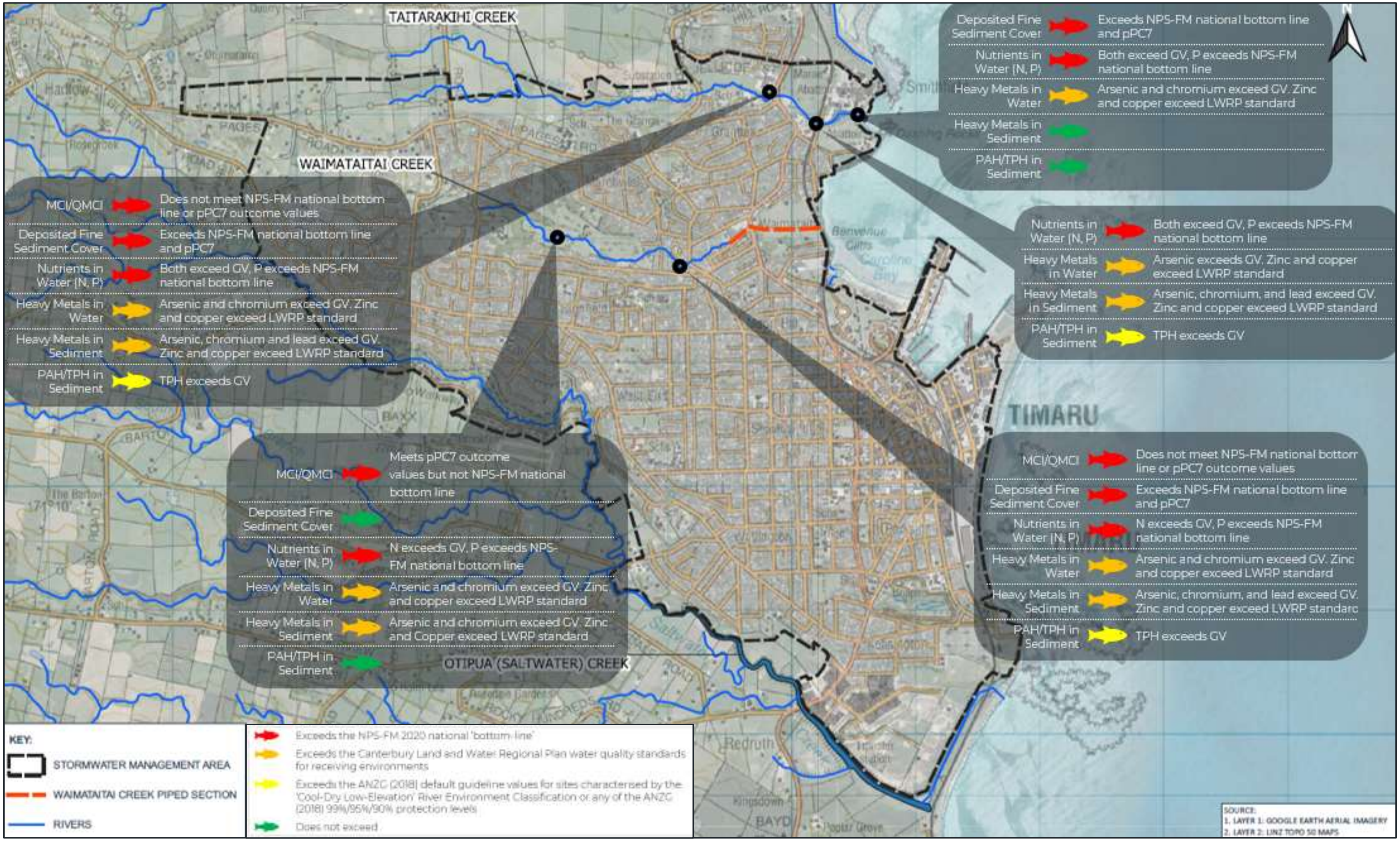


Figure 5-11 Summary of the Existing Aquatic Environmental Baseline Conditions for Waimataitai and Taitarakihi/ Te Ahi Tarakihi Creeks

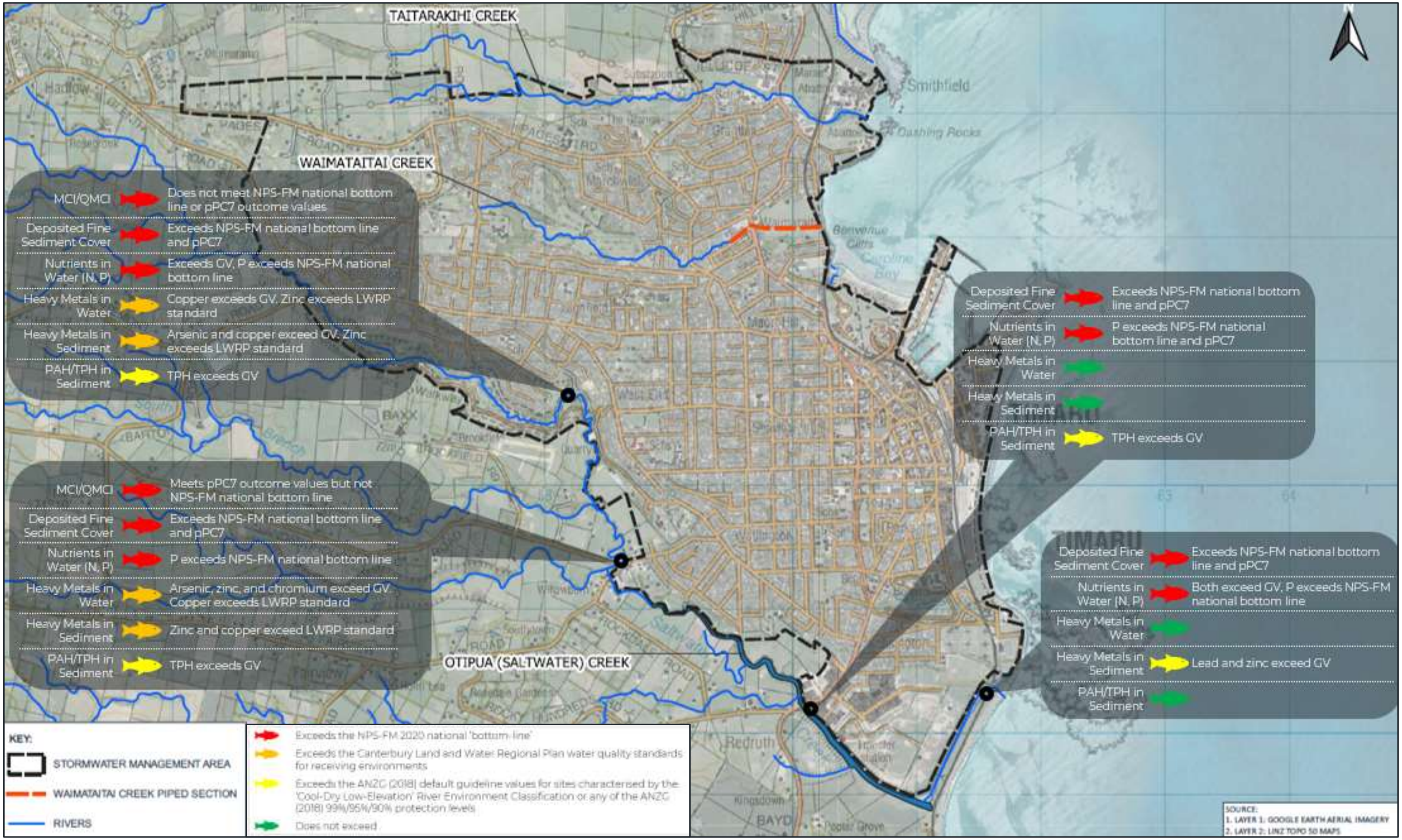


Figure 5-12 Summary of the Existing Aquatic Environmental Baseline Conditions for Ōtipua-Saltwater Creek

Table 5-4. Surface Water Characteristics of the three main creeks in the Timaru SMA.

