Council Agenda - 6 December 2023

Meeting will be held in the Council Chamber at Level 2, Philip Laing House, 144 Rattray Street, Dunedin and live streamed to the ORC YouTube Channel

Members:
Cr Gretchen Robertson, Chairperson
Cr Lloyd McCall, Deputy Chairperson
Cr Alexa Forbes
Cr Gary Kelliher
Cr Michael Laws
Cr Tim Mepham
Cr Kevin Malcolm
Cr Andrew Noone
Cr Bryan Scott
Cr Alan Somerville
Cr Elliot Weir
Cr Kate Wilson

Senior Officer: Richard Saunders, Chief Executive
Meeting Support: Trudi McLaren, Governance Support Officer

06 December 2023 01:00 PM

Agenda Topic — Page

That the public be excluded from the following parts of the proceedings of this meeting, namely:

1.1 Confidential Minutes of 22 November 2023
2.1 Port Otago Resolution in Lieu of Annual Shareholders Meeting
2.2 Property Resolutions
2.3 Approval to Notify the Draft Dunedin City Future Development Strategy

Otago Regional Council

Council
MINUTES

Minutes of an ordinary meeting of the Otago Regional Council held in the Council Chamber, Level 2 Philip Laing House, 144 Rattray Street, Dunedin on Wednesday 22 November 2023, commencing at 1:00 PM.

PRESENT

Cr Gretchen Robertson	*(Chairperson)*
Cr Lloyd McCall	*(Deputy Chairperson)*
Cr Alexa Forbes	
Cr Gary Kelliher	
Cr Michael Laws (online)	
Cr Kevin Malcolm	
Cr Tim Mepham	
Cr Andrew Noone	
Cr Bryan Scott	
Cr Alan Somerville	
Cr Elliot Weir	
Cr Kate Wilson	

1. WELCOME

Chairperson Gretchen Robertson welcomed Councillors, members of the public and staff to the meeting at 1:00 p.m. with a karakia. Staff present included Richard Saunders, (Chief Executive), Nick Donnelly (GM Corporate Services), Anita Dawe (GM Policy and Science), Gavin Palmer (GM Operations), Joanna Gilroy (GM Acting Regulatory), Amanda Vercoe (GM Governance, Culture and Customer), Kylie Darragh (Governance Support), and Jonathan Rowe (Dunedin City Council Programme Manager)

2. APOLOGIES

There were no apologies to note.

3. PUBLIC FORUM

Sarah Davie-Nitis and Paul Coffey Dunedin Tracks Network gave an update on current and planned cycle networks. Following an opportunity for questions Chair Robertson thanked both for attending. Cr Wilson sat back from the meeting table at this time.

Emily Cooper The Coastal Communities Cycleway Connection spoke and following an opportunity for questions Chair Robertson thanked Emily for attending.

Pierre Marasti from Rebellion Extinction spoke and after an opportunity for questions Chair Robertson thanked Pierre for attending.

4. CONFIRMATION OF AGENDA

The agenda was confirmed as published.

5. DECLARATIONS OF INTERESTS

No changes to Councillor Declarations of Interests were noted, Councillors were reminded to stand aside if any arise.

6. PRESENTATIONS

No presentations were held.

7. CONFIRMATION OF MINUTES

With the note of one amendment, it was moved:

Resolution: Cr Noone Moved, Cr Weir Seconded

That the minutes of the (public portion of the) Council meeting held on 25 October 2023 be confirmed as a true and accurate record.

MOTION CARRIED

8. ACTIONS (STATUS OF COUNCIL RESOLUTIONS)

There were no changes to note.

9. CHAIRPERSON'S AND CHIEF EXECUTIVE'S REPORTS

9.1. Chairperson's Report

Resolution: Cr Wilson Moved, Cr McCall Seconded
That the report be noted.
MOTION CARRIED

9.2. Chief Executive's Report

The Chief Executive undertook to report back on the progress of planned maintenance work for Kakanui and Kauru Rivers at the request of Cr Malcolm.

The Chief Executive will also report back to Council on gravel extraction which Cr Wilson understood would be finishing by June this year.

Cr Mepham noted the very good progress being made on the Land and Water Regional Plan; the number of milestones completed are significant.

Cr Scott added well done for significant work on the Long Term Plan.

Resolution: Cr McCall Moved, Cr Noone Seconded
That the report be noted.
MOTION CARRIED

10. MATTERS FOR CONSIDERATION

Cr Noone declared an interest and sat back from the item 1:34 pm.
Cr Wilson declared an interest and sat back from the item 1:34 pm.

10.1. Revised growth scenario for Dunedin Housing and Business Capacity Assessment

This paper sought approval for the adoption of a revised growth scenario for the housing component of the Dunedin Housing and Business Capacity Assessment (HBA) due to staff no longer considering the medium growth scenario as appropriate.

Anita Dawe, General Manager Policy, and Science presented the report with an opportunity for questions.

Resolution CM23-230: Cr Weir Moved, Cr Scott Seconded
That the Council*:*

1. ***Notes*** *the contents of this report.*
2. ***Approves*** *the use of a high growth scenario for the first 10 years of the Future Development Strategy (FDS), and then a medium growth scenario for the next 20 years, for the housing component of the Dunedin Housing Capacity and Business Assessment (HBA) that informs the 2024 Dunedin FDS.*
3. ***Notes*** *that the effect of resolution two is to amend the December 2022 resolution (medium growth scenario) for the housing component of the HBA that informs the 2024 FDS.*

MOTION CARRIED

Cr Noone returned to the meeting at 1:38 pm.
Cr Wilson returned to the meeting at 1:38 pm.

10.2. Queenstown Lakes Future Development Strategy: Delay to Programme
The purpose of this report is to seek Council approval to advise the Minister for the Environment of additional time required to deliver the Future Development Strategy for Queenstown Lakes.

Anita Dawe, General Manager Policy and Science, and Cameron Wood, Principal Planner from Queenstown Lakes District Council presented the report with an opportunity for questions.

Resolution CM23-231: Cr Wilson Moved, Cr Forbes Seconded
That the Council:

1. ***Notes*** *the contents of this report.*
2. ***Notes*** *that the Queenstown Lakes District and Otago Regional Councils will not meet the timeframes in the National Policy Statement on Urban Development to implement Policy 2 (Part 3 and Subparts 4 and 5): Housing and Business Capacity Assessment and Future Development Strategy.*
3. ***Notes*** *that work on the Housing and Business Capacity Assessment and Future Development Strategy are being progressed, with timeframes set out in the next steps section of this report.*
4. ***Agrees*** *to advise the Minister for the Environment in writing that additional time is required to enable the revised Housing and Business Capacity Assessment, and Future Development Strategy to be delivered.*
5. ***Notes*** *that the letter will be signed by the Chief Executives from both Councils.*

MOTION CARRIED

10.3. Limited Scope Delegations
This paper was presented to amend Council's Delegation Manual with provisions of delegations to staff for specific sections of the Natural and Built Environment Act 2023 and the Maritime Transport Act 1994.
Alexandra King, Acting Manager Consents, Tami Sargeant, Compliance Manager and Joanna Gilroy Acting General Manager Regulatory were present to respond to questions.

Resolution CM23-232: Cr Wilson Moved, Cr Weir Seconded
That Council:

1. ***Receives*** *this report.*
2. ***Approves*** *the new delegations as outlined in this report.*
3. ***Approves*** *the Chief Executive to update the Council's Delegations Manual accordingly.*

MOTION CARRIED

10.4. Regional Climate Strategy Working Group
The purpose of this paper was to present the Council a proposed terms of reference for a Regional Climate Strategy Working Group.

Amanda Vercoe, General Manager Governance Customer and Culture and Francisco Hernandez, Principal Climate Change Advisor were available to respond to questions.

Resolution: Cr Robertson Moved, Cr Forbes Seconded
That Council adjourn for 5 minutes to correctly note the resolution.
MOTION CARRIED

Cr Kelliher called for a division; noting Councillors could manage their individual interests.

Resolution CM23-233: Cr Wilson Moved, Cr Kelliher Seconded
That the Council*:*

1. ***Notes*** *this report.*
2. ***Approves*** *the terms of reference.*
3. ***Appoints*** *Cr Weir, Cr Somerville, Cr Forbes, and Cr Malcolm onto the Regional Climate Strategy Working Group.*

For	Cr Kelliher, Cr Laws, Cr Noone, Cr Weir, Cr Wilson, Cr Robertson
Against	Cr McCall and Cr Mepham
Abstained	Cr Forbes, Cr Scott, Cr Somerville

MOTION CARRIED

10.5. Council Meeting Schedule for 2024
This report sought to adopt a meeting schedule for the Otago Regional Council for 2024. Amanda Vercoe, General Manager Governance Customer and Culture was available to respond to questions.

Resolution CM23-234: Cr Weir Moved, Cr Forbes Seconded
That the Council*:*

1. ***Notes*** *this report and the draft attached meeting schedule.*
2. ***Adopts*** *the meeting schedule, with or without changes.*
3. ***Notes*** *that a review of the Committee structure and delegations will be programmed for July 2024, to check the structure and committee terms of reference remain fit for purpose.*

MOTION CARRIED

10.6. Port Otago Statement of Corporate Intent
This report provided Port Otago's Statement of Corporate Intent for the three years to 30 June 2026. Nick Donnelly, General Manager Corporate Services and CFO was available to respond to questions.

This paper was laid on the table until today to enable a public workshop to inform Councillors. Chair Robertson summarised the workshop which included aspects of port activities such as financial and non-financial environmental and community outcomes. Chair Robertson added that the Port is a significant contributor to the Otago community, describing a strong partnership with Otago Regional Council. The Chair added that the Port is doing well with Health and Safety, sustainability and climate change ambition as is informed by the 'Are We There Yet' document. The Chair described The Ports sustainability agenda as genuine and authentic, and added that the Otago Regional Council should be celebrating their success.

There was an opportunity for questions and Chair Robertson proposed a new recommendation:

Resolution CM23-235: Cr Robertson Moved, Cr Mepham Seconded

That the Council:

1. ***Receives** this report and the attached Statement of Corporate Intent for Port Otago Limited to 30 June 2026.*
2. ***Endorses** the Statement of Corporate Intent for Port Otago to 30 June 2026.*
3. *Notes and supports the Port's focus on both financial and non-financial returns within the Statement of Corporate Intent*
4. ***Requests** that staff consider a way to better recognise the financial contribution that Port Otago make to the Otago Regional Council on an annual basis.*
5. ***Requests** staff work with Port Otago prior to 30 June 2024 to ensure the process for reviewing the Statement of Corporate Intent meets statutory timeframes and enables Councillors to give feedback on the draft.*
6. ***Requests** that the Chief Executive work with the Port Liaison Committee members to develop a terms of reference and report back to Council no later than 30 June 2024.*
7. ***Extends** its thanks to the Port Otago Board and staff for their contributions to the wider Otago economy and communities.*

MOTION CARRIED

Cr Malcolm then proposed to move a subsequent motion:

Resolution CM23-236: Cr Malcolm Moved, Cr Noone Seconded

That Council

1. ***formally thank** Mr Tom Campbell for his service to The Port of Otago, the Otago Regional Council, and the people of Otago.*

MOTION CARRIED

10.7. SDF Programme Strategy Update

The purpose of this report is to seek Council approval of the revised strategy for the South Dunedin Future programme.

Jonathan Rowe, Programme Manager – South Dunedin Future, Gavin Palmer, General Manager Operations and Anita Dawe, General Manager Policy and Science were available to respond to questions.

Resolution CM23-237: Cr Wilson Moved, Cr Weir Seconded

That the Council:

1. ***Notes** this report.*
2. ***Notes** the South Dunedin Future programme has been operating in accordance with the strategic intent approved by both Councils in July 2022 (included at Attachment A).*
3. ***Notes** the work undertaken to develop a revised South Dunedin Future programme strategy.*
4. ***Approves** the revised South Dunedin Future programme strategy (included as Attachment B).*
5. ***Notes** the strategy will guide the South Dunedin Future programme, including programme communications and engagement, risk assessment, and development of adaptation options.*

MOTION CARRIED

11. RECOMMENDATIONS ADOPTED AT COMMITTEE MEETINGS
11.1. Recommendations of the Safety and Resilience Committee 2023.11.09

Resolution CM23-238: Cr Kelliher Moved, Cr McCall Seconded

That the Council:

1. *Adopts the recommendations of the 2023.11.09 Safety and Resilience Committee*

MOTION CARRIED

12. NOTICES OF MOTION
None were noted.

13. RESOLUTION TO EXCLUDE THE PUBLIC

Richard Saunders, Chief Executive, noted an amendment to the Public Exclusion table that the reasons for passing the resolution, noted below corrected.

Resolution: Cr Robertson Moved, Cr Mepham Seconded:

I move that the public be excluded from the following parts of this meeting, namely:

- *Confidential Minutes of 25 October 2023*
- *Continuation of the Lake Whakatipu Ferry Service Beyond the Current Trial*
- *Dunedin Future Development Strategy: Joint Hearing Panel*

MOTION CARRIED

Cr Laws voted against the resolution.

The general subject of each matter to be considered while the public is excluded, the reason for passing this resolution in relation to each matter, and the specific grounds under section 48(1) of the Local Government Official Information and Meetings Act 1987 for the passing of this resolution are as follows:

General subject of each matter to be considered	Reason for passing this resolution in relation to each matter	Ground(s) under section 48(1) for the passing of this resolution
1.1 Confidential Minutes of	To protect the privacy of natural persons, including that of deceased natural persons – Section 7(2)(a)	Section 48(1)(a); Subject to subsection (3), a local authority may by resolution exclude the public from the whole or any part of the proceedings of any meeting only on 1 or more of the following grounds: (a) that the public conduct of the whole or the relevant part of the proceedings of the

		meeting would be likely to result in the disclosure of information for which good reason for withholding would exist.
3.1 Continuation of the Lake Whakatipu Ferry Service Beyond the Current Trial	To protect information where the making available of the information—would be likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information – Section 7(2)(b)(ii)	
3.2 Dunedin Future Development Strategy: Joint Hearing Panel	To protect the privacy of natural persons, including that of deceased natural persons – Section 7(2)(a)	

This resolution is made in reliance on section 48(1)(a) of the Local Government Official Information and Meetings Act 1987 and the particular interest or interests protected by section 6 or section 7 of that Act or section 6 or section 7 or section 9 of the Official Information Act 1982, as the case may require, which would be prejudiced by the holding of the whole or the relevant part of the proceedings of the meeting in public.

14. CLOSURE

There was no further business and Chairperson Robertson declared the public part of the meeting closed at 3:01 p.m.

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Chairperson Date

Meeting Date	Item	Status	Action Required	Assignee/s	Action Taken	Due Date
22/02/2023	CS2304 Annual Plan 2023/24	Assigned	Have an independent efficiency review performed in FY 2023/24 to inform the Long-Term Plan process. **CM23-111**	Chief Executive, General Manager Transport	**13/09/2023 Governance Support Officer** Underway. A paper is on the agenda for 6 December	31/12/2023
22/03/2023	GOV2306 Proposal to participate in CouncilMARK programme	Assigned	The Chief Executive will execute an agreement with CouncilMARK to undertake an independent assessment in 2024. **Res CM23-130**	Chief Executive	**13/09/2023 Governance Support Officer** Underway. Assessment likely to take place February 2024	06/12/2023
22/03/2023	Recommendations of the Finance Committee	Assigned	Chief Executive directs staff to undertake further work towards development of an annual awards programme including detailed costs AND provide a report to Council for consideration during the upcoming LTP process (Res FIN23-103). **Res CM23-136**	Chief Executive	**13/09/2023 Governance Support Officer** Underway.	31/12/2023

26/04/2023	GOV2313 Notice of Motion - Request for report on feasibility of free off-peak travel	Assigned	Provide a report to the PATC on feasibility of free off-peak public transport and the potential costs (e.g. lost revenue) and benefits (e.g. reduced pressure at peak times, reduced delays at peak times, equity impacts, reputation impacts) to help inform relevant LTP decisions. **Res. CM23-147**	General Manager Transport, Manager Transport	**25/09/2023 Governance Support Officer** Still in progress	06/12/2023
22/06/2023	CEO2301 Internal Audit Options for Otago Regional Council	Assigned	Co-Chairs of the Committee to work with the Chief Executive Officer to commence an internal audit programme in the 23/24 year and report results back to the Committee. **AR23-116**	Chief Executive, Councillor, Andrew Douglas		31/08/2023
25/10/2023	REG2308 Dangerous dam policy	Assigned	Delegate to the Chair the appointment of the two suitable hearings panel members to consider the public submissions on the dam policy. **Res CM23-226**	Chairperson		29/12/2023
25/10/2023	REG2308 Dangerous dam policy	Assigned	Consultation of the proposed Dangerous Dams Policy 2023 using special consultative procedures under s83 of the Local Government Act 2002 subject to any minor editorial changes. **Res CM23-226**	Manager Consents		28/06/2024

25/10/2023	GOV2330 LTP Community Engagement	Assigned	Staff to implement the preferred community engagement approach included in Table 3 for the Long-Term Plan 2024-2034 based on the proposed scope presented in this report. **Res CM23-228**	General Manager Corporate Services and CFO, General Manager Governance, Culture and Customer		28/06/2024

8.1. South Dunedin Future Risk and Adaptation Approaches

Prepared for:	Council
Report No.	GOV2343
Activity:	South Dunedin Future
Author:	Jonathan Rowe, Programme Manager – South Dunedin Future
Endorsed by:	Gavin Palmer, General Manager Operations and Anita Dawe, General Manager Policy and Science
Date:	6 December 2023

PURPOSE

[1] The purpose of this report is to update Council on the South Dunedin Future programme, including findings from the risk identification stage, to seek endorsement of a longlist of generic adaptation approaches, and seek approval to engage the community on these topics.

EXECUTIVE SUMMARY

[2] The purpose of this report is to update Council on the South Dunedin Future programme, including findings from the risk identification stage, to seek endorsement of a longlist of generic adaptation approaches, and seek approval to engage the community on these topics.

[3] The South Dunedin Future (SDF) programme is a joint initiative between the Dunedin City Council (DCC) and Otago Regional Council (ORC) to develop a climate change adaptation plan for South Dunedin. The programme vision is "a safer and better South Dunedin, where sustainable urban regeneration leads to improved community resilience and wellbeing".

[4] The SDF programme has accelerated over the past six months, transitioning from a planning to delivery phase. Key outputs include ongoing monitoring and assessment of natural hazards, communications and community engagement activities, revision of the programme strategy, and production of early-stage technical reports in the risk assessment and adaptation approaches workstreams. These technical reports are the focus of this paper.

[5] The Risk Identification Report for South Dunedin constitutes the first stage of risk the assessment workstream. The report summarises the extensive body of work that has been undertaken to date to understand the natural hazards affecting South Dunedin, the anticipated impacts of a changing climate, and the exposure, vulnerability, and risks these present to the immediate subject area and wider city.

[6] The key finding at this early stage is that all 'elements' assessed – that is people, places and assets - are at direct physical risk from all the hazards included in the assessment. This finding reflects the broad and complex hazard and risk scape in South Dunedin. The risks identified are not uniform, but could vary greatly, including in terms of spatial

extent, severity, and consequence. Subsequent stages of the risk assessment workstream will explore interactions between natural hazards, and direct, indirect and cascading risks in more detail.

[7] The Domestic and International Good Practice Report, Longlist of Generic Adaptation Approaches – Context Summary Report, and 16 factsheets in the supporting Annex A-1, constitute stages one and two of the adaptation approaches workstream.

[8] The Good Practice Report provides insights and transferrable lessons for South Dunedin by exploring four case studies, describing the context, outcomes and applicability for South Dunedin. A key underlying theme is that some combination of the approaches studied may work best and the report makes recommendations for further case study work.

[9] The longlist of Generic Adaptation Approaches – Context Summary Report describes the context for the adaptation approaches workstream, outlining the case for change, problem statements, and explaining the high-level frameworks, methodology and criteria used to develop the adaptation approaches. Finally, Annex A-1 of the Context Summary Report presents 16 factsheets, one for each of the adaptation approaches that collectively make up the generic longlist.

[10] These factsheets provide a description of the adaptation approach, note key characteristics and benefits, and provide an initial high-level assessment. Visualisations of each option are included. In the South Dunedin context, many of these approaches are not stand-alone solutions, but puzzle pieces that could be combined and staged over time. Some could be used temporarily (for example, to reduce risk in the short- to medium- term until other approaches are in place).

[11] The paper concludes by seeking Council's endorsement of the longlist of generic adaptation approaches for the purposes of community engagement and approval to engage the community on risk assessment and adaptation approaches work in the New Year.

RECOMMENDATION

That the Council:

1) **Notes** the background of the South Dunedin Future programme and work undertaken since the previous update report to the Safety and Resilience Committee on 10 August 2023.

Risk Assessment

2) **Notes** the risk assessment workstream of the South Dunedin Future programme will be undertaken in three stages: (i) risk identification; (ii) risk exposure and vulnerability assessment; and (iii) detailed risk assessment.

3) **Notes** the attached Risk Identification Report for South Dunedin, which constitutes the first stage of risk assessment workstream, and has been prepared by the 'Kia Rōpine' consultant team (WSP, BECA and Tonkin & Taylor).

4) **Notes** the Risk Identification Report has undergone technical peer review by Jacobs New Zealand Ltd and Royal HaskoningDHV, and that there remain peer

review feedback items to resolve in the next stage of the risk assessment workstream.

5) **Notes** work has commenced on the second stage of the risk assessment workstream, confirming the risk assessment methodology, which will be completed by mid-2024 and reported back to Councils.

Adaptation Approaches

6) **Notes** the adaptation approaches workstream of the South Dunedin Future programme will be undertaken in five stages: (i) domestic and international good practice report; (ii) longlist of generic adaptation approaches; (iii) spatial longlist of adaptation approaches; (iv) spatial shortlist of adaptation approaches; and (v) preferred approaches.

7) **Notes** the attached Domestic and international good practice report, which constitutes the first stage of the adaptation approaches workstream, and has been prepared by the 'Kia Rōpine' consultant team (WSP, BECA and Tonkin & Taylor).

8) **Notes** the attached Longlist of generic adaptation approaches – Context summary report and Factsheets, which constitute the second stage of the adaptation approaches workstream, and have been prepared by the 'Kia Rōpine' consultant team (WSP, BECA and Tonkin & Taylor).

9) **Notes** that the Domestic and international good practice report, and the Longlist of generic adaptation approaches – Context summary report and Factsheets, have undergone technical peer review by Jacobs New Zealand Ltd, supported by Royal HaskoningDHV and Bell Adapt Ltd.

10) **Endorses** the attached Longlist of generic adaptation approaches – Context summary report and Factsheets for the purposes of community engagement.

Community Engagement

11) **Notes** the next stage of the risk assessment workstream includes seeking community input into identification and confirmation of relevant risks for South Dunedin.

12) **Notes** the next stage in the adaptation approaches workstream is to engage with partners, stakeholders and affected communities on the longlist of generic adaptation approaches.

13) **Approves** the SDF programme team undertaking engagement with partners, stakeholders and affected communities on the basis of the approaches identified in the Longlist of generic adaptation approaches – Context Summary Report and Factsheets, which will inform development of subsequent adaptation approaches work.

BACKGROUND

[12] The South Dunedin Future (SDF) programme is a joint initiative between the Dunedin City Council (DCC) and Otago Regional Council (ORC) to develop a climate change

adaptation plan for South Dunedin. A programme plan, which outlined the high-level approach for delivering the SDF programme was approved by DCC and ORC Council Committees in July 2022 (refer report OPS2223, Strategy and Planning Committee, 13 July 2022).

[13] Detailed planning has now broken the SDF programme into five phases, five workstreams, and a number of programme actions. The workstreams include: (i) natural hazards; (ii) strategy and programme management; (iii) communications and community engagement; (iv) risk assessment; and (v) adaptation approaches. This breakdown has been explained more fully in previous Council reports and workshops, but is also illustrated in the A3 SDF Programme Overview **(Attachment A)**.

External technical assistance

[14] The SDF programme involves detailed technical work and extensive community engagement over multiple years. External technical assistance has been sourced to support delivery of the SDF programme. In July 2023, following an open tender process, DCC contracted a consultant group comprising engineering, planning and environmental services firms WSP, BECA and Tonkin & Taylor (collectively known as 'Kia Rōpine'), to support delivery of the SDF programme over the next three years (2023/24 to 2025/26). The total value of this contract is $1,931,184.

[15] In August 2023, DCC also contracted a second consultant group comprising engineering, planning and environmental services firms Jacobs New Zealand Ltd, Royal HaskoningDHV and Bell Adapt Ltd, to undertake technical peer review of the risk assessment and adaptation approaches workstreams. The total value of this contract is $198,750.

[16] The SDF programme technical assistance contracts are funded from a mix of DCC South Dunedin Future operational funding, ORC funding, and central government grant funding.

Recent SDF programme activities

[17] The following points summarise work completed or ongoing across the SDF programme since the previous update report to the Strategy, Planning and Engagement Committee on 14 August 2023, broken down by workstream.

- Natural Hazards: ORC continues to lead the gathering and analysis of natural hazards information. This includes groundwater monitoring at 35 sites; engaging GNS Science to analyse groundwater levels and processes; continuing to monitor the sea level at the Green Island site (with the support of NIWA); updating maps of coastal inundation from extreme sea level; improving monitoring of vertical land motion in South Dunedin (with support from University of Otago, School of Surveying); and publishing a flyer summarising the "Science of South Dunedin".

- Strategy and programme management: Planned updates and wide-ranging analysis of external factors – including interactions across central government, local government, with mana whenua, and affected communities – led to further development and revision of the SDF programme strategy. The revised strategy was approved by Councils in November 2023 (refer Item 10, DCC Council Meeting, 28 November 2023).

- Communications and community engagement: A further phase of community engagement was undertaken in September and October2023, centred on three events:

  i. 'Meet the Scientists Night': An event exploring underlying science topics of relevance to the impacts of climate change on South Dunedin.

  ii. 'Street meet and sausage sizzle': A public event on South Dunedin's main street that sought community feedback on views, values and ideas for adaptation.

  iii. 'What can we do about it?': An event that explored adaptation experiences in New Zealand and The Netherlands, sought comments on existing approaches, and asked for ideas and new approaches from the community.

  These events were complemented by engagements at Otago Polyfest and the South Dunedin Community Network Hui, both in October. More broadly, an extensive set of community engagements in 2023 saw the SDF programme distribute 14,000 flyers (two flyers, 7,000 copies each) to households in the focus area; write a letter to 1,700 non-resident property owners to build awareness of the programme; host 25 engagement meetings and eight major engagement events with an estimated 1,000 people reached face-to-face; receive over 2,000 unique webpage visitors, 400 individual pieces of feedback, and 75 survey responses.

- Risk assessment: Meetings, workshops, and collation of a range of existing reports and material on the natural hazards affecting South Dunedin and the associated risks to support the first stage of the risk assessment workstream – development of a Risk Identification Report. This work is described more fully in the 'Discussion' section below.

- Adaptation approaches development: Meetings, workshops and collation of a range of existing reports and material on the natural hazards, climate change impacts, land use planning, infrastructure, and other relevant factors to support the first two stages of the adaptation approaches workstream. This includes development of the Domestic and international good practice report and the Longlist of generic adaptation approaches. This work is described more fully in the 'Discussion' section below.

Future Development Strategy

[18] DCC and ORC are collaborating to produce a Future Development Strategy (FDS), which focuses on ensuring Dunedin is a well-functioning urban environment, including having sufficient land and infrastructure for future growth. The FDS has similarities to the SDF programme, though differs in terms of scope, timeframes, and detail, so staff have sought to collaborate to ensure strategic coherence, noting South Dunedin specific issues will be explored in greater detail by the SDF programme over the period 2023-26,

and that this information will inform subsequent strategic spatial planning processes, district plan changes, and other planning functions.

DISCUSSION

[19] This section describes the key outputs produced for the risk assessment and adaptation approaches workstreams of the SDF programme. This includes the purpose of the reports, processes undertaken to develop them, the key findings, and next steps.

Risk Assessment

[20] The SDF programme risk assessment workstream seeks to consider the potential for things of value in South Dunedin, including people, places and assets, to be negatively impacted by natural hazards and the effects of climate change. This includes the likelihood of certain impacts occurring and the consequences should they occur.

[21] The risk assessment workstream will be delivered in three stages, as outlined below:

- Stage 1 – Risk identification: Includes identifying the natural hazards and ‘elements’ at risk (people, places and assets) and undertaking an initial high-level risk screening.
- Stage 2 – Confirming risk assessment methodology: Includes confirming overall risk assessment methodology, and key considerations such as interactions between natural hazards, exposure and vulnerability to risk; the consequences, indirect and cascading risks; and risks to mana whenua.
- Stage 3 – Detailed risk assessment: Includes undertaking quantitative and qualitative analysis of different risk scenarios to draw various conclusions and produce: maps showing spatial distribution of exposure risk pre and post assessment, and tables showing level of assessed risk for elements and community values.

[22] It is anticipated that in some instances variations to the above structure will be necessary to account for particular constraints or context relating to the SDF programme, for example availability of information, readiness of stakeholders to engage in risk assessment work, and interdependencies with other parts of the programme or external factors. Adjustments may also be required to ensure new information and findings from ongoing work are accounted for.

[23] During stage one of the risk assessment work, some variations were required relating to community input into identification of risks and confirming the assessment timeframes and scenarios. These variations were primarily due to information gaps and time constraints, and the corresponding tasks will now be undertaken early in stage two.

Risk Identification Report

[24] The SDF Programme Risk Identification Report **(Attachment B)** seeks to gather and synthesise the extensive body of work that has been undertaken to date to understand the natural hazards affecting South Dunedin, the anticipated impacts of a changing climate, and the exposure, vulnerability, and risk to people, places and assets in the area.

[25] Following best practice guidance from the Ministry for the Environment (MfE) on local government climate change risk assessments, and making best use of available information, the report:

- Collates available existing information regarding:
  i. Hazard awareness in relation to rainfall induced flooding, coastal, groundwater and seismic natural hazards and climate change.
  ii. People, place and asset information to support the exposure and vulnerability component of a risk assessment within South Dunedin.
- Provide a foundational understanding of natural hazard and climate change risk to South Dunedin that will be built upon in subsequent stages of the risk assessment.

[26] This first stage of the risk assessment process has involved initial high-level screening of rainfall induced flooding, coastal, groundwater and seismic natural hazards facing South Dunedin against elements at risk (people, places, assets) within South Dunedin to identify direct physical risks within the area. The hazards and elements considered are detailed in the report and summarised in the table below.

Natural hazards and climate change hazards	**Elements at risk in South Dunedin (people, places and assets)**
• Extreme rainfall and flooding • Coastal inundation • Coastal erosion • Tsunami • Groundwater • Earthquake • Landslide • Liquefaction • Land subsidence	• Natural environment • Buildings: ○ Residential ○ Educational ○ Commercial ○ Public amenities ○ Heritage buildings • Open spaces / sportsgrounds • Sites of cultural significance • Roads • Rail infrastructure • Water supply infrastructure • Wastewater infrastructure • Stormwater infrastructure • Solid waste and contaminated sites • Telecommunication infrastructure • Electricity transmission and distribution

[27] In addition to the initial screening, risk statements and descriptions have been developed for all identified risks, supplemented by an initial commentary on the potential downstream indirect risks they may generate across social, economic,

environment and cultural domains. These indirect risks are identified and discussed in the report against the following broad categories:

- Human health and wellbeing.
- Exacerbating existing inequities and creating new inequities.
- Risks to Kāi Tahu sites, identity and practices, and non-Kāi Tahu cultural heritage sites, due to climate change.
- Risks to community cohesion and resilience from climate change.
- Provision of public services.
- Financial hardships including increasing cost of doing business and availability of insurance.
- Environmental degradation.

Key Findings

[28] The key finding at this early stage is that all 'elements' assessed – that is people, places and assets – are at direct physical risk from all the hazards included in the assessment. This finding reflects the broad and complex hazard and risk scape in South Dunedin. The risks identified are not uniform, but could vary greatly, including in terms of spatial extent, severity, and consequence. Subsequent stages of the risk assessment workstream will explore interactions between natural hazards, and direct, indirect and cascading risks in more detail.

[29] Moreover, the interactions between natural hazards and the interconnectedness of physical elements within South Dunedin means that any disruptions or impacts on one part of the system can trigger a range of complex, interrelated and cascading consequences. Many of these risks to the physical elements of South Dunedin will result in indirect risks to people, communities, businesses, culture, and services within South Dunedin and the wider city. These interactions and interconnectedness will be considered further during the next stages of the risk assessment.

Risk Assessment Workstream – Next Steps

[30] The contextual summary and initial high-level risk screening findings provided in the Risk Identification Report will inform subsequent stages of the risk assessment. This will include developing the methodology to assess risk, conversations with affected communities and mana whenua about risk, and the detailed assessment of the identified risks. Risk identification report will also inform other workstreams, providing a basis for further natural hazards assessments, communications and community engagement, and development of adaptation approaches.

Adaptation Approaches

[31] The primary objective of the SDF programme is to produce a climate change adaptation plan for South Dunedin. Developing approaches for adapting to the locked-in and anticipated impacts of climate change and the associated natural hazards on South Dunedin, and weaving these together into a consolidated adaptation plan, will be a complex and iterative process.

[32] This work is undertaken by the adaptation approaches workstream. It includes identifying potential adaptation approaches, assessing the respective merits, constraints and trade-offs associated with each, refining approaches through technical assessment and community engagement, and developing a coherent final package (including approaches, options, pathways, signals and triggers), then integrating into an adaptation plan for South Dunedin.

[33] Internationally and in New Zealand, the 'PARA' framework (protect, avoid, retreat, accommodate) is used to identify and explain the types of actions or "approaches" that might be taken to adapt to natural hazards and the impacts of climate change. This framework, which is recommended by MfE[1] and in common use across local government, has been adopted by the SDF programme. A summary of the PARA categories is included below:

- Protect – Staying in place and building defences, e.g. pumps, pipes and seawalls
- Avoid – Staying away from areas where the risk is too high, e.g. restricting or preventing development and making changes to existing land use.
- Retreat – Purposely moving away from areas where the risk is too high, e.g. red-zoning, placing restrictions on land use and relocating community assets.
- Accommodate – Staying in place and making changes to building and infrastructure to improve resilience.

[34] The SDF programme adaptation approaches workstream will be delivered in five stages: (i) domestic and international good practice review; (ii) longlist of generic adaptation approaches; (iii) longlist of spatial approaches; (iv) shortlist of spatial approaches; (v) preferred approaches.

- Stage 1 – Domestic and international good practice review: Includes researching and showcasing a selection of relevant and innovative adaptation approaches, both in New Zealand an internationally, which could have relevance and potentially be applied in a South Dunedin context.
- Stage 2 – Longlist of generic adaptation approaches: Includes identifying a list of 15-20 generic adaptation approaches that could reasonably be expected to mitigate the impacts of natural hazard and climate change risks in a South Dunedin context.
- Stage 3 – Longlist of spatial approaches: Includes adding a GIS component to the work to spatially differentiate hazards, risk, objectives and approaches across different areas of South Dunedin. This would enable further refinement of approaches.
- Stage 4 – Shortlist of spatial approaches: Includes narrowing approaches to a spatial shortlist, including through spatial assessments and use of multi criteria assessment (MCA) analysis.
- Stage 5 – Preferred adaptation approaches: Includes finalising preferred approaches and pathways, including spatial assessments, and use of multi criteria assessment (MCA) analysis.

[1] Ministry for the Environment. 2022. *Aotearoa New Zealand's first national adaptation plan*. Wellington. Ministry for the Environment.

[35] The focus of this paper is stages one and two of the adaptation approaches workstream and technical reports relating to these stages are attached.

Domestic and International Good Practice Review Report

[36] The Domestic and International Good Practice Review Report (**Attachment C**) constitutes stage one of the adaptation approaches workstream. It seeks to provide insights and transferrable lessons for South Dunedin and act as a supporting document for development of the generic longlist of adaptation approaches. The report builds on previous case study work, including a report by Golder Deltares in 2017 that considered options for managing rising groundwater in South Dunedin[2]. It examines four case studies, selected using criteria that included alignment with the PARA framework, relevance to South Dunedin, and availability of up to date and insightful information. The case studies are summarised below:

- <u>House raising - Australia and New Zealand:</u> emerging lessons from property level adaptation initiatives.
- <u>Cloudburst Management Plan – Copenhagen, Denmark:</u> A city-scale response to increasing flood risk incorporating blue, green, and grey adaptation approaches.
- <u>Residential retreat, Christchurch, New Zealand:</u> transferable lessons from post-earthquake retreat.
- <u>Long Bay Development - Auckland, New Zealand:</u> An innovative example of stormwater management and making space for nature.

[37] The report explores the approach used in each of the case studies, describes the context, outcomes and applicability for South Dunedin. A key underlying theme is that approaches and approaches studied all work best in combination, with the main takeaway being there is unlikely to be a single, one-off solution for managing the impacts of climate change and associated natural hazards in South Dunedin. The report makes some recommendations for further case study-related work that could be undertaken to inform future stages of the adaptation approaches workstream.

Longlist of Generic Adaptation Approaches

[38] The Longlist of Generic Adaptation Approaches – Context Summary Report (**Attachment D**) and 16 Factsheets in the supporting Annex A-1 (**Attachment E**) constitute stage two of the adaptation approaches workstream.

Context Summary Report

[39] The Context Summary Report describes the SDF programme context, including the 'case for change' and wider strategic objectives described in the recent South Dunedin Future Programme – Strategy Update paper (Item 10, DCC Council Meeting, 28 November 2023). Against this backdrop, the report then articulates a specific set of problems that the adaption approaches are intended to address, including:

[2] South Dunedin Technical Work Programme Update, Report to ORC Technical Committee, Report No. EHS1829, 10 October 2018.

- Historically, South Dunedin was a wetland, and the legacy practice of draining and reclamation has erased culturally significant landscapes and resources for Kai Tahu and Te Rūnanga o Ōtākou. Tangaroa (the sea) continues to shape and reshape te taiao (the environment).
- The water infrastructure in South Dunedin was largely constructed more than 50 years ago (96% of the network before 1980 and 46% of the pipe network constructed before 1940). This infrastructure is aging and is vulnerable to failure during extreme events.
- South Dunedin is a highly developed, dense, hazard prone area that provides homes for roughly 10% of Dunedin's population. It particularly provides affordable housing for some communities that are already socio-economically disadvantaged.
- The communities and businesses in the area have significant exposure to, and as a result are less able to recover from flood events that will occur with increasing frequency and severity over time.
- Following the 2015 flood, communities in South Dunedin have reported feeling anxious when it rains and uncertain about the future.

[40] The Context Summary Report presents a summary of the planned methodological approach with a focus on the overarching frameworks, such as Dynamic Adaptive Planning Pathways (DAPP), Better Business Cases (BBC), and Multi Criteria Assessment (MCA), noting detail will be developed in later stages. The report outlines the factors and considerations informing development of the long list of generic adaptation approaches by building on site specific investigations over the past decade.

[41] The report explains the natural hazards, climate change impacts, and associated risks that have been used to develop the longlist of generic adaptation approaches, balancing these against existing infrastructure performance, and linking to the Risk Assessment Report.

[42] In describing the initial development process, the report notes possible approaches were identified and collated to create an initial "long long" list from national and international case studies and previous reports specific to South Dunedin, alongside further nominations received from subject matter experts within the consultant team, complemented by ideas received through public 'crowdsourcing' initiatives. This "long long" list is noted in the report.

[43] Criteria for organising the relative merits, challenges or constraints of various adaptation approaches were developed, based on strategic objectives, technical requirements and available information, and used to identify high-level advantageous and disadvantageous characteristics. These criteria include:

- Time (lead time to implement and design life)
- Cost (including whole of life)
- Emissions (beyond solely carbon footprint), pollution, and material re-use.
- Health of and connection to the natural environment
- Generational flexibility

- Technical feasibility (including ease of consenting and legal requirements)
- Technical efficacy
- Social co-benefits (such as economic potential, community ownership, wellbeing, housing affordability)
- Maintained sense of place / identity
- Interdependencies (e.g. when other approaches would be required or useful in combination as well as at a city-scale in terms of cascading impacts)

[44] In stage two of this workstream, longlist of generic adaptation approaches, potential approaches are identified and an initial high-level assessment undertaken. Importantly, approaches are not scored at this early stage as this allows further time to fully build understanding of the relative merits of the approaches being explored.

[45] In the third stage of the workstream, longlist of spatial adaptation approaches, assessment will be undertaken against a series of critical success factors and fatal flaws. To progress to the spatial long list stage approaches should, as a minimum, achieve critical success factors and have no 'fatal flaws'. At the fourth stage of the workstream, spatial shortlist of approaches, a full MCA will be undertaken for each option, including scoring against agreed criteria.

Key Findings - Factsheets

[46] In Annex A-1 of the Context Summary Report, Factsheets are presented for each of the 16 generic adaptation approaches on the generic longlist, which essentially capture the key findings of this stage of work. Grouped according to the PARA framework, these Factsheets provide a description of the adaptation option, note key characteristics and categorise these into pros, cons and neutral elements, note strategic considerations and comment on linkages to the SDF programme's strategic objectives. Visualisations are also included with each approach.

[47] The longlist of generic adaptation approaches comprises the following:

Protect
• <u>Ground reinforcements:</u> Ground reinforcement is a preventative method to stabilise soils and reduce liquefaction potential. Methods include densification of the crust or deeper liquifiable soils, crust strengthening, reinforcement, containment by ground reinforcement or curtain walls, and drainage improvements using stone columns or earthquake drums. • <u>Groundwater lowering / drainage / dewatering wells:</u> The presence of shallow groundwater beneath South Dunedin exposes the area to the threat of groundwater flooding. The extent of the groundwater lowering is specific to soil type, groundwater conditions, geology and is limited to above ground surroundings. Options to lower the groundwater could include drainage and dewatering wells. • <u>Land grading:</u> Land grading (also known as land elevation) is a flood risk management strategy that involves physically raising the ground level above the floodplain (existing and future). It is a measure that reduces the exposure of all activities located on the raised land.

- Conveyance improvements: Conveyance improvements involve the enhancement or modification of existing and new drainage systems. This might involve combinations of installing larger pumps and pipes to increase water flow, intercepting and diverting flows upstream, creating engineered channels or canals and/or enhancing stormwater conveyance capacity both overland and through piped networks.
- Remove wastewater network overflows and cross-connections: Removing wastewater network overflows would avoid wastewater spilling out from gully traps, manholes, or engineered/constructed overflow points when the network has reached full capacity protecting people from health risks associated with flooding. Stormwater “inflow and infiltration” into the wastewater network is a significant problem and a main cause for wastewater overflows.
- Dedicated water storage: Dedicated water storage areas include detention basins, ponds and wetlands that can be located at the coast or inland. They feature a permanent allocation of land/space for water storage, which typically incorporates a permanent body of water and a “live” storage component which fills during storms and is slowly released once the storm has passed. Can be incorporated into broader “Sponge City” concepts.
- Floodable infrastructure: “Floodable infrastructure” refers to open spaces, green spaces (e.g., parks, reserves), carparks, and roads being transformed into intentional temporary flood storage zones or overland flow paths to protect other areas from flooding.
- Increase permeability of ground surface: Increasing permeability of the ground surface improves the receiving environment’s ability to absorb and/or manage excess rainwater, reducing the volume and rate of runoff that would otherwise go through to the stormwater network. Reducing peak volumetric flows of water is important in reducing flooding in urban areas.
- Coastal protection: Coastal protection comprises various tactics aimed at safeguarding coastal areas and can include ‘hard’ or ‘soft’ engineering options, each of which have strengths and drawbacks. Hard options for coastal protection include sea walls, revetments, berms, dykes, tidal barriers, groynes, breakwaters and flap gates on stormwater networks create an impermeable barrier that keeps the sea from inundating the land. Soft engineering options like salt marsh, coastal wetlands, sand placement and dune restoration can be established at the coastal edge to reduce wave energy and surge effects and therefore erosion.

Accommodate

- Behavioural / societal changes: Resilience can be understood as the ability to prepare, respond, cope, and recover from natural hazard events, learning from past experiences and adapting accordingly. In the context of societal and behavioural changes, resilience strategies aim to reduce the impacts of hazards by emphasizing prevention and preparedness.
- Readiness and Response: “Readiness” (also known as “Preparedness”) measures typically refer to the operational systems, capabilities and educational activities that are put in place before an acute event. “Response” refers to actions taken during or immediately after an emergency event like a flood or earthquake. This typically involves consideration of risk assessment and planning, early warning systems, public education campaigns, emergency response plans, including deploying temporary flood barriers (e.g. sandbags) and providing support services prior, during

and immediately after an event. • <u>Property level interventions:</u> Property level interventions refer to adjustments or modifications that are made directly to individual properties to enhance their resilience against flooding. These could include raising homes, waterproofing first floors, rain tanks, flood barriers, or other individual property level interventions.
Retreat
• <u>Reactive retreat:</u> Reactive retreat is the withdrawal, relocation or abandonment of private or public assets in response to immediate threats or after damage has already occurred. It involves a more reactive approach where decisions are made in direct response to acute events like storms, flooding, tsunami, earthquakes or rapid erosion. Reactive retreat can include: emergency evacuation; and post-disaster buyouts or post-insurance withdrawal buyouts. • <u>Managed relocation:</u> Managed relocation (proactive retreat) is a strategic decision to withdraw, relocate or abandon private or public assets (including land and buildings) before significant damage occurs. It focuses on identifying areas at high or intolerable future risk of natural and climate hazards, thereby minimising long-term risk exposure by transferring people, property and assets away from these areas before the impacts of the hazard are experienced. Managed relocation can take a range of forms which can be phased overtime, including: voluntary buyouts on open market; buyouts with climate leases; targeted retreat of built environment; and retreat of critical infrastructure from vulnerable sites.
Avoid
• <u>More restrictive building/development standards:</u> These approaches involve controls on development to reduce exposure and vulnerability to hazards such as earthquakes and coastal flooding. They may include more restrictive standards, development guides, regional and district plan rules, resource consent conditions, bylaws, urban development or growth strategies to mitigate the impact of a hazard. The building code/building consent process could incorporate structural specifications to improve built environment resilience. • <u>No new development/redevelopment or change of land use that may exacerbate risk:</u> Restricting development of land uses through planning rules, can prevent further development and, overtime, reduce exposure to hazards. The aim of this approach is to ensure that any change in the South Dunedin area does not increase risk. This approach may also identify that an area may not be viable for development in the longer term and change the land use in the district plan to enable retreat.

Adaptation Approaches Workstream – Next Steps

[48] Subject to Council decisions and direction relating to the longlist of generic adaptation approaches for South Dunedin, the next steps would involve developing the approaches into a format suitable for public communication and undertaking a range of community engagement activities to build awareness and understanding of the approaches and collect community views. This information would then be combined with additional technical work to support the next stage of the workstream, developing a spatial long list of approaches, which would add a GIS component to the work to spatially

differentiate hazards, risk, objectives and approaches across different areas of South Dunedin.

Technical Peer Review

[49] The SDF programme includes technical peer review of work undertaken by the risk assessment and adaptation approaches workstreams. This peer review process is intended to enhance the technical robustness of the work and help ensure the SDF programme operates on the best available information.

[50] The following reports, all included as attachments to this paper, have been subject to technical peer review by Jacobs New Zealand Ltd, supported by Royal HaskoningDHV and Bell Adapt Ltd:

- Risk Identification Report;
- The Domestic and International Good Practice Report;
- Longlist of Generic Adaptation Approaches – Context Summary Report; and
- 16 Factsheets in the supporting Annex A-1.

[51] The technical peer review process resulted in a range of amendments to the reports, based on feedback from peer reviewers. It has not, however, resulted in consensus across the technical specialists developing and reviewing the reports.

[52] For the Risk Identification Report, there remain differences in professional opinion, preferences for various technical approaches over others, and issues to resolve in subsequent stages of the SDF programme. These will be an early focus of stage two of the risk assessment workstream, which involves confirming the risk assessment methodology.

OPTIONS

[53] Two options are outlined below which involve either proceeding with the SDF programme as scheduled or delaying the programme to undertake additional work as directed by Council. The respective advantages and disadvantages of each option are described in bullet points.

Option One – Recommended Option

[54] This option includes proceeding as outlined in the SDF programme plan and according to the high-level scheduled in **Attachment A**. It would involve Council noting the Risk Identification Report, endorsing the attached Longlist of generic adaptation approaches – Context Summary Report and 16 factsheets, and approving the SDF programme team undertaking engagement with partners, stakeholders and affected communities on the basis of these documents.

Advantages

- Enables the SDF programme to remain on schedule by completing the first major deliverables in the risk assessment and adaptation approaches workstreams on time and within budget, and to commence planned community engagement.
- Enables the SDF programme to deliver on stated objectives and to move the conversation forward, promoting confidence with partners, stakeholders and

affected communities, and further building positive forward momentum for the programme.

- Avoids potential delays and additional work, which could negatively impact stakeholder confidence, lead to additional unforeseen costs, and have negative downstream effects for other SDF programme workstreams and activities.
- Enables staff and consultant teams to turn their focus to subsequent stages of the SDF programme, which is work that is expected to be more complex and challenging.

Disadvantages

- Establishing the longlist of generic adaptation approaches now, while a range of uncertainties and information gaps still exist, could mean new information leads to substantive or disruptive shifts in the SDF programme. However, the iterative nature of the DAPP process and the SDF programme structure and staging, will provide further opportunities to work with and around these uncertainties and to fill information gaps.
- Moving forward to the next stage of the SDF programme could be viewed by some stakeholders as moving too fast, before they have had an opportunity to fully understand and engage with the key issues. This could be managed by more in-depth communications and community engagement, which is the planned next step for the SDF programme.

Option Two

[55] This option would involve Council requesting further work on the risk assessment or adaptation approaches development workstreams, before approving planned engagement with partners, stakeholders and affected communities.

Advantages

- Undertaking additional work could enable filling some existing information gaps and resolving some technical issues or programme uncertainties, potentially helping avoid substantive or disruptive shifts in the SDF programme at a later stage.
- The SDF programme could continue to undertake communications and community engagement activities to raise the profile of the programme and reach a greater number of stakeholders prior to making initial decisions about the longlist of generic adaptation approaches. This could help avoid perceptions that the SDF programme is moving too fast.

Disadvantages

- This would likely prevent the SDF programme from remaining on schedule by delaying completion of the first major deliverables in the risk assessment and adaptation approaches workstreams, which would likely lead to delays.
- Not delivering on stated objectives and slowing programme momentum could negatively affect partner, stakeholder and community confidence in the SDF programme.
- Potential delays and additional work could lead to unforeseen costs and have negative downstream effects for other SDF programme workstreams and activities.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[56] These are described in the paper and attachments, which build on previous advice on strategy and policy considerations, provided in the following reports:

- HAZ2109, ORC Council, 24 November 2021
- OPS2215, ORC Strategy and Planning Committee, 13 April 2022
- OPS2223, ORC Strategy and Planning Committee, 13 July 2022
- HAZ2302, ORC Safety and Resilience Committee, 10 August 2023
- HAZ2302, ORC Council, 22 November 2023

Financial Considerations

[57] Funding of the South Dunedin Future Programme is provided for in ORC's 2023/24 Annual Plan.

Significance and Engagement Considerations

[58] Not applicable.

Legislative and Risk Considerations

[59] These are described in ORC paper HAZ2302 presented to Council on 22 November 2023.

Climate Change Considerations

[60] The South Dunedin Future Programme is enabling adaptation to the effects of future climate change.

Communications Considerations

[61] These are described in the report.

NEXT STEPS

[62] The following work is ongoing under the SDF programme:

- ORC continues to undertake scientific and technical work to further identify, monitor and predict natural hazards and their likely impact on South Dunedin.
- Staff continue to develop the SDF programme partnership with mana whenua, including by establishing structures and processes to engage mana whenua and Māori communities, exploring programme-specific aspirations, and seeking to integrate mātauraka Māori and te ao Māori into the programme planning and processes.

[63] Subject to Council decisions and direction, the next steps for the SDF programme are to:

- Design and deliver communications and community engagement plans and activities associated with the longlist of generic adaptation approaches.
- Finalise two further flyers and publish in December 2023 / January 2024, including:
    - Flyer #3: Focussing on values and objectives, playing back to the community key messages collected from central government, local government, mana whenua, and through community engagement; explaining how that has informed the strategy for the programme, and outlining what that is in plain language.

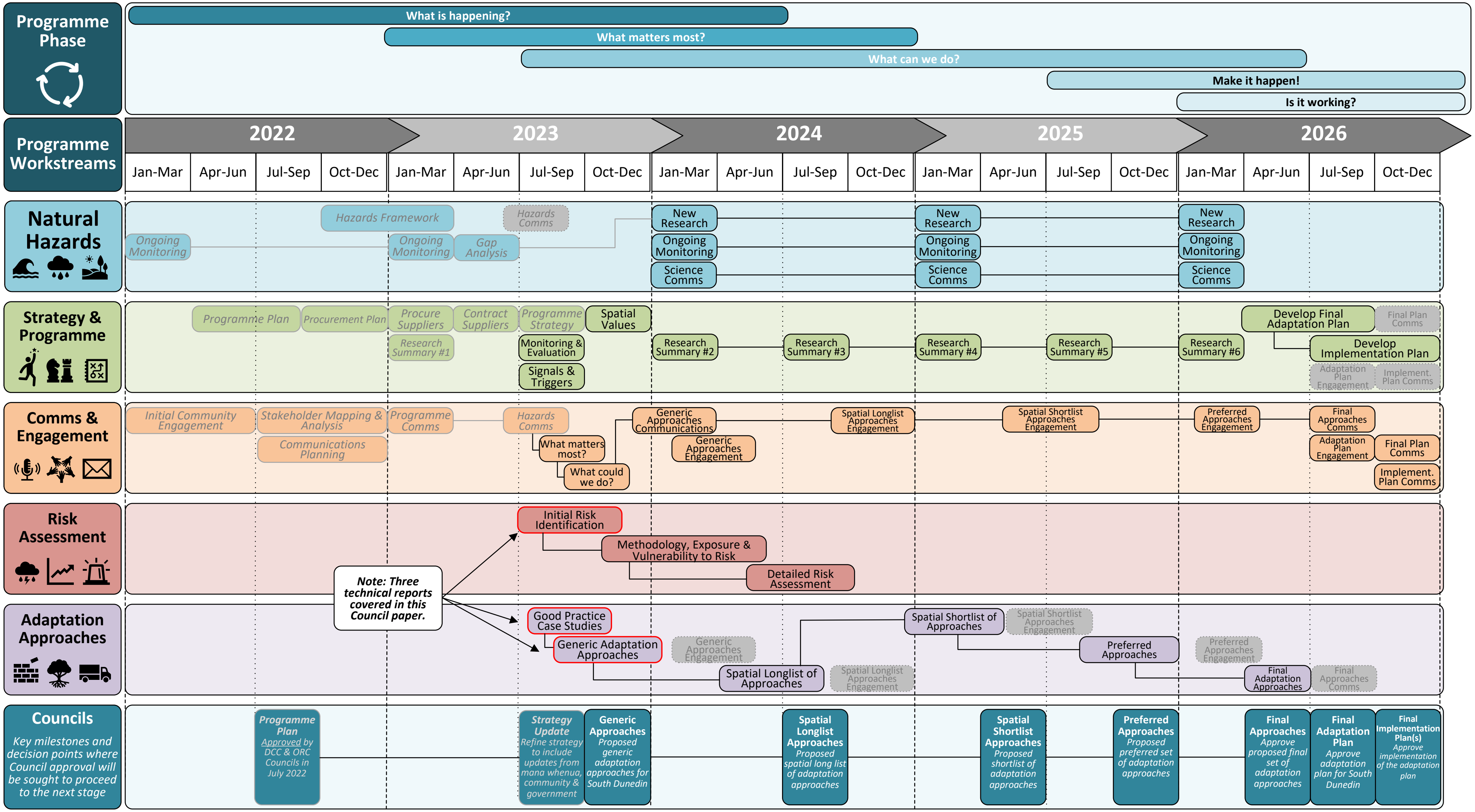
  - Flyer #4: Summarising the longlist of generic adaptation approaches, including though visuals, and basic information on the features, pros and cons of each option.
- Commence technical work on the second stage of the risk assessment workstream, finalising the risk assessment methodology; and on the third stage of the adaptation approaches workstream, which is developing a spatial longlist of approaches.

ATTACHMENTS

1. SDF Programme - Summary One- Pager (A 3) (Dec 2023) [**8.1.1** - 1 page]
2. SDF Risk Identification Report (Final) [**8.1.2** - 83 pages]
3. SDF Domestic and International Good Practice Case Studies Report (Final) [**8.1.3** - 30 pages]
4. SDF Generic Long List of Adaptation Approaches - Context Summary Report (Final) [**8.1.4** - 33 pages]
5. SDF Generic Long List of Adaptation Approaches - Factsheets (Final) [**8.1.5** - 16 pages]

South Dunedin Future Programme

- South Dunedin Future is a **joint programme** between Dunedin City Council and Otago Regional Council to find ways to respond to climate change and flooding problems in South Dunedin.
- We need to **adapt South Dunedin's infrastructure and environment** in a way that creates more room for increasing levels of rain, sea and groundwater, while protecting space for people and the things that matter.
- We are **making a plan** with the South Dunedin community, mana whenua and stakeholders to work out what's most important and to find the right balance between people, water and space.
- This will involve **lots of technical work and community engagement** over a number of years. Some key pieces of this work are mapped out below.



SOUTH DUNEDIN FUTURE

WORKSTREAM 3: RISK ASSESSMENT
STAGE 1: RISK IDENTIFICATION REPORT

24 NOVEMBER 2023

SOUTH DUNEDIN FUTURE

WORKSTREAM 3: RISK ASSESSMENT

STAGE 1: RISK IDENTIFICATION REPORT

FINAL (REVISION 6 FINAL VERSION)

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0.6	24.11.2023	Final version to issue to client.

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24 November 2023

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EXECUTIVE SUMMARY

SUMMARY OF RISK ASSESSMENT WORKSTREAM

Regional and district studies have identified that South Dunedin is exposed to multiple natural hazards. A history of flooding during heavy rainfall events has highlighted the area's exposure. Available scientific and technical information indicates many of these hazards will be amplified by climate change.

The South Dunedin Future (SDF) programme provides a framework for identifying, developing and selecting climate change adaptation options for South Dunedin to increase resilience. The programme includes five workstreams, covering: strategy and programme, communications and community engagement, risk assessment, adaptation options development, and natural hazards.

The purpose of the Risk Assessment Workstream is to "assess the potential for elements at risk (people, places, assets) to be negatively affected by rainfall-induced flooding, coastal, groundwater and seismic natural hazards in South Dunedin". This report is the first output of the risk assessment workstream. The objectives of this report are to:

- Collate available existing information regarding:
  - Hazard awareness in relation to rainfall induced, coastal, groundwater and seismic natural hazards and climate change.
  - People, places and asset information to support the exposure and vulnerability component of a risk assessment within South Dunedin.
- Provide a foundational understanding of natural hazard and climate change risk to South Dunedin that will be built upon in the subsequent stages of the risk assessment.

The Risk Identification Report is the first stage of work in the three-stage risk assessment workstream, i.e., this report does not present risk assessment findings. The subsequent stages will develop and implement an agreed detailed risk assessment methodology. Key considerations for the detailed risk assessment will include exposure and vulnerability, consequences, indirect and cascading risks, and risks to mana whenua. These different stages, key considerations, and outputs are shown in Figure E1.1 below.

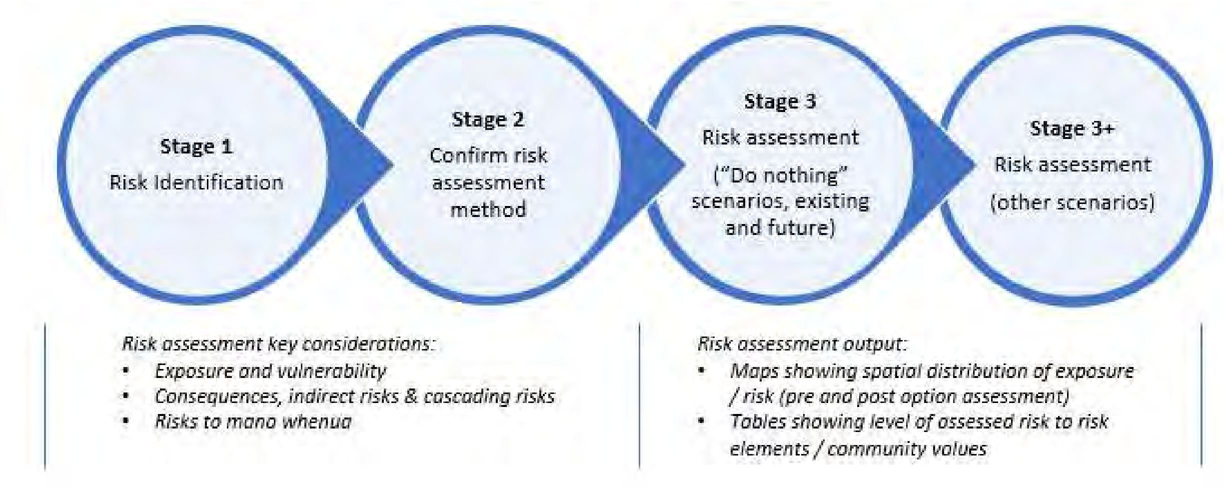

Figure E1.1 Overview of risk assessment stages.

SUMMARY OF NATURAL HAZARDS AND IDENTIFIED RISKS

South Dunedin comprises a large area of flat land close to the city centre, key transport networks and a range of important city services and amenities. As such, it plays a key role in the functioning of the wider city and it will feature prominently in considerations of Dunedin's future growth and development. South Dunedin is exposed to a range of natural hazards, partly due to its location on a low-lying area built on a former coastal wetland.

Potential hazards include coastal inundation from storm surge or tsunami; rainfall-induced flooding exacerbated by high groundwater; and seismic hazards such as liquefaction. Climate change will likely increase most of these hazards over time through rising sea level, rising ground water, and increased frequency and severity of storm events. Land subsidence may also increase both the impact of these hazards and the rate of onset.

Elements at risk (people, places, assets) within South Dunedin have been assessed against rainfall induced, coastal, groundwater and seismic natural hazards facing South Dunedin to identify direct physical risks within the area. Table E1-1 presents this screening, where tick-marks indicate the element is at risk due to a particular hazard.

The key finding from this risk identification process is that all elements are at risk from all hazards. This finding reflects the broad and complex hazard and risk scape in South Dunedin. The risks identified in this report are not uniform, but could vary greatly, including in terms of spatial extent, severity, and consequence.

Notable risks that arise from outside South Dunedin relate to:

- Wastewater overflows due to cross connection and inflow with stormwater and wastewater inflows from the wider Dunedin wastewater catchment.
- A 'high level overflow' stormwater system which operates to transfer stormwater into South Dunedin from the adjacent St Clair catchment.

The interconnectedness of physical elements within South Dunedin means that any disruptions or impacts on one part of the system can trigger a range of complex, interrelated and cascading consequences. The following broad categories of these are identified and discussed within the report:

- Human health and wellbeing.
- Exacerbating existing inequities and creating new inequities.
- Risks to Kāi Tahu sites, identity and practices, and non-Kāi Tahu cultural heritage sites, due to climate change.
- Risks to community cohesion and resilience from climate change.
- Provision of public services.
- Financial hardships including increasing cost of doing business and availability of insurance.
- Environmental degradation.

The identified risks will be assessed in the subsequent stages of the risk assessment. The contextual summary and risk identification findings will shape the methodology to assess risk that is to be developed as the next step in this workstream. Outputs from the risk assessment workstream will be used to inform decision-making regarding the preferred suite of adaptation options for South Dunedin.

Table E1-1 Risks identified to South Dunedin

RISK ELEMENT	EXTREME RAINFALL AND FLOODING	COASTAL INUNDATION	COASTAL EROSION	GROUND-WATER	EARTHQUAKE	LANDSLIDE	LIQUE-FACTION
Areas of ecological significance	✓	✓	✓	✓	✓	✓	✓
Buildings and open spaces	✓	✓	✓	✓	✓	✓	✓
Marae, and other culturally significant sites	✓	✓	✓	✓	✓	✓	✓
Roads	✓	✓	✓	✓	✓	✓	✓
Rail infrastructure	✓	✓	✓	✓	✓	✓	✓
Water supply infrastructure	✓	✓	✓	✓	✓	✓	✓
Wastewater infrastructure	✓	✓	✓	✓	✓	✓	✓
Stormwater infrastructure	✓	✓	✓	✓	✓	✓	✓
Solid waste and contaminated sites	✓	✓	✓	✓	✓	✓	✓
Telecommunication infrastructure	✓	✓	✓	✓	✓	✓	✓
Electricity transmission and distribution	✓	✓	✓	✓	✓	✓	✓

1 INTRODUCTION

Regional and district studies have identified that South Dunedin is exposed to multiple risks from natural hazards, many of which will be amplified by climate change. A history of flooding during heavy rainfall events has highlighted the area's exposure.

The physical characteristics of South Dunedin include its flat, low-lying topography, poorly consolidated underlying sediments, proximity to the ocean and harbour, and a shallow groundwater table strongly influenced by the sea. Land-use is primarily residential, commercial and industrial. The area also holds important infrastructure and national transport links, which increases its risk to flooding, drainage issues and other natural hazards.

The frequency and severity of climate hazards is projected to increase and the possible impacts from high magnitude, low frequency hazards (such as earthquakes and tsunamis), coupled with the high vulnerability of the systems and people within the area has driven the need to develop a climate change adaptation strategy for South Dunedin. Understanding climate change and natural hazard risk in a way that supports adaptation strategies are a critical component of this initiative.

The South Dunedin Future (SDF) programme provides a framework for identifying, developing and selecting climate change adaptation options for South Dunedin. The programme involves detailed technical work and extensive community engagement, ending in July 2026. The programme comprises four key workstreams:

1. Workstream 1: Strategic Programme Management Support.
2. Workstream 2: Communications and Community Engagement Support.
3. Workstream 3: Risk Assessment
4. Workstream 4: Adaptation Options.

This report relates to the first part of Workstream 3.

1.1 PURPOSE, OBJECTIVE AND PROCESS

1.1.1 PURPOSE

The purpose of *Workstream 3: Risk Assessment* is to "*assess the potential for elements at risk (people, places, assets) to be negatively affected by rainfall, coastal, groundwater and seismic natural hazards in South Dunedin*".

The outputs will be used to identify current and future risks and help guide adaptation options based on an understanding of how risk may change as a result of different interventions.

There are three stages to Workstream 3: Risk Assessment, and this *Risk Identification* Report is the first stage (refer Section 1.1.3 and Figure 1.1). The outputs from the risk assessment process will help decision-making regarding the preferred Adaptation Plan (Workstream 4).

1.1.2 OBJECTIVES

The objectives of this report are to:

- Collate available existing information regarding:
  - Hazard awareness in relation to rainfall, coastal, groundwater and seismic natural hazards and climate change.
  - People, places and asset information to support the exposure and vulnerability component of a risk assessment within South Dunedin.
- Provide a foundational understanding of natural hazard and climate change risk to South Dunedin that will be built upon in the subsequent stages of the risk assessment.

The information contained in this report is consistent with a key risk management principle relating to "making best use of available information". This report intends to gather and synthesise the extensive body of work that has been undertaken to date, to understand climate and natural hazard, exposure, vulnerability, and risk to people, places and assets within South Dunedin.

1.1.2.1 SCOPE

The scope of this assessment relates to the South Dunedin Future programme focus area (Figure 2.1) and includes consideration of risks to South Dunedin that arise outside the area. The scope of specified natural hazards and "elements at risk" are discussed below:

The specified natural hazards are rainfall, coastal, groundwater and seismic hazards. Seismic hazards include ground shaking and liquefaction. Landslide hazards were originally included as a seismic hazard; however we discuss them separately in this report primarily due to their storm-induced nature. Additional hazards are beyond the scope of the risk assessment.

"Elements at risk" relate to the people, places and assets which could negatively be affected by the natural hazards in South Dunedin. The term "Elements at risk" is used to be consistent with MfE guidance for risk assessment framework terminology[1]. The following "Elements at risk" have been used to be consistent with the Otago Climate Change Risk Assessment (OCCRA):

- Areas of ecological significance
- Buildings and open spaces
- Marae, and other culturally significant sites
- Roads
- Rail infrastructure
- Water supply infrastructure
- Wastewater infrastructure
- Stormwater infrastructure
- Solid waste and contaminated sites
- Telecommunication infrastructure
- Electricity transmission and distribution

A parallel Mana Whenua Risk Assessment within the SDF programme is currently underway to explore risks to Kāi Tahu sites, identity and practices due to climate change. This parallel assessment provides a key contribution to the overall programme to allow for adaptation responses to be made in partnership with Mana Whenua; who are likely to be disproportionately affected by climate change.

This report has been informed through a desktop review of previous studies of South Dunedin. This includes consideration of all existing and future scenarios referred to in the studies. The suitability of these studies in comparison with stakeholder agreed climate change scenarios and timeframes will be agreed in the Stage 2 Risk Assessment methodology.

Inputs from stakeholders have not been included at this stage, however it is intended that this will be included in subsequent stages.

1.1.3 RISK ASSESSMENT PROCESS

There are three stages to the Risk Assessment workstream, as outlined in Figure 1.1.

Figure 1.1 Overview of risk assessment stages.

The approach laid out above is broadly consistent with the process outlined in 'A guide to local climate change risk assessments[1] and Table 1-1 provides a high-level overview regarding where the three stages of the risk assessment align with the MfE guidance.

Additional points are raised below:

- This *Risk Identification* Report is the first stage in the risk assessment process (aligned to Step 3A in the MfE guidance). The reader is referred to the MfE guidance for further information regarding Step 3A.
- Stage 2 assesses the suitability of information to meet stakeholder agreed performance metrics.
- There is potential that at the end of Stage 2 (and before Stage 3) that additional information will be needed to meet the stakeholder agreed risk assessment methodology.
- "Stage 3+" relates to the potential use of the risk assessment methodology to assess future scenarios which have not yet been considered (e.g. to test efficacy of adaptation options).

[1] Ministry for the Environment. 2021. He kupu ārahi mō te aromatawai tūraru huringa āhuarangi ā-rohe / A guide to local climate change risk assessments. Wellington: Ministry for the Environment. [A guide to local climate change risk assessments | Ministry for the Environment]

Table 1-1 Process for local climate change risk assessments with steps related to the SDF Risk Assessment Workstream[1]

Phase	Step	Stage 1	Stage 2	Stage 3	Other SDF Workstream
Phase 1 *Getting started*	**Step 1A** Establish project team, governance, and communication plan				● WS1
	Step 1B Establish project principles, purpose, and level of assessment				● WS1
	Step 1C Identify stakeholders and plan for iwi/Māori and stakeholder engagement				● WS2
Phase 2 *Setting up the risk assessment*	**Step 2A** Inputs and scale of assessment		●		
	Step 2B Climate change scenarios and timeframes		●		
	Step 2C Develop and agree organising themes		○		○ WS1,2,4
Phase 3 *Carrying out the risk assessment*	**Step 3A** Identify hazards; screen elements as risk *(high-level assessment can conclude here)*	●			
	Step 3B Detailed physical risk assessment		●		
	Step 3C Additional analysis (optional): • consequence rating • opportunities • geospatial analysis to inform risk assessment		●		
	Step 3D Review risk-rating workbook		○	○	
	Step 3E Risk assessment report			●	
Phase 4 *Next steps*	**Step 4A** Risk prioritisation *(led by governance group)*				● WS4
	Step 4B Adaptation planning				● WS4

1.2 REPORT STRUCTURE

This report is structured as follows:

- Section 2 presents the geographic, social and economic context, climate change projections, and a summary of the natural hazards of focus in South Dunedin (i.e. rainfall induced flooding, coastal, groundwater and seismic).
- Section 3 presents a summary of the current knowledge regarding people, places and assets at risk within South Dunedin.

2 CONTEXT AND NATURAL HAZARDS OF SOUTH DUNEDIN

To understand risk to South Dunedin, the geological history (Section 2.1) and social and economic context (Section 2.2 and Section 2.3 respectively) provide useful context to understand why South Dunedin is so uniquely exposed to flood, coastal, groundwater, and seismic hazards. Further context is provided by understanding climate change projections for Otago (Section2.4).

South Dunedin is exposed to a variety of natural hazards. These are summarised in Section 2.5 to Section 2.8.

2.1 GEOLOGICAL SETTING

South Dunedin lies within the flat area between the Otago Harbour, St Clair and St Kilda beaches, and Dunedin's city and Otago Peninsula (Figure 2.1). The boundaries of the project area on the western and eastern sides roughly approximate to the 4 msl[2] elevation contour. For the most part, the project area overlaps with the geological area defined as the South Dunedin Coastal Plain, with the main exception being that the coastal plain extends beyond the project area, around the flat areas along the northern inner harbour coastline, toward the Water of Leith.

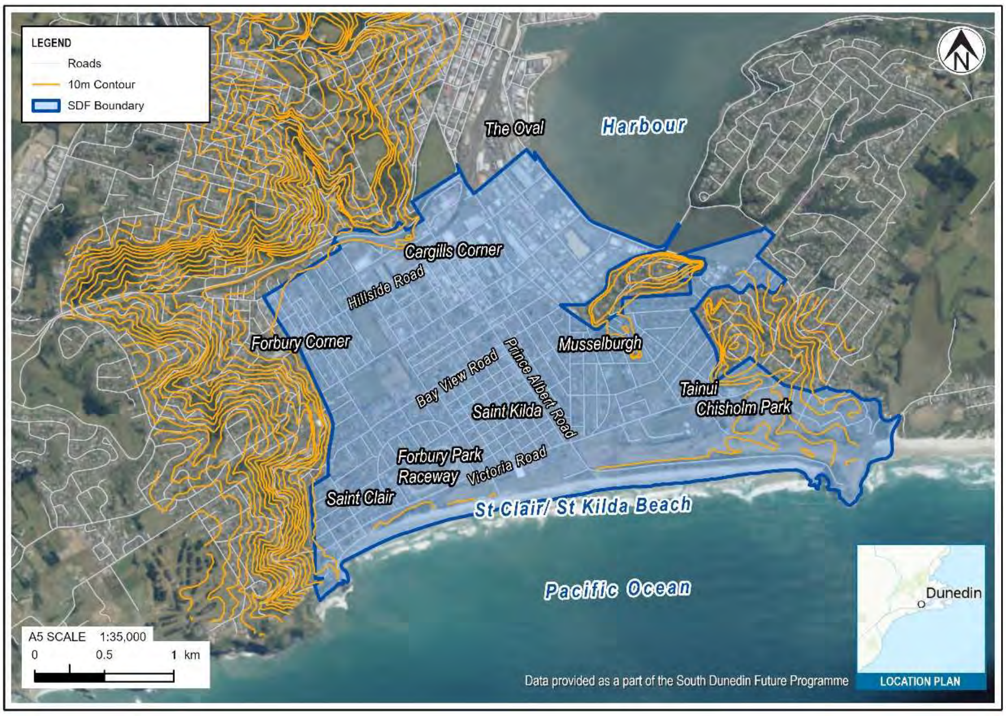

Figure 2.1 South Dunedin programme focus area

At the culmination of post-glacial sea level rise, the Otago Peninsula was an island, separated from the mainland by an ocean passage (now Otago Harbour) that extended from St Clair – St Kilda through to Aramoana. Over the past 7000 years or so since present sea level was attained, a sand barrier formed between St Clair and Lawyers Head, thereby connecting the peninsula to the

[2] Metres relative level

mainland. This connection became the St Clair-St Kilda dune belt, behind which soft, saturated sands and silts accumulated to form an extensive sand/mud flat at the head of Otago Harbour[3]. A salt marsh and lagoon developed in what is now South Dunedin.

Much of the low-lying land was reclaimed from coastal marshes and intertidal deposits following European settlement in the late 1800s, levelled with a thin (~1.0 m) veneer of fill and developed into a residential area. The harbour margin was reclaimed in the 1960s, extending the 1850 shoreline to the present wharf and rock wall shoreline, which raised the land to around 2 m, at a level above the earlier reclamations to the west and north[4]. The present day (2021) surface elevation of South Dunedin is shown in Figure 2.2.

The coastal frontage of South Dunedin has been modified over time, including construction of a seawall at the St Clair beach frontage in 1915[5], and significant dune planting of Marram in the early 1900's to form a more parallel dune system with the present high-water line towards Lawyers Head[6].

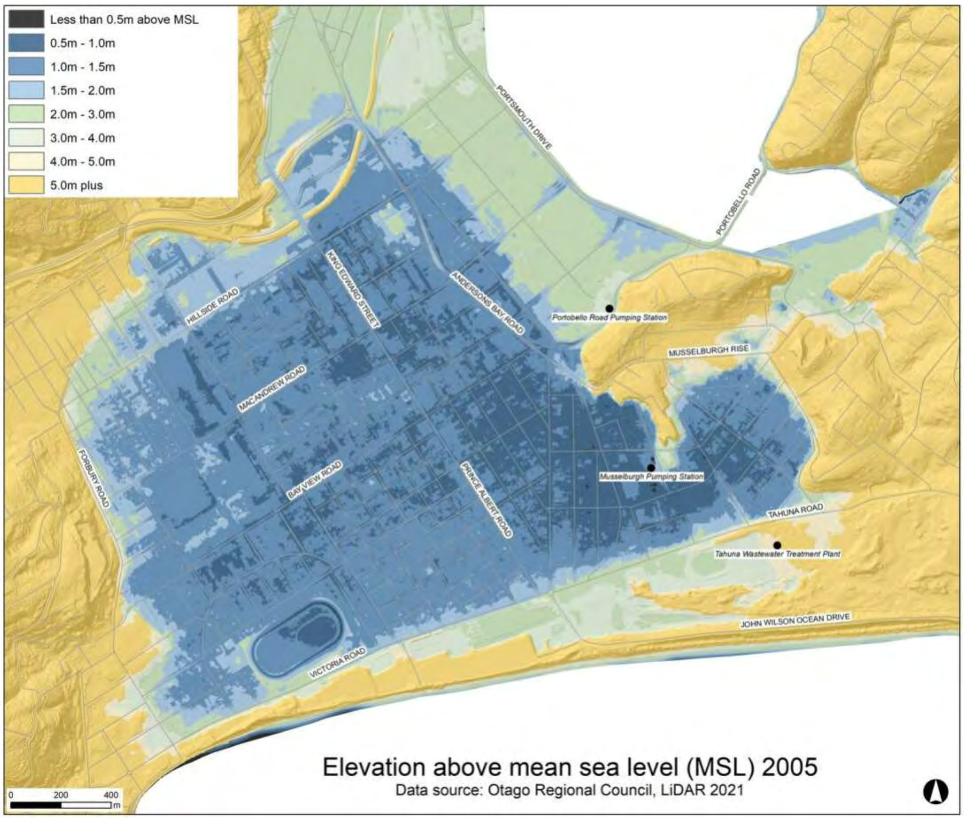

Figure 2.2 Elevation model of South Dunedin from 2021 LiDAR survey.

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[3] Barrell D. J. A., Glassey, P. J., Cox, S. C.., Smith Lyttle, B. (2014) Assessment of liquefaction hazards in the Dunedin City district. GNS Science Consultancy Report 2014/068.

[4] Cox, S. C., Ettema, MHJ., Mager, SM., Glassey, PJ., Hornblow, S., Yeo, S. (2020) Dunedin Groundwater Monitoring and Spatial Observations. GNS Science Report 2020/11.

[5] DCC (July 2012) Ocean Beach Reserve Management Plan.

[6] Tonkin + Taylor (2011) Ocean Beach Domain Reserve Management Plan Coastal issues and options.

2.2 SOCIAL CONTEXT

The social fabric of South Dunedin is shaped by its diverse population, ranging from families and individuals to students attending the University of Otago[7]. The population of South Dunedin is roughly 13,500, with approximately 6,000 households in the area, of which 42% are rented[8]. South Dunedin is a significant source of accessible housing for the city as it provides the largest area of flat land. In the 2018 Census, 16% of respondents in the area reported having at least some difficulty walking, which is significantly higher than that of the wider Dunedin population (7.2%) (Figure 2.3)[9].

The South Dunedin community is approximately 84% New Zealand European, 12% Māori, 7% Asian, 6% Pacific peoples, and 1% other (Figure 2.3). Relative to Dunedin, the population is slightly older, with approximately 21% of the population over 65-year-olds (relative to 16% in Dunedin) but similar proportion of over 30-65 years of age (approximately 43%). In the younger age groups, South Dunedin has approximately 19% of the population within the ages of 15-29 years (relative to 26% in Dunedin) with around 17% of the population under 15 years age group (similar to Dunedin) (Figure 2.4).

The area is home to a range of important community infrastructure. There are 12 schools, six early childhood centres, and six rest homes in South Dunedin. There are also a number of churches, community halls, medical centres, rest homes, parks, recreational grounds, heritage structures and social housing (Figure 2.6). There are a number of Samoan and Tongan churches based in South Dunedin, providing further connections to the area for many Pasifika communities[10]. The South Dunedin Community Network was established following the 2015 flooding event to connect people across the wider South Dunedin area. This network created opportunities for the community to come together and to strengthen and help people to use their voice to create a vibrant, resilient community and a safe future together[11].

Like many regions, South Dunedin faces existing social challenges, including issues related to housing affordability, healthcare access, and education disparities. The New Zealand Index of Social Deprivation provides one example of a measure of social vulnerability across communities. The Index rank's locations on a scale of decile 1 (least deprived) to decile 10 (most deprived) based on prescribed criteria by Statistical Area 1 using averaged data[12]. Figure 2.5 shows that a large proportion of South Dunedin is classified as 'most deprived'. However, it is worth noting that there are also portions of South Dunedin that are decile 1 and 2 (richest 20% of New Zealand), particularly focused around the St Clair area. The median income for people in South Dunedin is $26,000 which is slightly higher when compared to the wider Dunedin area ($25,500). However, when considering those with an income of greater than $70,000, South Dunedin has a lower percentage with 9%, compared to the rest of Dunedin (14%).

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[7] Dunedin City Council 10 Year Plan 2021-2031: [Snapshot of a great small city | He tirohaka o te tāone - Dunedin City Council.]

[8] Statistics NZ (2018) 2018 Census Data total population, household count, age, ethnicity, and mobility from all statistical areas within approximate SDF project extent.

[9] Data included as a part of the 2018 Census, represents South Dunedin, and some adjacent suburbs.

[10] Harrison, S. Macmilllan, A., Bond, S., Stephenson, J. (2022) Climate Change adaptation decision-making for health and wellbeing in South Dunedin. PhD Thesis, University of Otago.

[11] https://www.southd.org.nz/our-story/ .

[12] Statistics NZ (2018) Socioeconomic deprivation profile.

Further work on establishing community values is ongoing as part of the South Dunedin Future work program.

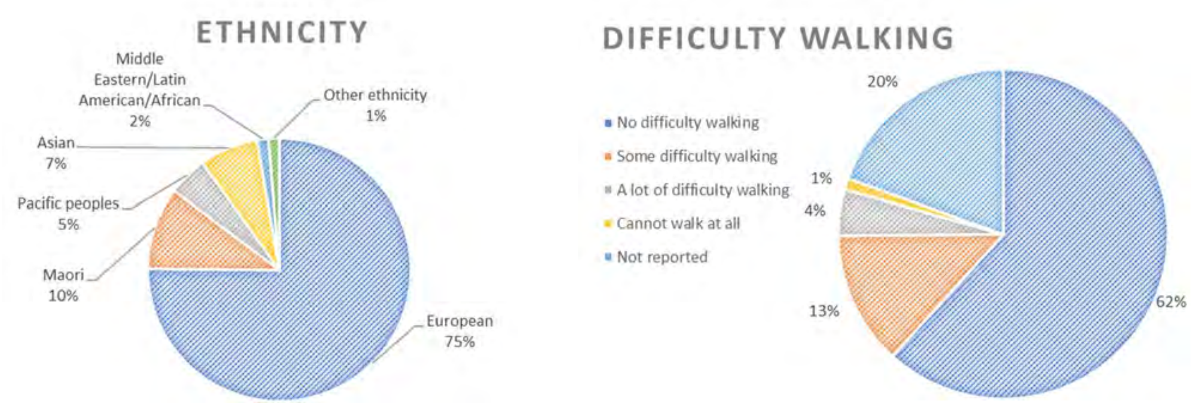

Figure 2.3 Ethnicity distribution and proportion of population with a disability within South Dunedin[8] (Source: 2018 Census).

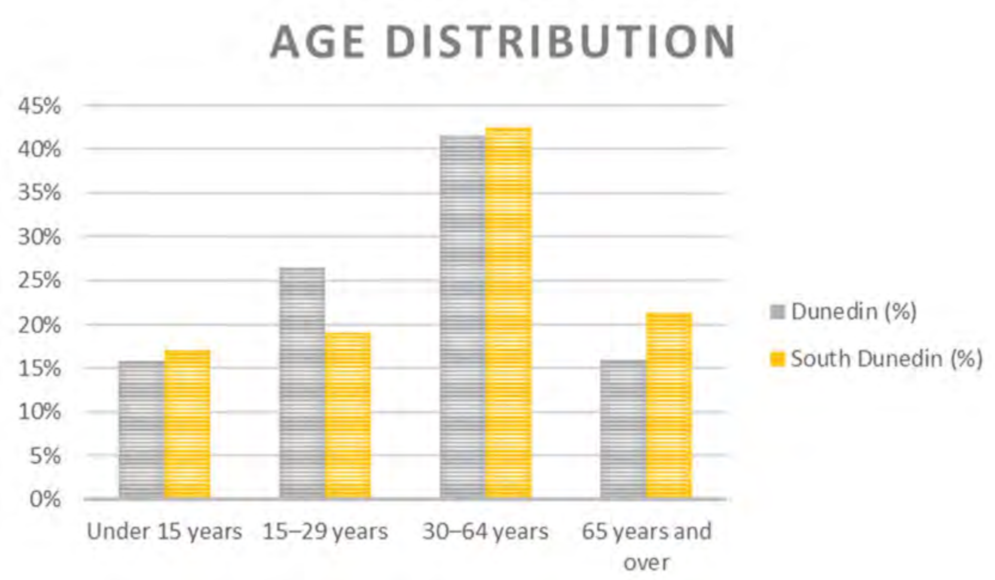

Figure 2.4 Age distribution of population within South Dunedin[8](Source: Statistics NZ (2018)).

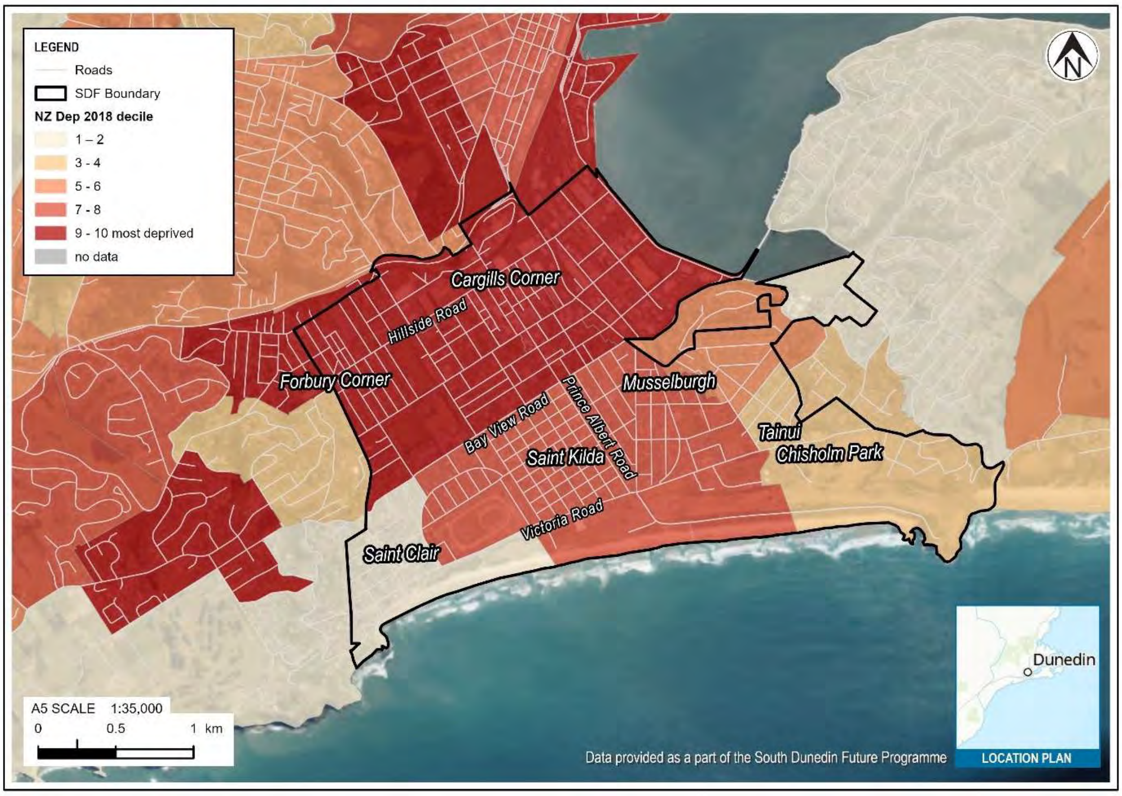

Figure 2.5 Social Deprivation Index for South Dunedin (Source: Statistics NZ (2018)).