	Taitarakihi/ Te Ahi Tarakihi Creek	Waimataitai Creek	Ōtipua/Saltwater Creek
Water Quality	• DO lower than guidelines at all sites • Elevated conductivity at coastal sites in winter and at all sites in summer. • Upstream and mid-reach sites had high turbidity in summer.	• Winter: Low DO in winner in areas with standing water and high conductivity in downstream areas. • Summer the same trend was observed for DO, and water clarity was poor at all sites. • Winter and summer: heavy metals concentrations elevated at all sites, whilst hydrocarbons were below detection limits. • Nutrient concentrations elevated at most sites and were higher in winter than summer.	• Winter: variable water quality but mostly clear, slightly low dissolved oxygen (DO) levels at upstream monitoring sites, and elevated pH and conductivity. Nitrate-nitrogen elevated at some monitoring sites • Summer: lower water clarity closer to the coast, elevated temperature, lower DO at upstream sites and increased DO at coastal sites. Both nitrate-nitrogen and phosphorus were elevated.
Aquatic Ecology (NZFFD)	• Seven taxa recorded, six native (longfin eel, banded kokopu, inanga, lamprey, and the common and giant bullies) and one non-native (goldfish). • Inanga and longfin eel: most consistently recorded; however, records are scarce across all taxa. • Lamprey have been historically recorded, potentially indicating a high value habitat, however, no records for lamprey have been recorded since 1921 and extensive development has since occurred. • Notable taxa recorded include the longfin eel, inanga, and giant bully, all assigned the 'At Risk – Declining' conservation status.	• Three taxa have been recorded from the catchment. • 1921: Lamprey (Notable record as lamprey are 'Threatened – Nationally Vulnerable', unlikely to still be present). • 1995: Eel and banded kokopu • Each of the taxa recorded require passage to and from the coast.	• Ten taxa recorded, six native (short and longfin eel, inanga, common and upland bullies, and common smelt) and four non-native (goldfish, perch, rudd, and tench). • While perch and tench have some recreational value as sports fish, each of these introduced taxa compete with native fish and impact native community structure. • Common bullies have the most records for this catchment; however, all native taxa except for longfin eel and common smelt have been recorded on more than one occasion. • Inanga and longfin eel have been attributed the 'At Risk – Declining' conservation status. The remaining native taxa included in the record are not threatened.

Monitoring	• Urban watercourse, with high sedimentation, long stretches of uniform slow flow, and patchy riparian cover. • Fine sediments were the dominant bed substrate throughout the monitoring reaches, with limited consistent hard bed substrate present only at the downstream T_S3 site. • Periphyton and macrophyte growth was not noted during the first monitoring round. However, very high periphyton cover was recorded at one site during the second monitoring round, where floating dislodged cyanobacteria mats were common. • 'Dry-season' conditions show very low MCI and QMCI scores, suggesting poor ecological health and severe pollution do not meet the NPS-FM (2020) national bottom line or cLWRP freshwater outcomes value. • Low UCI score suggests that the community has been simplified by urban stressors such as stormwater contaminants, with predominantly tolerant taxa remaining.	• In its upper reaches, the creek is small, urban, 'hard-bottomed' watercourse. Fine sediment cover is consistently lower, and the gravel/cobble dominated bed likely provides a diversity of instream habitat. • A small amount of macrophyte growth was consistent between monitoring rounds. • 50% long filamentous periphyton cover was detected during the first monitoring round, exceeding the cLWRP upper limit. A considerable reduction was observed during the second (summer) monitoring. • The mid-reach site is a concreted channel with substantial riparian shading, while the downstream site is a subsurface concrete channel.Both sites consistently had high sediment cover, with the highest levels being recorded downstream. • Periphyton film and macrophyte growth were noted at the mid reach, low levels during the first monitoring round only, with no periphyton or macrophyte growth noted on any other occasion at either site. • Benthic macroinvertebrates were sampled from the upper and mid reach sites during the second monitoring round. The macroinvertebrates at the upstream sample was approximately double that of the mid-reach site; however, the taxonomic richness at the upstream site was slightly lower. • Non-biting midges (Orthocladiinae) and earthworms (Oligochaetae) were noted upstream, with the New Zealand mud snail (Potamopyrgus anitpodarum) also common at lower abundances • The mid-reach sample indicated earthworms, and to a lesser extent, New Zealand mud snails, ram's horn snails (Gyraulus spp.), and seed shrimp (Ostracoda). • No taxa sampled belonged to the sensitive EPT insect orders, indicating potentially poor ecological health. • Correspondingly, both sites had very low MCI and QMCI scores, which strongly suggested poor	• Monitoring sites consistently had 'soft-bottomed' characteristics; water was typically slow flowing and overlaid a deep fine sediment dominated bed. • Periphyton cover was rare due to a lack of stable bed habitat; however, planktonic algae were noted at downstream sites. Macrophyte cover was typically rare throughout the catchment with the exception of the upstream site. • Macroinvertebrates were more abundant within the sample from the upstream compared with the confluence. The upstream site was dominated by enrichment tolerant molluscs and earthworms. Rarer representatives including snails, dipterans, mites, and crustaceans were also recorded. Similarly, the downstream sample was dominated by tolerant molluscs, crustaceans, dipterans, and hemipterans. • None of the taxa upstream belonged to the typically sensitive Ephemeroptera, Plecoptera, and Trichoptera (EPT) insect orders. The rarity of these sensitive taxa contributed to low Macroinvertebrate Community Index (MCI) and Quantitative Macroinvertebrate Community Index (QMCI) scores, indicating that organic pollution may be having a stronger effect on organisms at the upstream site. • MCI scores calculated for both sites indicate 'Poor' stream health and probable severe pollution. In contrast, the QMCI score for the downstream site is a slight improvement, indicating 'Fair' ecological health and probably moderate organic enrichment; • Compared to the cLWRP (2015) freshwater outcomes, the QMCI score calculated downstream fell within an acceptable range; however, the QMCI score calculated upstream was notably lower than the NPS-FM (2020) target of 4.5 and slightly lower than the cLWRP freshwater outcomes value of 3.5.

		ecological health and severe pollution (Stark & Maxted, 2007) and do not meet the NPS-FM (2020) national bottom line (both sites) and the cLWRP freshwater outcomes value (T-S8). • Variance in UCI scores between the two sites indicated an increased impact of urban inputs at the mid-reach site.	• UCI score calculated upstream was more than double that downstream, indicating a higher level of urban-derived stress on the Tdownstream community.
Fish Passage	• All native taxa recorded are diadromous, requiring passage to and from the coast to complete their life-cycle. • This is obligatory for all taxa except for the common bully, which readily form landlocked populations. • Six instream structures within the Taitarakihi/ Te Ahi Tarakihi Creek catchment have been identified as potential fish passage barriers. • Three of these structures have been assessed for fish passage capability with each being classified by the 'Very Low' risk level.	• This watercourse has been heavily modified through anthropogenic activities, and presently includes an approximately 1.1 km long subsurface (culverted) section that passes below Ashbury Park to the coast. • The NIWA Fish Passage Assessment Tool indicates that two structures on Waimataitai Creek may cause potential fish passage barriers; however, neither have beenssessed.	• Ōtipua-Saltwater Creek discharges into a coastal lagoon south of Patiti Point. The lagoon does not have permanent open flow to the coast and correspondingly, direct access to the coast for migratory species is not possible. • The Ōtipua-Saltwater Creek lagoon is occasionally opened to the coast during times of flooding risk, facilitating occasional access for migratory species; there is also potential for some species to migrate over or through the gravel bund (i.e. eels). • A large weir spanning the wetted width of Saltwater Creek has been identified as a 'Very High Risk' fish passage barrier and is known to result in high fine sediment accumulation in the reach upstream of the weir, impacting activities at the at Timaru Yacht & Power Boat Club. At the time of assessment, 8 cm of water depth was measured above the weir. • Access to upland habitat is limited by a further three 'Very High Risk' structures throughout the catchment. • Apart from the upland bully, all native fish species recorded have a migratory life-stage. This is obligatory for both eel species and the inanga, while the common bully and common smelt more readily form landlocked populations. • The large weir installed at the lower reaches of Saltwater Creek likely inhibits the upstream migration of juvenile fish to favourable adult habitats in the upper catchment.

5.8.5 Surface Water Ecological Summary

The summary below provides a list of the major aquatic environment issues:

- Macroinvertebrate communities were below the NPS-FM national bottom line at all of the surveyed sites in the ecological assessment.
- Elevated nutrients in water, in particular phosphorus, were observed at every monitoring site. Phosphorus exceeded the NPS-FM national bottom line at every site in the Ōtipua-Saltwater Creek catchment except the stormwater drain (T_S15), middle and upstream sites in Waimataitai Creek, and all sites in Taitarakihi/ Te Ahi Tarakihi Creek.
- Heavy metal concentrations in water exceeded the LWRP standards in the upstream sites in Ōtipua-Saltwater Creek catchment and Waimataitai Creek, and at all sites in Taitarakihi/ Te Ahi Tarakihi Creek. Most sites had an exceedance of at least one ANZG (2018) guideline value.
- Deposited fine sediment cover exceeded the NPS-FM national bottom line at all applicable sites in the Ōtipua-Saltwater Creek catchment and the Taitarakihi/ Te Ahi Tarakihi Catchment, as well as in the mid-reaches of Waimataitai Creek.
- Metal and metalloid stormwater contaminants have accumulated in sediment in the upper and middle reaches of most of the water bodies that were investigated within the Timaru SMA. Ōtipua-Saltwater Creek and Whales Creek also had elevated metals in sediment from their lower/coastal reaches.
- Hydrocarbons in sediment exceeded the guideline value in all sites in the Ōtipua-Saltwater Creek with the exception of the downstream lagoon site, in the middle reaches of Waimataitai Creek, upstream of Whales Creek, and in the middle and upper sites of Taitarakihi/ Te Ahi Tarakihi Creek.
- Contaminants in stormwater (and any other activities/discharges) are clearly having an effect on most of the waterways in the Timaru SMA, as evidenced by common stormwater contaminants being found in elevated concentrations in waterways throughout the SMA.
- In-stream structures may be acting as barriers to fish migration in all waterbodies, however further assessment is needed for some of these barriers.

5.9 Coastal Environment

5.9.1 Description of the Coastal Environment

The Timaru coastline predominantly consists of a steep shingle beach with sediments moving northward along the coast due to ocean currents and longshore drift. Shingle aggradation occurred on the south side of the breakwater after the development of Timaru Harbour and the construction of the breakwater in the late 1800s. This has disrupted the longshore drift and contributed to coastal erosion north of Caroline Bay. Additionally, the construction of the breakwater resulted in the accumulation of fine sand in Caroline Bay due to prevailing easterly winds, creating the sandy beach we see today. The beach at Caroline Bay has reached a state of quasi-equilibrium and has not grown for about 30 years, but the dunes continue to expand. Recent efforts to plant dune vegetation have helped to retain sand in the bay.

Caroline Bay is also known to Arowhenua as Waimātaitai. Waimātaitai was historically a hāpua (lagoon) situated close to the Tīmaru foreshore in what is now known as Waimātaitai Beach, Ashbury Park, Maori Park and Caroline Bay Park. The lagoon was renowned as an important source of mahinga kai. In 1880 Hoani Kāhu from Arowhenua described Waimātaitai as “e rauiri” (an eel weir) where tuna (eel) and inaka (whitebait) were gathered in large quantities. This saltwater lagoon was eventually lost in 1933 due to changes in sediment drift caused by the creation of the Port of Tīmaru.

The coastline is a direct receiving environment for stormwater discharges, from stormwater outlets and waterways. The Taitarakihi/ Te Ahi Tarakihi Creek catchment discharges to the coastline near to Dashing Rocks, which forms part of the Te Ahi Tarakihi Mātaitai. Communication with Arowhenua indicate that this coastline continues to be used for mahinga kai (i.e., coastal mussel gathering). There are three Mātaitai reserves along the Timaru coastline: Tuhawaiki, Te Ahi Tarakihi and Waitarakao, as discussed in Section 4.3.1.

The Timaru Port also sits within the coastal environment and is a key receiving environment for the TDC stormwater network discharges.

5.9.2 Coastal Water Quality and Aquatic Ecology

Elevated levels of lead, zinc, and TPH were recorded in surface sediments at two coastal stormwater outfalls located on the shore, near Timaru Port.

Mussels sampled at the Taitarakihi/ Te Ahi Tarakihi coastal sampling sites (near Dashing Rocks) measured zinc concentrations consistently well above the generally expected (GEL) concentration from the ANZFA food standards. Observations from the sampling assessment indicated that the mussels may be undersized and lacking in reproductive tissue. Dissolved concentrations of copper and zinc are recognised as a contributing factor to cause chronic and acute effects in some fish, which indicates that stormwater inputs to the creek may be impacting shellfish in the area.

Historic monitoring (Bolton-Ritchie, 2006) suggested that elevated nitrogen loads from stormwater or stream discharges could result in algal proliferation in nearshore coastal waters.

As mentioned in Section 5.4.2 there have also been instances where Caroline Bay has tested elevated levels of bacterial contamination, with wastewater overflows via the stormwater system a potential contributing factor.

The predominant longshore currents and the relatively open nature of the coastline south of the port means there is little potential for coastal water retention. Caroline Bay, including Waimataitai beach and Shark Bay are considered the coastal environments most sensitive to stormwater discharges from the SMA. The Timaru port has the highest concentration of stormwater coastal discharges; however, stormwater is only one of the contaminant sources impacting the harbour.

5.10 Critical Infrastructure

5.10.1 Wastewater Systems

Timaru has an extensive reticulated wastewater network servicing the SMA. A programme of extensive upgrades to the wastewater treatment plants, oxidation ponds, and trunk mains finished up in 2016, along with the introduction of pre-treatment at industrial facilities.

However, during periods of increased rainfall, there are parts of the wastewater network subject to inflow and infiltration of stormwater (Timaru District Council, 2022). This has resulted in the wastewater system overflowing in places, which can enter the stormwater network and discharge into receiving waterbodies (Timaru District Council, 2022). Figure 4-8 in Section 4.4.1 shows where TDC's wastewater model predicts wastewater overflows along with relevant customer complaints and areas TDC are focussing on further upgrades to address this issue.

5.10.2 Transport

State Highway 1, which passes through Timaru, is a critical transport link for the east coast of the South Island. Key transport routes in and out of Timaru are at risk of flooding and road closures. However, except for State Highway 1 around Taitarakihi/ Te Ahi Tarakihi

Creek, the at-risk areas are outside the Timaru SMA and relate to regional river flood risk or flooding of low-lying rural land in significant rainfall events.

5.10.3 Flood Protection

Notable flood protection infrastructure within the SMA includes the stop banks either side of Saltwater Creek near Scarborough (Figure 5-13). These stop banks were constructed to divert the flow around the historic Ōtipua Lagoon, which was drained to construct the Redruth Resource Recovery Park.

Figure 5-13 Stopbanks along Saltwater Creek

5.11 Climate Change Implications

MfE (2018) climate change projections for Canterbury forecast an increase in temperature, an increase in the number of hot days, a decrease in the number of frost days and snow days and an increase in annual rainfall. Specifically, MfE (2018) predicted temperatures will likely be 0.7 °C to 1.0 °C warmer by 2040 and 0.7 °C to 3.0 °C warmer by 2090.

A recent update of climate change predictions by NIWA (2020) is forecasting rainfall to change by between +/-5 percent for most of the canterbury region by 2040 and 2090. Winter rainfall is projected to increase considerably by 2090 in many eastern, western and southern parts of Canterbury a 15 to 40 percent more rainfall is projected. Of most relevance, NIWA (2020) predicts that annual rainfall is projected to increase by 20 to 25 percent in eastern parts of South Canterbury near Timaru by 2090.

Some of the impacts of climate change are already being felt in Timaru, with increased flooding, coastal erosion and extreme weather (Timaru District Council, 2023). Since 1900, 0.2 m of sea level rise has been seen in Canterbury, with a further rise to by 0.8 m expected by 2100 (P M Driver and Associates, 2022). This will increase the vulnerability of properties and infrastructure in the low-lying coastal areas of Timaru.

The NIWA (2020) predictions have formed the basis of PDP's (2021a) assessment that a future increase in groundwater levels underlying all four townships (Timaru, Washdyke, Temuka and Pleasant Point) is anticipated, although this could also lead to an increase in groundwater losses to streams which may provide a buffering effect. Climate change predictions of increased incidence and intensity of extreme events, particularly for shorter duration events, are associated with larger floods. An increase in the duration of stormwater infiltration to ground is expected, with associated groundwater level impacts, and is an important consideration for sizing future stormwater infrastructure and basins.

6. Stormwater Issues Summary

6.1 Overview

Community feedback in conjunction with the Technical Reports that supported the development of this management plan have identified a series of known issues associated with the management of stormwater in Timaru (below). These have fed into the identification of the goals and objectives of this SMA, which should be progressively addressed as TDC implements improvements to the stormwater infrastructure and/or management practices.