Figure 2.6 Social Infrastructure for South Dunedin

2.3 ECONOMIC CONTEXT

Dunedin City has historically served as the economic hub of the Otago region, accounting for approximately 54% of the region's total GDP. South Dunedin is a crucial area of Dunedin city's economic landscape, as it is one of the most important retail districts in Dunedin, with its focal point being Cargill's Corner[13]. Most businesses in South Dunedin fall within the small to medium enterprise (SME) category, encompassing a diverse range of establishments, including retail outlets, commercial services, restaurants, and light industrial operations. The South Dunedin area includes the large format and vehicle retail hub centred along Hillside Road and between Anderson Bay and Portsmouth Drive.

South Dunedin has extensive infrastructure network including critical assets that service the wider Dunedin area including the Tahuna Wastewater Treatment Plant, State Highway 1 (SH1), South Island Main Trunk Line, and major Chorus and Transpower assets.

Further detail on the economic profile of South Dunedin, and its interaction with the wider Dunedin area is required.

[13] DCC (2017) South Dunedin Integrated Catchment Management Plan – June 2017. Metropolitan Dunedin coastal marine areas.

2.4 SUMMARY OF OTAGO CLIMATE CHANGE PROJECTIONS

The impacts of climate change are currently being felt by communities across New Zealand, with these impacts set to increase with time. Changes include variations in ocean and air temperatures, precipitation and wind speeds. This in turn results in numerous hazards such as storms, extreme weather events and sea level rise causing flooding, coastal erosion and drainage issues. These hazards can be both gradual or chronic such as groundwater rise, or acute, such as extreme weather events.

While natural variations have always been present for New Zealand's climate, climate change is projected to shift these natural variations, both in size and intensity. The effects of climate change are predictable with some level of certainty over the coming decades[14].

The main driver, and as such associated measure, of climate change relates to carbon dioxide concentrations within the atmosphere, which have been extensively modelled by the IPCC. Based on these models from IPCC's Fifth Assessment Report, AR5 (2014)[15], four Representative Concentration Pathways (RCP) have been defined, providing greenhouse gas concentration trajectories to the end of the century (Figure 2.7).

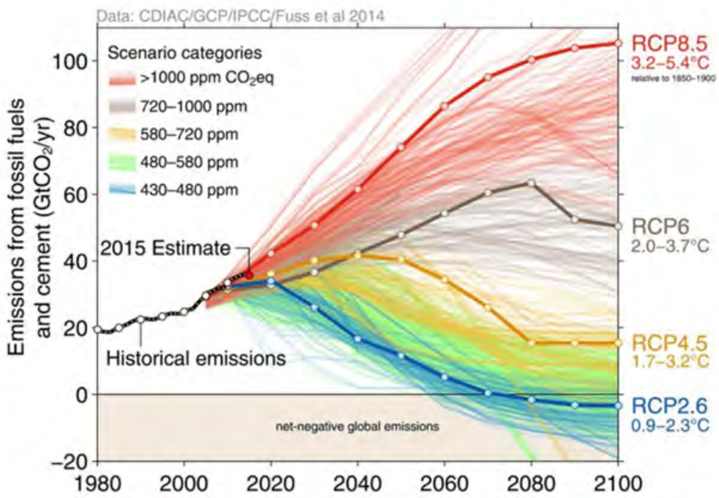

Figure 2.7 Global emissions scenarios and the four representative concentration pathway, with the historic emissions trajectory since 1980 (black)[14].

The IPCC's Sixth Assessment Report, AR6 (2021–22) has produced a new set of representative scenarios, based on Shared Socio-economic Pathways (SSPs)[16]. These comprise different socio-economic assumptions that drive future greenhouse gas emissions. New Zealand does not yet have downscaled data for SSPs, therefore RCPs from AR5 were used for the summary table[17]. Sea

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[14] Ministry for the Environment. (2018). Climate change projections for New Zealand: Atmosphere projections based on simulations from the IPCC Fifth Assessments, 2nd Edition. Wellington: Ministry for the Environment.

[15] IPCC. (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

[16] Intergovernmental Panel on Climate Change. (2023). Sixth Assessment Report – Synthesis Report.

[17] Bodeker, G., Cullen, N., Katurji, M., McDonald, A., Morgenstern, O., Noone, D., Renwick, J., Revell, L. and Tait, A. (2022). Aotearoa New Zealand climate change projections guidance: Interpreting the latest IPCC WG1 report findings. Prepared for the Ministry for the Environment, Report number CR 501, 51p.

Level Rise data is available using SSP's through NZ SeaRise: Te Tai Pari O Aotearoa and is included in this assessment. Broadly equivalent SSP scenarios are identified for each RCP and are explained below:

- RCP 8.5 M: This 'high-end' scenario used in IPCC's AR5 reflects high emissions with limited mitigation measures and no global emissions reduction policy settings. RCP 8.5 M broadly aligns with both SSP5-8.5 M and SSP3-7.0 M as introduced in IPCC's AR6.
- RCP 4.5 M: This 'mid-range' scenario used in IPCC's AR5 reflects moderate emissions and implementation of current global emissions reduction policy settings. RCP 4.5 broadly aligns to SSP2-4.5 M as introduced in IPCC's AR6.

NIWA's 2019 report Climate change projections for the Otago Region summarises these trajectories for the present day, mid-term (2040s) and long term (2090s). Consideration of the impacts of climate change across these three timeframes is recommended, to best understand changes with time. The climate projections for Dunedin are presented in Table 2-1.

Table 2-1 Regional climate change projections

HAZARD[18]	PRESENT DAY	MID TERM (RCP 4.5) 2040	MID TERM (RCP 8.5) 2040	LONG TERM (RCP 4.5) 2090	LONG TERM (RCP 8.5) 2090
Mean temperature	10.2°C	+0.5°C	+0.6°C	+0.9°C	+1.8°C
Hot days (above 30°C) annually	<0.2 day	+ 0.3 day	+ 0.4 day	+ 0.6 day	+ 1.6 day
Frost days (daily minimum temp below 0°C) annually	9.3 days	- 1.8 days	- 1.9 days	- 2.9 days	- 6 days
Drought (dry days <1 mm) annually	244 days	- 2 days	- 1 day	- 1 days	- 4 days
Rainfall (average annual)	Dunedin: 904 mm	2% increase	2% increase	5% increase	13% increase
Heavy rain days (>25 mm) annually	4.9 days	+ 0.2 day	+ 0.2 day	+ 0.5 day	+ 1 day
Extreme rainfall (1% AEP event, 24 hours)	Dunedin Musselburgh: 141 mm	150 mm (6% increase)	151 mm (7% increase)	155 mm (10% increase)	172 mm (18% increase)

[18] Unless otherwise noted, all hazard information is sourced from: Macara. (2019). Climate Change Projections for the Otago Region. NIWA. Prepared for Otago Regional Council.

HAZARD[18]	PRESENT DAY	MID TERM (RCP 4.5) 2040	MID TERM (RCP 8.5) 2040	LONG TERM (RCP 4.5) 2090	LONG TERM (RCP 8.5) 2090
Sea level rise + Vertical Land Movement[19,20]	Increase in annual mean sea level of 1.3 +/- 0.1 mm/year at Dunedin wharf from 1900 - 2008	Bayfield Park: 0.15 m Kitchener St: 0.17 m Middle Beach: 0.15 m	Bayfield Park: 0.16 m Kitchener St: 0.19 m Middle Beach: 0.18 m	Bayfield Park: 0.47 m Kitchener St: 0.52 m Middle Beach: 0.51 m	Bayfield Park: 0.66 m Kitchener St: 0.72 m Middle Beach: 0.71
Wind (99th percentile of daily mean windspeeds)	Measured between 2000 and 2018 26 - 36 km/h	- 2% change	+ 0.3 % change	+ 0.6 % change	- 1.3 % change

2.5 RAINFALL INDUCED FLOODING

South Dunedin is prone to rainfall induced flooding. The area has no major watercourses or natural connection to the coast, is generally flat, low lying, and is bounded by relatively elevated land, resulting in a basin. All stormwater is piped and discharged into the harbour via the Portobello Stormwater Pump Station (shown in Figure 2.8). A second stormwater pump station, Tainui, pumps stormwater from a low-lying area in the south-east of the catchment to the Portobello Pump Station. The lowest-lying residential area is in the southeast (parts of the suburbs of Tainui and Musselburgh), with other low-lying land scattered throughout the suburbs of St Kilda and South Dunedin, and part of St Clair adjacent to Forbury Park Raceway[21].

South Dunedin has experienced severe flooding on numerous occasions (1923, 1929, 1960, 2015 and 2018). Flooding experienced during the 2015 event was generally within the area bounded by King Edward Street and Hillside, Prince Albert, Victoria and Forbury roads.

With climate change, extreme rainfall events are projected to become more severe. Short duration events are projected to have the largest relative increase in intensity, for example the 1, 24 hour duration rainfall event is projected to generate 18% more rainfall by the end of the century (Table 2-1). Previous work has undertaken a range of modelled flood scenarios to test various land-use, rainfall, climate change and tide combinations within South Dunedin[22]. Results show modelled flooding extends throughout much of South Dunedin (Figure 2.9Figure 2.9), including in residential areas, on roadways and in industrial lots.

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[19] Sea level rise projections based on SSPs are available for New Zealand. These are included for coastal hazards. These projections are available (and are shown) at 2050 and 2090 timeframes.

[20] NZ SeaRise. (2022). Sea Level Rise and Vertical Land Movement Projections by Decade - Site 868. Note: SSP2-4.5 and SSP5-8.5 were used when modelling sea level rise.

[21] ORC (2016) The natural hazards of South Dunedin.

[22] DCC (2011) Dunedin 3 Waters Strategy: South Dunedin Integrated Catchment Management Plan. Opus, DCC, URS.

Work is currently underway to update the hydrodynamic flood model of South Dunedin, details of this ongoing work are included in Table 2-2.

Figure 2.8 Catchments surrounding South Dunedin

Figure 2.9 1% AEP current day flood model results of South Dunedin (Source: 2011 Integrated Catchment Management Plan[22]).

Table 2-2 Further information and ongoing work

SOURCE	DESCRIPTION	STATUS
Dunedin Three Waters strategy (2011)	This project provides baseline catchment characteristics and hydrodynamic modelling. Completed work includes: • South Dunedin ICMP (2011)[22]. • Saint Clair ICMP (2011)[23]. • Portsmouth Drive ICMP (2011)[24].	Completed
Dunedin Integrated Catchment Management Strategy (ICMP)	This project follows on from the prior Dunedin Three Waters strategy. Relevant work for South Dunedin includes stormwater model gap analysis and upgrades.	Stage 1 and Stage 2 of the three-stage project are complete.
Integrated System Planning (ISP) Programme	The objective of this project is to enable service providers to meet levels of service for drinking water, wastewater and stormwater and achieve its affordability obligations to customers. This four-stage program provides strategic direction to the ICMP.	Stages 1 (Baseline), Stage 2 (Objective setting), and Stage 3 (Strategic responses and short-listing) of this four-stage programme are complete. Stage 4: Investment Plans and Adaptive Plans is currently underway with completion scheduled for March 2024.

2.6 COASTAL INUNDATION, EROSION, AND TSUNAMI

South Dunedin is positioned between two major water bodies: The Otago Harbour (to the north), and the Pacific Ocean (St Clair and St Kilda beaches (to the south). This position means South Dunedin is potentially exposed to hazards from two coastal sources. However, the St Kilda to St Clair dune system and the elevated reclaimed land along on the Otago Harbour backshore provide a level of protection against coastal hazards such as tsunami and storm surge. Previous modelling and experience of storm surge and tsunami indicates that direct inundation of South Dunedin from the Pacific Ocean is unlikely under present conditions. However, previous storm events have had significant erosion effects on coastal dunes and beaches and future events may continue to do so. Should the St Clair to St Kilda dune system diminish, its ability to provide a buffer against the coastal hazards will also reduce therefore increasing the likely exposure of

[23] DCC (2011) Dunedin 3 Waters Strategy: Saint Clair Integrated Catchment Management Plan. Opus, DCC, URS.

[24] DCC (2011) Dunedin 3 Waters Strategy: Portsmouth Drive Integrated Catchment Management Plan. Opus, DCC, URS.

people and property in South Dunedin to coastal hazards. This exposure arises from South Dunedin's low-lying topography and close proximity to the coast[26].

Two categories of lower-lying land in South Dunedin and around the upper Otago Harbour are shown in Figure 2.10. These two categories are as described:

- Area A: Land which is below the height identified as the 1% AEP storm surge level. For the St Kilda / St Clair area, this level is identified as 2.05 m above mean sea level (msl[25]), while for the upper harbour, it is 1.9m above msl. The level of the Pacific Ocean and within the harbour does influence groundwater level within Area A[26].
- Area B: Land which is below the combined height of the 1% AEP storm surge level (at St Kilda / St Clair), plus an additional 1 m (i.e. land which is less than 3.05m above msl). This land would potentially be inundated if sea level was 1 m higher than at present, and a 1% AEP year storm surge event occurred.

The extent of inundation under both of these scenarios would depend in part on the "connectivity" between the ocean or harbour and the land. The South Dunedin dune system (or other engineered structures) could help to mitigate the effects of storm surge, if these features were to remain in place throughout the event.

Relative sea level (RSLR) is projected to increase in South Dunedin over the next century, as a result of increased warming. RSLR includes the rate of sea level rise relative to adjacent land and is a result of absolute sea level rise and vertical land movement (VLM). South Dunedin is likely to see subsidence, therefore RLSR is equal to 1.3 +/- 0.1 mm/ year. Relative sea level rise projections for South Dunedin are shown in Figure 2.11. Projected seal level rise will result in increased coastal inundation and erosion, and influence groundwater level[31].

Sources of further information and ongoing investigations are shown in Table 2-3.

[25] Dunedin Vertical Datum 1958

[26] ORC (2014) Coastal Hazards of the Dunedin City District. Review of Dunedin City District Plan—Natural Hazards

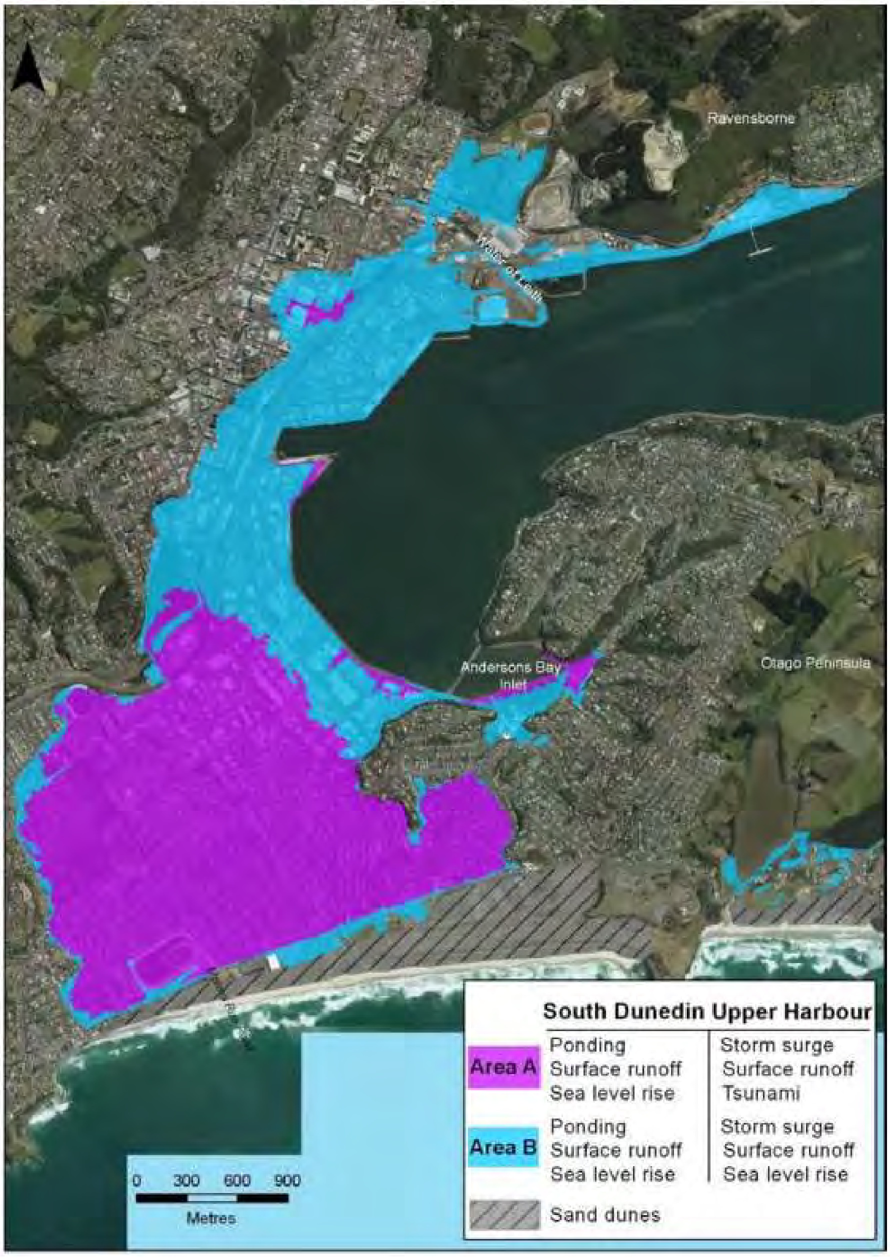

Figure 2.10 Mapped natural hazard areas in South Dunedin and around the upper Otago Harbour (Source: ORC, 2014[26])

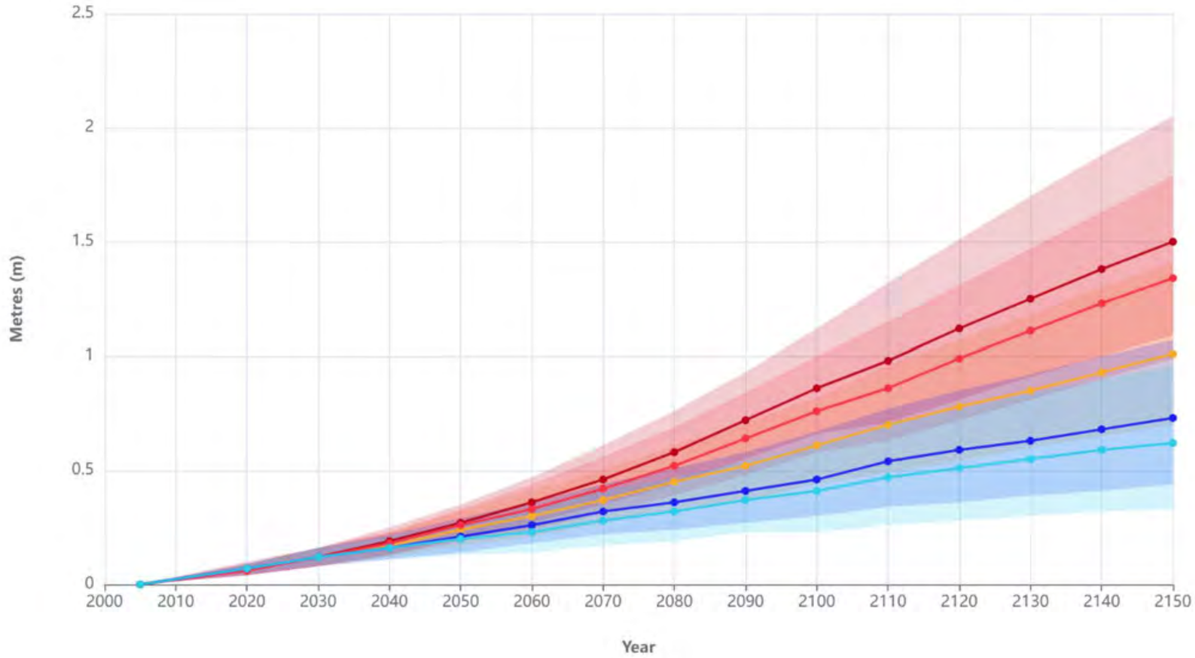

Figure 2.11 RSLR at Kitchener Street (VLM of -0.44 mm/year), for five different climate change projections[27].

Table 2-3 Further information and ongoing investigations

SOURCE	DESCRIPTION	STATUS
The Natural Hazards of South Dunedin	Description of natural hazards, environmental, and community setting of the South Dunedin plain.	Competed (ORC) 2016[21]
Coastal hazards of the Dunedin City District (ORC, 2014)	Description of the characteristics of natural hazards along the Dunedin City coastline	Competed (ORC) 2014[26]
St Clair-St Kilda Coastal Plan | Whakahekerau-Rakiātea Rautaki Tai	Outlines proposed coastal management options for resilience to coastal hazards and future sea level rise.	Completed (DCC) 2022[28]
NIWA's Aotearoa-New Zealand 1% AEP extreme sea level flooding viewer	Flood model showing 1% AEP extreme sea level flooding under current climatic sea conditions, plus relative sea level rise up to 2m above present-day mean sea level.	Completed (NIWA)[29]

[27] NZ SeaRise. (2022). RSLR by Decade – Site 4723.
[28] DCC (2022) St Clair-St Kilda Coastal Plan | Whakahekerau-Rakiātea Rautaki Tai.
[29] https://niwa.co.nz/natural-hazards/our-services/extreme-coastal-flood-maps-for-aotearoa-new-zealand

SOURCE	DESCRIPTION	STATUS
District Coastal Hazards Screening	Provides a high-level screening assessment of coastal hazards of coastal inundation, erosion and groundwater inundation for the Dunedin City District coastline.	Completed (WSP) [30]. Currently undergoing peer review.
St Clair St Kilda coastal modelling	Dunedin City Council is currently commissioning coastal modelling. When this data is available, the findings of this modelling should be considered in future risk assessment for South Dunedin.	In progress, due for completion early 2025.

2.7 GROUNDWATER

The groundwater table is usually very shallow within South Dunedin (Figure 2.12). This can cause significant drainage and water ponding issues in some places, as well as dampness in buildings and structural instability of foundations and roads. Groundwater infiltration into the stormwater and wastewater networks is a widespread issue across South Dunedin[4].

Groundwater levels within South Dunedin are expected to rise with climate change and may cause permanent surface water ponding in areas of South Dunedin. Groundwater modelling (SSP5-8.5) shows that by 2030, areas of permanent groundwater inundation may begin to emerge (Figure 2.13 a) and become more defined by 2050 (Figure 2.13 b). These areas of groundwater inundation are broadly constrained to three areas in 2030 but become increasingly widespread over time[31].

In some areas groundwater levels are tidally influenced, where the tidal signal increases with proximity to the Pacific Ocean. Groundwater fluctuations are also dominated by short term rainfall variability. Sea level rise and the increased frequency of rainfall events as a result of climate change are likely to increase groundwater levels, resulting increased exposure of people and assets across South Dunedin.

Monitoring of groundwater chemistry shows that there is generally increasing levels of salinity in groundwater approaching the coastal edge, reflecting direct mixing of groundwater with inland flow from the ocean[4]. This monitoring identified that the influence of salinity in groundwater is not as far inland as initially thought. Groundwater is also shown to be contaminated in some locations due to the former Dunedin Gasworks in the area[13].

Additional groundwater information is expected to be available later in 2023 when a modelling table study procured by ORC is complete (study details shown in Table 2-4).

[30] WSP (In progress) District Coastal Hazards Screening report. Note that this report is undergoing peer-review at the time of writing this report, and therefore there is not a final publication at this stage.

[31] Chambers, L. Hemmings, B., Cox, S.C., Moore, C., Knowling, M.J., Hayley, K., Rekker, J., Mourot, F.M., Glassey, P., Levy, R. (2023) Quantifying uncertainty in the temporal disposition of groundwater inundation under sea level rise projections. Frontiers in Earth Science.

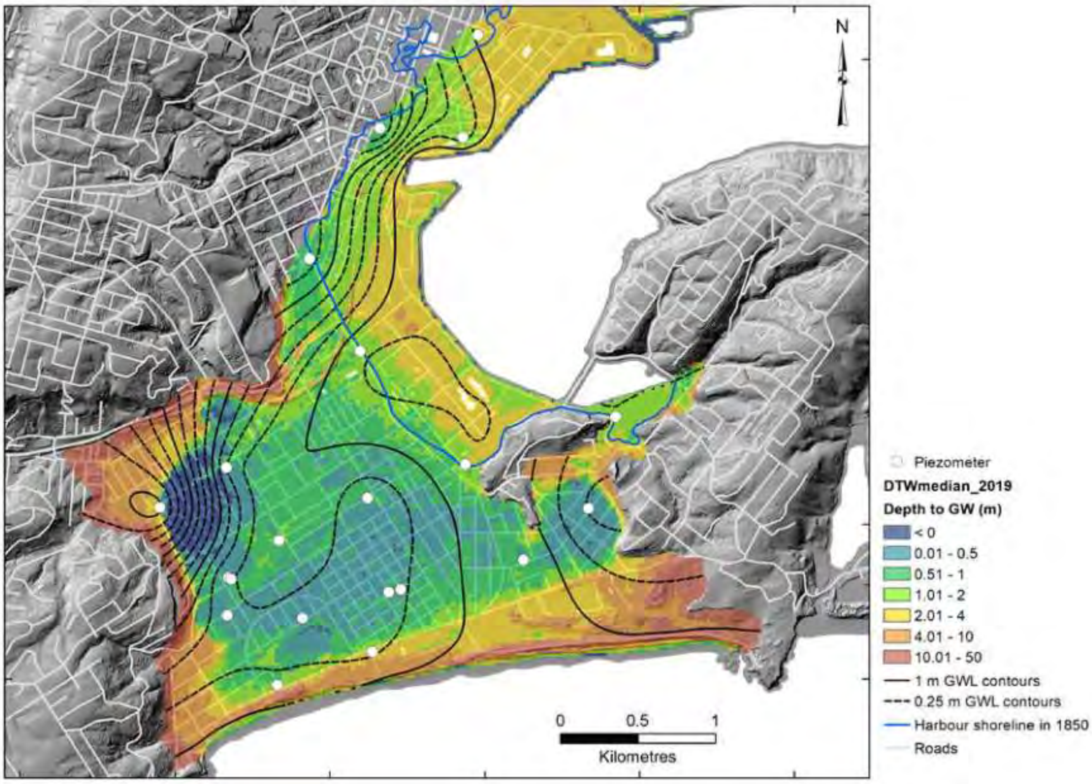

Figure 2.12 Interpolated depth to median groundwater elevation with elevation ranges and gradients highlighted by contours at 25 cm and 1 m intervals. White dots indicate the monitoring sites and median values used in the interpolation (Source: Cox et al. (2020)[4]).

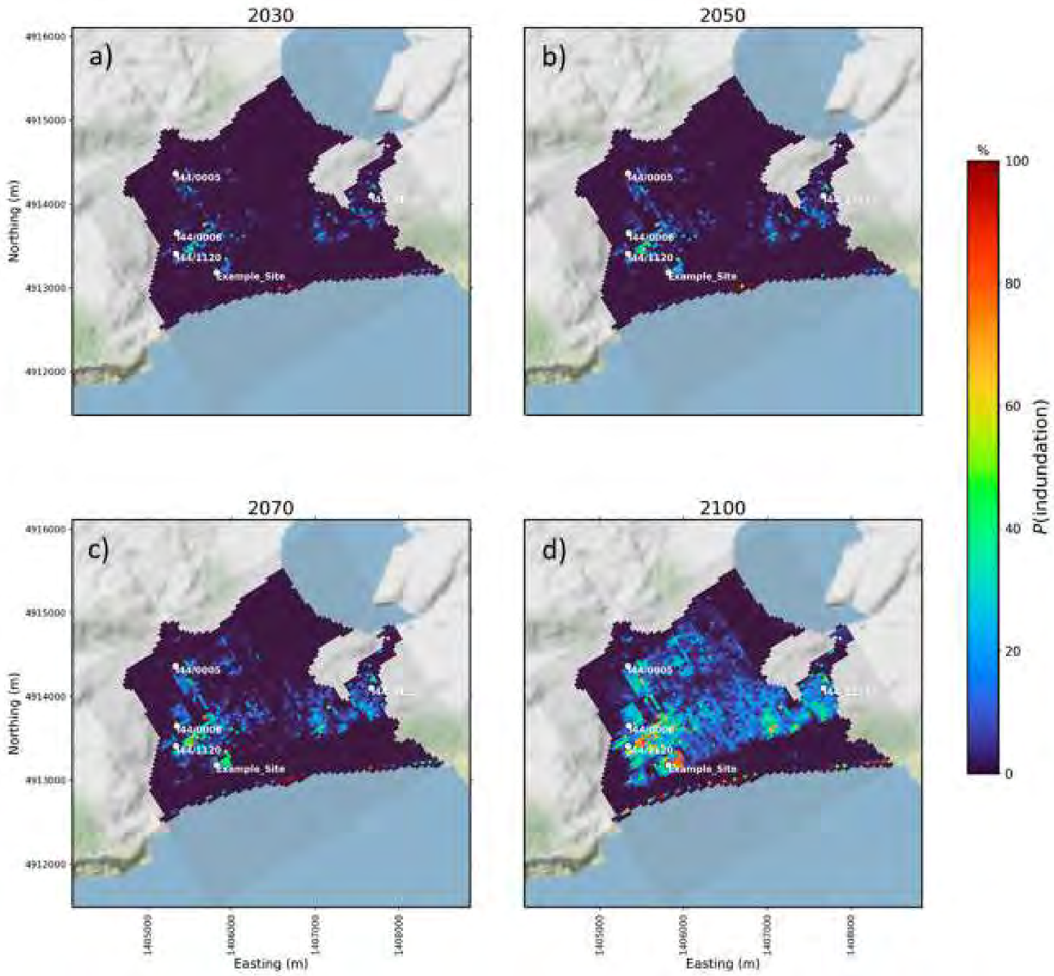

Figure 2.13 The projected SLR-driven probability of groundwater inundation for 2030, 2050, 2070 and 2100 based on the IPCC SSP5-8.5 (medium confidence) scenario[31]

Table 2-4 Further information

SOURCE	DESCRIPTION	STATUS
Groundwater modelling of South Dunedin	Stochastic (Monte Carlo) groundwater model (MODFLOW-NWT) is largely completed. The model includes rainfall recharge, interaction with coastal boundaries, and interaction with stormwater and wastewater networks (modelled as a single network) [31]. The model is set up to assess the probability of a certain outcome. It has been used to assess the spatial probability of groundwater inundation in South Dunedin for the following climate scenarios: • SSP5-8.5 • SSP5-4.5	Draft report has been completed (by GNS on behalf of ORC) (October 2023)

2.8 LANDSLIDES

Landslides are not a common issue in South Dunedin due to the flat topography although neighbouring hills are prone to shallow landslides after heavy rainfall and could face landslips in future strong earthquakes. Landslides are generally confined to the hillsides at the edges of South Dunedin, with notable locations near Forbury Corner and Saint Clair. Notable areas with possible land instability adjacent to South Dunedin are located within Southern Cemetery and around Andersons Bay / Bayfield (Figure 2.14)[32].

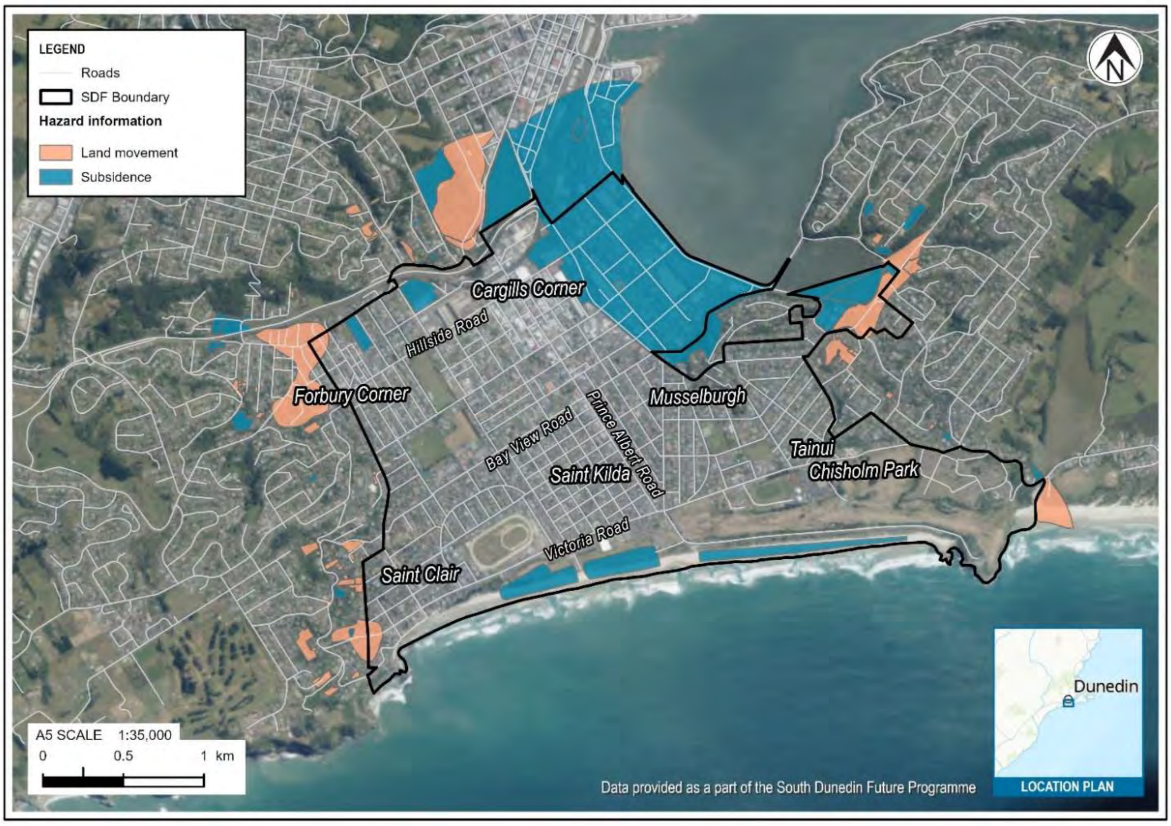

Figure 2.14 Land instability and land subsidence in South Dunedin (Source: DCC).

2.9 EARTHQUAKE, LIQUEFACTION AND LAND SUBSIDENCE

The South Island of New Zealand has experienced a number of earthquakes in recent history. Earthquakes can cause damage from ground shaking and subsequent landslides and liquefaction. The impacts of seismic hazards are outlined in this section.

There are numerous local (i.e. the Kaikorai Fault and Akatore Fault) and distal (i.e. Alpine Fault and Puysegur Subduction Zone) faults that could cause earthquakes within South Dunedin. Active local faults in Dunedin are shown in Figure 2.15[33]. These faults have the potential to generate ground surface rupture, however the specific impacts to South Dunedin have not been assessed.

[32] DCC Hazard database data provided for South Dunedin Future programme.
[33] Barrell (2021) General distribution and characteristics of active faults and olds in the Clutha and Dunedin City districts, Otago. GNS Science Consultancy Report 2020/88.

Investigation of the geology and ground conditions in 2020 found that most of South Dunedin's sediment is cohesive, clayey, with moderate to high plasticity which is not highly susceptible to liquefaction[34]. An assessment of liquefaction hazard found little to no damage expected with lower AEP (up to 0.01 AEP) earthquakes in South Dunedin. However, in higher AEP earthquakes (greater than 0.002 AEP) the impacts could be major in localised areas[35].

An earthquake could also cause lateral spreading, described as the horizontal movement and relaxation of ground[21]. Areas that are prone to lateral spreading include those close to coastlines or artificial embankments. The soft grounds beneath South Dunedin may also give rise to other geotechnical issues like foundation settlement or shaking amplification during an earthquake[35].

South Dunedin experiences vertical land movement subsidence due to gradual settling and sudden sinking. Land survey observations indicate an overall downward movement trend. Superimposed on average overall downward movement are apparent upward movements attributed to large, distant, earthquakes[21].

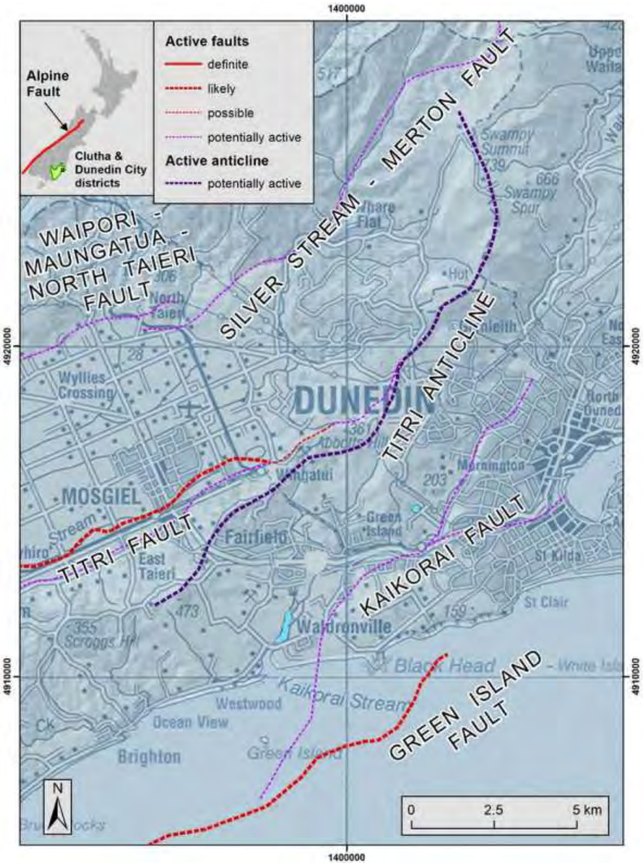

Figure 2.15 Active faults in South Dunedin[33].

[34] Mackey, B. Smith Lyttle, B., Barrell, D.J.A., Glassey, P.J., Hornblow, S. (2021) Characterising Subsurface South Dunedin to Better Define Multiple Natural Hazards.

[35] Hornblow, S. (2020) Update on the geology and ground conditions of South Dunedin and Harbourside. [update-on-the-geology-and-ground-conditions-of-south-dunedin-and-harbourside.pdf (orc.govt.nz).](update-on-the-geology-and-ground-conditions-of-south-dunedin-and-harbourside.pdf)

3 CLIMATE AND NATURAL HAZARD RISK IDENTIFICATION

Risk can be defined as “the potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems. In the context of climate change, risks can arise from potential impacts of climate change as well as human responses to climate change. Relevant adverse consequences include those on lives, livelihoods, health and wellbeing, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species”[36]. Risk assessments aim to understand the nature and level of climate change risk. They inform our actions to reduce such risks.

This section of the report seeks to identify risks to elements (i.e. people, places and assets) in South Dunedin arising from coastal, rainfall, groundwater and seismic hazards. Community consultation is currently underway to develop values and objectives of the South Dunedin community which may influence the elements included in future stages of work. The elements assessed in this phase of work are as follows:

- Natural environment
- Buildings:
  - Residential
  - Educational
  - Commercial
  - Public amenities
  - Civic buildings / public service
  - Heritage buildings.
- Open spaces / sportsgrounds
- Marae, and other culturally significant sites
- Roads
- Rail infrastructure
- Water supply infrastructure
- Wastewater infrastructure
- Stormwater infrastructure
- Solid waste and contaminated sites

[36] Reisinger, A., Howden, M., Vera, C., Garschagen, M., Hurlbert, M., Kreibiehl, S., Mach, K.J., Mintenbeck, K., O’Neill, B., Pathak, M., Pedace, R., Pörtner, H-O., Poloczanska, E., Corradi, M.R., Sillmann, J., van Aalst, M., Viner, D., Jones, R., Ruane, A.C., Ranasinghe, R. (2020). The Concept of Risk in the IPCC Sixth Assessment Report: A Summary of Cross-Working Group Discussions. Intergovernmental Panel on Climate Change, 15.

- Telecommunication infrastructure
- Electricity transmission and distribution.

Risks from climate change arise from the interaction between a hazard (triggered by an event or trend related to climate change), exposure (of the element, people, place or asset) to the hazard, and the vulnerability (susceptibility to harm) of the element, people, place or asset[36]. Risks can be both direct and indirect, where:

- Direct physical risks are those where there is a direct relationship between the natural hazard and the element at risk.
- Indirect physical risks can include two broad types:
  - "Downstream" risks resulting from the direct risk. For example, a direct risk of flooding of a road leads to a reduced level of service for the road and economic losses, loss of access etc.
  - "Upstream" risks which may arise as direct risks independently to South Dunedin (exogenously) and have consequential implications for the area. For example, supply chain interruptions which prevent critical inputs being received, or changes in policy by central government.

A screening of hazards against elements within South Dunedin is shown in Table 3-1, where tick-marks show that the element is at risk (exposed and potentially vulnerable) from the hazard. This shows that all elements are at risk from all hazards, with the exception of water supply infrastructure. Descriptions of the identified risks are outlined in the sections below. This list of risks has been cross referenced against the OCCRA and the NCCRA. The highest rated risks identified in the OCCRA and NCCRA are identified in the table, with a summary of highest rated regional risks and comments on their inclusion in this assessment included in Appendix A-2.

The interconnectedness of physical elements within South Dunedin means that any disruptions or impacts on one part of the system can trigger complex interrelated and cascading consequences. The following broad categories of these are identified and discussed in Section 3.11.

- Human health and wellbeing.
- Exacerbating existing inequities and creating new inequities.
- Risks to Kāi Tahu sites, identity and practices, and non-Kāi Tahu cultural heritage sites, due to climate change.
- Risks to community cohesion and resilience from climate change.
- Cost of doing business and availability of insurance.
- Provision of public services.
- Environmental degradation.

Further detail and categories may be added to both the direct and indirect risks as this project progresses.

Table 3-1 Summary of direct climate and natural hazard risks to South Dunedin. Tick-marks indicate that a risk is identified. Black outline indicates the risk is identified in the Otago or National climate change risk assessment†

ELEMENT AT RISK	RAINFALL	COASTAL HAZARDS			SEISMIC HAZARDS		
	EXTREME RAINFALL AND FLOODING† †	SLR AND COASTAL INUNDATION	COASTAL EROSION	GROUNDWATER† † †	EARTHQUAKE	LANDSLIDE	LIQUEFACTION
Natural environment	✓	✓	✓	✓	✓	✓	✓
Buildings and open spaces	✓	✓	✓	✓	✓	✓	✓
Marae, and other culturally significant sites	✓	✓	✓	✓	✓	✓	✓
Roads	✓	✓	✓	✓	✓	✓	✓
Rail infrastructure	✓	✓	✓	✓	✓	✓	✓
Ports	No port in South Dunedin						
Water supply infrastructure	✓	✓	✓	✓	✓	✓	✓
Wastewater infrastructure	✓	✓	✓	✓	✓	✓	✓
Stormwater infrastructure	✓	✓	✓	✓	✓	✓	✓
Airports	No airport in South Dunedin						

ELEMENT AT RISK	RAINFALL	COASTAL HAZARDS			SEISMIC HAZARDS		
	EXTREME RAINFALL AND FLOODING† †	SLR AND COASTAL INUNDATION	COASTAL EROSION	GROUNDWATER† † †	EARTHQUAKE	LANDSLIDE	LIQUEFACTION
Flood defences	Flood defences included in stormwater element						
Solid waste and contaminated sites	✓	✓	✓	✓	✓	✓	✓
Communications	✓	✓	✓	✓	✓	✓	✓
Electricity transmission and distribution	✓	✓	✓	✓	✓	✓	✓

†Risks outlined in black are identified as highly rated risks in the Otago Climate Change Risk Assessment

††[1]including wind and storm events

†††[2]including in relation to rainfall and salinity stress

3.1 AREAS OF ECOLOGICAL SIGNIFICANCE

South Dunedin currently has no ecologically significant habitats/breeding grounds for native fauna due to significant township development with no waterbodies present. However, the coastal beaches are frequently visited by sea lions and marine birds and provide habitat for native reptiles. The St Clair/St Kilda beach and dunes have issues relating to:

- The historical seaward advance of infrastructure and development,
- The loss of beach amenity and,
- The exposure of hazardous materials along the coast from the dunes at Middle Beach from Kettle Park 'historic' Landfill (Section 3.8).

The DCC St Clair - St Kilda Coastal Plan[28] recognises the importance and vulnerability of the St Clair to St Kilda beach and dunes. The vision of the plan is to enhance the natural environment for the St Clair to St Kilda coast, to be resilient to coastal hazards and future sea level rise and for future generations to be provided with access, and recreational opportunities.