Key known issues with stormwater management, include:

6.2 Flooding

Flooding is a natural phenomenon and typically occurs around waterway corridors, overland flow paths and in low lying areas. The stormwater network is designed to a specific capacity or level of service, during rainfall event which exceed the level of service, stormwater runoff will either pond or flow via secondary overland flow paths. This has the potential to cause adverse effects to the community. The stormwater ponding related issues we have identified in Timaru include:

- Poorly drained soils in most of Timaru presents issues for draining stormwater to ground and causes ponding for extended amounts of time. This happens more often in low lying areas and areas with no established connection to the stormwater system.
- The height of the ocean tide and/or blockage of coastal outfalls impacts on how quickly stormwater can drain from the system, as sometimes the stormwater ocean outfalls (i.e. in Taitarakihi/ Te Ahi Tarakihi Creek, Waimataitai Creek, Whales Creek and the Ōtipua/Saltwater Creek) are already full with sea water, leaving little room for stormwater to drain. This can increase flooding on properties and roadways including Caroline Bay and low-lying areas close to the coast.
- Limited and undersized pipe network in some areas cause stormwater to flow over ground when the pipe system is full or not available. This happens more often in areas with significant flood risk.
- Several areas have been identified as having a significant flood risk, including the Taitarakihi/ Te Ahi Tarakihi catchment, Caroline Bay, June Street, Kauri Street and the commercial areas downstream of the Highfield Golf Course.
- Blocked overland flow paths are causing stormwater ponding, as we have built in or obstructed places where stormwater would naturally flow. The loss of these natural flow paths mean stormwater moves into and impacts more on the built environment. In these areas, stormwater can no longer flow along the natural path and will continue to build up and cause flooding or other damage.
- In general, increasing impervious areas in Timaru, combined with more frequent heavy rainfall events, are exceeding the capacity of the existing stormwater system and causing ponding.

6.3 Pollution

Stormwater runoff picks up pollutants from hard surfaces such as roads, carparks, industrial yards and certain building materials. Polluted stormwater is discharged to the environment, putting strain on the health of our waterways. This can affect the aquatic ecosystem and how the community views and interacts with the waterways. The following stormwater pollution related issues have been identified in Timaru:

- Pollution in stormwater, and from other activities across Timaru, can directly enter the urban waterways, untreated and unchecked.
- Instances of high concentrations of bacteria can make some waterbodies (namely Caroline Bay) unsuitable for recreational use. Stormwater flowing into these waterbodies can contain high concentrations of bacteria, attributed to waste from animals (e.g. dogs/birds/livestock) or potentially from human sources (through sewage/wastewater overflows or unauthorised cross connections).
- High nutrient concentrations (Nitrogen and Phosphorus) have been found in the waterways, with phosphorus being particularly high. This is consistent with nutrients from agricultural runoff and surrounding urban activities in the areas. Elevated nutrients can result in algae growth that can harm aquatic life.
- High heavy metal concentrations (Zinc and Lead) have been found accumulating in the sediments in the waterways, particularly in the upper and middle reaches of waterways flowing through Timaru. These can be attributed to vehicle movements and roofs/building materials.
- Dry weather / baseflow water quality is exceeding the ANZG (2018) guideline values for heavy metal concentrations (Zinc and Copper).
- High petroleum hydrocarbon concentrations have been found in most of the waterways. This can be attributed to vehicles from the high use roads and carparks in the area.
- High use roads (e.g. State Highway 1) and carparks without treatment of the stormwater runoff contributes to pollution in waterways.
- Industrial and commercial activities in Timaru present risks to the quality of stormwater and waterways. There are numerous commercial and industrial properties in the plan area, some of these have been identified as high risk due to the potential impacts of spills and discharge to the system.
- Sewage/wastewater can overflow into the stormwater system and the waterways in Timaru. This can happen during very heavy rainfall, particularly in low lying areas, when stormwater flooding enters the sewer system, causing it to overflow into the stormwater system and the waterways. This can also happen when the sewer system is blocked causing overflows.

6.4 Reduced Aquatic Life

Our waterways have recreation and cultural significance and the protection and return to a healthy mauri / life-force is very important. A measure of the health of a waterway is the presence and variety of aquatic life like fish, plants and other native species, and the ability of these organisms to thrive and travel. The key stormwater issues related to aquatic life identified in Timaru include:

- Low number and variety of aquatic life was measured in all the waterways
- Fine sediment has been observed smothering vegetation, insects, and fish. This is likely from the erosion of soils within the urban area, stream bank erosion or upstream agricultural practices. This fine sediment can be resuspended in rainfall events resulting in low water clarity.
- Barriers to fish passage, including culverts, have been identified in all the waterways. These in-stream structures can prevent certain species from breeding and their offspring from migrating to suitable habitats, which can result in a decline in fish population.
- Mussels sampled from a coastline area still used for mahinga kai have been observed to be undersized and with elevated zinc concentrations.

6.5 Maintenance

The limited maintenance of the stormwater system and waterways has an impact on the system's ability to function and the community's enjoyment of the waterways.
Proactive management of the existing and future stormwater infrastructure within Timaru will improve the stormwater quality outcomes within the SMA. The key stormwater issues related to maintenance identified in Timaru include:

- Operations and maintenance responsibilities of the stormwater system and waterways are spread amongst multiple teams within TDC. This impacts the consistency and level of service provided.
- Parts of the streams are on private property which affects the maintenance and use of the waterways.
- Some maintenance of waterways that occurs generally falls under Environment Canterbury's drainage bylaw, which focuses on maintaining conveyance/flood capacity. There is currently no mechanism to consider maintenance of waterways from a water quality or aquatic health perspective.
- The stormwater network in Timaru is ageing and there is limited information on the condition of some of the stormwater infrastructure. Hence some parts of the network may be at the end of their service life and could be damaged or blocked.

6.6 Increased Development

The community within the Timaru SMA will continue to grow and as development intensifies, stormwater runoff will increases placing greater pressure on the existing stormwater system and the environment.

Previously as development occurred, stormwater systems were designed to collect and transport runoff as quickly as possible to waterways, largely untreated. This approach has resulted in damage to the natural environment and limitations for the system to cope with increased development and the need to provide treatment before discharge into waterways.

Growth and development in the town requires careful stormwater planning and management to ensure adequate level of service is provided. The key stormwater issues related to development identified in Timaru include:

- Legacy issues due to the previous approach to development, where existing stormwater networks are no longer meeting the capacity and treatment level of service.
- Development will increase stormwater runoff and put greater pressure on the existing capacity of stormwater networks, making flooding and water quality issues worse if we don't change the way we develop.

6.7 Climate Change

The existing climate is changing, and more extreme weather events are expected to heighten existing stormwater issues within the SMA. Whilst the magnitudes of the effects are uncertain due to the long-term nature of climate change, it is commonly accepted that there will be an increase the incidence and intensity of extreme and very extreme rainfall events, particularly for shorter duration events with associated larger floods.

This will result in an increase in the duration of stormwater infiltration to ground, and associated groundwater level impacts, and is an important consideration for sizing future stormwater infrastructure. The key stormwater issues related to climate change identified in Timaru include:

- It is likely that more intense rain events will occur more frequently, which will further increase flooding and damage to the natural environment.
- Sea level rise and projected future erosion of the coastline will significantly impact the ability of the stormwater system in Timaru to discharge to the waterways and the ocean.
- The projected erosion of the coast and sea level rise is expected to result in significant increase in groundwater levels (1 m or more) over parts of Timaru. This may result in groundwater inundating or coming up to the surface at times.
- The stormwater management system will need to be resilient and adaptable to cope with the impacts of climate change.

6.8 Review of Issues

The current set of key issues has been identified based on the community feedback and the reports that supported the development of this management plan. It is anticipated that new issues may be identified during the Monitoring Plan and included in the routine review of the SMP. However, a detailed review of the issues with the Timaru Stormwater Management system, including a possible realignment of the SMP goals and objectives to address the issue shall be undertaken periodically in line with section 11.

The review shall seek advice from the community, Arowhenua, and key stakeholders as well as an assessment of the performance of the Timaru stormwater infrastructure and management systems.

7. Options

Appendix A provides a suite of possible projects or management actions to address the issues summarised above. Whilst not an extensive list, this provides guidance on the possible solutions that TDC can apply in the Implementation Plan to address currently known issues and objectives for the Timaru SMA. The options are categorised under one of the following:

- Capital projects
- Planning and engineering
- Operations
- Maintenance
- Public involvement.

The degraded state of the waterways highlighted in Section 5.8, strongly indicates an urgent need for action in line with the monitoring programme and Trigger Action Response Plan, as explained in further detail in section 9.2 and 9.3 below and in the "Timaru Stormwater Management Plan - Monitoring Plan." To address issues such as poor water quality (exceeding the ANZG (2018) guideline values for heavy metal concentrations) in dry weather/baseflow conditions and low QMCI/MCI scores, the following option from the table in Appendix A will be the first project taken through the implementation process (Figure 9-1):

- Comprehensive watercourse assessments with GIS outputs for planning improvements. Including erosion, assets, fish barriers, stream ecological value, MCI, vegetation cover/type, fish species, etc. and further monitoring to identify contaminant sources (e.g. from long-term sediment accumulation).

8. Management Approach

8.1 Adaptive Management

TDC applies an adaptive management approach to the management of the stormwater in Timaru. Adaptive management is an investigational approach to management, often defined as 'structured learning by doing'. It has three elements, (1) monitoring, (2) adapting and (3) learning, as presented in Figure 8-1.

The monitoring plan will assess the performance of the management of Timaru's stormwater management systems relative to the specified Objectives and Goals, as well as identify projects or management actions that would progressively improve the management of stormwater or address a specific issue(s). As the Objectives and Goals may evolve in response to community concerns or changes in the environmental regulatory environment, TDC's Long Term Plan will need to adapt.

As outlined in Section 9 the Implementation Plan will be reviewed annually, which in turn will feed into TDC's Annual Plan and Long-term Planning processes. A continual review of the latest techniques and consideration of the performance of the implemented projects or management actions will ensure that TDC expenditure will be directed to projects and actions that will progressively address the Goals and Objectives of the Stormwater Management Plan.

As outlined in Section 9.3 the Monitoring Plan will allow TDC to evaluate the performance and progress of the stormwater management infrastructure to achieve these objectives and targets, and more importantly, trigger the identification of additional projects that would improve the outcomes of the stormwater system.

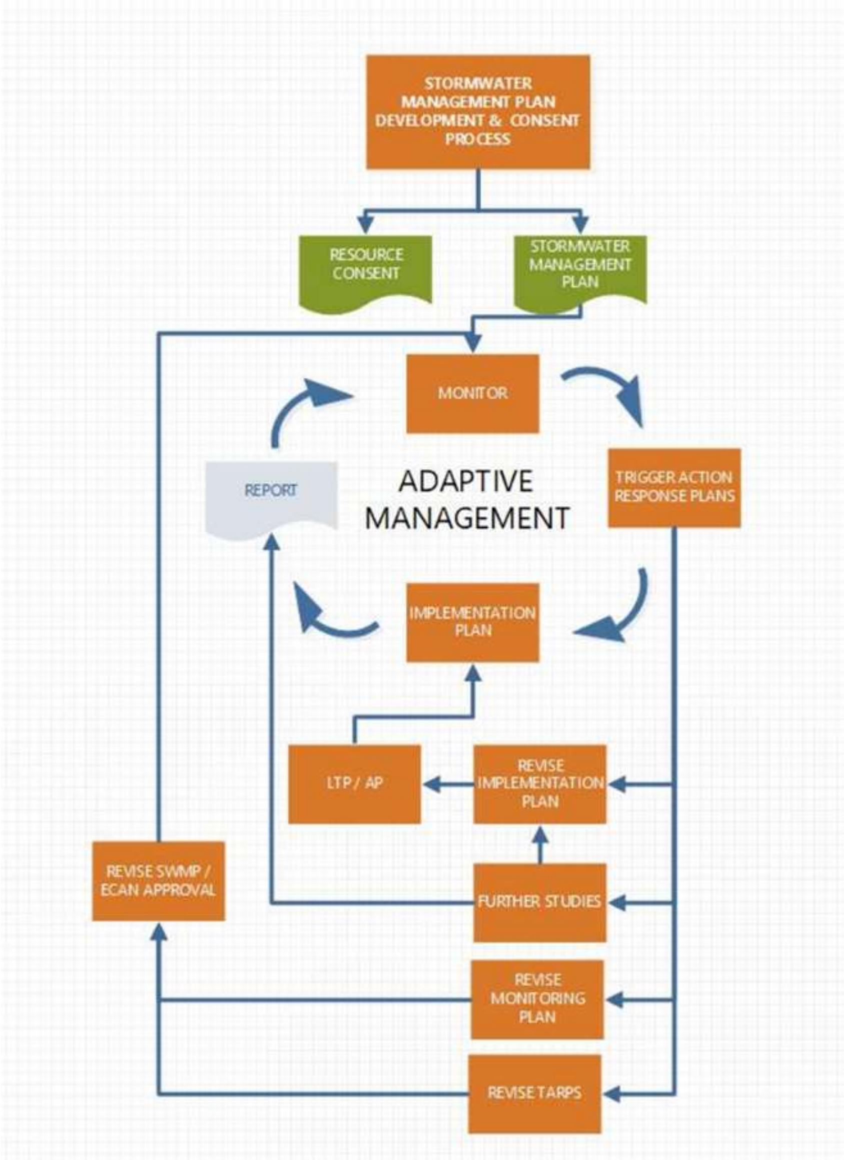


Figure 8-1 Stormwater Management Plan Adaptive Management Approach

Management Tools

TDC operates a suite of tools, management systems, policies, and procedures to manage the stormwater infrastructure and activities that occur within the SMA. These include:

- Asset Management System. The asset register includes details of:
  - *Public flooding complaints*
  - *Manhole and culvert inspections*
  - *Asset Invert surveys*
  - *CCTV condition inspections and assessments*
  - *Construction and maintenance records*
- Asset condition assessments include:
  - *Pipe CCTV inspections;*
  - *Downstream channel inspections; and*
  - *Outfall inspections.*
- Hydraulic Capacity Assessments
- Stormwater Bylaw

- District Plan
- Stormwater Infrastructure Standards, include Timaru district high intensity rain depths
- Soakaway Drainage Capacity Assessments
- Commercial / Industrial Site Audits
- Building Consent Approvals - new development controls (floor level, approval of new connections, network capacity assessments)
- Water Quality Monitoring
- Education programmes (both internal and external)

Monitoring of environmental parameters and the associated trigger and response plans (TARPs) (Section 9.3) enables a quantitative assessment of stormwater management. This monitoring provides key feedback into the management plan that identifies areas that should be targeted for improved stormwater management as well as monitoring the performance of management practices that have already been implemented.

A stormwater bylaw under the Local Government Act 2002 is operative, this can require existing sites connected to the stormwater network to undertake improvements to stormwater management on site and monitoring of discharge quality.

The draft Timaru District Plan review enables stormwater management standards in terms of Quantity and Quality to be enforced through activity rules and land-use zones.

Stormwater management can be implemented through the management of applications to the building consenting and stormwater approvals teams. TDC has minimum infrastructure standards that align with the stormwater management objectives and the District Plan Review is seeking that new developments and discharges will implement appropriate standards for improving stormwater management.

Audits of commercial and industrial sites that are operating under TDC's stormwater consents enable TDC to identify sites that are not performing by the consents and may be affecting TDC's compliance with their consents. Improved stormwater management will be recommended for non-complying sites. The consequence of not carrying out the required improvements will be the site losing its ability to discharge under TDC's stormwater consent, therefore requiring a separate consent from ECan with likely the same required improvements.

Education is a key component of improving stormwater management. The wider public may be unaware of the consequences of activities such as washing their vehicles or waste bins into the stormwater network or may not understand the steps they can take to improve the quality of stormwater in their neighbourhood.

9. Implementation

9.1 Preparation

The Implementation Plan provides a summary of the schedule of projects or management actions that TDC will implement to progressively improve the management of stormwater in Timaru. The plan includes indicative costing for each action or program (if the actions can be grouped into programs) as this is useful for planning and setting budgets in TDC Annual Plans and Long-term Plans; similarly, any funding limitations will be reflected in the scheduling of projects or actions.

The Implementation Plan defines who is responsible for implementing the actions and includes an implementation timeline from planning, design, and implementation. Table 9-1 provides an example of the structure of an Implementation Plan in a tabular format. Note, that the actual Implementation Plan would contain more specific information. If a project or action has actions for other agencies/groups, there will be a formalised agreement or partnership arrangement with the other agencies/groups regarding the implementation of the recommendations.

Implementation Plan Checklist:

- Introduction
- Review date
- List or map of proposed Project(s) or Management Actions.
- Implement Plan Table (similar to the example presented in Table 9-1)
  - *The issue to be addressed and the corresponding Objective*
  - *Description of the Project or Management Action*
  - *Estimated cost*
  - *Agencies or departments that will be responsible for the implementation of the project or action*
  - *Timeline, including planning, concept, design and delivery dates*
  - *Key performance indicator(s)*

As illustrated in Figure 9-1, the Implementation Plan is revised annually. During the year, new potential projects or management actions will be identified, either as the recommendation as to the result of the Monitoring Plan (Section 7.) or other sources (e.g. council officers, working party recommendations, etc). Annually these potential projects or actions are evaluated, along with the existing projects or actions in the Implementation Plan.

The evaluation considers how well the projects or actions will progressively improve the management of stormwater, specifically to achieve the Objectives and Targets of the SMA. Working within existing funding budgets the new and existing projects will be rescheduled, where projects and actions with the greatest benefit being prioritise.

A suite of possible projects or management actions has been prepared and summarised in Appendix A. Whilst not an extensive list, this provides guidance on the possible solutions that TDC can apply in the Implementation Plan to address currently known issues and objectives for the Timaru SMA.

The annual review process will allow the schedule of projects and action to adapt to changes in the environment or social issues, and regulatory changes during the life of the consent. Whilst, the schedule of projects or actions will be matched to budgetary restraints, the Implementation Plan can demonstrate and support the business case for possible increases in Annual Plan and Long-term Plan funding.