South Dunedin also provides the land-link to the Otago Peninsula which has several breeding grounds/habitats for local/regional/nationally important species. Common plant and bird species are likely to be present in the gardens of residential properties. However, these are not considered ecologically significant for the purpose of this risk identification. Due to the highly modified environment of South Dunedin, groundwater rise and salinity intrusion is not expected to have major impacts on ecological/environmental values in the area. However, groundwater rise may present an opportunity to restore some of the historical wetlands or salt marshes. A summary of climate and natural hazard risks to the natural environment are outlined in Table 3-2.

Table 3-2 Summary of climate and natural hazard risks to the natural environment

<table>
<tr><th>RISK STATEMENT</th><th>RISK DESCRIPTION</th><th>DOWNSTREAM INDIRECT RISKS</th></tr>
<tr><td>Risk to areas of ecological significance (St Clair to St Kilda dunes and coast) due to extreme rainfall and flooding</td><td>Exposure of the St Clair to St Kilda dunes and coast to rainfall is projected to increase with climate change. Extreme rainfall and flooding may exacerbate erosion of soils, primarily at the coast where the dunes provide a steep surface that may erode. Erosion of the dunes may damage terrestrial ecosystems.</td><td rowspan="3">• Environmental degradation (Section 3.11.8).
• Environmental degradation leading to impacts on community wellbeing (Section 3.11.2) and Kāi Tahu sites, identity and practices (section 3.11.5).</td></tr>
<tr><td>Risk to areas of ecological significance (St Clair to St Kilda dunes and coast) due to coastal inundation</td><td>The St Clair to St Kilda coast will become increasingly exposed to coastal inundation as sea levels rise. This may reduce habitats of native plants and animal species along the coastline.</td></tr>
<tr><td>Risk to areas of ecological significance (St Clair to St Kilda dunes and coast) due to coastal erosion</td><td>The St Clair to St Kilda coast will become increasingly exposed to coastal erosion associated with sea level rise and increasing frequency of storms. If nothing is done, it is expected this will lead to a lower, more eroded beach; poorer access to and along the beach and a more degraded natural environment[28].</td></tr>
</table>

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	Erosion along the St Clair to St Kilda coast is already contributing to inland migration of the dunes and squeezing of the dune system against the recreational fields. Erosion rates are likely to increase over time, however there is considerable uncertainty relating to how the dunes will respond with sea level rise. Erosion of the dunes may also damage terrestrial ecosystems.	
Risk to areas of ecological significance (St Clair to St Kilda dunes and coast) due to groundwater rise	The St Clair to St Kilda dunes and coast may be increasingly exposed to rising groundwater levels, which may impact dune stability. Instability of the dunes may damage terrestrial ecosystems.	
Risk to areas of ecological significance (St Clair to St Kilda dunes and coast) due to seismic hazards (Earthquake and Liquefaction)	In the event of an earthquake, the St Clair to St Kilda dunes and coast would be exposed to earthquake related ground displacement. This may damage the dune system, resulting in loss of terrestrial plant and animal species. Associated liquefaction related disruption (e.g. silt/sand discharge) could smother vegetation, resulting in loss of terrestrial plant and animal species.	

3.1.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

Interactions from outside South Dunedin may exacerbate the risks identified within South Dunedin. This section identifies what those interactions may be.

If opportunities to re-establish wetlands are undertaken within South Dunedin, it may restore ecological resilience, build amenity and strengthen mana whenua values for the benefit of the wider Dunedin area.

3.2 BUILDINGS AND OPEN SPACES

Land-use within the catchment primarily consists of residential areas, designated as Residential 2 zones (Figure 3.1). There are sizable zones allocated for commercial and retail purposes and an industrial land-use area is situated adjacent to the harbour22. The area inland from Portsmouth Drive is reclaimed land that is zoned industrial and is used for light industry, retail, and storage. The coastal edge along the St Clair / St Kilda Beaches, dunes, and Chisholm golf club provides the largest connected area of open space within South Dunedin. South Dunedin has several parks and reserves, including Forbury Park, Bathgate Park, Tonga Park, and the Edgar Centre.

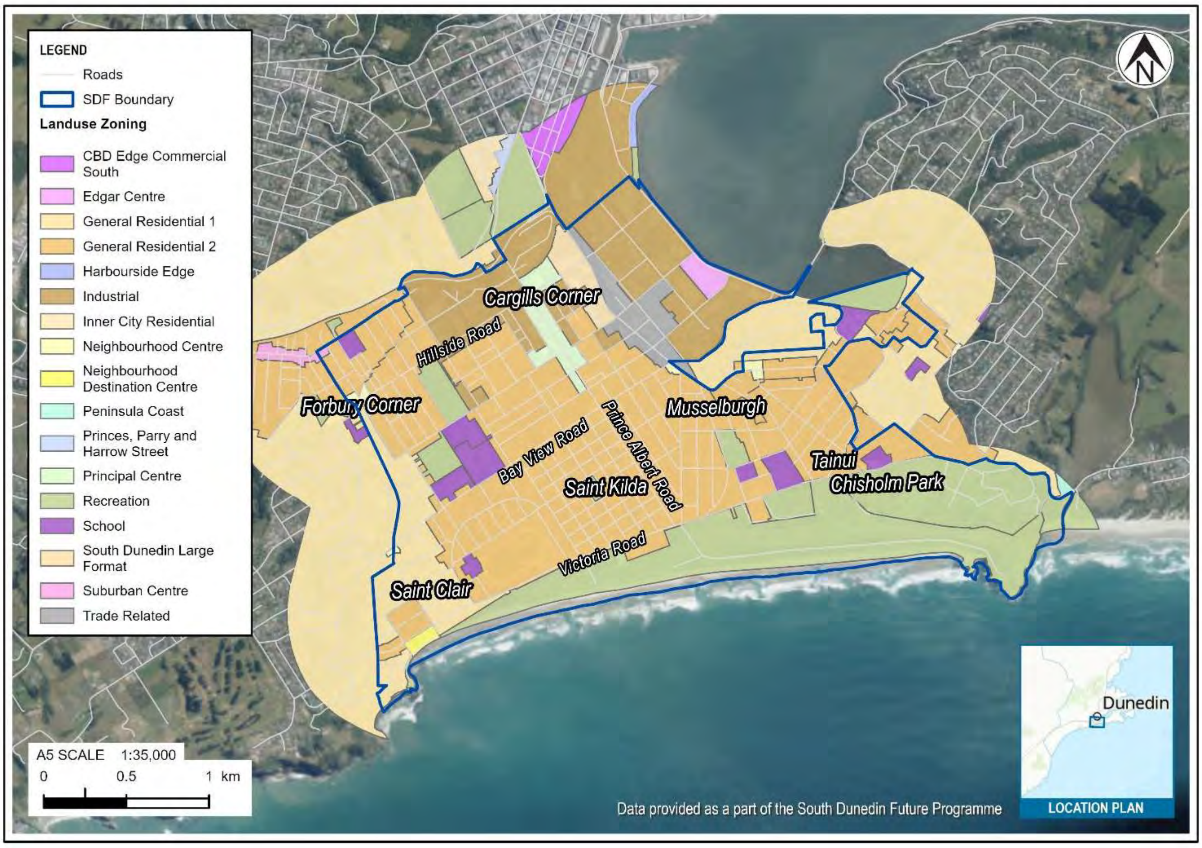

Figure 3.1 Land-use zones for South Dunedin

Rainfall related flooding occurs (and is modelled to occur) in localised areas across the entire catchment, with variations in topography the main driver of flood depth. South Dunedin's vulnerability to flooding was highlighted during the 2015 flood event, when flood damage was reported to around 1,200 homes and businesses[37]. Modelling indicates 8% of South Dunedin, and 40 land parcels are identified to be at risk of flooding in the 1% AEP rainfall event[22]. However, the extent of flooding experienced during 2015 (estimated 60 – 100-year ARI) was greater than the 1% AEP modelled prediction[38].

The majority of South Dunedin is potentially exposed to coastal inundation[26]. Should inundation occur, it would result in widespread and severe damage to private dwellings and a range of facilities, including schools, early childhood care centres, community buildings, commercial

[37] South Dunedin residents face flooding future | RNZ News.

[38] Goldsmith, M., Payan, L., Morris, R., et. al. (2015) Coastal Otago flood event 3 June 2015

buildings, electricity substations, a wastewater treatment plant, a stormwater pumping station, and fuel storage depots[22]. South Dunedin's shallow groundwater table is also likely to influence the dampness of basements and building foundations, which could result in mould both affecting wooden structures and human health.

The diverse range of buildings and open spaces in South Dunedin, will result in a diverse range of risks and consequences. For residential buildings, it is likely to be damage, and health related consequences, while for commercial and industrial it is likely to be damage and disruption to services.

A summary of climate and natural hazard risks to the buildings and open spaces of South Dunedin are outlined in Table 3-3.

Table 3-3 Summary of climate and natural hazard risks to buildings

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to buildings due to extreme rainfall and flooding. Buildings include: • Residential • Commercial • Educational • Civic buildings/ public service • Heritage buildings	A large extent of South Dunedin's buildings are potentially exposed to flood water. Flooding can cause complete loss or damage to buildings and can lead to the need for extensive repairs[39]. Building vulnerability to flooding is related to floor level, construction material, and building age. These characteristics are variable between building type and use. South Dunedin has a high proportion of ageing and poor condition buildings, which are particularly sensitive to flood damage.	• Increased building waste leading to environmental degradation (Section 3.11.8). • Loss of heritage buildings, public amenity buildings and lifeline buildings, building damage, and building dampness leading to increased risk to community health and wellbeing (Section 3.11.2). • Cost of repair and loss of access to businesses leading to loss of income, insurance increases, and increasing costs for businesses (Section 3.11.6) and increased inequality (Section 3.11.3). • Damage to place impacting Kāi Tahu sites, identity and practices (Section 3.11.5). • Loss of cultural heritage leading to impacts on wellbeing (Section 3.11.2) and community cohesion (Section 3.11.4).
Risk to buildings due to coastal inundation	Buildings within South Dunedin may be exposed to coastal inundation resulting from sea level rise driven coastal inundation from the harbour or slow or catastrophic failure of any of the coastal protection assets (dunes, unconsolidated material in middle beach landfill, sea wall etc). As identified with rainfall related flooding, buildings are highly vulnerable to flood damage.	
Risk to buildings due to coastal erosion	Buildings near the St Clair – St Kilda coast may be exposed to coastal erosion associated with sea level rise and increasing storm intensity. Buildings and building foundations are highly vulnerable to erosion, which can cause complete loss or damage to buildings,	

[39] Tonkin + Taylor (2021) Otago Regional Climate Change Risk Assessment.

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	and can lead to the need for extensive repairs.	• Repeated and increasing disruption causing risk to community wellbeing (Section 3.11.2) and loss of community cohesion (Section 3.11.4).
Risk to buildings due to groundwater rise and salinity stress	Large areas of South Dunedin are exposed to high ground water. Elevated groundwater levels can cause instability in building foundations (and roads), lead to issues of dampness and mould in housing, and may even surface to cause various environmental problems such as pollution and salinity stress[4]. Saline intrusion may cause corrosion in concrete reinforcing in foundations and may also affect garden amenity if salt enters the root zone. Groundwater can contribute to compound hazards by infiltrating and reducing the capacity of stormwater and wastewater systems and can elevate the risk of liquefaction.	
Risk to buildings due to landslides	Isolated locations within South Dunedin may be exposed to landslides. Landslides or other ground instability may damage or smother buildings, or cause instability of building foundations.	
Risk to buildings due to seismic hazards	Ground subsidence or liquefaction as a result of seismic shaking may occur throughout South Dunedin and has the potential to severely damage buildings.	

Table 3-4 Summary of climate and natural hazard risks to open spaces

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to open spaces due to extreme rainfall and flooding	Many open spaces such as parks, playing fields and gardens are exposed to rainfall induced flooding at present, and are likely to become increasingly exposed with increasing rainfall intensity associated with climate change. Flooding of open	• Damage to place impacting Kāi Tahu sites, identity and practices (Section 3.11.5) and loss of amenity impacting

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	spaces is likely to prevent use. Associated buildings and playing fields may be damaged and grounds may become waterlogged. Open spaces can also act as a beneficial element to reduce flooding by providing pervious ground to allow infiltration and provide flood storage space.	community wellbeing (Section 3.11.2) • Degradation or loss of public spaces causing loss of community cohesion (Section 3.11.4) and impacting community wellbeing (Section 3.11.2)
Risk to open spaces due to coastal inundation	Open spaces within South Dunedin may be exposed to coastal inundation. Inundation of open spaces may cause damage to associated buildings and cause grounds to become waterlogged or cause grass die-off due to increased salinity.	
Risk to open spaces due to coastal erosion	The St Clair / St Kilda beaches and dunes provide the largest connected area of open space within South Dunedin. These dunes experience erosion at present and may become increasingly exposed to erosion with sea level rise and increasing storm intensity.	
Risk to open spaces due to groundwater	Large areas of South Dunedin are exposed to high groundwater. Waterlogging of grounds or salinity stress on turf may prevent use.	
Risk to open spaces due to landslides	Isolated locations within South Dunedin may be exposed to landslides. Landslides or other ground instability may damage or smother open spaces and associated buildings, or cause instability of building foundations of associated buildings and structures.	
Risk to open spaces due to seismic hazards	Ground subsidence or liquefaction as a result of seismic shaking may occur throughout South Dunedin and has the potential to damage open spaces and supporting buildings.	

3.2.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

South Dunedin is a major economic hub of Dunedin, and a significant source of housing for the city. The suburb provides the largest area of flat land for housing, making the area an important source of accessible housing for the city.

3.3 RISKS TO KĀI TAHU SITES, IDENTITY AND PRACTICES, DUE TO CLIMATE CHANGE.

A parallel Mana Whenua Risk Assessment within the South Dunedin Future program is currently underway to explore risks to Kāi Tahu sites, identity and practices due to climate change.

South Dunedin is significant to Māori and in particular the people of Ōtākou, who are mana whenua of the area. Pre-European colonisation, the marshy wetland and sand dunes were an important hunting and gathering area for Māori[40]. The area also acted as a key travel route, forming part of a trail connecting the peninsula to other important mahika kai (food gathering) sites along the Taieri Plain and river, southwest of present day Ōtepoti Dunedin[40].

Damage to sites within South Dunedin due to the physical impacts of natural hazards and climate change are likely to impact Māori social, cultural, spiritual and economic wellbeing including loss of cultural identity, hauora, kotahitanga, mahika kai, and manaakitaka. These issues will be explored further in the Mana Whenua Risk Assessment.

3.4 TRANSPORT

South Dunedin has various transportation assets including roads that range from residential side streets to a section of State Highway 1. The South Island Main Trunk Line runs along the northern boundary of South Dunedin. The rail line also travels through South Dunedin which is used to transport goods throughout the South Island and accesses Port Chalmers. The Hillside rail yard is located adjacent to the Hillside Road Industrial area and a second rail yard is located just outside South Dunedin beyond Portsmouth Drive along Wharf Street[13]. There are also multiple bus routes that traverse across South Dunedin, providing public transportation and access in and out of the area.

Local roads provide the only road access to the Otago Peninsula, and to key infrastructure such as the Tahuna Wastewater Treatment Plant.

Many roads and railways within South Dunedin are positioned at elevations that are only slightly above sea level, making them susceptible to rainfall related flooding, coastal inundation, coastal erosion, and damage during storms and high tides.

A summary of climate and natural hazard risks to transport are outlined in Table 3-5.

[40] West, J. (2017). The face of nature: an environmental history of the Otago Peninsula. Otago University Press.

Table 3-5 Summary of climate and natural hazard risks to transport

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to rail due to extreme rainfall and flooding	The Main Trunk Line is not shown to be exposed to rainfall induced flooding within South Dunedin. However, parts of the rail yards may experience flooding. Flooding may result in disruption to rail services and cause track instability. Sections of the railway outside South Dunedin could experience inundation which can lead to rail interruptions.	• Disruption to critical infrastructure with impacts on the wider Dunedin area (Section 3.4.1) • Access disruption resulting in increasing risk to community health and wellbeing (Section 3.11.2) • Loss of access to businesses leading to loss of income for businesses (Section 3.11.6) and increased inequity (Section 3.11.3) • Repeated and increasing disruption causing loss of community cohesion (Section 3.11.4) • Loss of road access to Otago Peninsula
Risk to rail due to coastal inundation	The Main Trunk Line and yards are low lying and may be exposed to coastal inundation, with exposure increasing with sea level rise. Flooding may require closure of the tracks and may also impact the stability of the track/ballast.	
Risk to rail due to coastal erosion	The Ocean Beach Railway that runs along the South Coast is currently exposed and impacted by coastal erosion. Coastal erosion can undermine track integrity and cause disruptions on the network. The Hillside yard is not currently within mapped coastal erosion zones.	
Risk to rail due to groundwater	Parts of the Main Trunk Line and yards are likely to be exposed to rising groundwater. Elevated groundwater levels may cause instability and accelerated degradation of rail track foundations. High groundwater may also damage the roads and buildings which support rail activities.	
Risk to rail due to seismic hazards	In the event of an earthquake the Main Trunk Line and yards could be exposed to ground subsidence or liquefaction as a result of seismic shaking. This has the potential to damage railways, resulting in uplift/subsidence, breakages and misalignment.	
Risk to roads due to extreme rainfall and flooding	Roads within South Dunedin are highly exposed to flooding, which is likely to increase with increasing rainfall intensity associated with climate change. Much of the flooding within South Dunedin occurs within the local road network. Although flooding of roads prevents access, this	

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	provides important flood storage volume to minimise the flooding of private properties and buildings. Pavements may be damaged through repeated / regular wetting causing faster deterioration rates driving increased roading maintenance needs. Similarly, areas of higher velocity flow could impact pavement condition and structures. Ancillary roading infrastructure may be damaged by floodwater, for example, electrical switchgear (substations, road lighting access points and electrical items).	
Risk to roads due to coastal inundation	SH1 and many local roads within South Dunedin may be exposed to coastal inundation as a result of sea level rise. Inundation would require road closures, with wave runup possibly damaging pavements.	
Risk to roads due to coastal erosion	Sections of roading adjacent to the St Clair – St Kilda coastline may be exposed to coastal erosion. This may cause direct damage or complete loss of roads and walkways.	
Risk to roads due to groundwater	Many roads across South Dunedin are currently exposed to high groundwater, which is projected to increase with sea level rise and increasing rainfall associated with climate change. High groundwater is already impacting the structure of the foundation of the road, compromising the integrity of the road. This would likely be exacerbated with increased groundwater. Increased groundwater also increases the liquefaction potential of the area, leading to potential for greater ground damage and larger areas affected after an earthquake.	
Risk to roads due to landslides	SH1 and some local roads are located in close proximity to areas with potential ground instability. If a landslide were to occur, this may damage roads or block access.	

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to roads due to seismic hazards	All roads across the South Dunedin area are likely to be exposed to seismic hazards. Ground subsidence or liquefaction as a result of seismic shaking has the potential to damage roads, resulting in uplift, cracking and misalignment.	

3.4.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

South Dunedin provides transport links to both State Highway 1 and the South Island Main Trunk Line. Damage to these transport links may interrupt supply chains and cause widespread disruption, including disruption of access to Dunedin City Centre.

3.5 WATER SUPPLY INFRASTRUCTURE

Water is supplied to South Dunedin through the Dunedin water supply distribution network (trunk mains). Dunedin's water supply is drawn from a number of sources, including Deep Creek and Deep Stream in the Taieri River catchment[39]. The water supply network in South Dunedin consists of approximately 125 km of pipes, with the majority of these around 100 mm in diameter. The water mains supplying the South Dunedin catchment area are largely constructed from cast iron. At present the extent of leakage in the catchment is unknown, but it is likely that all mains will need replacing over the next 20 years[22].

Existing assessment has not identified specific risks to the South Dunedin water supply network. However, in general, severe weather and landslides can pose a risk to buried infrastructure, where falling trees and landslides can cause pipe breakages. Increasing salinity from groundwater and sea level rise can increase pipe corrosion and earthquakes can cause severe damage to buried pipe networks[41]. The ISP Programme has the objective of improving levels of service and adapting the water network to climate change. The ISP Programme is currently underway to enable the DCC (or any future water service entity) to meet current and adapt to future standards and levels of service for drinking water, wastewater and stormwater and achieve its affordability obligations to customers. System planning will provide an evidence-based strategic direction for future programmes (refer to Table 2-2 for further information).

A summary of climate and natural hazard risks to water supply infrastructure are outlined in Table 3-6.

Table 3-6 Summary of climate and natural hazard risks to water supply

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to water supply network due to extreme	As most components of the water supply network are buried and the whole system operates under pressure, surface flooding is not expected to pose a risk to the most	• Disruption to water supply resulting in

[41] EQC (2019) Spatial correlations of underground pipeline damage in Christchurch

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
rainfall and flooding	of the water supply network, however above ground components may experience damage during flooding.	increasing risk to community health and wellbeing (Section 3.11.2). • Disruption to businesses leading to loss of income for businesses (Section 3.11.6) and increased inequality (Section 3.11.3). • Repeated and increasing disruption causing loss of community cohesion (Section 3.11.4).
Risk to water supply network due to rainfall (severe weather)	Severe weather can pose a risk to buried infrastructure, where falling trees and landslides can cause pipe breakages. This type of damage is likely to increase with climate change.	
Risk to water supply network due to coastal inundation	As most components of the water supply network are buried and the whole system operates under pressure, coastal inundation is not expected to pose a risk to the network performance, however above ground components may experience damage due to coastal inundation.	
Risk to water supply network due to coastal erosion	Parts of the water supply network located near the St Clair – St Kilda coast and Otago Harbour may be exposed to coastal erosion resulting from sea level rise. Coastal erosion can damage water supply pipes or cause saltwater intrusion into pipes adjacent to the coast.	
Risk to water supply network due to groundwater	The water supply network is currently exposed to high groundwater, which may increase with sea level rise and rainfall associated with climate change. Increased exposure to groundwater and salinity can cause reduced infrastructure service life due to: • foundation failure due to higher groundwater levels. • increase corrosion in cast iron pipes. • Difficulty accessing and maintaining buried assets at/below the water table.	
Risk to water supply network due to landslides	Water supply pipes may be exposed to landslides within South Dunedin. Damage from landslides can break pipes and damage other buried components of the water supply network.	
Risk to water supply network due to seismic hazards	In the event of an earthquake the water supply network could be exposed to ground deformation and liquefaction. Earthquakes and liquefaction can be highly damaging to water supply pipes and can cause: • Lateral or vertical displacement of pipes/joins. • Crushing damage to pipes. • Fracture damage to pipes/joins (identifiable as 'new' damage). • Blockage of pipes due to earthquake damage. Experience from the 2011 Christchurch Earthquake sequence found that ageing pipes of asbestos cement	

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	(AC) or Cast Iron (CI) were the most susceptible to damage.	

3.5.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

Water supply to South Dunedin is sourced from outside the area. The risk to water supply infrastructure due to drought, fire weather, flooding and sea level rise and salinity stress is identified as one of the highest rated climate change risks to the region[39]. Discussion of the vulnerability of water supply infrastructure is focussed on threats to regional water supply and increasing usage associated with drought.

3.6 WASTEWATER INFRASTRUCTURE

The wastewater network of South Dunedin comprises approximately 76 km of wastewater pipelines and two pump stations (Musselburgh and Oval Pavilion)[22]. A substantial portion of the network consists of early 20th-century pipework, which is characterized by the extensive use of older earthenware pipes with more joints compared to modern equivalents.

The Tahuna wastewater treatment plant in South Dunedin treats wastewater from the greater Dunedin area. The wastewater system in South Dunedin conveys wastewater from as far as Halfway Bush and Wakari to the north-west. A main interceptor sewer (MIS) runs through South Dunedin to Musselburgh Pump Station for screening. Screened wastewater is then pumped to the Tahuna WWTP for treatment and discharged to the ocean[22].

The ageing network is prone to leakage. Investigation has identified extensive cracking in pipes and that insufficient welding techniques were used to join pipe lengths in the South Dunedin stormwater and wastewater networks, creating a significant potential for infiltration[22].

Further testing also showed extensive saline intrusion into the wastewater network at high tides[42].

Wastewater overflows occur in South Dunedin and are driven by both the network condition and combined stormwater and wastewater inflows from outside South Dunedin. These are wastewater flows from Kaikorai Valley that are discharged through a pipe through the old Caversham Tunnel into the top of Surrey Street. These overflows, in turn, find their way into stormwater catchments within South Dunedin as discussed in Section 3.7[43]. These overflows are included in existing hydrodynamic models of the South Dunedin and therefore their contribution to flood extents can be predicted. These network performance issues are included in the ISP Programme (refer to Table 2-2 for further information). The ISP Programme has the objective of improving levels of service and adapting the wastewater network to climate change. Therefore, may improve future resilience of the network.

A summary of climate and natural hazard risks to the wastewater network are outlined in Table 3-7.

[42] Rekker, J. (2012) The South Dunedin Coastal Aquifer & Effect of Sea Level Fluctuations, Dunedin: Otago Regional Council.
[43] DCC (2021) 10-year plan 2021 – 2031.

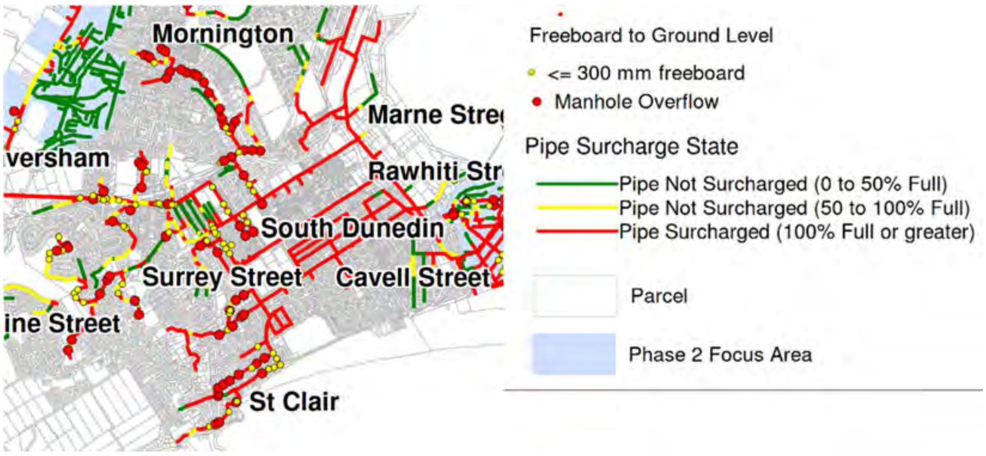

Figure 3.2 Snapshot of wastewater network surcharging and overflows, showing widespread surcharging and overflows of the wastewater network (Source: Dunedin ISP Programme).

Table 3-7 Summary of climate and natural hazard risks to the wastewater network

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to wastewater networks due to extreme rainfall and flooding	The wastewater network is currently exposed to rainfall induced flooding, including the Musselburgh pump station. This exposure will increase with projected increases in rainfall intensity. Flooding may damage above ground wastewater infrastructure and cause increased inflows to the wastewater network. Cross connections and combined wastewater/stormwater pipelines can result in wastewater overflows during rainfall events which can pose health risks and contamination of receiving environments. Increasing exposure to flooding will exacerbate this issue[44]. Rainfall induced flooding may cause access issues to the Tahuna wastewater treatment plant. Severe weather can pose a risk to buried infrastructure, where falling trees and landslides (most likely occurring outside South Dunedin) can cause pipe breakages or power outages. This type of damage may increase with climate change.	• Increasing wastewater overflows leading to environmental degradation (Section 3.11.8) and resulting in impacts on Kāi Tahu sites, identity and practices (Section 3.11.5). • Increasing wastewater overflows leading to increased risk to community health (Section 3.11.2). • Loss of services resulting in increasing risk to community health and wellbeing (Section 3.11.2).
Risk to wastewater networks due to coastal inundation	Parts of the wastewater network may be exposed to coastal inundation at present, with exposure increasing over time due to increasing inundation extents associated with climate change. Coastal	

[44] Hughes et al. (2019) Impacts and implications of climate change on stormwater and wastewater systems. Deep South Challenge.

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	inundation may cause flooding and damage of pump stations and the wastewater treatment plant. It may also cause excess inflow and infiltration to the network, resulting in wastewater overflows.	• Disruption to businesses leading to loss of income for businesses (Section 3.11.6) and increased inequality (Section 3.11.3). • Repeated and increasing disruption causing loss of community cohesion (Section 3.11.4).
Risk to wastewater networks due to coastal erosion	Parts of the wastewater network located near the St Clair – St Kilda coast may be exposed to coastal erosion resulting from sea level rise. Erosion may cause damage or complete loss of exposed parts of the network. The Tahuna Wastewater Treatment Plant is not currently exposed to coastal erosion and potential future erosion is unconfirmed. Increased coastal erosion exposure may lead to saltwater intrusion within wastewater treatment plants. It may also undermine the land in which the asset is built, which could lead to structural damage and potential loss of service.	
Risk to wastewater networks due to groundwater	The wastewater network is currently exposed to high groundwater, which may increase with sea level rise and rainfall associated with climate change. Increased exposure to groundwater and salinity can cause: • reduced infrastructure service life due to foundation failure due to higher groundwater levels. • reduced infrastructure service life due to increase corrosion in cast iron pipes. • Increasing groundwater drawdown effects resulting in a reduction in pipe capacity. • Increased salinity of wastewater flows which can impact treatment plant operation. • Increased maintenance difficulties where water tables are high. • Increase peak wet weather inflows, which may exceed treatment plant capacity, leading to increased wastewater overflows. • Increase volume of inflows being treated, leading to increased operational costs.	
Risk to wastewater networks due to landslides	Wastewater pipes may be exposed to landslides within South Dunedin. Damage from landslides can break pipes and damage other buried components of the wastewater network.	

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to wastewater networks due to seismic hazards	In the event of an earthquake the wastewater network could be exposed to ground deformation and liquefaction. Earthquakes and liquefaction can be highly damaging to wastewater pipes and can cause: • Lateral or vertical displacement of pipes/joins. • Crushing damage to pipes. • Fracture damage to pipes/joins (identifiable as 'new' damage). • Blockage of pipes due to earthquake damage. Experience from the 2011 Christchurch Earthquake sequence found that ageing pipes of asbestos cement (AC) or Cast Iron (CI) were the most susceptible to damage.	

3.6.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

As discussed in the main section, combined stormwater and wastewater overflows from outside South Dunedin result in wastewater overflows within South Dunedin.

The Tahuna wastewater treatment plant is important to Dunedin City as it treats wastewater from the greater Dunedin area.

3.7 STORMWATER INFRASTRUCTURE

The South Dunedin stormwater network is entirely piped, with no open drains or watercourses present in the catchment. The stormwater drainage network in South Dunedin consists of 65 km of shallow pipes and box culverts with widths of up to 2400 mm, laid at flat gradients. All stormwater from the catchment discharges into the harbour via the Portobello Stormwater Pump Station. A second stormwater pump station, Tainui, pumps stormwater from a low-lying area in the south-east of the catchment to the Portobello Pump Station. The following operational issues are identified in the catchment management plan[22]:

- Wastewater overflows due to wastewater-stormwater connections.
- High maintenance requirements such as regularly blocked catchpits and blocking of intake screens.
- Inflows from the adjacent St Clair catchment via a 'high level overflow'.
- Reliance on the Portobello Pump Station for all discharge of stormwater to the harbour.
- Ageing pipe network in variable condition, where approximately 55 % of the pipes in the catchment are more than 50 years old.
- Variable pipe size and level of service across the network causing constraints in the network in downstream locations.

The stormwater network currently operates below the typical requirement of a 10-year ARI (10% AEP) level of service with some sections currently performing at a level of service equivalent to a 1 in 2 year standard[22]. During intense rainfall events, the stormwater system can become overwhelmed, flooding streets, homes, and properties. This issue is compounded in areas where high groundwater levels coincide with high tides and is expected to intensify due to increasing rainfall intensity with climate change. Climate change induced sea level rise and groundwater rise will further exacerbate flooding issues.

Groundwater infiltration is a widespread issue across the network. The complex interaction between groundwater and the drainage networks has the disadvantage that groundwater driven baseflow reduces the effective capacity of the network. However, this also has the advantage that the stormwater (and wastewater) networks lower the groundwater level. Modelling shows that the drainage network may partially mitigate the climate change induced rise in groundwater levels[31].

Interconnections between the stormwater and wastewater systems are a significant contributor to flood issues. Combined stormwater and wastewater flows in the wastewater network are conveyed into the catchment from outside South Dunedin. This can result in wastewater overflows. During wet-weather events, flooding can affect both the wastewater and stormwater networks, particularly in Surrey Street. Residents have observed significant stormwater flowing overland or ponding in various parts of the catchment, including Forbury Road, Fitzroy Road, Sussex Street, Surrey Street and Hillside Road[13].

The above network performance issues are included in the ISP Programme (refer to Table 2-2 for further information).

A summary of climate and natural hazard risks to the stormwater are outlined in Table 3-8.

Table 3-8 Summary of climate and natural hazard risks to stormwater infrastructure

RISK STATEMENT		RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to stormwater networks due to extreme rainfall and flooding	The stormwater network has a number of design and performance issues that result in or exacerbate flood risk: • Ageing network. • Low and variable level of service. • Flat gradients. • High maintenance requirements. • Flows from adjacent catchments. • Wastewater overflows. • Groundwater inflows. Increasing rainfall intensity is likely to increase stormwater volumes, resulting in increased flooding.	• Increased flooding impacts all other risk elements, as such, downstream impacts are identified in other sections.	
Risk to stormwater networks due to coastal inundation	The intrusion of saltwater into pipelines is a major concern due to its corrosive effects and the reduction in carrying capacity of the network. Saltwater intrusion regularly occurs in outfalls positioned below the high tide mark. DCC have installed flap gates on outfalls below the high tide level[45] Sea level rise may increase the number of pipes located below the high tide level. It may also impact the hydraulic capacity of stormwater pipes, exacerbating inland flooding.		
Risk to stormwater networks due to coastal erosion	Parts of the stormwater network located near the St Clair – St Kilda coast may be exposed to coastal erosion resulting from sea level rise. Increased coastal erosion exposure can lead to damage of outfalls and pipework from corrosion and saline water intrusion.		
Risk to stormwater networks due to groundwater	The water supply network is currently exposed to high groundwater, which may increase with sea level rise and rainfall associated with climate change. Increased		

[45] DCC (2020) Dunedin Integrated Catchment Management: Model Gap Analysis Dunedin. Three Waters Strategy. Stantec, Beca, WSP.

RISK STATEMENT		RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	exposure to groundwater and salinity can cause: • reduced infrastructure service life due to foundation failure due to higher groundwater levels. • reduced infrastructure service life due to increase corrosion in cast iron pipes. • Increasing groundwater drawdown effects resulting in a reduction in pipe capacity. • More complex maintenance and construction activities.		
Risk to stormwater networks due to landslides	Parts of the stormwater network may be exposed to landslides. Damage from landslides can break pipes and damage other buried components of the stormwater network.		
Risk to stormwater networks due to seismic hazards	In the event of an earthquake the stormwater network could be exposed to ground deformation and liquefaction. Earthquakes and liquefaction can be highly damaging to wastewater pipes and can cause: • Lateral or vertical displacement of pipes/joins. • Crushing damage to pipes. • Fracture damage to pipes/joins (identifiable as 'new' damage). • Blockage of pipes due to earthquake damage. Experience from the 2011 Christchurch Earthquake sequence found that ageing pipes of asbestos cement (AC) or Cast Iron (CI) were the most susceptible to damage.		

3.7.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

As mentioned above, there is a 'high level overflow', which operates to transfer flows into South Dunedin from the adjacent St Clair catchment (from the Forbury Road stormwater interceptor) during heavy flows. These overflows are included in the hydrodynamic model of the South Dunedin (Table 2-2).

3.8 SOLID WASTE AND CONTAMINATED SITES

South Dunedin has a relatively high coverage of contaminated sites, predominately located in the Portsmouth Road catchment (Figure 3.3). Multiple closed landfill sites are located within the South Dunedin study area and are included in the Hazardous Activities and Industries List (HAIL). These include Ocean Beach domain landfills (1, 2 and 3), and Chisholm Park landfill.

Other notable potentially contaminated sites include the former Dunedin Gasworks site (including the tar well), the Otaki St substation, areas of waste disposal to land, and areas of reclaimed land adjacent to the harbour. The sediments in the harbour adjacent to the outfall from the South Dunedin catchment show signs of historical contamination, which is not unexpected given the historical land-uses in the catchment. Stormwater monitoring indicates that there may be sources of PAH and heavy metals in the catchment, however the extent and source of this contamination is unknown, as there are a number of different potential sources[22].

A summary of climate and natural hazard risks to solid waste and contaminated sites are outlined in Table 3-9.

Table 3-9 Summary of climate and natural hazard risks to solid waste and contaminated sites

RISK STATEMENT	RISK DESRIPTION	DOWNSTREAM INDIRECT RISKS
Risk to solid waste and contaminated sites due to extreme rainfall and flooding	A large number of contaminated sites are located in low lying areas within South Dunedin. Many of these sites may be exposed to rainfall induced flooding both at present and in the future. This exposure may increase as flooding extents increase associated with climate change. Excessive saturation of contaminated sites with no or compromised capping may result in discharge of contaminated water. Flood water present in the vicinity of contaminated sites may become contaminated. Severe weather and flooding may cause interruptions to solid waste and recycling operations, with uncollected rubbish potentially floating away and causing blockages of stormwater inlets.	• Environmental degradation (Section 3.11.8) • Contamination leading to increased risk to community health (Section 3.11.2) • Environmental degradation leading to impacts on community wellbeing (Section 3.11.2) and Kāi Tahu sites, identity and practices (section 3.11.5)
Risk to solid waste and contaminated sites due to coastal inundation	Low-lying coastal contaminated sites (particularly those north-east of Andersons Bay Road), are likely to be increasingly exposed to inundation. As with surface flooding, excessive saturation of contaminated sites with no or compromised capping may result in discharge of contaminated water.	
Risk to solid waste and contaminated sites due to coastal erosion	Some coastal contaminated sites are currently exposed to coastal erosion. Coastal erosion is likely to increase over time and will exacerbate existing erosion issues at coastal sites including the Ocean Beach landfills, and contaminated sites north-east of Andersons Bay Road. Erosion of these sites may result in contaminated material entering the	

RISK STATEMENT	RISK DESRIPTION	DOWNSTREAM INDIRECT RISKS
	receiving environment and may cause issues with land stability and integrity.	
Risk to solid waste and contaminated sites due to groundwater	Contaminated sites are likely to be increasingly exposed to groundwater. The frequency and duration of contact between contaminated material and groundwater is expected to increase which may cause contamination of the groundwater. The extent of contamination may require further investigation.	
Risk to solid waste and contaminated sites due to seismic hazards	In the event of an earthquake contaminated sites could be exposed to ground deformation and liquefaction. Ground cracking associated with earthquake events may damage sites and expose or release contaminated material. Liquefaction may mobilise contaminants that are associated with silts/silt-sized particles during a liquefaction event - this may result in contaminated sediments being brought to the surface if liquefaction mobilises silt-sized particles through contaminated land.	

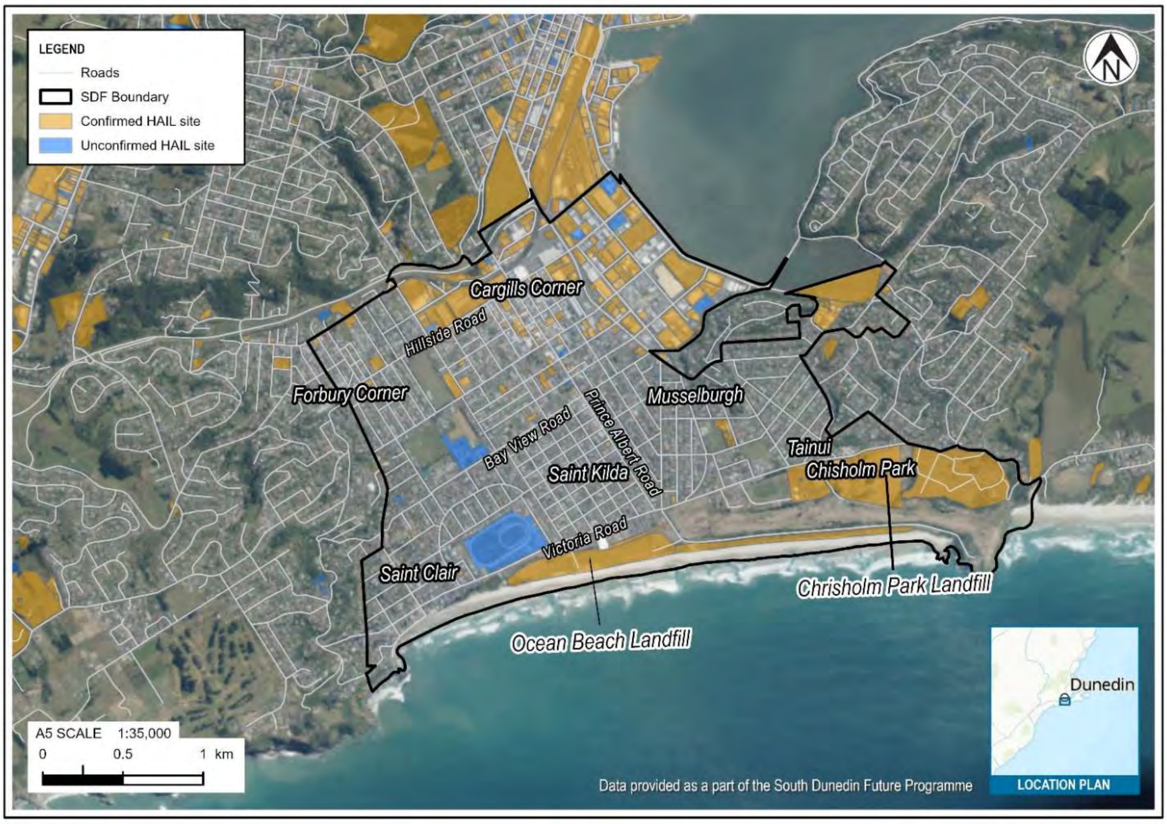

Figure 3.3 Contaminated sites within the approximate extent of South Dunedin (orange indicates confirmed sites, blue indicates unconfirmed sites). (Source: Hazardous Activities and Industries List (HAIL), DCC)

3.8.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

Currently, waste generated within South Dunedin is transported out of the area to landfills or other refuse centres. Further waste could be generated with the removal of contaminated material from identified HAIL sites within South Dunedin. This is likely to be transported out of the area.

As mentioned, the discharge of contaminated water as a result of flooding, could also impact receiving environments outside of South Dunedin.

3.9 TELECOMMUNICATIONS INFRASTRUCTURE

The telecommunication sector is a critical lifeline utility. The Otago Region is served via transmission fibre cables which run along a coastal and inland route shared by a number of providers. The Chorus main transmission route passes through South Dunedin to connect to Dunedin and a communications exchange is located in the area. Associated network and cell towers serve the South Dunedin community. A summary of climate and natural hazard risks to telecommunications are outlined in Table 3-10.

Table 3-10 Summary of climate and natural hazard risks to communications infrastructure

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risks to communication infrastructure due to extreme rainfall and flooding	Telecommunications infrastructure may be exposed to flooding which can be highly damaging. The communications exchange building currently houses copper wire, which is costly to replace. The communications exchange is a critical component of communications for the wider Dunedin area. Telecommunications poles and overhead lines may be sensitive to damage from debris, wind loading or lightning during severe weather.	• Disruption to critical infrastructure with impacts on the wider Dunedin area • Service disruption resulting in increasing risk to community health and wellbeing (Section 3.11.2) • Loss of service to businesses leading to loss of income for businesses (Section 3.11.6) and increased inequality (Section 3.11.3) • Repeated and increasing disruption causing loss of community cohesion (Section 3.11.4)
Risks to communication infrastructure due to coastal inundation	Telecommunications infrastructure may be exposed to flooding which can be highly damaging. Corrosion may occur due to saltwater ingress.	
Risks to communication infrastructure due to coastal erosion	Coastal erosion may undermine the land in which cabinets and exchange buildings are located. This could lead to a disruption in communications in the area. Further information on the exposure of telecommunication assets in South Dunedin is needed.	
Risks to communication infrastructure due to groundwater	Subsurface unsealed cables may be exposed to groundwater flooding. Rising groundwater may also cause saturated ground conditions resulting in instability of foundations.	

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	Subsurface unsealed cables may be damaged by increasing groundwater ingress and salinity.	
Risks to communication infrastructure due to seismic hazards	Ground subsidence or liquefaction as a result of seismic shaking has the potential to damage the foundation of telecommunication poles and subsurface cables.	