It is noted that the success of the Implementation Plan requires collaboration with AECL/Te Rūnanga o Arowhenua and it is recommended consultation on this matter in undertaken on at least an annual basis.

Table 9-1 Example of Implementation Plan Table

Issue	Objective	Project / Management Option	Estimated Cost		Agency/ Dept	Timeline	KPIs
			Capital	Ongoing			
Inadequate maintenance of stormwater devices	Ecology of Waimataitai Stream	Develop and use an electronic infrastructure management program	$ xxx	$ xxx	TDC – Infrastructure Group	2023	The infrastructure management programme and SMA annual reporting
Localised inundation Bridge St	Flooding Level of Service		$ xxx	$ xxx	TDC – Parks TDC - Drainage & Water	2024 – Plan 2026 - Implementation	Flood frequency
Etc.							

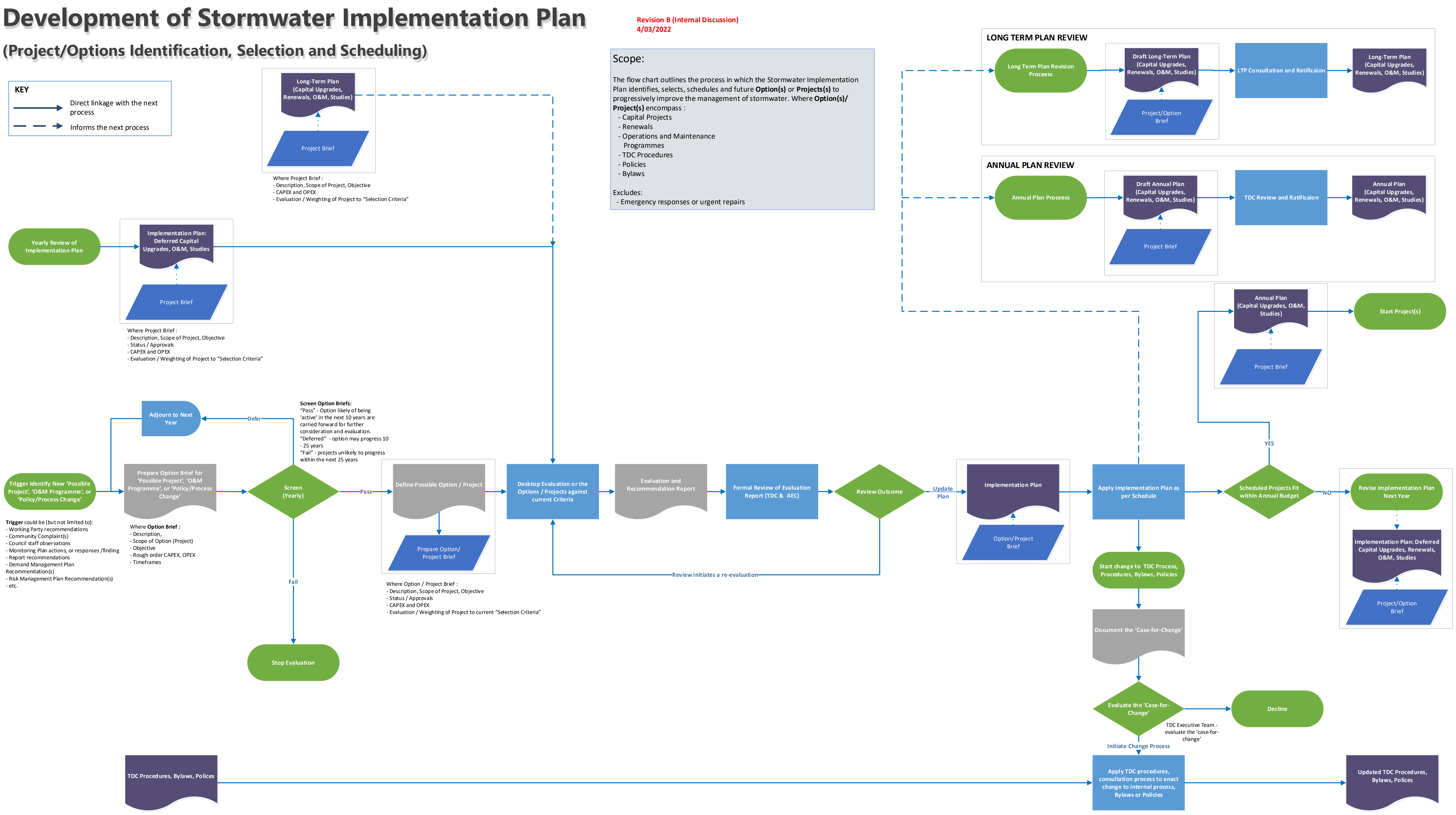


Figure 9-1 Stormwater implementation Flowchart

9.2 Trigger Action Response Plan

A key element of this management plan, and the success of the 'adaptive management approach is the use of a Trigger Action Response Plan (TARP). A TARP is a process that has been employed to feed information into the stormwater management or identify future projects that will improve the management of the stormwater in Timaru. Hence allowing TDC to evolve or adapt the management of stormwater where these future projects are identified as the result of actions that are triggered in response to the results from the monitoring plan.

The TARP consists of using the Monitoring Plan with a set of documented and known environmental (and cultural) indicators that are checked continually in the SMA. The level of risk to the environment (or cultural indicator) is pre-identified, and when a trigger is reached then a responsible person(s) is required to react accordingly.

In general, each monitoring parameter (or groups of parameters) have pre-defined actions which fall into three categories (or levels) as summarised below:

- Trigger Level 3 (Green): Parameters are within the nominal trigger values and are indicative of good quality/performance.
- Trigger Level 2 (Orange): Parameters are showing signs of a reduction in the performance of the stormwater management practices. Actions are likely to be required soon, some further monitoring is likely.
- Trigger Level 1 (Red): Parameters are indicating the poor performance of the stormwater management practices that are likely to be having a noticeable effect on the receiving environment. More urgent stormwater management improvements and investigations of possible solutions are required.

9.3 Monitoring

Monitoring of water quality, aquatic ecology, stream sediment quality, groundwater and cultural is outlined in detail in the Timaru Stormwater Monitoring Plan. The plan outlines the proposed frequency of monitoring, parameters to monitor, and monitoring locations for:

- Surface water quality and quantity
- Sediment quality
- Ecology
- Groundwater quality
- Flooding complaints
- Commercial and industrial site audits
- Stormwater network outfall inspections
- Mātauranga Māori monitoring

The monitoring programme has been designed to monitor the performance and ecological impact of the stormwater discharges on the environment and guide both reactive and proactive management and any additional maintenance of the stormwater infrastructure in Timaru. Current adaptive management actions are detailed within the TARP (trigger, action, and response plan) and included in the Monitoring Plan.

This includes the monitoring requirements that are recommended to be included in the resource consent as well as additional monitoring provided to assist TDC management of the network and understanding of the base environmental characteristics better.

The Monitoring Plan shall be reviewed annually. The annual review shall identify the monitoring parameters that should be added, dropped or frequency changed.

9.3.1 Database

In addition to any specific resource consent monitoring requirements, TDC will maintain an Environmental Compliance Database. This database will be used to record all aspects relating to compliance of the SMWP to resource consent requirements in addition to additional elements identified in this SMA.

The Database/Register will be managed and maintained by the Drainage and Water Manager to ensure all SMA compliance matters are addressed on time and per the monitoring requirements.

9.4 Maintenance Register

As part of the ongoing management of stormwater infrastructure within the Timaru SMA, a maintenance register is to be established which outlines the location, known issues and maintenance requirements of TDC stormwater infrastructure within the SMA. A work in progress template is included in Table 9-2.

Table 9-2 Example Timaru Stormwater Infrastructure Maintenance Plan.

Asset	Description	Date Installed	Last Inspected	Known Issues	Maintenance Requirements
HLTN-SO15102	Waimataitai Creek outfall into Caroline Bay	June 1997	Xx/xx/20XX	Stormbeat Location	Every three months, maintenance team to remove deposited sediment and dispose of appropriately.
ST-INL - 81681	132-134 Selwyn Street	June 1954	Xx/xx/20XX	Blockages	Inlet screen to be inspected twice yearly and prior to large rainfall events.
ST-SMP 72550	16 Barnes Street	April 1970	Xx/xx/20XX	Debris on Sump Gratings	Inspect sump twice yearly and prior to large rainfall events.
Etc.					

10. Communication and Reporting

Effective and regular communication of the performance of the Timaru stormwater network is important to deliver the successful implementation of the Timaru SMA.

10.1 Internal Stakeholders

Internal communication refers to communication with TDC personnel (including maintenance and operations contractors) who are associated with providing and maintaining the stormwater infrastructure for Timaru. Key internal communication mechanisms will include:

- Customer Services receiving and responding to any stormwater 'complaints' or 'problems', per TDC's service complaints management procedure.
- Annual Reporting
  - *Asset data collection activities completed*
  - *Asset data collection activities programmed*
- Project status and milestones

- *Operations and maintenance activities*
- *Implementation Plan revisions and programme progress*
- *Monitoring results*
- *Planned monitoring activities*
- *Additional investigations required*
- *Education activities completed*
- *Education activities proposed*

- Internal reporting & liaison, including but not limited to
  - *Waste Minimisation (Education programmes and monitoring)*
  - *Roading Section (O & M and Capital works programme)*
  - *Animal Control Section (Education programmes and monitoring)*
  - *Planning Section (new development requirements)*
  - *Timaru Community Board (Upcoming projects and general activities, management plan milestones and achievements)*
  - *Infrastructure Community (upcoming projects)*
  - *Environmental Services Committee (new development requirements and planned servicing upgrades)*

10.2 External Stakeholders

External stakeholders and details required may include but are not limited to:

- Environment Canterbury (Pollution Control, waterway maintenance issues, environmental monitoring, compliance requirements)
- Te Rūnanga o Arowhenua (Upcoming projects and general activities of interest, management plan milestones and achievements)

11. Reviews

The Timaru Stormwater Management Plan should be reviewed initially every two years, with a detailed review of the issues, goals and objectives being undertaken every six years. The TDC Drainage & Water Manager (or delegate) shall undertake the review of the plan, policies and procedures associated with the implementation of the plan. The review of the management plan should be undertaken in consultation with Te Runanga of Arowhenua and Environment Canterbury.

Any changes to the plan shall be approved by the TDC Group Manager – Infrastructure.

The next routine review is due to be completed by XXXX insert date XXX , whilst a detailed review, incorporating a review of the key issues, goals and objectives shall be completed by XXX insert date XXX.

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List of Abbreviations/Terms and Definitions

Abbreviation/Term	Definition
ARI	Average Recurrence Interval
ANZG	Australia and New Zealand Guidelines for Fresh and Marine Water Quality (2018)
bgl	Below ground level
DGV	Default Guideline Value
ECan	Environment Canterbury
F-IBI	Fish Index of Biological Integrity
LWRP	Land and Water Regional Plan
MCI	Macroinvertebrate Community Index
NPSFM	National Policy Statement for Freshwater Management 2020
NZFFD	New Zealand Freshwater Fish Database
PDP	Pattle Delamore Partners Ltd
QMCI	Quantitative Macroinvertebrate Community Index
RMA	Resource Management Act 1991
SMA	Stormwater Management Area
Target	Concentration or physical parameter (e.g. flow rate or % coverage) that is desired in order for the objectives of the SMA to be met
Trigger Value	Concentration or physical parameter (e.g. flow rate or % coverage) from national or regional guidelines that

	must be met to minimise effects on the receiving environment
TDC	Timaru District Council
TPH	Total Petroleum Hydrocarbons

Appendix A
Stormwater Options

A suite of possible projects and management actions

Issues		Options				
		Capital Projects	**Planning & Engineering**	**Operations**	**Maintenance**	**Public Involvement**
Issue 1 - Flooding	1.1 Poorly drained soils in most of Timaru/Te Tihi o Maru presents issues for draining stormwater to ground and causes ponding for extended amounts of time. This happens more often in low lying areas and areas with no established connection to the stormwater system. 1.2 The height of the ocean tide and/or blockage of coastal outfalls impacts on how quickly stormwater can drain from the system, as sometimes the stormwater ocean outfalls (i.e. in Taitarakihi/ Te Ahi Tarakihi Creek, Waimataitai Creek, Whales Creek and the Ōtipua/Saltwater Creek) are already full with sea water, leaving little room for stormwater to drain. This can increase flooding on properties and roadways including Caroline Bay and low-lying areas close to the coast. 1.3 Limited and undersized pipe network in some areas cause stormwater to flow over ground when the pipe system is full or not available. This happens more often in areas with significant flood risk. 1.4 Several areas have been identified as having a significant flood risk, including the Taitarakihi/ Te Ahi Tarakihi catchment, Caroline Bay, June Street, Kauri Street and the commercial areas downstream of the Highfield Golf Course. 1.5 Blocked overland flow paths are causing stormwater ponding, as we have built in or obstructed places where stormwater would naturally flow. The loss of these natural flow paths mean stormwater moves into, and impacts more on the built environment. In these areas, stormwater can no longer flow along the natural path and will continue to build up and cause flooding or other damage. 1.4 In general, increasing impervious areas in Timaru/Te Tihi o Maru, combined with more frequent heavy rainfall events, are exceeding the capacity of the existing stormwater system and causing ponding.	Pipe upgrades and extentions to the reticulated stormwater network - as identified from stormwater model/master plan - NZTA planned upgrade of SH1 taitarakihi culvert - June St intake capacity imporvements (planning/investigation stage) - Caroline Bay sealing of main and localised upgrades (design /construction stage) Formalised attenuation storage - could be public and/or private (e.g. rain tanks). - detention bund to attenuate upper taitarakihi catchment runoff - attenuation within Highfield Golf Course (currently in in planning phase) Modify/formalise/create overland flow paths - this may include regrading/ reforming roads, upsizing culverts, modifying fences... Consider whether any improvements could be funded by new development	Comprehensive 1D-2D hydraulic model builds of all catchments System performance and development of a master plan to achieve LoS requirements No engineered soakage systems for stormwater disposal Programme to reduce imperviousness (scheduled or opportunistic?) Flood Risk Certificate process and communication of floor level requirements for new buildings	Flood event monitoring (e.g. caputuring flood photos and data) Rain gauge data collection and analysis Recording of customer complaints - review process and look for improvements in the way data is recorded to better support analysis of flood events. Liaison with LTU around aligning stormwater with roading projects, including reduction in imperviousness of the road corridor Investigate TDC role/responsibility and associated internal process (e.g. under SW bylaw) for undertaking compliance of private SW systems	Street sweeping Sump clean-out Maintain rain gauges Maintain flood carrying capacity of waterways	Public awareness on safety around flooding and stormwater assets (e.g. streams, catchpits, manholes). Education on homeowner obligations and expectations around retention/detention, hydraulic neutrality (Proposed District Plan) rain tanks and impervious site coverage Public assist in capture of flood event photos and data - need system to enable this.

Issues		Options				
		Capital Projects	Planning & Engineering	Operations	Maintenance	Public Involvement
Issue 2 - Pollution	2.1 Pollution in stormwater, and from other activities across Timaru/Te Tihi o Maru, can directly enter the urban waterways, untreated and unchecked. 2.2 Instances of high concentrations of bacteria can make some waterbidies (namely Caroline Bay) unsuitable for recreational use. Stormwater flowing into these waterbodies can contain high concentrations of bacteria, attributed to waste from animals (e.g. dogs/birds/livestock) or potentially from human sources (through sewage/wastewater 2.3 High nutrient concentrations (Nitrogen and Phosphorus) have been found in the waterways, with phosphorus being particularly high. This is consistent with nutrients from agricultural runoff and surrounding urban activities in the areas. Elevated nutrients can result in algae growth that can harm aquatic life. 2.4 High heavy metal concentrations (Zinc and Lead) have been found accumulating in the sediments in the waterways, particularly in the upper and middle reaches of waterways flowing through Timaru/Te Tihi o Maru. These can be attributed to vehicle movements and roofs/building materials. 2.6 Dry weather / baseflow water quality is exceeding the ANZG (2018) guideline values for heavy metal concentrations (Zinc and Copper). 2.6 High petroleum hydrocarbon concentrations have been found in most of the waterways. This can be attributed to vehicles from the high use roads and carparks in the area. 2.7 High use roads (e.g. State Highway 1) and carparks without treatment of the stormwater runoff contributes to the pollution in waterways. 2.8 Industrial and commercial activities in Timaru/Te Tihi o Maru present risks to the quality of stormwater and waterways. There are numerous commercial and industrial properties in the plan area, some of these have been identified as high risk due to the potential impacts of spills and discharge to the system. 2.9 Sewage/wastewater can overflow into the stormwater system and the waterways in Timaru/Te Tihi o Maru. This can happen during very heavy rainfall, particularly in low lying areas, when stormwater flooding enters the sewer system, causing it to overflow into the stormwater system and the waterways. This can also happen when the sewer system is blocked causing overflows.	Stormwater treatment - at source, bottom of pipe, somewhere in between... Proprietary treatment (typically on exisitng pipes/outfalls), incorporating as part of road or footpath re-design (e.g. raingardens, swales), vegetated filter strip/riparian buffer, dedicated land purchase and incorporation of wetland, basin, etc - Stormwater treatment wetland in Highfield Golf Course (currently in planning stage) Preference for at source treatment through a green infrastrucutre approach Removal/dredging of sediment Stormwater treatment on site or communal device downstream of sites designed for predicted contaminant loads. Further wastewater improvement projects to reduce overflows e.g. Increas capacity, raise gully traps (identified using wastewater model) stormwater improvements to reduce ponding where this may enter the wastewater system e.g. new stormwater connection or land reshaping	Feasibility assessment to review all outfalls and identify those that could practicably be upgraded to incorporate stormwater treatment prior to discharge. Use CLM to prioritise which of the feasible outfalls for treatment could have the biggest reduction in contaminant load TDC support and promote initiatives on riparian margin work in rural land with ECan, and fish passage improvements with Ecan, such that rural land uses undertake recognised good management practices within the catchment Roof and guttering material review and (if necessary) initiate a programme of roof painting and/or downpipe treatment Commprehensive watercourse assessments as described below under Issue 3 and further monitoring to identfy contaminat sources (e.g. from long-term sediment accumulation) Feasibility assessment to highuse roads and carparks to identify those that could practicably be upgraded to incorporate stormwater treatment prior to discharge. Industrial site assessment starting with identified high-risk site - auditing programme including a requirement for improvements such as site management practices and on-site stormwater treatment. Where there are large roof areas this could include downpipe treatment units Investigate stormwater ponding on private porperty and whether this regularly ponds high enough to enter gully traps or instances of downpipes connected to wastewater system. Source tracing in dry weather to identify potential cross-conections	On-going relationship and enagement with Rūnanga Auditing and compliance of industrial sites assessment (on-going) Recording of customer complaints - review process and look for improvements in the way data is recorded to better support analysis of overflow instances.	Provision for adequate maintenance of new storwater treatment facilities in council maintenance programmes/budgets	Public consultation around level of investment in stormwater treatment will influence available budgets Public education to ensure instances of stormwater ponding entering gully traps is reported to council. And no downpipes are connected to the wastewater system.