3.9.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

The Dunedin telecommunication network is supplied by transmission fibre cables which run along a coastal and inland route shared by a number of providers. If these cables were to be impacted, the local network within South Dunedin may be disrupted. Further information on specific exchanges within South Dunedin and whether they could impact the wider Dunedin City network is needed.

3.10 ELECTRICITY TRANSMISSION AND DISTRIBUTION

There are at least four sub stations in South Dunedin (Otaki Street (South Dunedin), Neville zone, Carisbrook zone and St Kilda zone). The Otaki Street Electricity Substation, also known as the South Dunedin Substation, is a critical component of South Dunedin's electricity infrastructure and forms part of the Transpower National Grid (Figure 3.4). This substation plays a central role in supplying electricity to a significant number of houses in the area[21]. Electricity distribution in South Dunedin is typically via overhead lines.

Flooding associated with rainfall and coastal inundation can potentially damage power line foundations, transformers, and other substation components, leading to power outages. A summary of climate and natural hazard risks to transmission and distributions are outlined in Table 3-11.

Table 3-11 Summary of climate and natural hazard risks to transmission and distribution

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
Risks to electricity transmission and distribution due to extreme rainfall and flooding	A range of electricity infrastructure could be exposed to flooding. Transmission and distribution lines may be sensitive to damage from debris, wind loading or lightning during severe weather. Increasing heavy rainfall and flooding associated with climate change can potentially damage electrical equipment located on the ground surface such as transformers, and other substation components, leading to power outages.	• Disruption to critical infrastructure with impacts on the wider Dunedin area • Service disruption resulting in increasing risk to community health and wellbeing (Section 3.11.2)

RISK STATEMENT	RISK DESCRIPTION	DOWNSTREAM INDIRECT RISKS
	Assets such as poles may be sensitive to waterlogged soils as a result of flooding, which can cause failure.	• Loss of service to businesses leading to loss of income for businesses (Section 3.11.6) and increased inequality (Section 3.11.3) • Repeated and increasing disruption causing loss of community cohesion (Section 3.11.4)
Risks to electricity transmission and distribution due to coastal Inundation	Many of the substations in South Dunedin are in low-lying areas, exposure to flood water is likely to compromise its functionality. Transpower have identified the Otaki Street substation as a priority for resilience measures[46]. Corrosion of equipment may also occur due to salt water.	
Risks to electricity transmission and distribution due to coastal erosion	Coastal erosion may undermine transmission and distribution power pole foundations, and the land in which substations are located. Underground lines may also become exposed if located within close proximity to the coast. This could lead to power outages and disruption to the network. Further information on the exposure of electricity assets in South Dunedin is needed.	
Risks to electricity transmission and distribution due to groundwater	Underground electricity infrastructure in low lying areas may become exposed to groundwater. Rising groundwater may cause saturated ground conditions resulting in instability of power poles.	
Risks to electricity transmission and distribution due to seismic hazards	Earthquakes can potentially damage power poles, transformers, and other substation components, leading to power outages. Ground subsidence or liquefaction due to seismic shaking has the potential to damage power poles, under-ground pipes and structure foundations.	

[46] Transpower identifies 12 substations for additional resilience work | Transpower.

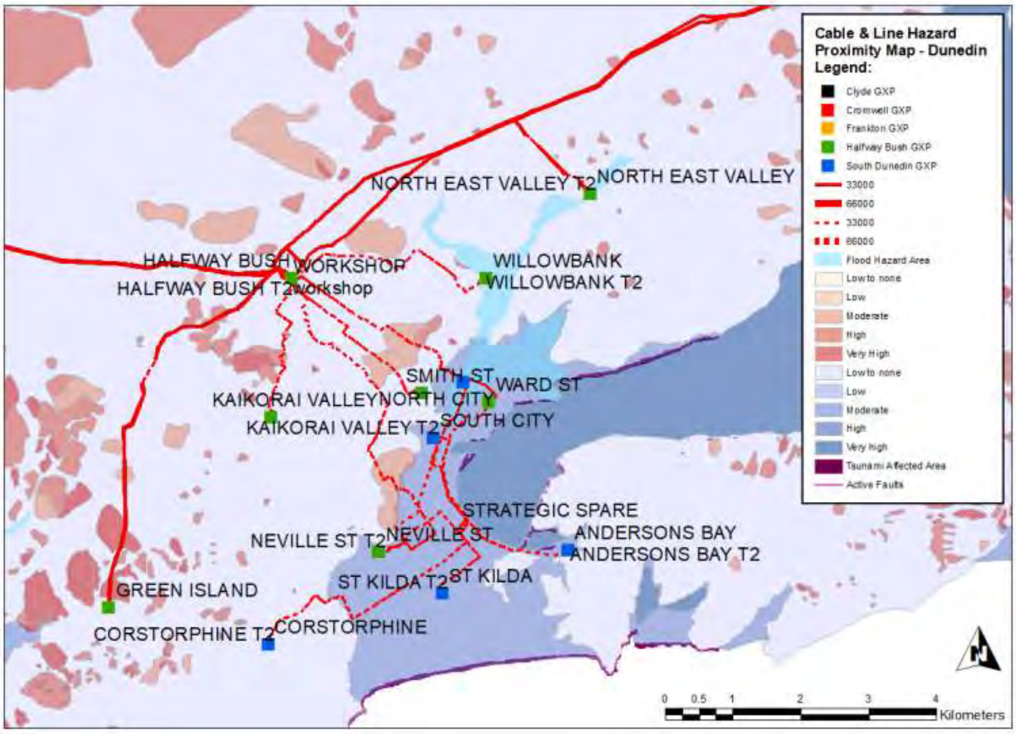

Figure 3.4 Aurora Energy transmission network showing flood hazard areas in Dunedin (Source: WSP 2018[47]).

3.10.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

The Dunedin electrical transmission system comprises a regional supply from the national grid to a local distribution network. The South Dunedin substation is a critical component of this network[39]. As a lifeline utility, damage to the substation would have widespread impacts on electricity supply.

3.11 INDIRECT RISKS

This section presents the indirect risks arising from the direct risks identified in Sections 3.1 to 3.10.

3.11.1 INTERACTIONS BETWEEN SOUTH DUNEDIN AND THE WIDER AREA

South Dunedin comprises a large area of flat land close to the city centre, key transport networks and a range of important city services and amenities. South Dunedin serves as the connection between the Otago Peninsula and the mainland.

Many of the indirect risks to South Dunedin may be relevant to people living outside Dunedin who work, play, or use the amenities of South Dunedin.

3.11.2 RISK TO COMMUNITY HEALTH AND WELLBEING

Climate change can directly impact communities through increased exposure to hazards such as heavy rainfall, flooding, and coastal inundation (exacerbated by sea level rise). Residents can be endangered during flooding due to:

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[47] WSP (2018) Independent review of electricity networks Aurora Energy. Project No PS109832.

- drowning,
- risk of injury due to electrocution,
- exposure to debris or landslides caused by heavy rainfall, and
- injuries from fires started in an event[39].

Exposure to heavy rainfall, flooding and groundwater rise can create damp indoor living and working environments that can lead to a higher incidence of respiratory diseases such as asthma, hypersensitivity pneumonitis, rhinosinusitis, bronchitis, and respiratory infections[39]. Additionally, disruptions to wastewater and stormwater infrastructure due to climate hazards can result in water quality issues, potentially exposing communities to unsafe and contaminated water sources. Increasing health challenges may necessitate heightened healthcare services and treatments, translating to escalated healthcare costs.

Physical impacts of climate change are also acknowledged to impact both mental and physical wellbeing and both household and community functions including, way of life and income sources. Research into the potential community impacts of climate change-related flooding and sea-level rise in the greater South Dunedin area[10] identify the following major issues (noting that these have complex cause and effect pathways) within the community:

- Quality of housing.
- The housing market.
- The insurance market.
- Economic impacts of flooding and sea-level rise.
- Access issues arising from flooding.

Damage to residential buildings can result in:

- Forced evacuation,
- Reduced housing availability,
- Increased dampness causing unhealthy living conditions, and
- Reduced accessibility.

These can then lead to cascading implications such as disruption to household and community way of life, financial and personal distress, social deprivation, public health concerns and a loss of community[39]. Economic impacts on individuals/households may also arise from increasing repair bills, insurance premiums, and a loss of income for households reliant on employment within the affected businesses. When businesses suffer operational setbacks or closures due to events such as earthquake, flooding or extreme weather, employees may face job insecurity, reduced work hours, or face temporary unemployment[48].

After the 2015 floods, many families faced the situation of being unable to return to their damaged homes. Moreover, dealing with insurance claims and completing necessary repairs often stretched over several months, causing further distress[49]. These delays can significantly affect the well-being of the affected residents. Such consequences are anticipated to become more common in areas

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[48] https://www.employment.govt.nz/leave-and-holidays/other-types-of-leave/employment-during-and-after-disasters/.

[49] https://www.odt.co.nz/news/dunedin/its-been-constant-battle-flood.

vulnerable to coastal and inland flooding as climate change continues to exert a growing influence.

Additionally, "climate anxiety" is an escalating concern stemming from two main sources: firsthand exposure to significant climate-related events and ongoing stress about an unpredictable future[50]. Communities that frequently face such events are at a higher risk of enduring amplified mental health repercussions. For example, following the 2015 flooding event, several residents of South Dunedin were anxious whenever there was heavy rainfall. Uncertainty relating to the future impacts of climate change can create additional layers of stress, including in relation to uncertainty in the housing market[10].

3.11.3 RISK OF EXACERBATING EXISTING INEQUITIES AND CREATING NEW INEQUITIES

Like many regions, South Dunedin faces existing social challenges, including issues related to housing affordability, healthcare access, and education disparities. Communities and individuals that are exposed to the same climate hazards will vary in their ability to respond, adapt or cope with the impacts. This variability can be due to inequities, where climate change is likely to exacerbate existing inequities, and create new ones. This can have cascading implications for livelihoods and wellbeing[39].

The New Zealand Index of Social Deprivation provides one example of a measure of social vulnerability across communities. The Index rank's locations on a scale of decile 1 (least deprived) to decile 10 (most deprived) based on prescribed criteria[12]. Figure 2.5 shows that a significant area of South Dunedin is classified as 'most deprived'. Figure 2.5 also identifies small pockets of areas with the highest decile (1-2), with particular focus in the Saint Clair area.

Inequity in South Dunedin could be worsened if property values decrease due to exposure to climate hazards. Residents may be unable to move to less exposed properties as those areas are often more expensive. Those living in houses exposed to climate hazards could experience inequities from insurance rate increases or insurance retreat. Those who are uninsured or underinsured may not be able to repair their house or replace damaged items during a flood.

Climate change may exacerbate disparities and disproportionately affect those who are already marginalised/disadvantaged due to factors like age, race, ethnicity, economic status, gender, education, or health[39]. These marginalised groups may struggle to access the resources necessary to cope with climate-related risks. The increasing frequency of climate change-related disruptions to communities, primary industries, and supply chains is expected to result in elevated living costs. This, in turn, may cause food insecurity and result in increased consumer expenses[39].

South Dunedin has an ageing population and one of the lowest decile demographics in the country[43]. Older adults of South Dunedin may face difficulties in accessing essential services, medical facilities, or even necessities during extreme weather events and infrastructure failures. This can lead to increased stress and potential health risks. Older adults are also more likely to have chronic health conditions such as heart disease and diabetes, which makes them more susceptible to health impacts related to heat stress or the impacts of flooding[39].

School closures, disruptions in transportation to educational institutions, and challenges in maintaining a consistent learning environment can arise from a natural hazard event. This may be further exacerbated by an unstable home environment and loss of ability to provide online

[50] Climate anxiety: Psychological responses to climate change - ScienceDirect.

schooling as well due to impacts on households. This can result in educational setbacks for students, potentially affecting their education and therefore future opportunities and well-being.

3.11.4 RISKS TO COMMUNITY COHESION AND RESILIENCE FROM CLIMATE CHANGE.

The social fabric of South Dunedin is shaped by its diverse population, ranging from families and individuals to students attending the University of Otago[7]. The South Dunedin Community Network was established following the 2015 flooding event to connect people across the wider South Dunedin area. This network created opportunities for the community to come together to strengthen and help people use their voice to create a vibrant, resilient community and a safe future together[11].

Changes or disruptions in one aspect of South Dunedin can have a ripple effect on the wider social landscape. A loss of community cohesion and community function may arise from a range of issues including[39,10]:

- Risks to lifeline infrastructure, such as energy networks, transport networks and water, can increase pressures on populations and lead to isolated neighbourhoods.
- Physical impacts on homes can exacerbate physical and mental health issues, affect a sense of cultural belonging and identity, and increase inequalities and cost of living.
- Loss of, or damage to cultural heritage sites and practices. This may also impact community character, values and community wellbeing.
- Climate change-related economic pressures, particularly related to disruption to local businesses and employment are also likely to impact community cohesion.

When recurrent over the long term, these issues are likely to exacerbate the loss of social connections and community cohesion, which can also impact residents' mental and emotional well-being, the way the community functions and community character and values.

3.11.5 RISKS TO KĀI TAHU SITES, IDENTITY AND PRACTICES, AND NON-KĀI TAHU CULTURAL HERITAGE SITES, DUE TO CLIMATE CHANGE

A parallel Mana Whenua Risk Assessment within the SDF programme is currently underway to explore risks to Kāi Tahu sites, identity and practices due to climate change. However, there is widely acknowledged risks to iwi/Māori that should be flagged at this early stage, for example: risk that climate change will have a disproportionate impact on Māori, that this could further entrench current inequalities, and that barriers to Māori participation in adaptation could exacerbate risks for Māori communities, including in South Dunedin.

The location of Heritage sites and buildings and Wahi Tupuna sites are shown in Figure 3.5. A group of heritage buildings are located along King Edward Street and Wahi Tupuna sites are primarily surrounding Bayfield Park and Ocean Beach Domain. Loss or damage to these sites can cause a loss of identity and reduce cultural wellbeing. Cultural heritage can also play a significant role in economic development for an area or community and if impacted by climate change, can result in a number of economic, mental health and social cohesion impacts.

Figure 3.5 Heritage buildings and sites and Wahi Tupuna in South Dunedin

3.11.6 RISK OF FINANCIAL HARDSHIPS INCLUDING INCREASING COST OF DOING BUSINESS AND AVAILABILITY OF INSURANCE

Both public and private sectors are sensitive to flooding, storm damage and landslides as these can cause significant direct and indirect damages to property and assets. Widespread flooding throughout South Dunedin can lead to evacuations, road closures, damage to infrastructure and associated power outages, such as during the 2015 floods[39]. Following such an event, council, businesses or their insurers must invest in repairing, rebuilding or replacing assets. For example, the 2015 flooding incident resulted in substantial insurance payouts totalling NZD 28 million, with the broader economic impact estimated at NZD 64 million, along with social damages amounting to NZD 18 million, culminating in a total of NZD 138 million[51].

Businesses may also experience temporary disruption such as loss of trade, loss of power and other services, business relocation, supply chain disruption, impacts to staff wellbeing, and increased insurance premiums[44]. Additionally, if viable, businesses may need to invest in adaptation measures to reduce future disruption[39].

Recent events such as Cyclone Gabrielle, have shown how insurance premiums can increase when a business or home is in an exposed area. Insurance for businesses and homeowners in South Dunedin may become unaffordable increasing the likelihood of financial hardships. Insurers may also choose to no longer provide cover for an area because the risk is too high.

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[51] https://www.odt.co.nz/news/dunedin/dcc/flood%E2%80%99s-true-cost-138-million

3.11.7 PROVISION OF PUBLIC SERVICES

Climate change will increase the frequency, severity and spatial extent of natural hazard events. The community impacts that result will increase demands on a range of public services including healthcare, social services, agencies and emergency management services. This may place a strain on service delivery, particularly if these services are also experiencing increased damage from climate and natural hazards. Increasing damage to public infrastructure is likely to increase cost and resourcing demands on Council.

Physical damage to community facilities such as churches, cultural centres and recreational centres, and schools may disrupt these services and/or prevent them from operating. Similarly, disruption or loss of facilities may undermine volunteer networks, community groups, and religious networks. Disruption to or loss of these community facilities may undermine the social fabric of South Dunedin.

Increasing disruption to a range of public services will impact multiple agencies, and regions and require human and financial resources from many areas in order to respond. This issue is likely to span across the South Dunedin community, as well as central and local government[39].

3.11.8 ENVIRONMENTAL DEGRADATION

Many of the risks identified to South Dunedin will result in environmental degradation which may damage indigenous biodiversity, water quality and coastal ecosystems.

Risks to wastewater infrastructure may result in increasing wastewater overflows, causing reduced water quality in both freshwater and marine waterbodies.

Risks to solid waste and contaminated land may result in increasing environmental contamination from contaminated sites. Flood damage can also generate large volumes of runoff / debris, generate building waste and cause contamination.

4 CONCLUSIONS AND NEXT STEPS

The South Dunedin Future (SDF) programme provides a framework for identifying, developing and selecting climate change adaptation options for South Dunedin. Understanding climate change and natural hazard risk is crucial to support decision-making for adaptation planning.

The objective of the risk assessment workstream is to assess the potential for elements at risk (people, places, assets) to be negatively affected by coastal, rainfall induced flooding, groundwater and seismic hazards in South Dunedin.

This *Risk Identification Report* provides the output from the first stage of the three-stage risk assessment workstream. It collates available existing information regarding hazard awareness and elements at risk within South Dunedin and presents a screening of the elements at risk against the hazards. The screening is used to identify where there is potential for impact on each element.

This report identifies that all the key elements of South Dunedin are at risk from all of the studied hazards. These elements at risk include areas of ecological significance; ·buildings and open spaces; marae, and other culturally significant sites roads; rail infrastructure; "Three waters" infrastructure; solid waste and contaminated sites; telecommunication infrastructure and electricity transmission and distribution. Furthermore, the interconnectedness of physical elements within South Dunedin means that any disruptions or impacts on one part of the system can trigger complex interrelated and cascading consequences. Many of these risks to the physical elements of South Dunedin will result in indirect risks to people, communities, businesses, culture, and services within South Dunedin and the wider area.

This *Risk Identification Report* is the first stage of work in the risk assessment workstream. The subsequent stages will develop and implement an agreed detailed risk assessment methodology. Key considerations for the risk assessment will include exposure and vulnerability, consequences, indirect and cascading risks and risks to mana whenua, refer Figure 4.1. below. These outputs will be used to inform decision regarding adaptation options.

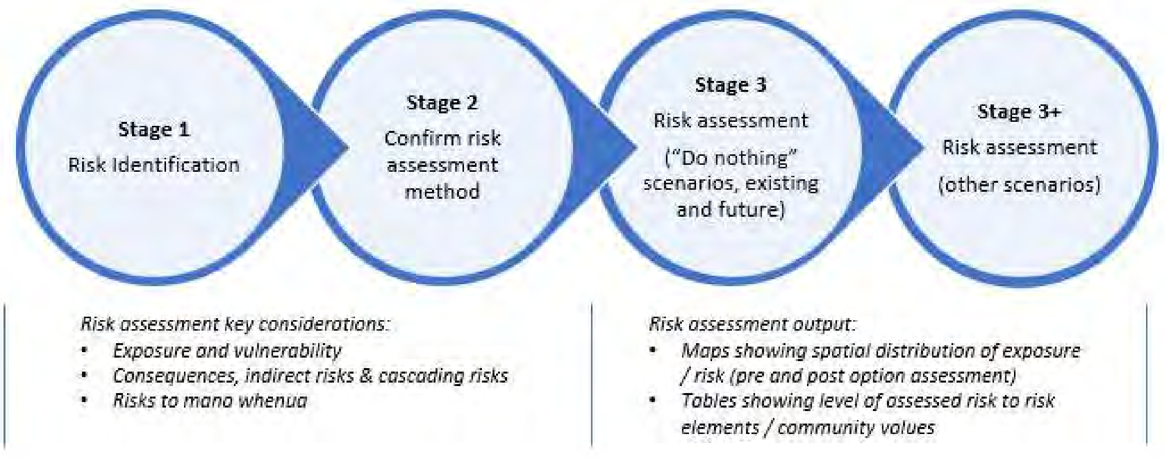

Figure 4.1 Risk assessment stages, considerations and high level outputs

The risk assessment methodology will be developed with input from stakeholders in the next stage (Stage 2) of this workstream. The risk assessment methodology will be guided by the following steps:

Stage 2 Develop and confirm the risk assessment methodology:

- Adopt following principles:
  - Make best use of available data, largely based on the understanding gathered from this report.
  - Ensure effort is proportionate to outcome (i.e. how will this method help to identify, develop and assess adaptation options?).
  - Identify risks and opportunities arising from the above including recommendations for additional studies where necessary.
- Confirm scenarios (RCPs/SSPs, time horizons, and return periods).
- Confirm the critical components from the 'elements at risk' (i.e. people, places, assets) that will inform decision-making for adaptation.
- Establish the key performance indicators52 and thresholds (tolerable/intolerable) that are relevant for the South Dunedin community i.e. What level of hazard exposure would lead to an unacceptable level of impact/damage to a particular risk element? E.g. flood water depth relative to habitable floors, level of groundwater impacting on road sub-base etc.
- Assess the suitability of existing information to support the risk assessment methodology.

Stage 3: Risk assessment

- Carry out detailed risk assessment:
  - Assess current 'exposure / risk' for different hazard magnitudes (incl RCPs/SSPs, time horizons) for each of the agreed risk elements.
  - Prepare summary maps and tables of current exposure to inform adaptation options development.
  - Outputs from this risk assessment will be designed to support prioritisation of adaptation options.

[52] May relate to levels of service or thresholds of damage/impact.

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APPENDIX A-1 GLOSSARY

Key term	Definition
Acute hazard	Natural hazards that take effect over a shorter, more immediate timeframe such as increasingly extreme weather (e.g. cyclones, droughts, floods).
Adaptation	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects[53].
Annual Exceedance Probability (AEP)	The probability that a natural hazard event of a certain size will occur, or will be exceeded, in a given time period. If the time period is one year, it is referred to as an Annual Exceedance Probability (AEP), (Civil Defence and Emergency Management Auckland Council, 2014).
Annual Recurrence Interval (ARI)	The average period of time between hazard events of a given magnitude, and often referred as a return period (e.g., a 1 in 100-year event), (Civil Defence and Emergency Management Auckland Council, 2014). Conversion from AEP to ARI: • 0.02% AEP = 1 in 5000-year ARI. • 0.2% AEP = 1 in 500-year ARI. • 1% AEP = 1 in 100-year ARI. • 2% AEP = 1 in 50-year ARI. • 5% AEP = 1 in 20-year ARI. • 20% AEP = 1 in 5-year ARI.
Assets	"Things of value", which may be exposed or vulnerable to a hazard or risk. Physical, environmental, cultural or financial/economic element that has tangible, intrinsic or spiritual value[54].
Baseline	The baseline (or reference) is any datum against which change is measured.

[53] IPCC (2014) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

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Key term	Definition
Cascading effects (of climate change)	Cascading effects are those that flow on from a primary hazard to compound and affect many systems in a dynamic sequence.
Chronic hazard	Longer-term shifts in precipitation, temperature, sea-level rise, and more variable weather patterns.
Climate	Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description, of the climate system[53].
Climate change	Climate change refers to a change in the state of the climate that can be identified (for example, by using statistical tests) by changes or trends in the mean and/or the variability of its properties, and that persists for an extended period, typically decades to centuries. Climate change includes natural internal climate processes or external climate forcings such as variations in solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land-use[53].
Climate projection	A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases (GHGs) and aerosols, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission/concentration/radiative forcing scenario used, which is in turn based on assumptions concerning, for example, future socio-economic and technological developments that may or may not be realised[53].
Community	A community may be a geographic location (community of place), a community of similar interest (community of practice), or a community of affiliation or identity (such as industry) [54].
Compound hazards and stressors	Combined occurrences of multiple hazards and stressors (that is, cumulative hazards) which will become more significant in the future as adaptation thresholds are reached, for example, for a low-lying coastal area, a persistent wet season (high groundwater, reduced field capacity) is followed by a coastal storm on the back of sea-level rise, coinciding with intense rainfall, leading to compound flooding impacts[54].
Confidence	A qualitative measure of the validity of a finding, based on the type, amount, quality and consistency of evidence (for example, data,

Key term	Definition
	mechanistic understanding, theory, models, expert judgment) and the degree of agreement[54].
Consequence	The outcome of an event that may result from a hazard. It can be expressed quantitatively (for example, units of damage or loss, disruption period, monetary value of impacts or environmental effect), semi-quantitatively by category (for example, high, medium, low level of impact) or qualitatively (a description of the impacts) (adapted from Ministry of Civil Defence and Emergency Management, 2019[55]). It is also defined as the outcome of an event affecting objectives (ISO/IEC 27000:2014 and ISO 31000: 2009) [54].
Disaster	Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery[53].
Driver	An aspect that changes a given system. Drivers can be short term but are mainly long term in their effects. Changes in both the climate system and socio-economic processes, including adaptation and mitigation, are drivers of hazards, exposure, and vulnerability; so drivers can be climatic or non-climatic[54].
Element at risk	People, values, taonga, species, sectors, assets etc that are potentially vulnerable to climate change impacts.
Emissions	The production and discharge of substances that are potentially radiatively active (that is, absorb and emit radiant energy) in the atmosphere (for example, greenhouse gases, aerosols)[54].
Exposure	The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by a change in the external stresses a system is exposed to. In the context of climate change these are normally specific climate and other biophysical variables[53]. The number, density or value of people, property, services, or other things of value that are present in an area subject to one or more hazards (I.e., within a hazard zone), and that may experience potential loss or harm[55].

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Key term	Definition
Extreme weather event	An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (for example, drought or heavy rainfall over a season) [53].
Frequency	The number or rate of occurrences of hazards, usually over a particular period of time[54].
Greenhouse gas (GHG)	Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere.
Hazard	The potential occurrence of a natural or human-induced physical event, trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources[53].
Impacts (consequences, outcomes)	The effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period, and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes[53].
Intergovernmental Panel on Climate Change (IPCC)	Intergovernmental Panel on Climate Change – a scientific and intergovernmental body under the auspices of the United Nations.

Key term	Definition
Land-use	Land-use refers to the total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The term land-use is also used in the sense of the social and economic purposes for which land is managed (for example, grazing, timber extraction and conservation). In urban settlements it is related to land-uses within cities and their hinterlands. Urban land-use has implications on city management, structure and form and thus on energy demand, greenhouse gas (GHG) emissions and mobility, among other aspects[53].
Land-use change	Land-use change is a change in the use or management of land by humans, which may lead to a change in land cover. Land cover and land-use change may impact on the surface albedo, evapotranspiration, sources and sinks of greenhouse gases (GHGs), or other properties of the climate system and may thus give rise to radiative forcing and/or other impacts on climate, locally or globally[53].
Likelihood	The chance of a specific outcome occurring, where this might be estimated probabilistically[53].
Mana whenua	Authority over land or territory, and the power associated with possession and occupation of tribal land.[56]
Mitigation	A human intervention to reduce the sources or enhance the sinks of greenhouse gases[53].
NCCRA	National Climate Change Risk Assessment
OCCRA	Otago Climate Change Risk Assessment
Percentiles	A percentile is a value on a scale of 100 that indicates the percentage of the data set values that is equal to, or below it. The percentile is often used to estimate the extremes of a distribution. For example, the 90th (or 10th) percentile may be used to refer to the threshold for the upper (or lower) extremes.
Representative concentration pathway (RCP)	A suite of representative future scenarios of additional radiative heat forcing at the Earth's surface by 2100 (in Watts per square metre), which is the net change in the balance between incoming solar radiation and outgoing energy radiated back up in the atmosphere. Each RCP can be expressed as a greenhouse gas concentration (not emissions) trajectory adopted by the IPCC for its Fifth Assessment Report (AR5) in 2014[53].

[56] Te Aka Māori Dictionary (2023): https://maoridictionary.co.nz/

Key term	Definition
Resilience	The capacity of social, economic, and environmental systems to cope with a hazardous event, trend or disturbance by responding or reorganising in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation[53].
Risk	The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends, multiplied by the impacts if these events or trends occur. The term risk is used to refer to the potential, when the outcome is uncertain, for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure. Risk results from the interaction of vulnerability, exposure and hazard. To address the evolving impacts of climate change, risk can also be defined as the interplay between hazards, exposure and vulnerability[53].
Risk - direct	Risks where there is a direct relationship between the climate hazard and the element at risk.
Risk - indirect	Indirect physical risks can include two broad types: • Downstream risks which may result from the direct risk. For example, a direct risk of flooding of a road, may lead to indirect risks such as: reduction in service level, economic losses, loss of access etc. • Upstream risks which may arise as direct risks independently (exogenously) and have consequential implications for the area. For example, supply chain interruptions which prevent critical inputs being received, or changes in policy by central government.
Risk assessment	The overall qualitative and/or quantitative process of risk identification, risk analysis and risk evaluation, with multiple entry points for communication and engagement and monitoring and reviews (AS/NZS ISO 31000:2009, Risk Management Standard).
SDF	South Dunedin Future
Shared Socio-Economic Pathway (SSP)	A collection of pathways that describe alternative futures of socio-economic development in the absence of climate policy intervention. The combination of SSP-based socio-economic scenarios and RCP based climate projections, should provide a useful integrative frame for climate impact and policy analysis[57].
Shock	A sudden, disruptive event with an important and often negative impact.

[57] IPCC (2023); Glossary of terms https://www.ipcc-data.org/guidelines/pages/glossary/glossary_s.html

Key term	Definition
Stress	A long-term, chronic issue with an important and often negative impact.
Stressor (climate)	Persistent climatic occurrence (for example, change in pattern of seasonal rainfall) or rate of change or trend in climate variables, such as the mean, extremes, or the range (for example, ongoing rise in mean ocean temperature or acidification), which occurs over a period of time (for example, years –decades – centuries), with important effects on the system exposed, increasing vulnerability to climate change[54].
System	A set of things working together as parts of an interconnected network and/or a complex whole.
Three waters	Three waters refers to drinking water, wastewater and stormwater infrastructure.
Uncertainty	A state of incomplete knowledge that can result from a lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from imprecision in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour[53].
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt[53].
Wellbeing	Wellbeing is achieved when people are able to lead fulfilling lives with purpose, balance and meaning to them (New Zealand Treasury, 2019). In New Zealand, the Treasury's living standards framework (LSF) notes that intergenerational wellbeing relies on growth, distribution and sustainability of four capitals: natural capital, social capital, human capital and financial/physical capital. The capitals are interdependent and work together to support wellbeing. The Crown–Māori relationship is integral to all four capitals (New Zealand Treasury, 2019). Within te ao Māori – the Māori world – wellbeing is not simply driven by stocks of capitals identified in the LSF. Instead, the drivers of wellbeing are considered against the values that imbue te ao Māori with a holistic perspective. These values are interconnected and span many aspects of wellbeing. Wellbeing results applying these values through knowledge, beliefs and practices[58].

[58] The Treasury. (2018). Our Living Standards Framework. Retrieved from https://treasury.govt.nz/information-and-services/nz-economy/living-standards/our-living-standardsframework.

APPENDIX A-2 SUMMARY OF REGIONAL AND NATIONAL RISKS

Otago Climate Change Risk Assessment (OCCRA)		National Climate Change Risk Assessment (NCCRA) (shading indicates top 10 priority risk)		Notes on inclusion in South Dunedin risk identification
N1	Risks to the terrestrial ecosystems from increasing temperatures, changes in rainfall and reduced snow and ice.	N6	Risks to terrestrial, freshwater and marine ecosystems, due to increased extreme weather events, drought, and fire weather.	Included within risks to Areas of ecological significance.
		N8	Risks to sub-alpine ecosystems, due to changes in temperature and a reduction in snow cover.	No sub-alpine ecosystems in South Dunedin.
N2	Risks to the freshwater (rivers and lakes) ecosystems from increasing temperatures and extreme weather events.	N3	Risks to riverine ecosystems and species from alterations in the volume and variability of water flow, increased water temperatures, and more dynamic morphology (erosion and deposition), due to changes in rainfall and temperature.	No freshwater bodies in South Dunedin.
N3	Risks to the coastal and marine ecosystems from climate change hazards including ocean acidification and marine heatwaves.	N1	Risks to coastal ecosystems, including the intertidal zone, estuaries, dunes, coastal lakes and wetlands, due to ongoing sea-level rise and extreme weather events.	Included within risks to Areas of ecological significance.
		N7	Risks to oceanic ecosystem productivity and functioning, due to changes in sea-surface temperature, ocean mixing, nutrient availability, chemical composition and vertical particle flux.	
N4	Risks to coastal, inland and alpine wetland ecosystems from drought, higher temperatures, changes in rainfall and reduced snow and ice.	N4	Risks to wetland ecosystems and species, particularly in eastern and northern parts of New Zealand, from reduced moisture status due to reduced rainfall.	No wetlands within South Dunedin.
N5	Risks to Otago water quality and quantity from changes in rainfall, higher temperatures, flooding, drought and reduced snow and ice.	-	-	No freshwater bodies in South Dunedin.
N6	Risks to native ecosystems posed by increasing threats from invasive	N2	Risks to indigenous ecosystems and species from the enhanced spread, survival and establishment	Included within risks to Natural Environment.

Otago Climate Change Risk Assessment (OCCRA)		National Climate Change Risk Assessment (NCCRA) (shading indicates top 10 priority risk)		Notes on inclusion in South Dunedin risk identification
	plants, pests and disease due to climate change.		of invasive species due to climate change.	
-	-	N5	Risks to migratory and/or coastal and river-bed nesting birds due to reduced ocean productivity, ongoing sea-level rise and altered river flows.	Included within risks to Natural Environment.
-	-	N9	Risks to carbonate-based, hard-shelled species from ocean acidification, due to increased atmospheric concentrations of CO2.	Marine ecosystems are outside the program extent.
B1	Risk to buildings and open spaces from climate change hazards including inland and coastal flooding, coastal erosion, sea level rise and salinity stress, and wildfire.	B2	Risks to buildings due to extreme weather events, drought, increased fire weather and ongoing sea-level rise.	Included (buildings and open spaces).
B2	Risk to flood management schemes from inland and coastal flooding, and sea level rise and salinity stress.	-	-	Flood management typically refers to stop banks and is the primary focus of discussion in this risk. As there are no watercourses in South Dunedin this risk is not directly relevant. Flood control measures used within South Dunedin are discussed within the context of Stormwater management.
B3	Risk to water supply infrastructure and irrigation systems due to drought, fire weather, flooding and sea level rise and salinity stress.	B1	Risk to potable water supplies (availability and quality) due to changes in rainfall, temperature, drought, extreme weather events and ongoing sea-level rise	Infrastructure related risks are included (Water supply), supply risks are not included as this is a regional issue.
B4	Risk to stormwater and wastewater networks from increased temperature, sea level rise and salinity stress, extreme weather events and flooding.	B4	Risk to wastewater and stormwater systems (and levels of service) due to extreme weather events and ongoing sea-level rise.	Included (Wastewater and Stormwater).
B5	Risks to linear transport (roads and rail) from flooding, coastal erosion, extreme weather events and landslides.	B6	Risks to linear transport networks, due to changes in temperature, extreme weather events and ongoing.	Included (Transport).

Otago Climate Change Risk Assessment (OCCRA)		National Climate Change Risk Assessment (NCCRA) (shading indicates top 10 priority risk)		Notes on inclusion in South Dunedin risk identification
B6	Risk to airports and ports from flooding and extreme weather events.	B7	Risk to airports, due to changes in temperature, wind, extreme weather events and ongoing sea-level rise.	No ports or airports located within South Dunedin.
B7	Risk to solid waste (landfills and contaminated sites) to flooding and sea level rise and salinity stress.	-	-	Included (Solid waste and contaminated sites).
B8	Risks to electricity (generation, transmission and distribution) networks from changes in rainfall, extreme weather events and flooding.	B8	Risks to electricity infrastructure, due to changes in temperature, rainfall, snow, extreme weather events, wind, and increased fire weather.	Included (electricity transmission and distribution).
B9	Risks to telecommunications infrastructure due to sea level rise and salinity stress and extreme weather events.	-	-	Included (Telecommunications).
-	-	B3	Risks to landfills and contaminated sites due to extreme weather events and ongoing sea-level rise.	Included (Solid waste and contaminated sites).
-	-	B5	Risks to ports and associated infrastructure, due to extreme weather events and ongoing sea-level rise.	No ports or airports located within South Dunedin.
H1	Risks to Kāi Tahu sites, identity and practices, and non-Kāi Tahu cultural heritage sites, due to climate change.	H8	Risks to Māori and European cultural heritage sites, due to ongoing sea-level rise, extreme weather events and increasing fire weather.	Included in direct and indirect risks (Risks to Kāi Tahu sites, identity and practices, and non-Kāi Tahu cultural heritage sites, due to climate change).
H2	Risks to community cohesion and resilience from climate change.	H1	Risks to social cohesion and community wellbeing from displacement of individuals, families and communities due to climate change impacts.	Included in indirect risks (Risks to community cohesion and resilience from climate change).
H3	Risk to mental wellbeing and health from climate change.	H7	Risks to mental health, identity, autonomy and sense of belonging and wellbeing from trauma, due to ongoing sea-level rise, extreme weather events and drought	Included in indirect risks (Risk to community health and wellbeing from climate change).
H4	Risk to physical health due to climate change.	H3	Risks to physical health from exposure to storm events, heatwaves, vector-borne and zoonotic diseases, water	Included in indirect risks (Risk to community health and wellbeing from climate change).

Otago Climate Change Risk Assessment (OCCRA)		National Climate Change Risk Assessment (NCCRA) (shading indicates top 10 priority risk)		Notes on inclusion in South Dunedin risk identification
			availability and resource quality and accessibility, due to changes in temperature, rainfall and extreme weather events.	
H5	Risk to increased inequities and cost of living due to climate change.	H2	Risks of exacerbating existing inequities and creating new and additional inequities due to differential distribution of climate change impacts.	Included in indirect risks (Risk of exacerbating existing inequities and creating new inequities climate change).
-	-	H4	Risks of conflict, disruption and loss of trust in government, from changing patterns in the value of assets and competition for access to scarce resources, primarily due to extreme weather events and ongoing sea-level rise.	Governance related risks are not specifically covered in the South Dunedin Assessment as this risk is generally influenced by central government, which is outside the project extent.
-	-	H5	Risks to Māori social, cultural, spiritual and economic wellbeing from loss and degradation of lands and waters, as well as cultural assets such as marae, due to ongoing sea-level rise, changes in rainfall and drought.	Included in direct and indirect risks (Risks to Kāi Tahu sites, identity and practices, and non-Kāi Tahu cultural heritage sites, due to climate change).
-	-	H6	Risks to Māori social, cultural, spiritual and economic wellbeing from loss of species and biodiversity, due to greater climate variability and ongoing sea-level rise.	Included in direct and indirect risks (Risks to Kāi Tahu sites, identity and practices, and non-Kāi Tahu cultural heritage sites, due to climate change).
E1	Risks to the livestock farming sector from climate change hazards including drought, increased fire weather, inland flooding, and increased landslides.	E3	Risks to land-based primary sector productivity and output due to changes in mean rainfall and temperature, seasonality, weather extremes and changes in the distribution of invasive species.	No livestock farming in South Dunedin.
E2	Risks to horticulture and viticulture from climate change hazards including temperature, drought, changing rainfall patterns and extreme weather.			No Horticulture in South Dunedin.
E3	Risks to the forestry sector from climate change hazards including temperature, drought, fire and extreme weather.			No Forestry in South Dunedin.

Otago Climate Change Risk Assessment (OCCRA)		National Climate Change Risk Assessment (NCCRA) (shading indicates top 10 priority risk)		Notes on inclusion in South Dunedin risk identification
E4	Risks to the fisheries and aquaculture sector from climate change hazards including marine water temperature and water quality.	E5	Risks to fisheries from changes in the characteristics, productivity, and spatial distribution of fish stocks, due to changes in ocean temperature and acidification.	No Fisheries in South Dunedin.
E5	Risks to primary sector supply chains from climate change hazards including inland flooding, coastal flooding and increased landslides.	-	-	Not included as this is a regional issue.
E6	Risks to cost of doing business from climate change hazards including coastal and inland flooding, landslides, and extreme events.	E1	Risks to governments from economic costs associated with lost productivity, disaster relief expenditure and unfunded.	Included in indirect risks (risk of increasing cost of doing business and availability of insurance).
		E2	Risks to the financial system from instability due to extreme weather events and ongoing, gradual changes.	
E7	Risks to the tourism sector from climate change hazards including higher temperatures, reduced snow and ice, inland and coastal flooding, landslides and erosion.	E4	Risks to tourism from changes to landscapes and ecosystems and impacts on lifeline infrastructure, due to extreme weather events and ongoing, gradual changes.	Not included due to lack of data on tourism in South Dunedin. The regional assessment does not identify risks to tourism that are specific to South Dunedin.
-	-	E6	Risks to the insurability of assets, due to ongoing sea-level rise and extreme weather events.	Included in indirect risks (risk of increasing cost of doing business and availability of insurance).
-	-	E7	Risks to businesses and public organisations from supply chain and distribution network disruptions, due to extreme weather events and ongoing, gradual changes.	
G1	Risk that existing planning, decision making, and legislative frameworks are inadequate for responding to long-term climate change risks and result in maladaptive responses, and potential liability.	G1	Risk of maladaptation across all domains due to the application of practices, processes and tools that do not account for uncertainty and change over long timeframes.	Governance related risks are not specifically covered in the South Dunedin Assessment as they are generally influenced by local government and/or central government, which is outside the project extent.
G2	Risk of local authorities lacking capacity to effectively respond to climate change.	-	-	

Otago Climate Change Risk Assessment (OCCRA)		National Climate Change Risk Assessment (NCCRA) (shading indicates top 10 priority risk)		Notes on inclusion in South Dunedin risk identification
G3	Risk that the national, regional and local governance/institutional structures for managing climate change are inadequate.	G2	Risk that climate change impacts across all domains will be exacerbated because current institutional arrangements are not fit climate change adaptation. Institutional arrangements include legislative and decision-making frameworks, coordination within and across levels of government, and funding mechanisms.	
G4	Risk that a low level of community awareness and engagement hinders communication of climate risk and uncertainty and leads to de-prioritisation.	G4	Risk of a breach of Treaty obligations from a failure to engage adequately with and protect current and future generations of Māori from the impacts of climate change.	
G5	Risk that climate change will result in increasing damage costs, with insufficient financing for adaptation and risk reduction.	G5	Risks of delayed adaptation and maladaptation, due to knowledge gaps resulting from under-investment in climate adaptation research and capacity building.	
G6	Risk that public services will be impacted by climate change.	G6	Risks to the ability of the emergency management system to respond to an increasing frequency and scale of compounding and cascading climate change impacts in New Zealand and the Pacific Region.	
-	-	G3	Risks to governments and businesses from climate change-related litigation, due to inadequate or mistimed climate change adaptation.	
-	-	G7	Risk that effective climate change adaptation policy will not be implemented and sustained, due to failure to secure sufficient parliamentary agreement.	
-	-	G8	Risk to the ability of democratic institutions to follow due democratic decision-making processes under pressure from an increasing frequency and scale of compounding and cascading climate change impacts.	

APPENDIX A-2

Appendix A-2: Reports review

List of background reports reviewed as part of long list collation:

Dunedin 3 Waters Strategy - South Dunedin Integrated Catchment Management Plan (OPUS, URS - 2011)

Protecting Options for Managing Rising Groundwater in South Dunedin (Golder Deltares - 2017)

Preparing for future flooding: a guide for local government in New Zealand (MfE - 2010)

Preparing for climate change: a guide for local government in New Zealand (MfE – 2008)

Coastal Hazards and Climate Change: guidance for local government (MfE – 2017)

Interim guidance on the use of new sea-level rise projections (MfE – 2022)

Dunedin Integrated Catchment Management South Dunedin Options: Dunedin Three Waters Strategy (Stantec, Beca, WSP - 2020)

Options Report: Assessment of Options for Protecting Harbourside and South City from Direct Impacts of Sea Level Rise (Beca – 2014)

Ocean Beach Domain Reserve Management Plan Coastal issues and options (T&T – 2011)

Preparing NZ for rising seas - certainty and uncertainty (PCE - 2015)

DCC Coastal Dune Reserves Management Plan (DCC - 2010)

Funding Managed Retreat (EDS – 2023)

Quantifying uncertainty in the temporal disposition of groundwater inundation under sea level rise projects (Chambers, L. et al., 2023)

Dunedin Groundwater Monitoring and Spatial Observations (GNS Science – 2020)

The South Dunedin Coastal Aquifer and Effect of Sea Level Fluctuations (ORC – 2012)

Stormwater Integrated Catchment Management Plan (DCC – 2017)

The Natural Hazards of South Dunedin (ORC – 2016)

Climate Change impacts on Dunedin (DCC – 2010)

National Adaptation Plan (2022)

Assessing indirect impacts of extreme sea level flooding on critical infrastructure (Lan, C et al., 2023)

Community-led retreat and adaptation funding: issues and options (MfE, 2023)

Geological, seismic hazard, and liquefaction work in South Dunedin (ORC, 2020)

Assessment of liquefaction hazards in the Dunedin City district (GNS Science – 2014)

District Coastal Hazards Screening, *interim* (WSP – 2023)

Case study: challenges with implementing the Clifton to Tangoio Coastal Hazards Strategy 2100 (MfE/HBRC – 2020)

APPENDIX A-3

Appendix A-3: Domestic and International Good Practice Case Studies Report

DOMESTIC AND INTERNATIONAL GOOD PRACTICE CASE STUDIES REPORT:

INSIGHTS AND TRANSFERABLE LESSONS FOR SOUTH DUNEDIN

24 NOVEMBER 2023

Beca · South Dunedin Future · DUNEDIN CITY COUNCIL kaunihera a-rohe o Ōtepoti · Otago Regional Council · wsp · Tonkin+Taylor

Sensitivity: General

DOMESTIC AND INTERNATIONAL GOOD PRACTICE CASE STUDIES REPORT: INSIGHTS AND TRANSFERABLE LESSONS FOR SOUTH DUNEDIN

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REV	DATE	DETAILS
0.1	8 November 2023	Draft Report
0.2	13 November 2023	Final Report – released for independent peer-review process
0.3	24 November 2023	Final Report – revised following peer-review

	NAME	DATE	SIGNATURE
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Technical Approval by:	Jon Rix	20 November 2023	
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Approved for Release by:	Kevin Wood	24 November 2023	

24 November 2023

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Sensitivity: General

TABLE OF CONTENTS

1 INTRODUCTION

The purpose of this report is to showcase a selection of relevant and innovative adaptation approaches and options, both in New Zealand and internationally. These case studies will be used to highlight good practice processes and tools that have the potential to be applied in the South Dunedin context. This report is a supporting document for the development of an initial list of adaptation options for South Dunedin, which sits within a broader programme of Technical Support Services for South Dunedin Future.

The approach taken in this report is to examine in detail four case studies that are aligned to adaptation response themes of the PARA framework (Protect, Accommodate, Retreat, Avoid). These themes have also been used to develop the long list of adaptation options, hence promoting conceptual consistency across the project.

The case studies were selected using criteria that included alignment with the PARA framework, relevance to South Dunedin, and availability of up to date and insightful information. We have also aimed to provide a range of case studies that combine intervention-specific examples (e.g., house raising) with site-based examples that incorporate a combination of adaptation options. The latter is important for South Dunedin since it is likely that a range of spatially differentiated options will be needed. As such, there are important lessons that can be learnt about the process of combining and blending options. In some of the case studies, we have incorporated multiple examples, supplementing international practice with experiences closer to home.

The case studies were developed through desk-based research which was supplemented wherever possible with interviews with those involved in the design and delivery of the various projects and schemes.

The four case study examples are as follows:

- House raising - Australia and New Zealand: emerging lessons from property level adaptation initiatives.
- Cloudburst Management Plan – Copenhagen, Denmark: A city-scale response to increasing flood risk incorporating blue, green, and grey adaptation approaches.
- Residential retreat, Christchurch, New Zealand: transferable lessons from post-earthquake retreat.
- Long Bay Development - Auckland, New Zealand: An innovative example of stormwater management and making space for nature.

2 HOUSE RAISING - AUSTRALIA AND NEW ZEALAND

CASE STUDY HIGHLIGHTS
The hazard being addressed in the case study is rainfall induced inland flooding. This approach could be applied to coastal flooding.
Connection to PARA Framework: Flooding is being accommodated as the property below the dwelling is allowed to flood.
Adaptation options: Grey engineering is used in these case study examples through house raising.

2.1 CASE STUDY OVERVIEW

This case study examines examples of house raising in Queensland, Australia, and Gisborne, New Zealand. These two examples illustrate the challenges and opportunities associated with raising homes and the financial mechanisms developed to enable household-level adaptations. The case studies relate to piled-foundation housing, where the feasibility is greater than for concrete foundation buildings[1].

House raising is the process of separating a house from its foundation, using jacks to elevate it, and installing new support piles (Figure 2.1). To protect a house from flooding, the floor level is raised above the flood level. The resultant area beneath the house may be used for parking if there is adequate space, although it is recommended not to use the area for storage or to build walls around the piles. During a flood, the stored goods could be damaged, and walls can prevent floodwater from flowing, causing damage to the house.

The National Institute of Water and Atmospheric Research (NIWA) states that raising timber framed houses is more straightforward and cost-effective than raising concrete slab houses, however, the infrastructure around and leading to the house should also be considered before proceeding.[11]. For example, if access is cut off and service provision is lost frequently and/or for long periods after flooding, raising a house may not be a suitable option. If flooding is infrequent, and has minor impacts to access or service provision, house raising could be a suitable adaptation option.

In the context of the PARA framework, raising houses is an example of accommodation as it reduces the consequences of flooding through an in-situ option, as opposed to altering the hazard or moving away from the hazard. House raising is implemented on a household level, therefore each house would need assessment to ensure viability to raise.

Figure 2.1: A house that is being raised [6].

[1] Raising buildings with concrete foundations is significantly more costly making the option less feasible than piled foundations.

2.2 APPROACH

The approaches used in Queensland and Gisborne are shaped by a range of factors including the scale and nature of the hazard; the size of the scheme being proposed (related to the number of houses); local laws and standards; and the available funding sources and financial mechanisms. The examples presented below are at different stages in terms of planning and implementation.

QUEENSLAND:

Following multiple rainfall-induced flood events in Queensland, Australia, the state government established the Resilient Homes Fund in 2022.

The AU$741 million fund provides homeowners across 39 local government areas (whose homes were impacted by flooding in 2021-2022 flooding) with four options to increase resilience [7]. The funding is part of a wider Disaster Recovery Funding Arrangements (DRFA) worth AU$7.2 billion ringfenced in response to 32 events between 2019 and 2023. The options available through the Resilient Homes Fund are to:

— Repair or retrofit the home.

— Raise the home.

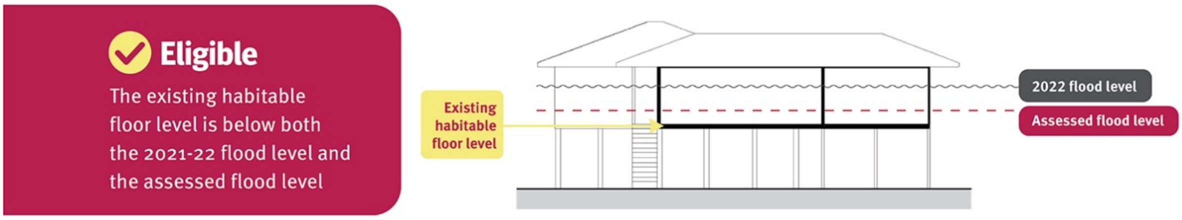
— Demolish and rebuild or relocate the home.

— Voluntary home buy-back.

As of 31 July 2023, 6,548 homeowners had registered their interest in accessing the Fund, 1,598 of whom had registered their interest in house raising as an option [9]. The timeframe for this project runs from 2022 to 2024, and monitoring reports show the programme was 23% complete as of July 2023[2].

The Resilient Homes Fund provides homeowners with AU$ 100,000 towards the cost of raising their home. Additional costs above this sum are split on a 50:50 basis between the homeowner and the government. Homeowners who are experiencing genuine hardship can apply to have the additional costs covered. The funding for the programme is jointly funded (50:50) between the Queensland Government and Australian Government. Both insured and uninsured homes are eligible. Residents are also encouraged to receive a like-for-like payout from their insurance and the Resilient Homes Fund would finance flood-resistant alternatives (e.g., replacing standard plasterboard with flood-resistant linings like fibre cement sheeting).

The Queensland Government has provided clear eligibility criteria for homeowners seeking assistance. The habitable floor level must be raised above the flood level specified by the local council. The eligible costs for raising homes are also clearly provided. Figure 2.2 shows an infographic used by the Resilient Homes Fund to show a house that is eligible for house raising.



[2] Precise data on the number of houses raised was not available.

Figure 2.2: Example of a home that is eligible for the Resilient Homes Fund house raising program [8].

A list of licenced contractors is available through the Queensland Building and Construction Commission to carry out the work. House raising companies, like Raise My House, outline the steps homeowners will need to carry out after being provisionally approved for funding, they are as follows [10]:

1 Obtain a full set of house raising plans which outline the plan for raising a specific house.

2 Obtain a set of structural engineering drawings that approve the plan for the house.

3 Obtain a quote for the cost of raising a house.

4 Speak with professional builders to determine if any other essential services like stairs, earthworks or plumbing need to be carried out, and quote a price.

5 Submit an itemised quote to the Queensland Government.

6 If funding is approved, payment plans, objectives and milestones will be discussed between the government and the homeowner and contractors.

7 Complete a house raise certificate for council approval.

8 Book the house raising and associated works to be carried out.

In July 2023, approximately 100 stakeholders came together to compare the respective recovery arrangements in Queensland and New South Wales to identify elements that were working well and where improvements could be made, and to identify gaps [9]. To allow for ongoing communication between the affected communities and the Queensland Government, dedicated email and phone services have been provided for appeals, complaints and comments.

GISBORNE:

In February 2023, Cyclone Gabrielle caused extensive damage to areas of Gisborne, New Zealand. Communities located in floodplains adjacent to rivers faced extensive damage to houses, infrastructure and the natural landscape. In September 2023, the government announced that they are initiating funding for 200 houses to be raised. At the time of this case study publication, the fund has yet to be implemented. NZ$15 million was approved to raise homes in Gisborne/Tairāwhiti above the design flood level [1]. This funding comes from the NZ$75 million interim recovery package established in early 2023 to support businesses affected by the North Island weather events [3].

Approximately 100 homes will be raised in Te Karaka settlement and a further 100 houses will be identified by Gisborne District Council. Priority is being given to properties that were inundated during Cyclone Gabrielle. Te Karaka settlement was badly damaged when the Waipāoa River flooded and breached the stopbanks during Cyclone Gabrielle. In addition to raising homes in Te Karaka, damaged stopbanks will be repaired and strengthened, providing a further level of protection.

The government acknowledges that wider and more complex resilience measures take longer to develop and implement, however raising homes is something that can happen relatively quickly and is a tangible solution for residents that considerably reduces their risk of future flooding [1]. This solution may allow residents to return to their homes earlier than other options.

The funding request was made jointly by Gisborne District Council and mana whenua of Te Karaka - Te Aitanga-a-Māhaki. The council did not directly consult with the community; however, Te Aitanga-a-Māhaki was advocating for funding on behalf of the community through pre-established partnerships. Gisborne District Council has a treaty partner engagement team, including local iwi representatives that are seconded to the council, which provides a further avenue for community consultation.

A report was produced by the National Institute of Water and Atmospheric Research (NIWA) in 2023 to assess which residential and commercial buildings are cost effective to raise. The assessment determined that timber framed residential houses (single story and 2 or 3 story houses) that do not have facades installed on the ground floor were the only building types that were cost effective to lift when compared to rebuilding [12]. Single story timber framed houses were estimated to cost $1,624/ m^2 with a 106 m^2 floor plate ($172,129 total cost) and 2 or 3 story timber framed house with a 52 m^2 floor plate was estimated to cost $2,536/ m^2 ($131,874 total cost) [12]. Residential buildings with concrete bases cost between $3,326/m^2 and $4,395/m^2 [12]. In comparison, single residential buildings built in rural areas can range between $3,800 - $4,400/m^2 [12]. Commercial buildings were shown to be uneconomical to lift as cost estimates range between $3,099 - $4,233/m^2 for buildings with concrete bases while rebuilding large commercial buildings is estimated to cost between $2,900 - $3,800/m^2 [12]. The cost to raise timber framed commercial buildings ranged from $1,878 - $2,528 /m^2 [12]; a cost the report concluded to be uneconomical.

Complementary flood resilience work happening in Gisborne includes enhancing flood monitoring telemetry and communication systems that will improve real-time data for analysis of flood modelling and issuing warnings [2].

2.3 OUTCOMES

The Resilient Homes Fund (Queensland, Australia) is in early implementation stages and, as a result, there is no publicly available information regarding lessons learned; however, this information is expected to become available in the future. Natural Hazards Research Australia has a project in the planning phase to evaluate the Resilient Homes Fund. It will be "assessing the four dimensions of resilience (physical, financial, social, and emotional) by assessing buy-back, retrofit and house raising, to demonstrate the success factors and lessons learnt for each as they link to the four resilience dimensions" [4]. The assessment will evaluate the program's design, engagement with stakeholders, implementation, whether desired outcomes were achieved, and lessons learnt [4]. The outputs from this will help guide the Australian Government when managing future destructive events and are likely to provide relevant insight for New Zealand.

2.4 APPLICABILITY

House raising could present a practical solution in locations with housing where floor levels are below identified flood levels and is a relevant property-level adaptation option for lighter timber framed house on piles. Chronic flooding to roads and other infrastructure should be considered when assessing the viability of house raising.

House raising may be considered alongside other options as part of a holistic adaptation response; for example, allowing certain areas to temporarily flood to protect other areas, improving stormwater management and changing land use in flood-prone areas to prevent future development. It may also be used as a medium-term adaptation option in locations where retreat may be necessary, but only in decades to come. Raising a house can also help flood-affected residents gain agency after experiencing flooding as it provides a practical solution over which they have control.

The two examples provided illustrate that cross-community house raising programmes require careful planning, clear criteria and agreed standards, as well as a clear financial plan. More specifically, the Resilient Homes Fund (Queensland) highlights the following key learnings that are of relevance to South Dunedin:

— Blended finance and cost-sharing by different tiers of government, insurers and homeowners can help overcome financial barriers.

— Establishing funding mechanisms with clear, easy-to-understand eligibility criteria is important.

— House raising can be offered within a portfolio of property-level adaptation options such as repairs, retrofit and relocation, giving further agency to affected communities and avoiding one-size-fits-all approaches,

While still in its infancy, the Gisborne case study frames house raising in the context of maintaining community cohesion by allowing residents to remain in their community and maintain relationships. It also highlights the central role of mana whenua in community decision-making and may yield valuable lessons for South Dunedin as the project progresses.

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3 CLOUDBURST MANAGEMENT PLAN - COPENHAGEN, DENMARK

CASE STUDY HIGHLIGHTS
The hazard being addressed in the case study is rainfall induced flooding.
Connection to PARA framework: Options to reduce flood risk are primarily using a combination of accommodation, protection, and avoidance measures.
Adaptation options: A combination of blue-green infrastructure and grey engineering measures are used in this case study. They include increasing drainage pipe capacity and installing rain gardens, green roofs, and rainwater retention areas.

3.1 CASE STUDY LOCATION OVERVIEW

Copenhagen, Denmark, is a coastal city in a region connecting the North Sea and the Baltic Sea. It is situated on a flat coastal terrain and has canals flowing through the old city centre [5]. Copenhagen is vulnerable to sea level rise and extreme weather, including heavy rain events and increased temperatures [1]. These hazards are projected to worsen with climate change. The built-up urban area and aged combined stormwater/wastewater system increased Copenhagen's vulnerability [5].

Meteorological projections for Denmark estimate that average seasonal precipitation will increase between 25-55% in the winter months by 2100 and decrease in the summer by 0-40% [2]. The intensity of rainfall events could increase by 20-50% [2]. The intensity of a 1 in 10-year flood event may increase by 30% by 2100, which could overwhelm existing sewage and runoff systems [2].

Between 2011 and 2016, Copenhagen, and the neighbouring municipality of Frederiksberg, experienced four major rainfall events that caused extensive damage. The July 2011 cloudburst event caused nearly one billion euros in damage [1]. The term cloudburst is used to describe a sudden intense rainstorm. The city developed a Cloudburst Management Plan to reduce the impacts of short, intense rainfall events [3].

This case study outlines how an existing suburb can be retrofitted to better withstand rainfall-induced flooding. It also highlights the importance of community engagement and allowing the community to contribute and test ideas that can then be implemented. It showcases that adaptation measures can be prioritised and integrated into planned works, then be implemented over decades.

3.2 APPROACH

The goal of the Cloudburst Management Plan was to protect the city from rainfall flooding and to integrate the plan into the wider effort to combine climate mitigation and adaptation strategies to reach carbon neutrality by 2025 in Copenhagen [4]. The Cloudburst Management Plan, introduced in 2012, assessed the costs of different measures, the cost of damage without the measures and the resulting financial impacts [3]. The city undertook detailed catchment modelling to inform their approach [4]. The assessment showed that focusing on innovative adaptation measures rather than combined stormwater/wastewater systems would lead to a better outcome for the community [3]. The plan included 300 adaptation projects and approximately 15 of these will be implemented each year, over a 20 to 30-year period [3]. An example of one of these projects is an experimental urban neighbourhood that was established so that citizens, NGOs and small businesses can develop local solutions for rainwater retention and other adaptation options [5]. A local centre for climate and neighbourhood regeneration was established to support the activities in the experimental urban neighbourhood by facilitating collaboration, sharing expertise, and fostering innovation [5]. The adaptation projects have also increased the adaptation knowledge and skills of the local administrators [2].

The projects were prioritised based on the area's flood risk, co-benefits and a socio-economic assessment to protect those most vulnerable [3]. Additionally, the prioritisation process considered ease of implementation and alignment with other urban development projects taking place [2]. The staggered approach to project prioritisation and implementation helps to overcome the challenge of accessing the funding and resources needed to implement all initiatives at once [2].

The adaptation projects used in Copenhagen included:

1. Creating stormwater conveyance along roads and within pipes that transport water to lakes and the harbour.
2. Green roads with floodable linear parks and gardens between the lanes of the road to detain water [3].
3. Implementation of green roofs as part of their Sustainable Urban Drainage System (SUDS) (referred to as Water Sensitive Design in New Zealand). Green roofs can absorb between 50% and 80% of annual rainfall received on a rooftop [7] and can slow down or prevent rainwater from reaching the drainage system.

Enghaveparken, as seen in Figure 3.1, is an example of a park in Copenhagen that has been enhanced to retain rainwater and increase amenity by implementing adaptation projects aligned to the Cloudburst Management Plan.

Figure 3.1: Enghaveparken in Copenhagen was transformed to hold up to 22,600 m^3 of rainwater [6].

Projects that prioritised blue-green infrastructure, stored water in the upper catchment and made use of overland flow were prioritised over increasing the size of the pipes [4]. Copenhagen's drainage system was also improved by separating rainwater from wastewater which increased the drainage system's capacity from managing a 1 in 10-year rainfall event to a 1 in 100-year event [5].

In 2017, the upgrades for the combined stormwater/wastewater system were expected to cost DKK 20 billion (~NZ$4.8 billion) compared to the DKK 13 billion for the solutions put forward in the Cloudburst Management Plan [3]. Residual losses from the stormwater/wastewater system upgrade approach were estimated to be DKK 4 billion [3]. It is uncertain whether the residual losses from the Cloudburst Management Plan have been quantified.

Part of the justification for the Cloudburst Management approach was that it would contribute towards increased property values, increased employment, urban space upgrades and increased tax revenues [3].

While developing the Cloudburst Management Plan, the City of Copenhagen coordinated with Copenhagen Energy, the City of Frederiksberg and neighbouring local authorities since all rainwater from an extreme rainfall event is discharged into sewage treatment plants or shared watercourses leading to the sea.

A 2015 cost breakdown[3] for the Cloudburst Management Plan estimated the following [2]:

- Surface solutions: estimated DKK 4.975 billion. These include detention roads, detention parks, and green roads. The costs of municipal and private co-financing projects will be reimbursed through water charges.
- Cloudburst pipes: transport water to the harbour and cost an estimated DKK 2.66 billion, covered through water charges.
- Disconnection and connection outside the property boundary: (assumed to be related to the separation of stormwater and wastewater systems) estimated DKK 1 billion, covered through water charges.
- Protection of homes with anti-flood backwater valves and disconnection within the property: estimated at around DKK 2.4 billion, financed by landowners.
- Urban space improvements: estimated DKK 1 billion and will be financed by the City of Copenhagen.

The construction estimate contains 20% for project planning and 20% for unforeseen expenses. The estimate does not contain depreciation and operating costs.

3.3 OUTCOMES

A combination of grey and blue-green infrastructure was chosen to reduce flood risk and offer the added benefit of enhanced mobility, recreation, safety, and biodiversity in the city [4]. Such projects also increased amenity by creating more meeting places and improved the microclimate [4]. The Cloudburst Management Plan has contributed to increasing property values and employment; the programme is expected to employ the equivalent of 13,000 people during the construction period. The council will benefit from increased revenue from property taxes from houses that increased in value.

[3] The estimated cost of the Cloudburst Management Plan increased from DKK 11 billion in 2015 to DKK 13 billion in 2017.

The City of Copenhagen Government pushed for a change in national-level legislation to use water-use fees, private financing, and taxes to invest in the water management system [1]. The City of Copenhagen worked with private-sector stakeholders, including insurance companies, to complete a cost-benefit analysis of various adaptation measures to justify significant budget allocation and to monetise actual and projected losses [1]. An approach like this could benefit other cities when the adaptation plan's financial requirements are larger than the amount available within the city's budget and where alternative funding sources are constrained [1].

The key success factors and learnings from the programme to date have included:

- The importance of securing strong political buy-in for change, triggered by several flooding events [1].
- Framing of the adaptation measures as opportunities to improve the city's green space, which created enthusiasm within the community and acceptance of major infrastructure works throughout the city [1].
- The use of a public-private financing scheme to fund the Cloudburst Management Plan which helped to prioritise and allocate responsibility for green scaping.
- A holistic approach to stakeholder engagement [1], which included extensive engagement of citizens, civil society groups, the public sector and the private sector.
- The benefits of combining multiple adaptation options and supporting innovative approaches.
- The importance of making the economic case for adaptation actions, including examining actual and prevented losses.
- Recognition that implementing larger-scale projects requires cooperation between municipalities and local landowners from the outset.

3.4 APPLICABILITY

The Copenhagen Cloudburst Plan incorporates processes and actions that are of relevance to South Dunedin:

- A mosaic of solutions has been used in Copenhagen and this approach may also be useful in South Dunedin.
- Increasing rainwater storage in the upper catchment can reduce the amount of water that pools in the lowest-lying areas.
- Allowing certain areas to flood resulting in decreased flooding in other areas. The adaptation options presented in this case study could be effective in South Dunedin while maintaining or even increasing public amenity land.
- Green roofs could be selectively implemented in South Dunedin.
- Some strategies outlined in the Cloudburst Management Plan could be a challenge in areas where groundwater levels are already very high, as there is little storage available for stormwater.

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4 RESIDENTIAL RETREAT – CHRISTCHURCH, NEW ZEALAND

CASE STUDY HIGHLIGHTS
The hazards being addressed in this case study are earthquakes, liquefaction and lateral spreading.
Connection to PARA framework: Avoidance and retreat measures were used, as land that was heavily damaged from an earthquake is being bought out. Protection measures are used for houses that are constructed on land susceptible to liquefaction in future earthquakes.
Adaptation options: In addition to retreat, grey engineering is used in this case study to rebuild or repair damaged houses.

4.1 CASE STUDY LOCATION OVERVIEW

The 'retreat' from the Christchurch red zone presents an opportunity to learn from New Zealand's largest scale example of residential relocation.

Christchurch and the wider Canterbury Region experienced damaging earthquakes in 2010 and 2011. The faults that ruptured were not well known or studied, and before these earthquakes, it was assumed that the Alpine Fault, about 100 km from Christchurch, was the greatest threat to the city [2]. At the time of the 2010 census, shortly before the earthquakes, the Canterbury Region's population was 565,800, 376,700 of whom lived in Christchurch [3].

The 4 September 2010 earthquake was magnitude 7.1 and occurred 40 km from Christchurch causing approximately NZ$5 billion in damages to infrastructure and buildings [2]. Due to the region's generally good building practices, there were very few injuries and no deaths directly caused by the earthquake [2].

On 22 February 2011, another earthquake occurred 6 km from the city centre. The earthquake was magnitude 6.3 and shallow – less than 5 km below ground. The earthquake led to one hundred and eighty-five fatalities, caused two buildings to collapse and 65,000 homes were damaged [2]. The reconstruction has been estimated to cost approximately NZ$40 billion and is still underway (2023). Between September 2010 and September 2012, over 4,400 aftershocks were registered [2].

In addition to the ground shaking associated with the earthquakes, Christchurch and the surrounding districts also experienced liquefaction, lateral spreading, rockfalls, and landslips. Much of Christchurch's eastern suburbs were constructed on reclaimed wetlands and areas near the Ōtākaro/Avon River. As a result, the eastern suburbs experienced extensive lateral spreading, land subsidence and liquefaction which caused major damage to infrastructure and houses [2]. The roads, water and wastewater pipes, powerlines and drainage systems were severely damaged [4]. It was decided that the damage was too extensive to repair many houses or to reconstruct houses in the same location [2]. A Crown package was announced that bought out properties in these areas [2].

4.2 APPROACH

The response to the Canterbury earthquakes was complex and drew from the lessons learned from other large-scale responses to natural hazards. Shortly after the September earthquake, the

Canterbury Earthquake Recovery Commission (CERC) was established to help speed up the recovery process by streamlining consenting and statutory powers were provided to them to assist with earthquake response [2]. Within a few months, Christchurch City Council was able to return to business-as-usual and most of the recovery work was completed by CERC and the central government [2]. After the February earthquake, CERC was dissolved and the Canterbury Earthquake Recovery Authority (CERA) was formed in March 2011 [2]. It was established alongside the Canterbury Earthquake Recovery (CER) Act 2011 which provided the CER Minister with a range of unilateral powers [2]. Some of these powers were to take land in the name of the Crown and acquire land compulsorily and suspend, amend, and revoke the whole or any part of some existing Acts or the plans and policies created under the Acts [2].

The CER Act also allowed the chief executive of CERA to [2]:

— Undertake or commission works. This included erecting, reconstructing, demolishing removing and disposing of any building.

— Control or prohibit access to any specified area including buildings, roads or public places.

— Subdivide, amalgamate, improve and develop all or any land acquired by the Crown.

— Purchase or otherwise acquire, hold, sell, exchange, mortgage, lease and dispose of land and personal property.

Since a large portion of Christchurch's housing stock experienced damage, a methodological process was needed to quantify the damage. Toka Tū Ake EQC created a process to determine region-wide damage followed by property-level damage that could be used for insurance claim settlements [4]. The damage assessments were used to zone all residential properties in the Canterbury region as either suitable or unsuitable for rebuilding [4]. In June 2011, CERA released maps that classified residential properties into one of four zones [4]:

— Green zones were deemed suitable for rebuilding.

— Red zones were deemed unsuitable for reconstruction because land repair would be "prolonged and uneconomic."

— Orange and white zones required further assessments and were classified as green or red zones in due course.

The zones were issued to provide certainty for homeowners and insurers regarding whether reconstruction could occur on the land [4].

The standards for repairs and reconstruction of houses in the green zones were set by the Department of Building and Housing in three categories [4]:

— Technical Category 1 (TC 1) are areas where future land damage from liquefaction is unlikely and ground settlements are expected to be within normally accepted tolerances.

— Technical Category 2 (TC 2) are areas where minor to moderate land damage is possible in future earthquakes.

— Technical Category 3 (TC 3) are areas where moderate to significant land damage from liquefaction, including lateral spreading, is possible in future large earthquakes.

Building foundation requirements were set out for each category.

A package to buy out insured residential properties in the red zone was announced alongside the maps that zoned properties in Canterbury [4]. The package had two options [4]:

1 The government purchases the land and buildings based on the most recent tax valuation and takes over the property's insurance claims.

2 The government purchases the land only based on the most recent tax valuation and the owner retains the building and the benefit of all insurance claims for building damage.

The offer was voluntary and property owners were not obliged to accept it; however, it was unclear what would happen to the property if it was not bought out [4]. The government also announced that there will not be new utility services installed in the red zone which added to the uncertainty about what would happen to property owners who did not sell [4]. The CER Act 2011 also granted the government power that could require property owners to sell their properties in the future at market value which could be lower than the offer made at the time [4]. In September 2012, the offer was extended to commercial property and vacant land within red zones [4]. By June 2013, 7,090 properties of the total 7,414 properties that were eligible for the buyout had accepted a Crown offer [2]. The cost to the central government to purchase and manage the red zoned land is estimated at NZ$678 million [2].

Throughout 2012 and 2013, planning was underway for the redevelopment of the central city which outlined the core government's sector activities and was used to attract investment from the private sector [2]. The regional Land Use Recovery Plan was also created and reviewed by the public which promoted Greenfields and intensification areas across the Canterbury region [2].

Under the CER Act, public consultation was required for all planning efforts [2]. The CERA Community Forum and Cross-Party Parliamentary Forum were two forums mandated by the CER Act to allow for local and national contribution and coordination [2]. Following the announcement of the zones, CERA immediately began a series of community meetings to inform the affected communities about the zones [6]. These community meetings required expert communication skills, expertise in community engagement, existing connections to the community, and trustworthiness [6]. An earthquake assistance centre was opened in Avondale, one of the worst affected suburbs, to provide information and advice for those receiving an offer from the Crown to purchase their land [6]. During the first year, the forums identified organisational challenges and CERA and Christchurch City Council faced criticism for a lack of meaningful engagement [2]. During the second year, two-way communication was improved by increasing the frequency of the Community Forum [2]. Two new community consultation forums were established in the second year for the red zone buyout program and the regional land use recovery plan [2].

4.3 OUTCOMES

The policies and procedures used for acquiring land were praised for promptly providing certainty for homeowners to relocate and recover. It was also criticised for having reactive and unclear reasoning for the decisions [2]. After the earthquake, residents who lived in red zoned areas had trouble finding housing that was comparably priced to the money they expected to receive from the government buyout [4]. The population shifted in the region and urban planning could not keep up [4]. Some areas experienced population increase without adequate roading and utilities to service the community [4]. Red zones became vacant, and concerns about crime and vandalism increased [4]. Christchurch did experience a short-term increase in crime rates immediately following the 2011 earthquake; however, all crime rates in Christchurch, except domestic violence, decreased between July 2008 and June 2013 [7]. New Zealand Police officials reported that crime in the Residential Red Zones had been adequately managed [7].

For those who could remain in their damaged houses, repairs proved expensive, particularly for those in TC3 land that requires geotechnical investigations and foundation designs [4]. The resale value for TC3 land could decrease and lead to neighbourhood decline [4].

Since the earthquake, there has been notable population movement. Christchurch experienced migration outside the district after the earthquake but regained its pre-earthquake population by

2017. Neighbouring Waimakariri and Selwyn District Councils also experienced a population boom following the earthquake, with those displaced in Christchurch moving to smaller satellite towns on the fringe of Christchurch. For example, Selwyn has the highest rate of housing consents granted in New Zealand in 2021 [5].

From 2013 onwards, there was a spike in the number of new houses and replacement housing gaining consent in Christchurch [1]. From 2014 to 2016, a significant portion of housing consents were for replacement housing, while new housing has continued to follow an upward trend into 2022, when more than 4,000 new house consents were granted [1].

Shortly after the earthquake, engineers suggested that the entire red zone area surrounding the Avon River could be remediated to mitigate liquefaction to allow for residential redevelopment, although this has not occurred [4]. Remediation techniques include grouting and soil consolidation but can only be applied to large areas of vacant land [4]. It was also suggested that the red zone around the Avon River could be transformed into a permanent open space, which more closely aligns with what has occurred to date (2023). The red zone currently remains relatively untouched, after homes and fences were demolished. The land is used as a park, and some community gardens have been established.

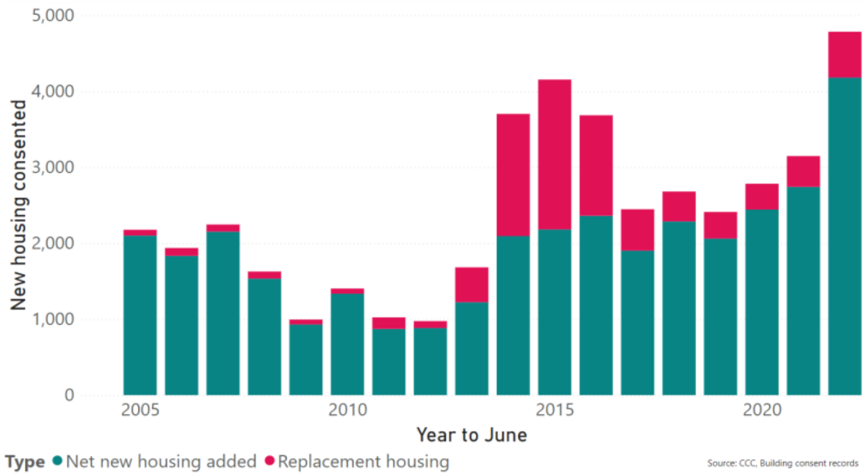

Figure 4.1: Housing consents granted by Christchurch City Council each year.

4.4 APPLICABILITY

There are lessons from the Christchurch experience that can provide insight for communities responding to ongoing flooding and groundwater rise [2]. These lessons are as follows:

— Creating a new organisation within the government, or significantly rearranging existing organisations to increase capacity to manage the recovery and reconstruction caused by large-scale events, leads to better outcomes [2]. Staff outside the designated organisation can continue with their business-as-usual work and those within the designated organisation can prioritise the recovery work [2].

— There is a political risk to the different levels of government if they do not respond with urgency and consensus [2]. The true power of the recovery is held by the level of government that controls the flow of money and how it is acquired, allocated, dispersed and audited [2].

— Planned (pre-emptive) retreat creates an opportunity to establish a vision for the vacated land, which can be challenging in a reactive post-event context such as the Christchurch red zone.

— The red zone experience highlights the need for community engagement to start early, regularly and meaningfully. CERA and Christchurch City Council adapted their approach to social engagement by increasing the frequency and number of public forums available for engagement.

- Those implementing the engagement should have experience in community-facing roles [6]. Those with technical knowledge of the hazard can support but may not have the specialist skills required to implement the engagement on their own.
- Including high-ranked public figures in the delivery of key messages can also be effective [6].
- In Christchurch, the community was given clarity as soon as possible about whether their land was suitable for repairs or redevelopment. The geotechnical maps and zoning maps were released only a few months after the earthquake and concurrently for all affected areas.
- Although some houses still needed further assessment to determine whether they were in a green zone or red zone, most houses were categorised promptly, providing clarity for most residents.

The process of buying out land that is not suitable for redevelopment could be applied in other locations. In areas where the impacts of natural hazards are progressing slowly over time, the buyouts do not need to happen over a short period, as was the case in Christchurch. Instead, properties could be bought out over time as they become available. Such approaches will need to account for the potential impacts on property prices as buyouts increase.

Classifying land into different zones with various levels of risk can be used in flood-prone areas. Zoning can determine areas that are not suitable for future development and place restrictions or timeframes for development on land that is currently liveable but may face an unacceptable level of risk in the future.

The retreat from the Christchurch red zone emphasises the need for plans to be in place regarding where households can relocate to, including the importance of having sufficient capacity within the planning system. It also highlights the need for investment in infrastructure and public services where relocation leads to a sudden increase in population elsewhere.

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5 LONG BAY DEVELOPMENT - AUCKLAND, NEW ZEALAND

CASE STUDY HIGHLIGHTS
The climate hazard being addressed in the case study is rainfall induced inland flooding.
Connection to PARA framework: In this study flooding is being avoided and stormwater is being managed (protect). Some areas are allowed to flood, and drainage is being improved.
Adaptation options: Blue and green engineering is used in this case study, including largescale earthworks and wetland development.

5.1 CASE STUDY LOCATION OVERVIEW

Long Bay is a 162-hectare master-planned urban development, located on the east coast of Auckland's North Shore. It showcases a New Zealand-based example of urban design which has worked with the natural environment to accommodate rainfall-induced flooding and preserves the natural landform on a suburban scale. Phase one of Long Bay was planned and constructed between 2012 and 2022 [1]. Construction is ongoing at the northern reaches of the Long Bay development in the second phase.

Manmade wetlands were added into Long Bay's design to retain stormwater and the council appealed the initial development plan in the Environment Court when the watercourses were threatened with degradation. This case study highlights that leaving sections of a suburb undeveloped can improve flood protection for the surrounding area.

Located 25 km north of the Auckland CBD, the Long Bay suburb surrounds a central shopping precinct including a supermarket, eateries and medical centres. A bus line traverses through the main street of Long Bay – Te Oneroa Way which connects to State Highway 1. Long Bay had a population of 1,365 in the 2018 census [3]; however, the number of residents in 2023 is expected to be greater, as a lot of the development was completed post-2018. In 2018, 50% of residents worked full-time and the unemployment rate was 2.8% [3]. Homeownership in the suburb was 55.6% in 2018 and a further 21.7% of homes were held in a family trust [3].

5.2 APPROACH

The Long Bay development used an environmentally responsive approach throughout its planning and implementation, due to its proximity to several sensitive natural areas including the Okura Marine Reserve, Long Bay Regional Park, Vaughan's Creek and Awaruku Stream [1]. The development aimed to find the right balance between efficient land use and maintaining and enhancing the natural environment. The development features 28 hectares of parkland dispersed throughout the approximately 2500 single and multi-unit homes [1]. Upon completion, Long Bay is expected to be home to up to 5000 residents [4].

When designing the Long Bay development, higher-density areas were put in places of lower environmental sensitivity and locations which were less exposed to climate hazards. More sensitive areas were developed less intensively or not at all. This approach was reflected in the objectives outlined by Boffa Miskell [2], who completed the landscape architecture, which included [2]:

- Restore an ecological stream and wetland to manage stormwater.
- Allow for open space design within existing floodplains, stream corridors, and steep slope areas.
- Design streetscapes and open places that connect communities through safe and pleasant pedestrian routes.
- Use of native planting within wetlands, parks and streetscapes (Figure 5.1).

Figure 5.1: A wetland and walking path in Long Bay. The wetland is used to retain excess rainwater.

Long Bay has been targeted for development since the early 2000s. Before the current development was constructed, an alternative plan was proposed that used traditional development approaches that did not prioritise the fragile natural environment that encircles the current Long Bay neighbourhood or address future climate-related risks. The development that was originally proposed would have led to Vaughan Stream being further eroded and degraded. Auckland Council opposed environmental degradation through the resource consenting process (including the Environment Court). Subsequently, the masterplan and engineering solutions were refined leading to better alignment between stakeholders and developers. Since the watercourse was prioritised, less land was able to be developed and a significant proportion was left as natural park areas.

Long Bay is located between two floodplains from the Vaughan Stream to the north and Awaruku Creek to the south. Most of the development is outside the floodplain on elevated land. The land is steep and has a history of deep (about 20 m) landslips in the area, which is common along the east coast of northern Auckland. Additionally, there are numerous overland flow paths identified throughout the development that have runoff during storms. When planning the development, landslips and stormwater flooding were identified as risks to be managed.

The adaptation measures taken to address flooding are the focus of this case study; however, it is worth noting that significant earthworks were required to improve ground stability. When carrying out the earthworks, the natural topography was maintained, when possible, to reflect the natural landform [1]. Flood models were used to determine areas that were prone to flooding within Long Bay and assessed how grading could help prevent flooding. Land use planning and catchment planning methods were used in tandem to inform the development. A sediment management plan and catchment stormwater runoff plan were created for the site. These plans were well received by the developer and guided engineers when designing Long Bay.
The streets are designed to capture rainwater through green infrastructure (i.e. rain gardens, and swales) which has the added benefit of treating the stormwater before it reaches the wider environment [1]. An integrated treatment train for stormwater was implemented in the design. The treatment train is a blend of sequential stormwater management devices beginning with stormwater runoff controls at the source, followed by additional treatment devices throughout the catchment [1]. The last step in the Long Bay treatment train is a stormwater wetland at the bottom

of the catchment [1]. Flood modelling was carried out to ensure that the wetlands would not be damaged or destroyed during a large storm and that there was adequate capacity to prevent flooding to houses and infrastructure. Examples of stormwater management strategies used in Long Bay are shown in Figure 5.2. Some of the stormwater management features used in the stormwater treatment train include [1]:

— Rain gardens to capture stormwater primarily from private driveways. They help remove pollutants as water filters into the ground. They also help slow down stormwater flow into the piped network to reduce the volume at peak flow.
— Swales are used to collect stormwater from roads and convey it to the piped stormwater network.
— Plantings around Vaughan's Stream which can help reduce bank erosion and flooding.
— Plantings on slopes help treat water by capturing and holding stormwater and allowing it to permeate the ground.
— The Awaruku wetland was constructed as a part of the design to store stormwater runoff from Long Bay. Stormwater enters the wetland before entering the Awaruku Stream and the sea. An existing area was remediated and re-vegetated to improve and enhance the natural qualities of the area. The wetland is also a public park to improve overall amenity for the area.

Figure 5.2: Stormwater management features used in Long Bay A. Rain gardens line residential streets B. Rain gardens with mesh and stones C. Garden Street with a large rain garden at the end of a cul-de-sac D. Wetland constructed to retain stormwater runoff.

Additional design considerations were made for the stormwater management features. Rain gardens and swales were designed to prevent soil scouring by ensuring rainwater enters them with low impact [1]. The rain gardens are further protected with rocks and mesh to act as a buffer before the water reaches the planted area.

Leading up to the Environment Court case, there was extensive consultation with the community. The council regularly presented to the community to keep them informed.

5.3 OUTCOMES

The Council and developer were able to find a solution for building on land that had a challenging hazardscape to manage; however, the solution was costly and took several years. Some other lessons learned from the project are as follows:

— Bioretention areas in the development need to be regularly maintained to maintain flow and increase amenity. The wetland in Long Bay is stagnant at times, as shown in Figure 5.3.

- Monitoring should occur throughout and after construction to assess the consequences of the development in this area. These lessons can be applied to future developments and intervention can be made if there are negative consequences.
- A strong policy background is needed when assessing and approving developments, and councils need to hold their ground even if they receive push-back from developers.
- The scheme made good use of expert insights on innovative stormwater management in urban design.
- Guidance about water-sensitive design could have supported this scheme in ensuring that environmental effects are considered when developing land.

Figure 5.3: Notice at Long Bay notifying residents that the pond is stagnant during dry conditions and that the dark colour and odour are normal

5.4 APPLICABILITY

South Dunedin can benefit from the lessons learned in this development, for example, how urban planning can improve the stormwater management of an area, increase amenity and lead to better outcomes for the natural environment.

The case study differs from South Dunedin's context as the works to improve stormwater runoff were carried out before the land was developed. However, this development utilises principles and approaches that could be applied in other locations like South Dunedin, including the following:

- By assessing risk and environmental sensitivity the developers were able to 'make space for nature' while achieving residential development objectives.
- This approach was supported by using different residential densities across the site.
- The creation of a wetland corridor including walkway and native planting, illustrates how water might be incorporated into the urban form for a large site regeneration programme.
- Increased planting was used to retain stormwater and could help reduce peak flow and reduce flooding after heavy rainfalls.
- Integrating blue and green infrastructure in the urban design can collect and manage stormwater.

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6 RELATED CASE STUDIES

While compiling the case studies presented in this document, numerous other case studies and guidance materials were found that could be relevant for South Dunedin to explore. They are presented in Table 6.1.

Table 6.1 Other relevant material

NAME	DESCRIPTION	RELEVANCE
Design Guidance for Flood Resilient Homes, Queensland Government	The guidance outlines steps that can be taken to reduce flood impacts on properties.	The guidance could be applied to flood-prone houses in other areas, for example, South Dunedin.
City of Philadelphia Green Street Design Manual	Highlights various stormwater management practices being used throughout the city.	Able to communicate the projects occurring throughout the city to residents. Assesses the suitability of the practices for different road types.
Philadelphia Stormwater: Best Management Practices	An ArcGIS Story Map outlining the stormwater issues in the city with interactive maps.	An example of how projects across the city can be shown to the community while educating them about the flood hazard.
Adaptation Good Practice (AGP) case studies	A catalogue of adaptation projects that have taken place in Australia organised by categories.	List of case studies focusing on community engagement, identifying, and testing adaptation approaches, and planning for adaptation.
Sustainable Urban Drainage Systems: Themes of Public Perception—A Case Study	A Norwegian city implemented a green corridor to reduce flooding, but it was not adequately maintained and led to the community concerns.	Shows the importance of ongoing maintenance and investment into projects. Includes comments from the public.
WSUD Case Study: Talbot Park	Water-sensitive urban design techniques used for a residential development in Auckland.	Redevelopment of a community, including lessons learned from the process.
Flooding from rising groundwater	Tauranga City has been monitoring groundwater levels at Mt. Maunganui and Pāpāmoa area for over 15 years.	Insight about how other cities in New Zealand are monitoring groundwater.
Project Twin Streams case study: Large-scale property purchase without recourse to compulsory purchase	A project that aimed to restore 56 km of Waitakere Stream in Auckland to reduce flood risk.	Includes partial and full property buyouts without having to invoke mandatory acquisition.
Managed retreat as a response to natural hazard risk	Provides a conceptual model to understand different experiences with managed retreat.	Includes additional reading for several cases of retreat across the world.
Implementing pre-emptive managed retreat: Constraints and novel insights. Current Climate Change	Focuses on pre-emptive managed retreat, including examples how it can be sequenced, socialised and implemented.	Provides guidance about managing stressors associated with managed retreat.