<table>
<tr><th colspan="2" rowspan="2">Issues</th><th colspan="5">Options</th></tr>
<tr><th>Capital Projects</th><th>Planning & Engineering</th><th>Operations</th><th>Maintenance</th><th>Public Involvement</th></tr>
<tr><td>Issue 3 - Reduced Aquatic Life</td><td>3.1 Low number and variety of aquatic life was measured in all waterways.

3.2 Fine sediment has been observed smothering vegetation, insects and fish, which is likely from upstream agricultural practices and stream bank erosion.

3.3 Barriers to fish passage – including culverts – have been identified in all the waterways. These in-stream structures can prevent certain species from breeding and their offspring from migrating to suitable habitats, which can result in a decline in fish
3.4 Mussels sampled from a coastline area still used for mahinga kai have been observed to be undersized and with elevated zinc concentrations.</td><td>Improvement in physical habitat (including riparian habitat and connected water bodies

Removal/dredging of sediment

Remove barriers to fish passage

Investigate daylighting piped section of Waimataiai through Ashbury Park</td><td>Comprehensive watercourse assessments with GIS outputs for planning improvements. Including erosion, assets, fish barriers, SEV, MCI, vegetation cover/type, fish species, etc.

Masterplanning stream restoration, linking cultural values, amenity, ecology/habitat and water qualityoutcomes into a multi-functional corridor. Interventions/actions for private and public land.

Comprehensive TARP monitoring plan (linked to consent conditions and implementation plan), using te mana o te wai as a framework and integrated with cultural monitoring.</td><td></td><td></td><td>Education around interventions/actions for private land, particularly those with waterway on their property.

Community planting days with mana whenua influence on source and type of planting</td></tr>
<tr><td>Issue 4 - Maintenance</td><td>4.1 Operations and maintenance responsibilities of the stormwater system and waterways are spread amongst multiple organisations. This impacts the consistency and level of service provided.

4.2 Parts of the streams are on private property which affects the maintenance and use of the waterways.

4.3 Some maintenance of waterways that occurs generally falls under Environment Canterburys drainage bylaw, which focuses on maintaining conveyance/flood capacity. There is currently no mechanism to consider maintenance of waterways from a water quality or aquatic health perspective.

4.4 The stormwater network in Timaru/Te Tihi o Maru is ageing and there is limited information on the condition of some of the stormwater infrastructure. This means that some parts of the network may be at the end of their service life and could be damaged or blocked.</td><td>Consider whole of life costs and operation and maintenance safety in the the development of capital projects</td><td>stream condition assessment and criticality mapping

Asset criticality mapping.
CCTV and pipe condition assessment following a risk-based approach to identify asset renewal or rehabilitation.</td><td>Monitoring/inspection and enforcement (e.g. under bylaw) for stormwater infrastrucutre compliance</td><td>Provision for adequate maintenance of new storwater treatment facilities in council maintenance programmes/budgets

Risk-based programme of cleaning stormwater assets</td><td>Educate owners on responsibilities for maintenance of private stormwater infrastructure (and connected to teh reticulated network) and how they can do it safely.

Educate owners on responsibilities for stream maintenance through private property and how they can do it safely.

Community campaigns for stream maintenance</td></tr>
</table>

Issues		Options				
		Capital Projects	Planning & Engineering	Operations	Maintenance	Public Involvement
Issue 5 - Development	5.1 Legacy issues due to the previous approach to development, where existing stormwater networks are no longer meeting the capacity and treatment level of service 5.2 Development will increase stormwater runoff and put greater pressure on the existing capacity of stormwater networks, making flooding and water quality issues worse if we don't change the way we develop.	Legacy issues will be addressed as outlined under Issues 1-4 above Council design and construct key infrastructure (e.g. Attenuation and treatment) and recover through developer contributions Council fund 'extra-over' to extend stormwater design for new development to also offset some exisitng issues. New greenfield development in SMP Area adjacent to Taumatakahu Stream provides for a suitable riparian margin and plantings that protects and enhances Stream Health	Legacy issues will be addressed as outlined under Issues 1-4 above Network capacity mapping to inform development on capacity/ contributions. Development of engineering design and construction standards Guidance notes for developers including requirements around mapped overland flow paths, flooding and floor levels. Council involvement and input to guide development designs towards achieving water quantity and quality objectives through early involvement in individual development applications or through structure planning checking development design proposals using the stormwater model Write guidance document for operation and mainenance of private stormwater infrastructure	Legacy issues will be addressed as outlined under Issues 1-4 above Implementation of Proposed District Plan policy and rules relating to achieving hydraulic neutrality, restricting the use of particular building materials, limits on site imperviousness and protection of waterways and OLFPs Subdivision and building consents issued compared to those requiring land use consent due to non-compliance with draft District Plan Rules SW-R1 to R3 Engineering design and construction standards Stormwater connection approvals will record compliance and improvements Environmental design evaluation undertaken and recorded. Compliance monitoring	Legacy issues will be addressed as outlined under Issues 1-4 above Provision of adequate maintenance of new storwater facilities in council maintenance programmes/budgets e.g. Nominal additional funds included in annual budgets new infrastructure Guidance for landowners regarding operation and maintenance of private infrastructure i.e. soak pits, rain tanks etc	Legacy issues will be addressed as outlined under Issues 1-4 above Education around the benefit and use of rainwater tanks for stormwater attenuation as well as other 'green infrastructure'
Issue 6 - Climate Change	6.1 It is likely that more intense rain events will occur more frequently, which will further increase flooding, pollution and damage to the natural environment. 6.2 Sea level rise and projected future erosion of the coastline will significantly impact the ability of the stormwater system in Timaru/Te Tihi o Maru to discharge to the waterways and the ocean. 6.3 The projected erosion of the coast and sea level rise is expected to result in significant increase in groundwater levels (1 m or more) over parts of Timaru/Te Tihi o Maru. This may result in groundwater inundating or coming up to the surface at times. 6.2 The stormwater management system will need to be resilient and adaptable to cope with the impacts of climate change.	Any Capital projects implemented are designed to include a suitable cimate change allowance Timing of future capital projects to align with/pre-empt realisation of climate change impacts Designs built with redundancy and/or the ability to expand in future e.g. build a smaller basin now but ensure sufficient land available to increase size in future Adjustable control structures	Hydraulic modelling to include climate change scenarios along with assessment of current issues (based on historic rainfall) to help defferentiateand prioritise resolution of current issues as well as future adaptation measures	Rules/standards/guidelines around new development needing to allow for climate change in their designs [check source in place / required e.g Draft District Plan policy/rules]		