Cascading climate change impacts and implications	A research project that explores the effects of cascading hazards will affect New Zealand, for example, transport links, infrastructure, agriculture, and the economy.	South Dunedin is exposed to a range of hazards which can have cascading effects to the community.
Formulating a 100-year strategy for managing coastal hazard risk in a changing climate: Lessons learned from Hawke's Bay, New Zealand	Highlights the importance of deliberative, flexible, and transparent governance processes that can enable collaboration amongst Māori, local and region-wide stakeholders. The process should be consistent with and supported by the national governmental frameworks, and regulatory and non-regulatory measures.	Guidance for tailoring adaptation planning and decision making so it is relevant for South Dunedin.
Coastal Adaptation: Adapting to coastal change and hazard risk in Aotearoa New Zealand	Guidance for adapting to coastal hazards in New Zealand.	A variety of resources including: — Planning and policy frameworks — Engagement, collaboration and partnership guidance — Advances in coastal science — Tools for adapting to coastal change in urban and built environments
Enabling Coastal Adaptation using current legislative settings	This report outlines how current planning and related legislation can be used to transition to adaptive planning practice based on Dynamic Adaptive Pathways Planning (DAPP) to help avoid further lock-in of developments in areas at risk from coastal hazards including sea-level rise.	Can inform DAPP pathway development for South Dunedin.

7 RECOMMENDATIONS

While it is not the objective of this report to make specific recommendations in terms of adaptation options, there are a number of opportunities to further explore good practices for the duration of the project.

1) Maintain and build links to those involved in the implementation of the case studies: There are opportunities to continue dialogue and expand peer-to-peer learning with regard to adaptation options. For example, an engineer who worked at Auckland Council during the construction of Long Bay has offered to present their experiences to the SDF team, while partners in Queensland, Australia, were also willing to engage directly with DCC. We acknowledge that DCC and ORC will already have an extensive network of expertise and experience within New Zealand and beyond, but Kia Rōpine could facilitate further dialogue or provide additional analysis if needed.
2) Deep dives into specific adaptation options that emerge through the shortlisting process. As the list of adaptation options is refined, the project may benefit from a more comprehensive study of examples from other locations. For example, planned retreat options could be considered in greater detail, including consideration of relocation sites and master planning approaches. To date, much retreat has been focused on post-disaster relocation; however, planned retreat is a fast-evolving area of focus for local governments across the world.
3) Adaptation Futures Conference 2025. Christchurch is hosting the Adaptation Futures Conference in 2025. This is the leading global adaptation conference and could present an opportunity for South Dunedin to facilitate a session on specific options that are emerging from this process. This could bring together the leading minds on issues such as planned retreat, with a focus on experiences and lessons from across the world.

SOUTH DUNEDIN FUTURE

WORKSTREAM 4: ADAPTATION

STAGES 1 & 2: LONG LIST OF GENERIC ADAPTATION APPROACHES

- CONTEXT SUMMARY REPORT

29 NOVEMBER 2023

SOUTH DUNEDIN FUTURE
GENERIC LONG LIST CONTEXT SUMMARY REPORT

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GLOSSARY/ACRONYMS

Term / Acronym	Definition
Accommodate (for PARA framework reference purposes)	The process of making adjustments or modifications to systems, infrastructure, policies and practices to cope with the impacts of climate change in place. This involves implementing measures such as changes to buildings and infrastructure that enhance resilience, thereby not changing exposure to hazard extents but reducing vulnerability to changing climatic conditions, ensuring societies can adapt effectively.
Adaptive Capacity	The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.[1]
Avoid (for PARA framework reference purposes)	Minimising exposure by staying away from areas at risk (or where risk is above an acceptable threshold).
Climate Adaptation (also referred to as Adaptation)	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.[2]
Climate Change	Climate change refers to a change in the state of the climate that can be identified (for example, by using statistical tests) by changes or trends in the mean and/or the variability of its properties, and that persists for an extended period, typically decades to centuries. Climate change includes natural internal climate processes or external climate forcings such as variations in solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land-use.[3]
Climate Hazard	The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.[1]
Compound hazards and stressors	Combined occurrences of multiple hazards and stressors (that is, cumulative hazards) which will become more significant in the future as adaptation thresholds are reached, for example, for a low-lying coastal area, a persistent wet season (high groundwater, reduced field capacity) is followed by a coastal storm on the back of sea-level rise, coinciding with intense rainfall, leading to compound flooding impacts.[4]

[1] ISO 14090:2019 (Adaptation to Climate Change)
[2] ISO 14090:2019 (Adaptation to Climate Change) and IPCC definition as per IPCC, 2014: Annex II:
[3] IPCC (2014) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
[4] Ministry for the Environment (2019). Environment Aotearoa 2019: New Zealand's Environmental Reporting Series. Wellington. Ministry for the Environment. Retrieved from https://www.mfe.govt.nz/publications/environmental-reporting/environment-aotearoa-2019.

Term / Acronym	Definition
Criteria	Critical success factors, principles, standards and strategic objectives used to assess and compare approaches.
DAPP	Dynamic Adaptive Planning Pathways, a series of actions which provide a way to act now in the face of uncertain futures, and make decisions early to alter adapt actions over time in response to changing social, environmental, or other factors
DCC	Dunedin City Council
Exposure	The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by a change in the external stresses a system is exposed to. In the context of climate change these are normally specific climate and other biophysical variables.[9] The number, density or value of people, property, services, or other things of value that are present in an area subject to one or more hazards (I.e., within a hazard zone), and that may experience potential loss or harm.[5]
Flooding	The covering or submergence of an area of land below water. In the context of this report, flooding includes coastal flooding (temporary submergence during storm events), coastal inundation (when sea levels rise and the land is now intertidal or permanently submerged), surface or pluvial flooding (caused by rainfall events), and groundwater flooding (when groundwater rises and emerges above the surface). The report does not include riverine or fluvial flooding due to geography of South Dunedin.
Green infrastructure	Green infrastructure refers to the use of natural and semi-natural elements in infrastructure planning and design. It involves utilizing and enhancing the existing natural systems, such as forests, wetlands, rivers, and green spaces, to provide multiple benefits for both the environment and society, including to manage flooding.
Hard infrastructure	Hard infrastructure is typically characterized by physical structures, engineered systems, and technological components. Also known as grey infrastructure.
Hazard	The potential occurrence of a natural or human-induced physical event, trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.[3] Natural hazards refer to naturally occurring events or phenomena. These hazards are typically beyond human control and result from natural processes such as geological, meteorological, hydrological, or biological forces.

[5] Ministry of Civil Defence and Emergency Management. (2019). National Disaster Resilience Strategy. Retrieved from https://www.civildefence.govt.nz/assets/Uploads/publications/National-Disaster-ResilienceStrategy/National-Disaster-Resilience-Strategy-10-April-2019.pdf.

Term / Acronym	Definition
Intergovernmental Panel on Climate Change (IPCC)	Intergovernmental Panel on Climate Change – a scientific and intergovernmental body under the auspices of the United Nations.
Integrated Systems Planning (ISP)	Integrated Systems Planning provides a 50 year strategy for the three waters systems operated by DCC.
Land use	Refers to the purpose or activity for which a particular area of land is utilised or managed. It describes how land is allocated and used by individuals, communities or institutions for various specific purposes, such as residential, commercial, agricultural, industrial, recreational or conservation purposes.
Land use change	The process or transition from one type of land use to another within a specific geographical area. It involves altering the purpose or activity for which a particular piece of land is utilised, leading to shift in its functional character and associated activities.
Liquefaction	Liquefaction is a phenomenon that occurs in saturated, loose, or poorly compacted soil during seismic events, such as earthquakes. It refers to the transformation of solid soil into a liquid-like state, temporarily losing its strength and ability to support structures and foundations.
Mana Whenua	Refers to the authority, power and connection to the land that Māori hold as traditional custodians.
Mātāwaka Māori	Māori living in the Ōtepoti Dunedin region who are not mana whenua.
Mātauraka	Māori knowledge or ways of knowing
Mahika kai	Garden, cultivation, food-gathering place
MCA	Multi-Criteria Assessment
MfE	Ministry for the Environment
Nature-Based Solutions	Nature-based solutions (NBS) refer to actions that utilize or mimic natural processes to address societal and environmental challenges. They involve working with nature rather than against it and recognising the value of natural systems in providing essential services and resources.
ORC	Otago Regional Council
Adaptation Pathways	Sequences of actions or options over time to reduce risk of climate change impacts

Term / Acronym	Definition
PARA Framework	The PARA (Protect, Accommodate, Retreat, Avoid) Framework provides four strategies or categories through which to manage risk and adapt to climate change. Definitions of the categories under 'PARA' are provided individually in the glossary. There are growing trends to add a fifth category – Re-purpose – to include options for re-purposing land use after hazards change the character of the site. This category is included within the context of retreat (e.g. post-retreat actions) herein.[6][7]
Protect (for PARA framework reference purposes)	Building physical measures in place, thereby changing the extent of hazards.
Representative concentration pathway (RCP)	A suite of representative future scenarios of additional radiative heat forcing at the Earth's surface by 2100 (in Watts per square metre), which is the net change in the balance between incoming solar radiation and outgoing energy radiated back up in the atmosphere. Each RCP can be expressed as a greenhouse gas concentration (not emissions) trajectory adopted by the IPCC for its Fifth Assessment Report (AR5) in 2014.[3]
Retreat (including proactive managed relocation/retreat, and reactive retreat) (for PARA framework reference purposes)	Managed retreat or managed relocation refers to purposefully moving away from areas where the risk is too high, noting that retreat is not a 'do nothing' approach but can be an opportunity for regeneration and that these opportunities need to be proactively identified. Reactive retreat refers to moving away from areas after a climate event has occurred that has made the area unsafe/uninhabitable. Retreat includes the re-purposing of land (land use change).
Resilience	The capacity of social, economic, and environmental systems to cope with a hazardous event, trend or disturbance by responding or reorganising in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.[3]
Risk	The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends, multiplied by the impacts if these events or trends occur. The term risk is used to refer to the potential, when the outcome is uncertain, for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure. Risk results from the interaction of hazard, exposure and vulnerability.[3]

[6] Kool et al (2020) https://doi.org/10.3390/infrastructures5110092
[7] White et al (2023), https://doi.org/10.1016/j.gecadv.2023.100002

Term / Acronym	Definition
Risk Assessment	The overall qualitative and/or quantitative process of risk identification, risk analysis and risk evaluation, with multiple entry points for communication and engagement and monitoring and reviews (AS/NZS ISO 31000:2009, Risk Management Standard).
SDF	South Dunedin Future programme
Sea Level Rise	Sea level rise refers to the long-term increase in the average global sea level relative to the land. It is primarily driven by two main factors: thermal expansion of seawater and the melting of land-based ice, including glaciers and ice sheets.
Seismic hazards	Seismic hazards refer to potential sources of harm or risk associated with earthquakes and related phenomena. These hazards are specifically concerned with the geologic activity and movement of the Earth's crust, which can result in seismic events such as earthquakes, liquefaction aftershocks, tsunamis, and ground shaking.
Sensitivity	The degree to which a system or species is affected, either adversely or beneficially, by climate variability or climate change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).[8]
Shared SocioEconomic Pathway (SSP)	A collection of pathways that describe alternative futures of socioeconomic development in the absence of climate policy intervention. The combination of SSP-based socio-economic scenarios and RCP based climate projections, should provide a useful integrative frame for climate impact and policy analysis.[9]
STAT	Signals, triggers and adaptation thresholds
Three waters	Three waters refers to drinking water, wastewater and stormwater infrastructure.
Threshold	A critical limit where a system responds drastically when exposed to an external forcing, resulting in the system changing into a different state.
Uncertainty	A state of incomplete knowledge that can result from a lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from imprecision in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour.[3]
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.[3].

[8] IPCC definition as per IPCC, 2014: Annex II:

[9] IPCC (2023); Glossary of terms https://www.ipcc-data.org/guidelines/pages/glossary/glossary_s.html

1 INTRODUCTION

1.1 SOUTH DUNEDIN FUTURE PROGRAMME

South Dunedin is a low-lying coastal area vulnerable to flooding, particularly due to intensifying rain events, rising sea levels, coastal inundation and erosion and groundwater as the climate changes. Seismic hazards such as earthquakes, landslides and liquefaction also present a risk. The South Dunedin Future (SDF) programme is a collaborative initiative between the Dunedin City Council and Otago Regional Council to develop and implement a long-term (100+ years) adaptation strategy for the area. The SDF programme purpose is "to enable South Dunedin to prepare for, and adapt to, the impacts of climate change, while also realising the opportunities that come with change."

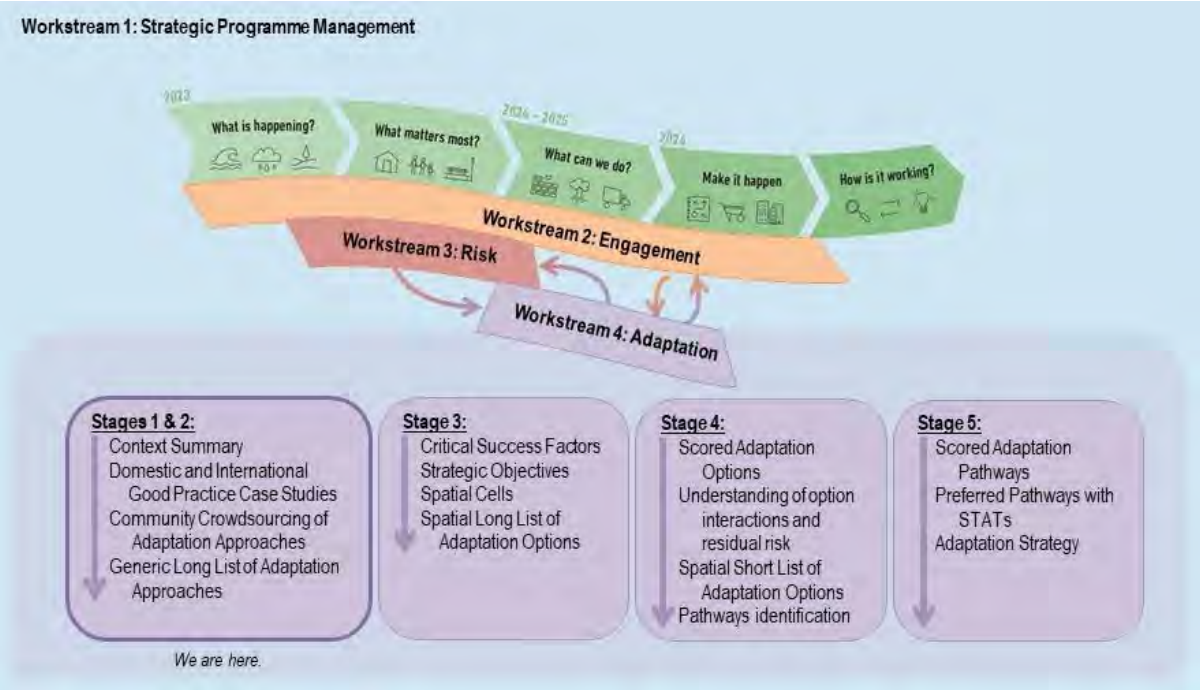

Figure 1: Programme Overview (note STATs are signals, triggers, adaptation thresholds)

Within SDF, the *Adaptation Workstream* is informed by the engagement and risk workstreams and consists of five stages, as shown in Figure 1:

- Stage 1: Review of Domestic and International Good Practice Case Studies and identify programme objectives,
- Stage 2: Develop a long list of generic adaptation approaches,
- Stage 3: Develop a spatial long list of adaptation approaches,
- Stage 4: Develop a spatial short list of adaptation approaches, and
- Stage 5: Develop preferred pathways and an adaptation strategy for South Dunedin.

This report presents the progress, findings, and challenges of Stage 1 to identify strategic objectives while also framing Stage 2, presenting the generic long list of adaptation approaches. This report builds on the risks identified in the South Dunedin Future Risk Identification Report (2023) and uses these findings to help inform the potential adaptation approaches for South Dunedin. The Domestic and International Good Practice Case Studies Report has informed the generic long list development process and is included as an appendix (Appendix A-3). This, alongside the risk and community engagement workstreams, provides a baseline of "what is happening?" and "what matters most?", and a foundation for the continued development of the SDF programme ("what can we do?"). The long list of generic adaptation approaches presented in this report will be refined over the course of the programme as shown in Figure 1. At the end of the Adaptation Workstream during the 'What can we do about it' stage for the South Dunedin Future programme, an adaptation strategy for South Dunedin will be recommended to DCC and ORC for approval and then implementation.

1.2 REPORT SCOPE

The objectives of this report are as follows:

- Provide a high-level overview of the project context, namely the project's "problem definition" and draft strategic objectives;
- Present a summary of the proposed methodological approach for the adaptation workstream with a focus on the overarching frameworks, with detail to be developed as the SDF programme continues; and
- Outline the considerations/factors informing the long list of generic adaptation approaches building on site specific investigations over the past decade, including the long list itself and its development process.

Appendices to this report include:

- Fact sheets for each of the 16 generic adaptation approaches (Appendix A-1)
- An indicative list of reports reviewed in the generic long list development (Appendix A-2)
- Domestic and International Good Practice Case Studies Report used for interrogation of approaches and inspiration for implementation (Appendix A-3).

2 SOUTH DUNEDIN FUTURE PROGRAMME AREA

2.1 SOUTH DUNEDIN FUTURE PROJECT BOUNDARIES

2.1.1 GEOGRAPHIC AREA

The project area lies within the low-lying flat area between the Otago Harbour, St Clair, Middle and St Kilda beaches, Dunedin's city, hill suburbs, and the Otago Peninsula. The boundaries of the project area on the western and eastern sides are roughly approximated by the 4 mRL elevation contour. The project area extends from the harbourside to the South Coast on the Pacific shoreline and includes the suburbs of South Dunedin, St Kilda North and St Kilda South, parts of St Clair, Caversham, Tainui and Musselburgh (Figure 2).

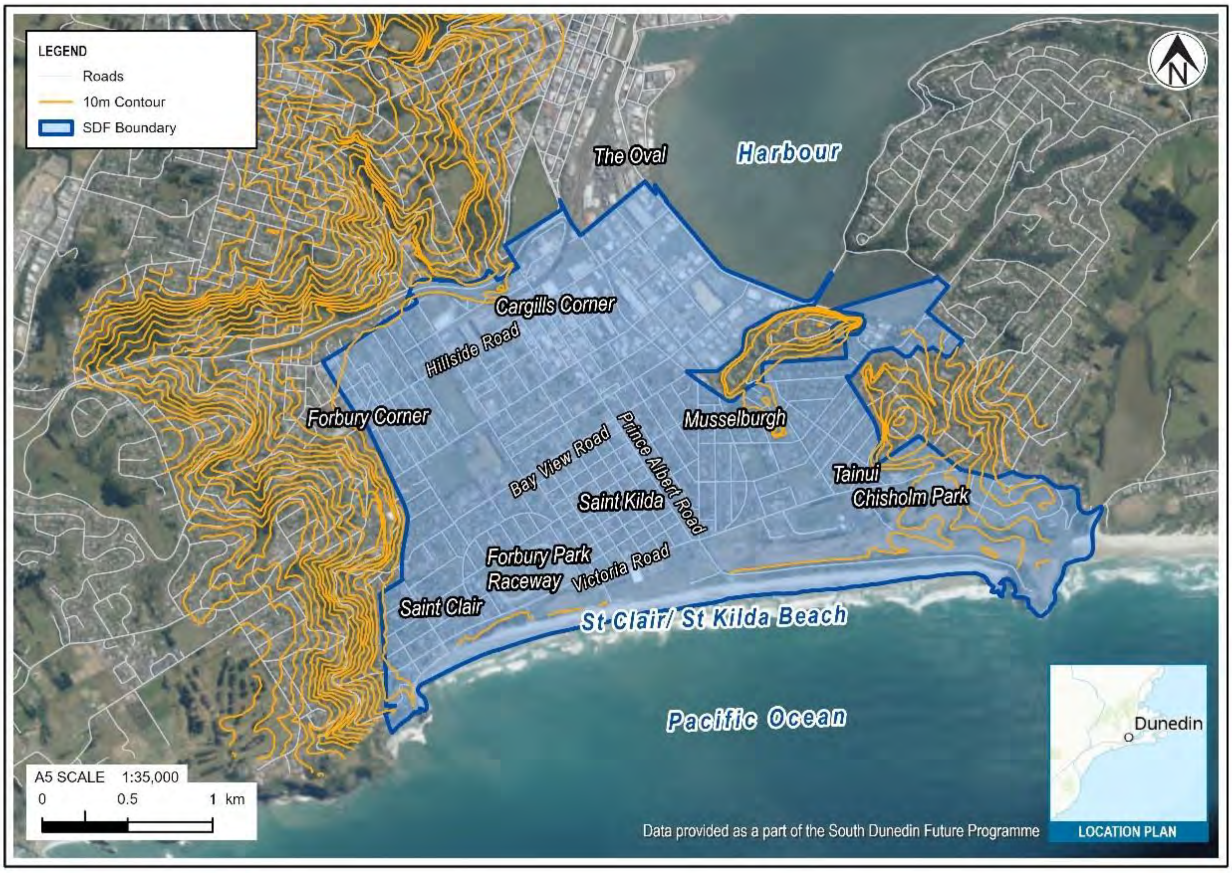

Figure 2: South Dunedin Future project area (in blue)

2.1.2 INTERACTING ONGOING WORK

South Dunedin is home to approximately 10% of Dunedin's population and provides schools, cultural and recreational facilities, and other key city infrastructure. As such, decisions made in South Dunedin will impact the wider area. There are several ongoing programmes which will inform or be informed by the SDF programme as set out in Figure 3.

South Dunedin faces an array of natural hazards and climate related risks, including some that stem from or relate to St Clair – St Kilda coastline. Given the complex nature of this coastal system, and the immediate risks presented by coastal erosion, a dedicated programme was created for the St Clair – St Kilda Coastal Plan | Whakahekerau – Rakiātea Rautaki Tai. The direct and indirect influences of hazards and risks arising at St Clair – St Kilda coast are material for wider South Dunedin and are therefore also within the wider scope of the SDF programme. Adaptation options for the South coast have already been identified and are being evaluated in parallel by this Coastal Plan and so have not been included within the South Dunedin Future longlisting process. Management of the St Clair to St Kilda shoreline is intrinsically linked to land use in the hinterland, and the project teams will collaborate accordingly to develop a holistic strategy. Consideration of how respective longlists of adaptation approaches can be integrated in the future is ongoing so as to ensure overall coherence and better outcomes for South Dunedin. This will be explored more fully in subsequent stages of the South Dunedin Future programme and Coastal Plan.

Consistent with the Ministry for the Environment Interim Guidance on the use of new sea-level rise projections (2022), the adaptation strategy will provide adaptation pathways extending 100 years into the future.

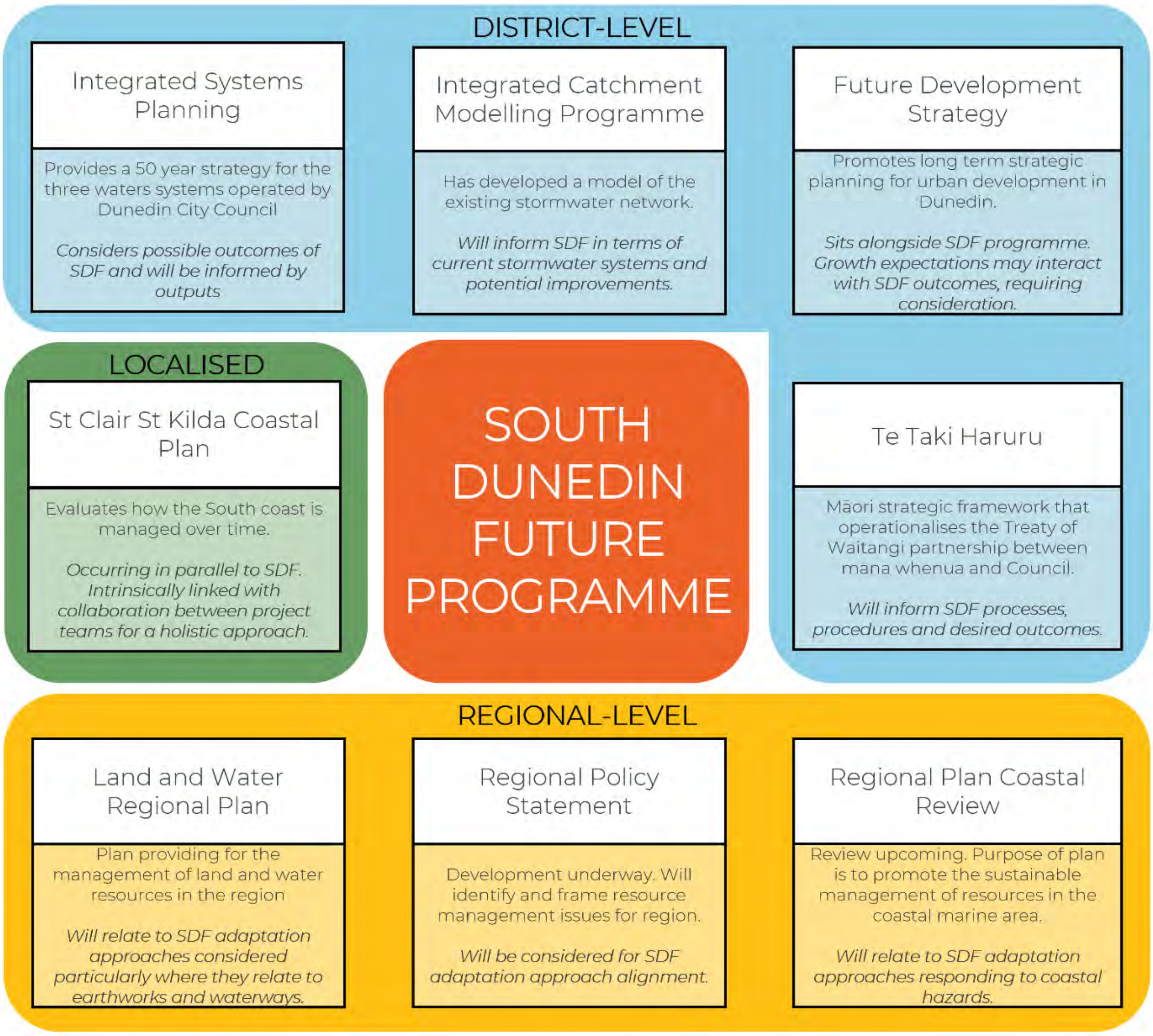

Figure 3: Interactions of ongoing programmes with South Dunedin Future programme (SDF)

2.2 MANA WHENUA CONTEXT AND PARTNERSHIP

The South Dunedin area is within the rohe of Te Rūnaka o Ōtākou and the Kāi Tahu iwi. While the Ōtākou Marae is on Muaupoko (Otago Peninsula), the South Dunedin area was an important site for Ōtākou with evidence of their presence dating back to the 13th and 14th centuries (with the Sydney Packet arriving in 1836 and signing of the Treaty of Waitangi in 1840). The historic wetland area (now South Dunedin) was a moa butchery as well as a tuna (eel) fishery.

In this report, and in subsequent reports, Kāi Tahu place names[10] will be used alongside English names, these include:

- Ōtepoti | Dunedin (George Street area in particular)
- Te Rakiātea | Tahuna
- Whakahekerau | St Clair beach
- Te Rakiātea | Musselburgh
- Kaituna | Bathgate (historically was a lagoon near the Gas Works)
- Puketai | Andersons Bay

The Ōtākou | Otago Harbour is an important water body for both Te Rūnaka o Ōtākou and Kāti Huirapa Rūnaka ki Puketeraki to the north.

To operationalise the partnership commitment of the Treaty of Waitangi, Te Rūnaka o Ōtākou, Kāti Huirapa Rūnaka ki Puketeraki, and Dunedin City Council have developed Te Taki Haruru – Māori Strategic Framework. Te Taki Haruru promotes four principles – autūroa, autaketake, autakata, and auora – and associated values – mana, tapu and noa, whakapapa, and mauri – across the four wellbeings. This framework is intended to be operationalised in DCC programmes, and the SDF programme has identified the commitments below:

- Mana whenua can actively participate in the programme, and exercise rakatirataka (chieftainship, right to exercise authority, right of self-determination), including rights to make decisions on issues affecting the wellbeing of South Dunedin.[11]
- Mana whenua exercise kaitiakitaka (guardianship) over te taiao (environment) and taoka (natural treasures) to shape restoration and regeneration of South Dunedin environments. The programme supports the social and economic wellbeing of Māori communities in Ōtepoti Dunedin.
- Integration of tikaka (customs) and kawa (practice) into the programme ensure balance (utu) and outcomes that contribute to the wellbeing of te taiao, our whānau and wider community.
- The programme will draw on mātauraka Māori (knowledge) and te ao Māori (world view) to support a strengthened Māori presence in South Dunedin.

Throughout the programme, engagement and further refinement of the commitments will endeavour to meet the aspirations of mana whenua, and cultural values and Rūnaka perspectives will be operationalized to inform decision making. A cultural narrative to further inform the SDF programme is being prepared by Aukaha.

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[10] https://www.otakourunaka.co.nz/language-history
[11] A decision making framework is under development

3 SOUTH DUNEDIN: THE NEED FOR ADAPTATION PLANNING

South Dunedin, also commonly known as 'The Flat', was originally a low-lying marsh that pre-European settlement provided Māori with abundant mahika kai resources and reserves. It was not until the 1800s that the area was drained and expanded by reclamation of land, with flood hazards becoming apparent as early as 1923. With the additional reclamation along Portsmouth Drive in the 1970s, there is no natural outlet for water to drain. The low elevations of South Dunedin, coupled with aging water infrastructure, high groundwater and a history of flooding mean that there are inherent risks driven by the local geography and historic development.

Figure 4: South Dunedin, prior to reclamation in 1856 (source: Hocken collections)

The area is at high risk from natural hazards and climate change with exposure to coastal, rainfall, groundwater and seismic hazards.[12] Infrastructure in South Dunedin is already struggling, particularly with regards to the wastewater and stormwater network, as identified in the South Dunedin Future Risk Identification Report. The effects from exposure to hazards have already been felt to varying extents, and the impacts are expected to increase as our changing climate brings heavier rain, rising seas and rising groundwater. This poses significant challenges for South Dunedin and its communities.[12]

South Dunedin is already experiencing effects of climate change, and the need for resilient solutions has been apparent for the past decade following the impacts of the 2015 flooding. These solutions will not be simple and in order to achieve the vision of Dunedin being "one of the world's

[12] The South Dunedin Future Risk Identification Report provides further detail on these hazards.

great small cities", multiple sequential adaptation actions will be required over time to respond to changes in South Dunedin.

The consequences of these hazards are informed by their social, economic, infrastructure, and cultural context. Climate change is expected to worsen existing inequities, particularly the ability for communities to respond, adapt, or manage impacts from climate hazards. With South Dunedin's existing vulnerabilities, this reinforces the need for a pro-active climate resilience response to support the communities.

In responding to these hazards and associated risks[13] there is an opportunity to enhance wider community outcomes beyond the immediate natural hazard response. For this future state to be realised, a clear adaptation pathway is needed, and this will require a documented case for improvement.

While this introduction to adaptation planning views South Dunedin in isolation, as the project progresses from the long list of generic adaptation approaches to spatially defined options, a wider system perspective will consider the cascading impacts and interdependencies between South Dunedin and its surroundings to inform spatial implications.

3.1 PROBLEM DEFINITION

In the South Dunedin Future Strategy, a case for change is identified, namely:

- South Dunedin is subject to flooding and other natural hazards, which present risk to people, places and assets. Some of these risks are expected to increase due to climate change, though uncertainty remains about timing and severity of impacts, which makes planning more difficult for councils, affected communities, and other stakeholders.
- This uncertainty means that current investment by public and private sectors is likely not adequately accounting for current or future flood risk. The consequences could include maladaptation and potentially higher costs for communities, councils and central government in the long term, including through disaster response, recovery and rebuild or a reduction in the expected operational life of assets and critical infrastructure.
- Downstream risks of systemic shocks and market failures are increasing (e.g. major flood event, finance or insurance withdrawal, property market decline), potentially leading to sudden and significant disruption or damage to social and economic wellbeing, particularly for affected communities in South Dunedin.

This case for change provides an underlying rationale for the South Dunedin Future Strategy programme and identifies the need for a climate change adaptation plan for the area. The risk that flooding and other natural hazards pose to South Dunedin is such that, if not managed, the risk of systemic shocks and market failures may become unacceptable. This section seeks to "define the problem" or rather the root causes of this issue that requires management.

Adapting a dense urban and industrial area requires an integrated, staged plan that stays in front of the expected changes. A business case approach provides a standard methodology to frame and assess options to promote outcomes and secure funding (methodology further discussed in Section 4). As such, elements of business case approaches will be incorporated into the adaptation

[13] See the South Dunedin Future Risk Identification Report for further detail on hazards.

option and adaptation strategy development. Clear, concise problem definition is a key component of a business case to describe the issue or opportunity that the project or programme will address. It specificity allows for articulating what is included in the scope of the problem to be addressed. Without a clear problem definition, the solutions may lack focus or ultimately not be suitable. With a clear problem definition, opportunities can be readily identified.

Importantly, a problem definition exercise does not attempt to simply identify problems (e.g. “climate change is a problem for South Dunedin”) but rather to identify the root causes of the problem by untangling key drivers ("South Dunedin is low lying”) or trying to understand why the problem is a problem (“People live in South Dunedin and the infrastructure isn’t built for these changing hazards”).

While a full investment logic mapping exercise[14] was not completed for SDF, the kick-off workshop with representatives from DCC, ORC, Aukaha and the South Dunedin Community Network included a session to define the problem. The problems identified by groups were then sorted into six themes (socio-economic, infrastructure, cultural, community and equity, uncertainty, other) and then distilled to the problem definition below which link with the strategic objectives (provided in Section 6.2):

- Historically, South Dunedin was a wetland, and the legacy practice of draining and reclamation has erased culturally significant landscapes and resources for Kai Tahu and Te Rūnanga o Ōtākou. Tangaroa (the sea) continues to shape and reshape te taiao (the environment).
- The water infrastructure in South Dunedin was largely constructed more than 50 years ago (96% of the network before 1980 and 46% of the pipe network constructed before 1940). This infrastructure is aging and is vulnerable to failure during extreme events.
- South Dunedin is a highly developed, dense, hazard prone area that provides homes for roughly 10% of Dunedin’s population. It particularly provides affordable housing for some communities that are already socio-economically disadvantaged.
- The communities and businesses in the area have significant exposure to, and as a result are less able to recover from flood events that will occur with increasing frequency and severity over time.
- Following the 2015 flood, communities in South Dunedin have reported feeling anxious when it rains and uncertain about the future.

To build a vision for South Dunedin, while engaging on the long list of generic adaptation approaches the problem statements can be investigated to identify opportunities, e.g. “if we solve this, then…?”. These opportunities are then – together with communities – used to define a vision for the future of South Dunedin guiding changes to the future urban form as adaptation options are implemented.

[14] Investment Logic Mapping (ILM) is a structured approach used to develop a clear and comprehensive understanding of the drivers, objectives, and expected outcomes of an investment project or program (in this case, adaptation options). It helps stakeholders define the problem, identify potential solutions, and make informed decisions regarding resource allocation and investment prioritisation. ILM involves a visual mapping process that captures and communicates the logic behind an investment. It helps to clarify the underlying assumptions, dependencies, risks, and benefits associated with the investment.

3.2 HAZARD MANAGEMENT FOCUS

There are a number of natural hazards affecting South Dunedin, as identified in the South Dunedin Future Risk Identification Report (2023). These are identified in the table below.

Table 1 : Summary of direct climate and natural hazard risks to South Dunedin. Tick-marks indicate that a risk is identified. Black outline indicates the risk is identified in the Otago or National climate change risk assessment† (Source: South Dunedin Risk Identiifcation Report)

ELEMENT AT RISK	RAIN-FALL	COASTAL HAZARDS			SEISMIC HAZARDS		
	EXTREME RAINFALL AND FLOODING† †	SLR AND COASTAL INUNDATION	COASTAL EROSION	GROUNDWATER† † †	EARTHQUAKE	LANDSLIDE	LIQUEFACTION
Natural environment	✓	✓	✓	✓	✓	✓	✓
Buildings and open spaces	✓	✓	✓	✓	✓	✓	✓
Marae and other culturally significant sites	✓	✓	✓	✓	✓	✓	✓
Roads	✓	✓	✓	✓	✓	✓	✓
Rail infrastructure	✓	✓	✓	✓	✓	✓	✓
Ports	No port in South Dunedin						
Water supply infrastructure	✓	✓	✓	✓	✓	✓	✓
Wastewater infrastructure	✓	✓	✓	✓	✓	✓	✓
Stormwater infrastructure	✓	✓	✓	✓	✓	✓	✓
Airports	No airport in South Dunedin						
Flood defences	Flood defences included in stormwater element						
Solid waste and contaminated sites	✓	✓	✓	✓	✓	✓	✓
Communications	✓	✓	✓	✓	✓	✓	✓
Electricity transmission and distribution	✓	✓	✓	✓	✓	✓	✓

†Risks outlined in black are identified as highly rated risks in the Otago Climate Change Risk Assessment
††1including wind and storm events
†††2including in relation to rainfall and salinity stress

Rainfall, coastal, groundwater and seismic natural hazards facing South Dunedin have been screened against elements at risk (people, places, assets) within South Dunedin to identify direct physical risks within the area. Table 1 presents this screening, where tick-marks indicate the element is at risk due to a particular hazard. This shows that all elements are at risk from all hazards. Tsunami hazards are also relevant to the area but have a generally low frequency of occurrence.

Rainfall, coastal, groundwater and seismic hazards were the primary hazards evaluated in the Risk Identification Report given the risk they pose on the South Dunedin community. South Dunedin has a history of flooding during high intensity rainfall events (including 1923, 1929, 1968, 2015 and 2018). The frequency of these types of events will increase over time as sea levels drive higher groundwater levels and rainfall intensity increases due to climate change.[15] Large portions of the project area are exposed to coastal flooding due to sea level rise and storm surges within the 100 year planning time horizon of the South Dunedin Future programme. Groundwater within the South Dunedin area is typically shallow, and as climate change continues, the risk of emergent groundwater or groundwater ponding will increase, potentially affecting large portions of the project area. Seismic hazards such as liquefaction are also a risk to be considered in the South Dunedin Future Programme considering prior history of these impacts in Aotearoa New Zealand, including retreat as a result of impacts.

The above hazards pose significant risks that intersect and amplify one another. Climate change has the potential to exacerbate existing hazards and introduce new ones, leading to complex interactions and compounding effects. For example, sea level rise can combine with storm surge events and therefore heighten the risk of coastal flooding. Understanding these compounding and cascading effects is crucial for effective adaptation planning.

[15] ORC (2016) The Natural Hazards of South Dunedin.

4 ADAPTATION PLANNING METHODOLOGICAL APPROACH

To develop a regenerative climate change adaptation strategy for South Dunedin, a combination of three approaches will be used to support decision making within the context of assessing environmental, social and cultural outcomes. These include:

- Dynamic Adaptive Planning Pathways (DAPP) as recommended by the Ministry for the Environment in the 2017 Coastal Hazards and Climate Change Guidance for Local Government as well as the forthcoming Ministry for the Environment guidance on climate change adaptation.

  DAPP, and adaptation pathways more broadly, provides a way to plan for uncertainty, taking action in the short term, and developing a series of actions to respond to change over time. This approach recognises the increasing hazards and need for a staged approach to implementation while allowing for flexibility in future decision making if conditions do not change as expected.

  In Aotearoa, DAPPs are typically developed using the MfE 10-step cycle as shown in Figure 5. Future option evaluation under the SDF programme will be structured following this process. Option evaluation can be done in a variety of ways, and the approach is presented below.

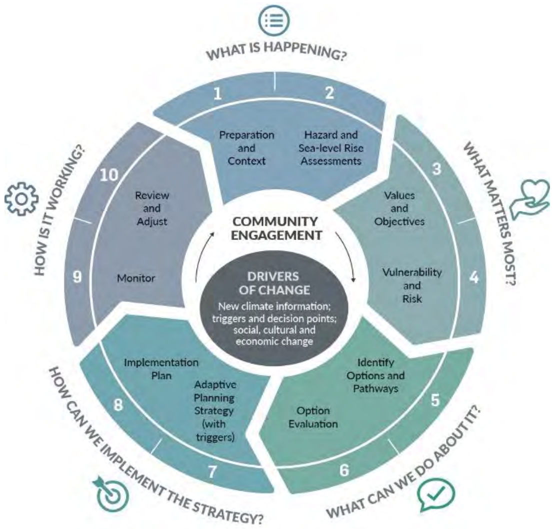


Figure 5: MfE 10-step Adaptation Planning

- Better Business Case as recommended by Treasury New Zealand to provide a transparent, consistent, objective analysis of options to streamline funding applications. This will be used to inform decision making within a DAPP style process.

  The Better Business Case approach includes:

  - Strategic Case to evaluate how options or projects align with the strategic intent of the programme
  - Economic Case to assess value for money including consideration of wider social and environmental effects
  - Commercial case to evaluate viability of procurement and opportunities for public-private partnership
  - Financial case to demonstrate affordability and funding sources
  - Management case to describe implementation requirements.

Figure 6: Better Business Case Approach

This approach will be tailored and adjusted to provide sufficient flexibility to incorporate the dynamic long-term changes associated with climate-related risks as well as the impacts of variability in planning horizons on processes and outcomes.

- Multi Criteria Assessment consistent with Waka Kotahi's 2020 guidance in alignment with the Better Business Case process, supported by additional economic and circular economy assessments (more detail to be provided in Stage 3 of the Adaptation workstream). This will inform our use of a DAPP style process., taking into account the importance of social, cultural, and environmental outcomes.

5 LONG LIST OF GENERIC ADAPTATION APPROACHES

The first step (for the adaptation workstream) in developing an adaptation strategy is to identify a long list of generic approaches to manage risk. A range of approaches are presented that could be incorporated to manage risk and provide regeneration opportunities over time. At this early stage, the approaches are non-spatial while still considering the South Dunedin context.

South Dunedin is a low-lying coastal area vulnerable to flooding, particularly due to intensifying rain events, rising sea levels and groundwater as the climate changes. These factors have resulted in the development of multiple long list adaptation approaches that carefully consider South Dunedin's unique characteristics. By considering the region's susceptibility to flooding and other related challenges, these non-spatial approaches aim to address key issues while laying the groundwork for future stages of adaptation planning.

Long-list adaptation approaches have been categorised against the PARA (Protect, Accommodate, Retreat & Avoid) framework to develop a range of approaches.[16] These PARA approaches can be applied to elements at risk as identified in the South Dunedin Future Risk Identification Report (2023). Each provides a different way to manage risk and adapt to climate change as outlined below:

- *Protect:* building physical protection measures in place, thereby changing the extent of hazards.
- *Accommodate:* staying in place and making changes to buildings and infrastructure to improve resilience, thereby not changing exposure to hazard extents but reducing vulnerability.
- *Retreat:* managed retreat or managed relocation refers to purposefully moving away from areas where the risk is too high, noting that retreat is not a 'do nothing' approach but can be an opportunity for regeneration and that these opportunities need to be proactively identified. Reactive retreat refers to moving away from areas after a climate event has occurred that has made the area unsafe/uninhabitable. Retreat includes the re-purposing of land (land use change).
- *Avoid:* minimising exposure by staying away from areas where the risk is too high.

These approaches are not mutually exclusive, with a combination of approaches likely required to respond to specific context and challenges over time.

5.1 DEVELOPMENT METHODOLOGY

The generic long list methodology recognises the work to date to understand South Dunedin risks and hazards as well as existing infrastructure performance in the South Dunedin Future Risk Identification Report (2023). Possible approaches were collated to create an initial "long long" list from national and international case studies and previous reports specific to South Dunedin (listed in Appendix A-2) alongside further nominations received from subject matter experts within the consultant team and community crowdsourcing.

[16] See *Glossary* for a definition of PARA.

The domestic and international case studies report (in Appendix A-3) examines raising buildings in Australia and New Zealand, Copenhagen's Cloudburst Management Plan (which uses a range of conveyance and storage options to manage intense rainfall), retreat following the Christchurch earthquakes, and the Long Bay development in Auckland which incorporated water sensitive and nature-based solutions to manage flood hazards. These case studies not only present an overview of types of options that might be useful but also how they were developed and implemented, including funding and consenting mechanisms to encourage participation of the private sector.

Community crowd-sourced options were received through engagement events during September-October 2023, including:

- Otago like Polyfest 2023: A popular youth event celebrating Māori and Pasifika cultures.
- Meet the Scientists Night: An SDF programme event exploring underlying science topics of relevance to the impacts of climate change on South Dunedin.
- Street meet and sausage sizzle: An SDF programme public event on South Dunedin's main street that sought community feedback on views, values and ideas for adaptation.
- 'What can we do about it?': An SDF programme event that explored adaptation experiences in New Zealand and the Netherlands, sought comments on existing approaches and asked for ideas for new approaches from the community.

Additional 'crowd-sourced' adaptation ideas were also received via an online survey, through direct approaches from community members, and from analysis of community ideas captured during the many SDF programme engagement events over the past four years. Table 2 shows the themes, number of people and example feedback gained from crowd sourcing events. All options that related to adaptation approaches were taken forward into the generic long list, with the only options not included at this stage being those that were not adaptation focused, e.g. a children's theme park.

Table 2: 2023 Engagement block feedback themes

Themes	Number	Percentage of total responses
Stormwater infrastructure	46	20%
Nature-based solutions	41	18%
Managed retreats and buyouts	18	8%
Forbury Park	16	7%
Recreation and amenities	14	6%
Transport	11	5%
Economic	9	4%
Coastal	9	4%
Don't lift that rock!	9	4%
Building controls	8	3%
Chemtrails etc.	7	3%
Wellbeing	7	3%

Themes	Number	Percentage of total responses
Civil Defence	5	2%
Accessibility	5	2%
Engagement	5	2%
Seismic	4	2%
Māori/Pacific	4	2%
Miscellaneous	13	6%
Total	231	100%

The "long long-list" was consolidated, removing duplicates and combining approaches where appropriate, to avoid too much overlap in assessing approaches (e.g. ponds and wetlands being included as examples of dedicated water storage) to create a generic long list. All risk management options identified in community engagement sessions have been included in the generic long list but have been integrated or combined where appropriate.[17] Where appropriate, when individual suggestions have been combined the specific details have been maintained through sub-approaches provided within the approach. The generic long list, presented below, has been reviewed, discussed, and confirmed by the Kia Rōpine Challenge Team. The Kia Rōpine team consists of WSP, Tonkin and Taylor and Beca specialists in climate change and resilience, Climate Change Risk Assessments, adaptation and communications and community engagement.

5.2 LONG LIST OF GENERIC ADAPTATION APPROACHES

An overview of the long list of generic adaptation approaches is provided above in Table 1. Sub-approaches under more general solution types (such as increasing permeability) have been included for greater process transparency and understanding of the approaches. As the evaluation process continues beyond the generic long list these sub-approaches may be split out and assessed individually as appropriate. The approaches suggested during public engagement events have been identified with the use of asterisks.

These approaches are further presented in high-level fact sheets provided in Appendix A-1. Each fact sheet includes a visualization and description of the approach; an evaluation of approach characteristics grouped into pros, cons and neutral factors; and a high-level assessment of the approach against strategic objectives (presented in the next section) to facilitate comparison.

It is important to note that due to the lack of space in South Dunedin caused by the existing land use and infrastructure, many of the adaptation approaches require significant disruption, demolition or temporary modification to existing buildings and assets. The specific requirements of the approaches will be looked at in more detail in the next phase.

[17] For example, consolidation occurred for feedback received on 'drain it better' and 'stormwater network improvements' into 'conveyance improvements', and similarly for 'wetlands' and 'ponds' into 'dedicated storage' to allocate them to the correct level of approaches and sub approaches.

While this assessment is occurring at an individual approach level, the final 'solution' will require a combination of multiple adaptation approaches over time to respond to the changing risk profile of South Dunedin.

Table 1: Generic Long List of approaches

GENERIC LONG LIST OF APPROACHES		Description
Protect	Ground reinforcements	Ground reinforcement is a preventative method to stabilise soils and reduce potential of seismic impacts including liquefaction and landslides.
	Groundwater lowering / drainage / dewatering wells	Process of reducing the water table or groundwater levels in an aquifer.
	Land grading	A flood risk management strategy that involved physically raising the ground level above the floodplain.
	**Conveyance improvements	The enhancement or modification of existing new drainage systems. This might involve combinations of installing larger pumps and pipes to increase water flow, intercepting and diverting flows upstream, creating engineered channels or canals, and/or enhancing stormwater conveyance capacity both overland and through piped networks.
	**Remove wastewater network overflows and cross connections	Includes measures such as fixing cracked pipes or manholes (that may have been caused by ground movement, deterioration of aged pipes or tree roots).
	Dedicated water storage	Include detention basins, ponds, and wetlands and they be located at the coast or inland.
	*Floodable infrastructure	Floodable infrastructure refers to open spaces, green spaces (e.g., parks, reserves), carparks, and roads being transformed into intentional temporary flood storage zones or overland flow paths to protect other areas from flooding.
	Increase permeability of ground surface	Increasing permeability of the ground surface improves the receiving environment's ability to absorb and/or manage excess rainwater, reducing the volume and rate of runoff that would otherwise go through to the stormwater network.
	Coastal protection	Coastal risk management comprises various tactics aimed at safeguarding coastal areas and can include 'hard' engineering options and 'soft engineering' options to manage erosion, flooding and/or tsunami.
Accommodate	**Behavioural / societal changes	Resilience strategies that aim to reduce the impacts of hazards by emphasizing prevention and preparedness. Potential options to increase community resilience and understanding of climate hazards include: o *Mental health support o *Climate hazard safety education and awareness o Financial incentives / disincentives

GENERIC LONG LIST OF APPROACHES		Description
	*Readiness and response	"Readiness" (also known as "Preparedness") and "Response" measures typically refer to the operational systems and capabilities that are put in place before an acute event occurs and immediately after (e.g. generally not slow onset hazards such as erosion or rising groundwater). Readiness and Response planning generally falls within the responsibilities of Civil Defence Emergency Management (CDEM).[18]
	Property level interventions	Property level interventions refer to adjustments or modifications that are made directly to individual properties to enhance their resilience against flooding. These could include raising homes, waterproofing first floors, raintanks, flood barriers, or other individual property level interventions.
Retreat	*Managed retreat (proactive retreat)	A strategic decision to withdraw, relocate or abandon private or public assets (including land and buildings) before significant damage occurs. This may include: o Voluntary buyouts on open market o Buyouts with climate leases o Targeted retreat of built environment - buyouts for enabling works (e.g. detention) o Post-disaster buyouts or post-insurance withdrawal buyouts o Retreat of critical infrastructure from vulnerable sites o Whole community relocation
Retreat	Reactive retreat	Reactive retreat is the withdrawal, relocation or abandonment of private or public assets in response to immediate threats or after damage has already occurred. It involves a more reactive approach where decisions are made in direct response to acute events like storms, flooding, tsunami, earthquakes or rapid erosion.
Avoid	More restrictive building/development standards	Involves controls on development to reduce exposure and vulnerability to hazards such as earthquakes and coastal flooding. They may include more restrictive standards, development guides, regional and district plan rules, resource consent conditions, bylaws, urban development or growth strategies to mitigate the impact of a hazard.
Avoid	*No new development / redevelopment or change of land use that may exacerbate risk	May involve permitting more development in areas of low risk (through intensification or traditional development including outside of South Dunedin), restricting new development, construction and land use changes in high-risk areas, changing land uses to prevent rebuilding, all of which could include district plan changes.

*Approaches suggested by members of the communities during public engagement events

** Approaches suggested multiple times by members of the communities during public engagement events during public engagement events

At this stage, the fact sheets do not include economic, commercial, financial or management cases, but as the approaches are further refined, additional cases will be incorporated into more detailed templates. Visualizations will also be refined with additional detail added in subsequent stages.

[18] While included under 'Accommodate' of the PARA Framework for completeness, it is worth noting that many Civil Defence measures should already be in place under existing emergency management practices and so this approach is focused on options outside of Civil Defence's remit.

As the South Dunedin Future programme continues, additional details will be added to each of the approaches if they are taken forward into the spatial long list. It will be critical that for approaches such as managed relocation (and all other approaches), there is clear information about how this process might occur including funding mechanisms (who pays, how much, when, etc.), relocation destinations (if land or property swaps are considered), and how social, economic and environmental outcomes are promoted in a changing urban setting. Consideration of cost, consentability (under both the current statutory system and potential future system) and funding will be included in the spatial long list phase.

6 APPROACH FRAMING

Within the business case framework, a multi criteria assessment is used to evaluate alignment of approaches with the strategic case. While at this generic long list phase, approaches are not scored, communicating the direction of the future assessment framework is key to allow time to build understanding of the relative merits of the range of approaches being considered. At this stage, approach characteristics are presented in the fact sheets as well as alignment with strategic objectives, both discussed below. As the approaches move into the spatial long list phase, assessment of approaches against critical success factors will be key to determine whether the approaches are or are not taken forward.

Importantly, approaches will be assessed in the future based on:

- Ability to achieve strategic objectives (discussed below) that include social, cultural, and environmental outcomes as well as economic
- Ability to be implemented and ability to effectively reduce risk (critical success factors, discussed below).

Because of the early stage of the programme, approach characteristics are also presented to begin to provide an understanding of benefits and trade-offs of the various approaches.

6.1 CHARACTERISTICS

The characteristics below help differentiate between adaptation approaches and begin to identify the relative merits or challenges of the various approaches. They are:

- Time (lead time to implement and design life)
- Cost (including whole of life)
- Emissions[19] (beyond solely carbon footprint), pollution, and material re-use[19].
- Health of and connection to the natural environment
- Generational flexibility
- Technical feasibility (including ease of consenting and legal requirements)
- Technical efficacy
- Social co-benefits (such as economic potential, community ownership, wellbeing, housing affordability)
- Maintained sense of place / identity
- Interdependencies (e.g. when other approaches would be required or useful in combination as well as at a city-scale in terms of cascading impacts)

[19] As approaches progress through shortlisting, this will include considering the possible use of circular design principles. Circularity acknowledges that emissions encompass more than just carbon and considers other pollutant emissions, resource depletion, waste generation and overall lifecycle impacts among other sustainability outcomes.

These factors are used in the long list fact sheets presented in Appendix A-1 to identify high-level advantageous and disadvantageous characteristics of approaches. There is no selection or evaluation of approaches occurring at this stage. This will occur in the future stages of this workstream in conjunction with the community, stakeholders and partners. Criteria used in evaluating options as part of subsequent stages will be developed further with stakeholders ahead of the evaluation.

It is also noted that these characteristics are not intended to represent the strategic objectives and will be considered alongside the strategic objectives (Section 6.2) and critical success factors / fatal flaws (Section 6.3).

6.2 STRATEGIC OBJECTIVES

The identification of values and objectives for an adaptation strategy are key to providing a clear trajectory for the future to inform option assessment. The strategic objectives, which may be further refined or added to in order to incorporate Rūnaka values, draw on:

- *The South Dunedin context:* Available local information was considered including South Dunedin Future's Strategic Intent, responses from the previous community engagement efforts, and the outputs from the problem-definition session at the South Dunedin Future kick-off workshop.
- *City, regional and national context:* The local context was then grounded in regional and national strategic direction including:
    - Otago Regional Council Strategic Directions,
    - Dunedin City Council's Te Ao Tūroa (The Environment Strategy) and Social Wellbeing Strategy, and
    - Arotakenga Huringa Āhuarangi (New Zealand National Climate Change Risk Assessment Framework) which includes Treasury's Living Standards Framework (LSF) for wellbeing and the 'He Ara Waiora' framework.
    - Te Taki Haruru – Māori Strategic Framework which provides a framework to operationalise the Treaty of Waitangi partnership between mana whenua and council.
    - New Zealand Coastal Policy Statement (2010) which provides guidance relating to the development of strategic options and transition mechanisms for areas of existing development.
- *International practice:* Alignment with the UN Sustainable Development Goals to measure impact, increase project visibility and attract support was also considered.

The strategic objectives are provided in Table 2 and used in the Strategic Case section of the generic long list fact sheets presented in Appendix A-1. Outcomes will continue to be used, alongside other criteria, to evaluate options throughout the project. Assessing alignment with community objectives and Rūnaka values provides a measurement of how options do/do not move South Dunedin towards a preferred future state.

Table 2: Strategic objectives for South Dunedin Future

STRATEGIC OBJECTIVE		ALIGNMENT WITH CENTRAL, REGIONAL, AND LOCAL STRATEGIES AND FRAMEWORKS
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	• 'Waiora Wellbeing' in Treasury's LSF and He Ara Waiora framework • ORC mission: 'enriching life in a way that ensures positive relationships between environment, people and place, now and the future' • DCC Te Ao Tūroa vision: Dunedin is one of the world's great small cities with a thriving environment we look after, respect and enjoy • DCC Social Wellbeing Strategy vision: we are a city with connected people, cohesive communities and quality lifestyles for all
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	• 'Natural Capital' in Treasury's LSF and He Ara Waiora framework • ORC vision: 'An environment that supports healthy people and ecosystems'. 'Communities that connect with, and care for, Otago's environment' • DCC Te Ao Tūroa objectives: 'Plan for and adapt to climate change', 'manage natural resources sustainably', 'sustain ecosystem services', 'increase indigenous biodiversity',
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	• 'Social Capital' in Treasury's LSF and He Ara Waiora framework • ORC vision: 'Communities that are resilient in the face of natural hazards, climate change and other risks' • DCC Social Wellbeing Strategy strategic directions: a reasonable standard of living for all, connected people
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and bounce back.	• 'Financial / Physical Capital' in Treasury's LSF and He Ara Waiora framework • ORC vision: 'Communities that are resilient in the face of natural hazards, climate change and other risks' • DCC Te Ao Tūroa objectives: 'Plan for and adapt to climate change', • DCC Social Wellbeing Strategy strategic directions: vibrant and cohesive communities
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	• 'Human Capital' in Treasury's LSF and He Ara Waiora framework • ORC vision: 'A sustainable way of life for everyone in Otago' • DCC Te Ao Tūroa objectives: 'enjoy, connect to, and celebrate the natural world', 'increase understanding of the natural world' • DCC Social Wellbeing Strategy strategic directions: Healthy and safe people
NOTE: These objectives have had input from Rūnaka through Te Taki Haruru and Aukaha but may be further refined or amended to align with Rūnaka values as the project progresses.		

6.3 CRITICAL SUCCESS FACTORS AND FATAL FLAWS

As the long list of generic adaptation approaches begin to be evaluated spatially, certain 'critical success factors' must be met for approaches to continue to be considered. Critical success factors provide a starting point for identifying and agreeing on specific criteria that are required for implementation (e.g. "go / no-go" factors). They do not define what success looks like on a project. The approaches that proceed onto the spatial long list should be able to, as a minimum, achieve the critical success factors and not have 'fatal flaws'. Fatal flaws are characteristics that mean the approach cannot be achieved or would pose such significant risks or impacts that it is not worth further assessment. Matters relating to high cost (but affordable) or complexity can bring implementation challenges but are not considered fatal flaws. Initial thinking on what these screening factors might comprise are included below, noting that these will be refined and confirmed as part of the project's next steps (see Section 4.4):

- Technically unfeasible or impractical to implement in South Dunedin
- Inconsistent with the principles of the Treaty of Waitangi
- Results in higher health and safety risks than the 'do nothing' option
- Institutional/governance capability
- Unable to provide required level of service within an acceptable whole-of-life cost budget (to be defined)
- Unconsentable
- Results in risk to life or is unable to mitigate risk to life.

As the programme progresses, the approaches will be assessed against critical success factors and strategic objectives. The "do nothing" approach (which includes business as usual maintenance, etc.) should also be assessed to provide a base case for comparison of outcomes.

7 NEXT STEPS

The long list of generic adaptation approaches as identified above and in Appendix A-1 signify an early step in adaptation planning for South Dunedin. Immediate next steps include continuing engagement with Rūnaka and local communities on the long list of approaches. Concurrently, the Rūnaka are developing project-specific aspirations that will respond to the higher level Rūnaka values. The strategic objectives identified in this document will be used in future multi-criteria assessments of options (weightings, if any, are undetermined at this stage).

Following confirmation of methodology with Dunedin City Council, Otago Regional Council, Rūnaka as project partners, and the Kia Rōpine Challenge Team, this generic long-list will be developed into a spatial long list. How preferred approaches will eventually be selected should be determined in the coming months to allow transparent communication of the decision-making process to occur before the decision making begins. At a high level it is expected that this will involve:

- Confirming fatal flaws and critical success factors to be used to screen spatial approaches from the generic long list, as mentioned in Section 6.3;
- Identifying spatial cells by grouping similar hazard characteristics (e.g., areas with high groundwater, likely stormwater ponding, lower exposure to hazards etc.); and
- Developing spatial long list by removing approaches from the generic long list that do not meet the critical success factors or have fatal flaws for each spatial cell.

In the process of refinement from generic long-list to spatial long-list through to spatial short-list, the approaches presented in this report will become increasingly specific and targeted to the needs of South Dunedin, culminating at the end of the process in a recommended (preferred) adaptation options pathway.

APPENDIX A-1

Appendix A-1: Generic Long List Approach Fact Sheets

Protect

Ground reinforcements

Groundwater
× Rising groundwater

Rainfall
× Flooding

Coastal
× Erosion
× Flooding
× Tsunami

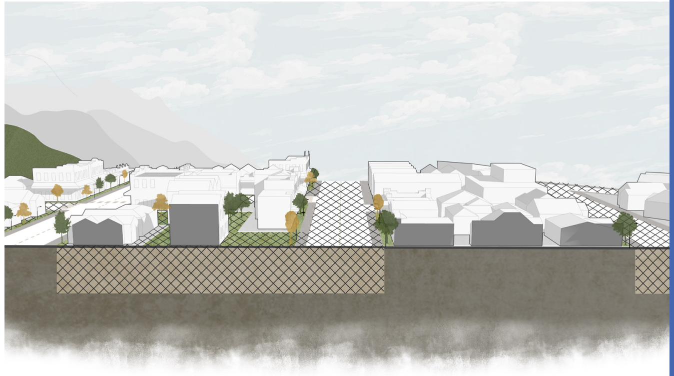
Seismic
✓ Earthquake
✓ Liquefaction
× Landslides

Description

Ground reinforcement is a preventative method to stabilise soils and reduce liquefaction potential. Liquefaction is a loss of ground rigidity due to earthquake-induced water pressure. Ground reinforcement methods can be effective in reducing liquefaction potential by improving soil density and/or cohesion, thereby reducing water pressure (and lowering groundwater with some ground reinforcement options) and soil instability during seismic events.

Methods include densification of the crust or deeper liquifiable soils, crust strengthening, reinforcement, containment by ground reinforcement or curtain walls, and drainage improvements using stone columns or earthquake drums.

Ground reinforcement is one of a number of geotechnical responses to seismic risks, which include slope stabilization and the use of mesh fencing to reduce rockfall risk. These additional responses are not considered in this fact sheet due to the flat nature of the majority of South Dunedin.



Interdependencies

To reinforce land, removal and redevelopment may be required. The reinforced land would require new connections to services (e.g. roads, water, power).

Pros

- **Maintained sense of place / identity:** By implementing ground improvements, long term benefits can be achieved in terms of reducing the risk of liquefaction and landslides and raising the ground level above future flood levels, thereby enhancing the overall sense of place.
- **Generational, flexible solutions:** Can provide sustained protection against seismic movements for generations. Can be retrofitted for future modifications and expansion.

Cons

- **Cost:** The costs associated with ground reinforcement will be highly dependent on the outcomes from more detailed studies and the scale and complexity of the reinforcement work. Costs are likely to be very high, although these should be compared to the costs of doing nothing.
- **Technical feasibility and efficacy:** The feasibility of ground improvements at the scale needed to mitigate the liquefaction hazard risk needs to be assessed. Evaluation of efficacy of ground improvements to reduce risk would require a detailed understanding of soil behaviour under seismic conditions. Comprehensive geotechnical investigations are required, which may require further information and possible ground investigation to support this assessment.
- **Emissions, pollution and materials reuse:** Due to the material used, especially concrete, this approach increases carbon emissions. It also could affect natural landscape and water quality.
- **Time:** The process from the planning stage to the construction stage is very time-consuming and requires different skills and disciplines. Ground improvement measures require detailed ground investigation prior to developing an appropriate ground reinforcement design.
- **Social co-benefits:** Many ground reinforcement techniques (but not all) would require temporary relocation of residents and potential house/building removal, as well as construction disruptions across the area.

Neutral

- **Health of and connection to the natural environment:** Ground reinforcement measures can control erosion and protect against loss of topsoil, preserving fertile land. However, some ground reinforcement techniques may involve disruptive construction activities or alteration of natural landforms which can result in habitat disruption and ecosystem modification.

In South Dunedin, implementing ground reinforcement measures could be logistically and technically challenging due to the area's low-lying and flat terrain. Investigation into soil composition and groundwater levels would be required. Ground reinforcement techniques could mitigate the liquefaction potential in South Dunedin and improve resilience to seismic events, providing greater community safety in place. The role of ground reinforcement is to reduce, not eliminate ground deformation, therefore ground mitigation measures are recommended to be included as part of an integrated liquefaction resilience solution. For example, ground reinforcement could be combined with vertical infrastructure such as deep foundations to further stabilise buildings. The efficacy of specific methods will depend on the local soil and groundwater conditions and the nature of the seismic activity. Some (but not all) ground reinforcement techniques would require temporary relocation of residents and potential house/building removal which would have social implications.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Ground reinforcements increase the safety and resilience of the buildings and the surrounding area against liquefaction, earthquakes and landslides. Ground reinforcements may also create opportunities for increased green spaces within urban areas, providing recreational areas for residents and enhancing overall urban aesthetics
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Certain ground reinforcement techniques, such as the construction of retaining walls and deep foundations, can contribute to increased carbon emissions due to the use of concrete. In addition, these practices have the potential to disrupt biodiversity if they involve significant alterations to the natural landscape. Furthermore, ground reinforcement can have implications for water quality as sediments generated during construction may contain pollutants like suspended solids, heavy metals, and chemicals, posing risks to aquatic organisms and ecosystem stability. To assess the specific environmental impacts of ground reinforcement projects, it is recommended to conduct thorough environmental assessments tailored to the project site. Some ground reinforcement techniques may cause habitat destruction.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Engaging the local community in voluntary initiatives to enhance building structures and foundations can be a promising approach. By providing stability to critical infrastructure, ground reinforcement measures support community activities. This contributes to serving community connections, which are essential elements of maintaining a sense of place and identity. However, voluntary initiatives may increase the risk of inequity as those with the means to adapt will, and those without the means will be forced to stay in vulnerable homes.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Ground reinforcement efforts can be initiated in critical areas, particularly where the presence of essential buildings or reliable site access is paramount.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Even though there may be time and cost involved, implementing ground enforcement measures has important long-term advantages. Measures to strengthen buildings and infrastructure, makes them more resilient and gives people a sense of control over their surroundings. This increased safety helps improve how people feel and allows them to plan for a safer future.

SOUTH DUNEDIN FUTURE

Protect

Groundwater lowering / drainage / dewatering wells

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

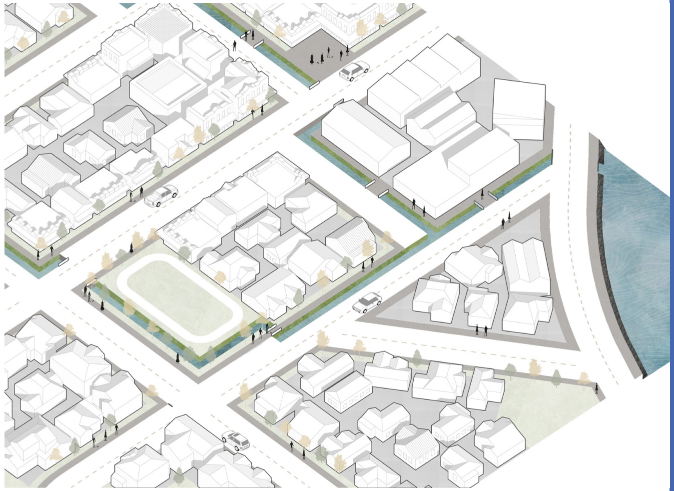
Coastal
✕ Erosion
✓ Flooding
✕ Tsunami

Seismic
✕ Earthquake
✓ Liquefaction
✕ Landslides

Description

The presence of shallow groundwater beneath South Dunedin exposes the area to the threat of groundwater flooding. Groundwater can contribute to surface flooding and a large part of existing underground infrastructure is already under the water table, posing significant risk to old deteriorating systems. When the sea level rises, groundwater rises and flooding risk increases. This exposes underground structures and networks, building foundations and low-elevation roads to wetter conditions. Options to lower the groundwater could include drainage and dewatering wells.

The extent of the groundwater lowering is specific to soil type, groundwater conditions, geology and is limited to above ground surroundings.



Interdependencies

Lowering groundwater would increase the capacity of the ground to absorb water; however, additional measures to reduce flood risk would be required. Renewal of stormwater and wastewater pipes in parallel should be considered if significant works are proposed.

SOUTH DUNEDIN FUTURE

Pros

- **Maintained sense of place / identity:** Reduces short term risks and does not change the landscape dramatically so not likely to be any aesthetic changes.
- **Health and connection to the natural environment:** Groundwater lowering can contribute to the well-being of the community by reducing health risks associated with groundwater flooding and promoting sustainable water management practices, which benefit the natural environment.

Cons

- **Emissions, materials and pollution:** Carbon emissions generated due to the source of energy used for groundwater lowering and drainage activities. The energy (which could be generated by micro solar on pump stations) required for pumping and the potential for contaminant discharges from groundwater may result in some emissions and pollution. Less carbon intensive materials can be chosen and there is scope for renewals of wastewater or stormwater networks simultaneously to reduce the impacts of construction.
- **Generational, flexible solution:** Can be used on a small scale but not very feasible as a long-term generational solution.
- **Time:** Can be introduced when ground levels begin to rise as a result of rising sea level and is recommended as a medium-term solution. However, it is unlikely to be suitable in the long-term due to saltwater intrusion into the groundwater network.
- **Cost:** Implementing groundwater lowering will be costly, likely requiring changes in land use (at least temporarily) for either below ground drainage or for canals. There will also be an ongoing investment cost due to the level of monitoring and increasing levels of pumping required.
- **Technical feasibility and efficacy:** A feasible approach in the short term however subsurface networks and underground infrastructure will be exposed to rising groundwater over time. Very dependent on soil conditions and site specific and may result in increased ground subsidence over time due to frequent dewatering. Overall difficult to implement due to the large volumes of water and spatial area involved. Will require resource consent authorisation.
- **Social co-benefits:** The physical disruption caused by construction and ongoing pumping may temporarily impact the local environment. There is also a risk of ground subsidence.

Neutral

- **Health of and connection to the natural environment:** Reduces the likelihood of flooding damaging the natural environment. Unlikely to improve the health or people's connection to the natural environment. Can also lead to the depletion of groundwater levels which may impact the availability of water for ecosystems.

Lowering the groundwater reduces the risk of pressures on underground structures, allows more infiltration of water into the sub surface to attenuate and treat rainfall as the soil is saturated post events for smaller periods of time. This may be a viable adaptation approach in the short to medium term; however, as sea levels rise, the ability to manage groundwater to an acceptable standard affordably may diminish.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	This approach can manage water related risks and prevent damage to infrastructure and property, improving the urban environment and enhancing the overall livability of an area. Preventing excess moisture in the soil and minimizing standing water can support healthier living conditions by reducing the likelihood of mould and vector-borne water diseases.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Groundwater lowering, drainage and dewatering wells will help to prevent damage to biodiversity from flooding. It can also be used protect cultural heritage sites. Lowering the groundwater may have unintended consequences on ecosystems and water resources. Groundwater lowering and dewatering of wells can lead to the depletion of groundwater levels or alteration to hydrological patterns which may impact the availability of water for ecosystems and agriculture.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	There are limited opportunities for the community to be part of the adaptation process or take ownership. However, it is an equitable solution that is unlikely to further exacerbate existing inequalities as the benefits will be accessible by most.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	In the short-term, groundwater lowering, drainage and dewatering wells can reduce groundwater flooding hazards, surface water flooding, and groundwater infiltration. However, this is only a short-term solution and is not likely to increase economic resilience in the long term. It is a costly solution that will require multiple upgrades as climate change hazards exacerbate. It can be expensive to install and operate. This can be a burden for businesses and communities and reduce social cohesion. Implementation of these options may result in the displacement of people and local businesses in the short term disrupting community wellbeing.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	This approach creates a safer environment in the short term as it reduces the risk of flooding, thereby preventing damage to infrastructure and properties. However, it is unlikely to promote safety in the long term.

Protect

Land grading

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

Coastal
✗ Erosion
✓ Flooding
✓ Tsunami

Seismic
✗ Earthquake
✗ Liquefaction
✗ Landslides

Description

Land grading (also known as land elevation) is a flood risk management strategy that involves physically raising the ground level above the floodplain (existing and future). It is a measure that reduces the exposure of all activities located on the raised land because the floodplain extents have changed but requires consideration of flood risk management approaches alongside raising.

Much of South Dunedin's low-lying land was reclaimed from coastal marshes and intertidal deposits following European settlement in the late 1800s, levelled with a thin (~1.0 m) veneer of fill and developed into a residential area. Therefore, historically South Dunedin has implemented a "land elevation" technique which has served the area for ~150 years.

Interdependencies

The area of land elevation required to elevate the desired number of people, places, and assets is strongly influenced by land use planning policy particularly regarding intensification rules and building height restrictions. The elevated land would require resilient connections to infrastructure services (e.g. roads, water, power). The elevation of access routes (e.g. streets) can be a limiting factor if access to raised land is frequently restricted This also requires cut and fill considerations to avoid displacing flooding and could be used in combination with other measures to reduce flooding.

SOUTH DUNEDIN FUTURE

Pros

- **Social co-benefits:** Raising land levels above the floodplain removes people, places and assets from flood risk (to the level of service agreed, for example 1% likelihood event in 2110 using a high emission scenario in accordance with the coastal hazards guidance). It is a long-term resilient approach which increases safety and contributes to community confidence and mental wellbeing.

Cons

- **Cost:** Likely to be highly costly to implement due to large scale construction, building removal and replacement and earthworks.
- **Technical feasibility and efficacy:** High complexity and may not be feasible (cost, practicality, fill material). Considerations will need to be worked through such as what areas to be raised, where fill will be sourced from, how developed areas will be raised and what the interim impacts are (i.e. staged land raising). Given that land elevation will require "filling in a floodplain" there will likely be negative flood impacts elsewhere and if these cannot be managed resource consent approval will be difficult. Land elevation cannot be considered in isolation, which could present opportunities to utilise "cut" earthwork volumes from one approach (e.g. dedicated water storage, or floodable infrastructure) to raise land elsewhere. This is only an option if the material is suitable for raising land, which would require testing. If suitable material cannot be sourced nearby, then importing fill material would significantly increase cost (and carbon cost). There is also the practical issue of implementing this approach with existing buildings in place or via a piece-meal approach as building turnover occurs.
- **Emissions, pollution and material re-use:** The process of land elevation may involve contaminated soil excavation and disposal, and will produce emissions from the work involved.
- **Health of and connection to the natural environment:** Raising land levels historically in South Dunedin "buried" the natural environment and removed connection. This could occur again if not managed.

Neutral

- **Generational, flexible solution:** Land elevation will provide long term benefits but future generations may continue to be faced with issues. Land raising is not a flexible solution as it is difficult to reverse once implemented.
- **Maintained sense of place/identity:** This would likely require temporary relocation of residents and removal of buildings. Consulting with the community and utilizing interdisciplinary approaches play an important role. Raising the land can impact sense of place and identity. Could result in people feeling a sense of disconnect from their community.

Implementing a land elevation approach in South Dunedin at a meaningful scale is likely to be highly complex and require consideration of many factors including the unique geology and topography of the area, the high groundwater table, poorly consolidated sediments, seismic risk, contaminated land, impacts on the horizontal infrastructure (including all utilities), temporary relocation of residents, potential house/building removal and sourcing the necessary quantities of suitable fill material. Although complex, land elevation enacted with a long-term design perspective can significantly reduce the risks associated with flooding, groundwater and coastal inundation hazards for people, properties, business and infrastructure which can be moved to higher, flat land.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Elevating land requires careful design and planning considerations; otherwise, it could create an urban eyesore and disrupt biodiversity.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Land elevation can have various environmental impacts, depending on the method used. This includes alterations to natural overland and subsurface drainage patterns, soil erosion, and disruptions to vegetation and wildlife.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	The decision-making process for land elevation projects should involve active engagement with the affected communities. Ensuring participation and inclusion can help address concerns, build trust, and create positive social outcomes. However, if partial land elevation occurs there may be a perception of unfairness if some parts of the community are not raised.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Those people, places and assets which can be moved to higher land through a land elevation approach will be at significantly less risk from flooding and thereby there will also be increased economic resilience. However, the technical feasibility and cost of this approach needs to be more fully considered before understanding the scale and efficacy of this approach for South Dunedin. There is the added complexity that the multi-decadal staging of a land elevation programme would need to be carefully considered to ensure that the potential negative flood effects on others are well addressed and local businesses are not impacted by long term construction activities in the area. Raising ground levels may increase the frequency of limited or no access to the lower elevation streets during events.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Implementing significant changes like this in urban areas will increase safety for those whose land is elevated. However, areas not raised will be subject to increased flood risk.

Protect

Conveyance improvements

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

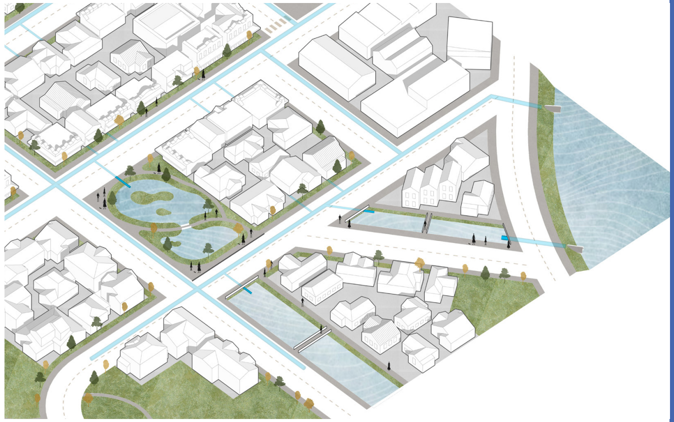
Coastal
✗ Erosion
✗ Flooding
✗ Tsunami

Seismic
✗ Earthquake
✗ Liquefaction
✗ Landslides

Description

Conveyance improvements involve the enhancement or modification of existing and new drainage systems. This might involve combinations of installing larger pumps and pipes to increase water flow, intercepting and diverting flows upstream, creating engineered channels or canals and/or enhancing stormwater conveyance capacity both overland and through piped networks.

The permanent and temporary use of flood storage, including planted infrastructure to support green-blue corridors is closely associated with conveyance improvement and therefore this approach should be considered alongside the "preparedness and response", "dedicated water storage" and "floodable infrastructure" approaches.



Interdependencies

Stormwater conveyance improvements should be considered alongside temporary and permanent flood storage solutions and alongside groundwater lowering and coastal protection approaches. Flood infrastructure should be included in preparedness and response planning.

Pros

- **Maintained sense of place/identity:** Improved stormwater conveyance may increase the sense of place if the amenity of the area is increased through more open space (open channels) and flood hazard reduced.
- **Health of and connection to the natural environment:** Incorporating sediment traps and biofiltration helps remove pollutants from stormwater runoff before reaching natural water. Green-blue corridors can create more green spaces and enhance the community's connection to the environment.

Cons

- **Cost:** Cost is subject to the size, scale and complexity of the conveyance improvements. It is likely that most solutions would require significant funds and land purchases, requiring approval through Council processes. The cost of implementing is likely high although it is currently unclear how this cost compares with the "do nothing" option. A maintenance programme to ensure the proper functioning will be required.
- **Emissions, pollution and material re-use:** In the short term, construction activities could increase energy consumption, lead to higher emissions, and be disruptive to existing ecosystems. The built elements will result in high carbon emissions. Green-blue corridors however have the potential to act as carbon sinks and absorb carbon dioxide.

Neutral

- **Generational, flexible solution:** It is related to site-specific consideration. Useful for existing areas that are in danger of flooding. In the long term, planted conveyance can enhance wildlife habitat and improve water quality.
- **Social co-benefits:** An interception and diversion solution that benefits South Dunedin may require the cooperation and support from landowners that are not beneficiaries. However, in the long run, it brings resilience to the community. It can reduce the relocation of houses and businesses and will help economic growth.
- **Technical feasibility and efficacy:** Areas are protected by storing, displacing and conveying water into dedicated water storage areas in other locations or enabling faster discharge into the harbour. Evaluation of changing flood risk requires an understanding of many factors including the interactions between stormwater, groundwater and coastal inundation, and the current network performance and condition. Conveyance improvements such as fixing leaks and cross connections may also lead to increased groundwater levels resulting in maladaptation.

The low-lying, flat topography of South Dunedin presents challenges to stormwater conveyance due to the lack of gradient to convey flows by gravity to the coast, and the high groundwater levels limiting the potential for soakage/infiltration.

It is important that the stormwater conveyance system is considered alongside the wider "water" system since the stormwater, groundwater and sea level interact with each other. Given the difficulties previously outlined, this is why conveyance improvements should be considered alongside all other approaches. Some of the stormwater conveyance approaches may not result in reduced peak water levels during extreme storm events, but they may cause less frequent flooding, or shorter durations of flooding for less extreme events. The community's acceptance of these outcomes needs to be assessed but it is expected that improved conveyance systems would contribute to public health outcomes and protect property and infrastructure.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Upgrades to conveyance systems can improve overall urban form by creating more open spaces. The addition of green-blue corridors can improve access to recreational and green spaces. Improved conveyance via pipes and pumps reduces risk to places and spaces but does not create space for wildlife.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Green-blue corridors can create a sense of environmental stewardship and uphold the concept of kaitiakitaka. These corridors serve as connections between Papatūanuku and Tangaroa, promoting the well-being of ecosystems and indigenous biodiversity. Other built conveyance improvements such as bigger pipes may require larger areas of disturbance and will not regenerate the environment.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Effective conveyance systems reduce risk to properties and infrastructure from flood-related damages and will not exacerbate existing inequities
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Effective conveyance systems protect properties and infrastructure from flood-related damages, preventing potential financial burdens for individuals and businesses. Reduced flood risks can also attract investment and promote economic growth in the area. This resilience builds confidence among residents in their ability to recover quickly from these events and adapt to future challenges.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Upgrading conveyance systems can contribute to the overall safety and well-being of residents by reducing the risk of flooding and associated property damage. This enhances the quality of life, reduces stress, and provides peace of mind for individuals living in flood-prone areas. Proper conveyance systems prevent stagnant water accumulation, which can serve as breeding grounds for unwanted pests and the accumulation of pollutants, toxins and bacteria. By reducing standing water, upgrades can minimize the risk of waterborne diseases and vector-borne illnesses, benefiting public health.

SOUTH DUNEDIN FUTURE

Protect

Remove wastewater network overflows and cross-connections

Groundwater	Rainfall
✕ Rising groundwater	✓ Flooding

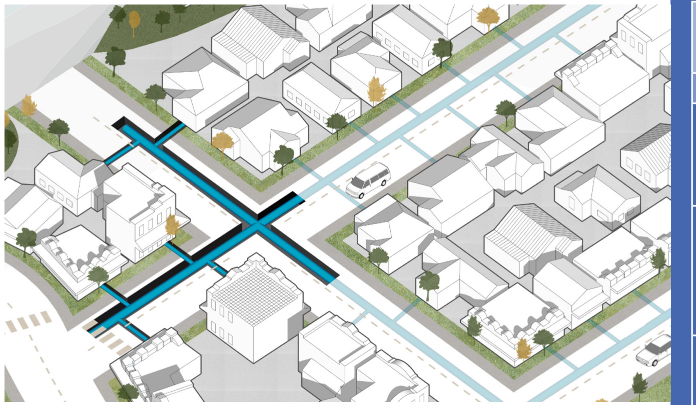
Coastal	Seismic
✕ Erosion	✕ Earthquake
✕ Flooding	✕ Liquefaction
✕ Tsunami	✕ Landslides

Description

Removing wastewater network overflows would avoid wastewater spilling out from gully traps, manholes, or engineered/constructed overflow points when the network has reached full capacity protecting people from health risks associated with flooding. Stormwater "inflow and infiltration" into the wastewater network is a significant problem and a main cause for wastewater overflows.

Resolving wastewater network overflows and cross-connections can be achieved by measures such as fixing cracked pipes or manholes (that may have been caused by ground movement, deterioration of aged pipes or tree roots).

By improving/resolving wastewater network overflows and private cross-connections, this helps reduce the infiltration/overflow of stormwater into the wastewater network which then reduces the likelihood of wastewater overflows. This reduces the potential for bacterial (e.coli) contamination of stormwater which could result in an acute human health risk for the community as well as reducing contamination of receiving waterbodies and frequency/extent of surface water flooding.



Interdependencies

There are limited interdependencies with this approach. While wastewater cross connections are being removed, additional below ground works could be actioned simultaneously to streamline construction. More capacity in the wastewater or stormwater networks may be required to offset resolving the leakage and cross connections.

SOUTH DUNEDIN FUTURE

Pros

- **Pollution:** This approach reduces the risk of releasing pollutants into natural water bodies, thereby improving water quality, preserving ecosystems, and reducing greenhouse gas emissions associated with treatment of wastewater (versus a larger volume diluted with water).
- **Health of and connection to the natural environment:** Resolving overflows and cross-connections improves the quality of water bodies used for recreation, drinking water sources, and aquatic habitats.
- **Maintained sense of place/identity:** Addressing overflows and cross-connections helps preserve the cultural and historical identity of communities by safeguarding natural water bodies, local heritage, and recreational spaces.

Cons

- **Social co-benefits:** Local disruptions during construction may lead to temporary inconveniences or negative social impacts.
- **Generational, flexible solution:** The pace of implementation may not meet the immediate needs of a growing population or changing environmental conditions.
- **Cost:** Space for adding more storage through the wastewater (or stormwater) systems are limited by existing urban land uses. The costs to provide below ground storage are significant and the feasibility for delivery will be challenged by ground conditions, existing services, and high groundwater levels.
- **Emissions and material re-use:** Resolving network overflows and cross-connections through repair or replacement may require substantial material usage and result in carbon emissions.

Neutral

- **Cost:** Improving/resolving wastewater overflows and illegal cross-connections would require capital budget approval but is generally within 'normal' capital spend, subject to the scale and pace of improvements. Thus, rehabilitation of the network would be a cost-effective solution compared to full replacement.
- **Generational, flexible solution:** Requires ongoing management and maintenance. However, can be flexible in terms of adapting to changing conditions. In many cases existing wastewater networks can be retrofitted with additional infrastructure.
- **Technical feasibility and efficacy:** Increased urbanisation associated with new greenfield housing and densification in existing areas will challenge the existing design parameters of the network. A potential consequence of reducing stormwater infiltration into wastewater is higher groundwater and reduced drainage as a result of reduced conveyance via the wastewater system.

This approach focuses on improving/resolving wastewater overflows and private cross-connections, which significantly reduces the acute human health risk due to the bacterial contamination from wastewater overflows and cross-connections. This can have significant cultural benefits as it can help to restore the mauri of sites of significance to mana whenua. A cleaner environment also improves broader social (beyond public health outcomes) and environmental outcomes by providing increased recreational and biodiversity opportunities.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Addressing overflows and cross-connections can reduce the risk of waterborne diseases and bacterial contamination, leading to improved public health outcomes for the community. Cleaner and safer water bodies can provide increased recreational opportunities, promoting physical and mental well-being for residents through activities like swimming, boating, and fishing
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Resolving wastewater overflows and cross-connections enhances ecosystem resilience by reducing water pollution, aiding native flora and fauna. This restoration contributes to biodiversity preservation and improved water quality, benefiting both the environment and aquatic life, aligning with the principle of kaitiakitaka. Many natural water bodies hold cultural significance for communities. Preserving these areas by resolving overflows and cross-connections could contribute to the cultural and spiritual well-being of the community, particularly for Māori/iwi groups.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Communities affected by wastewater overflows often experience social and economic challenges due to degraded living conditions and potential health risks. By removing overflows, South Dunedin can experience improved quality of life, enhanced well-being and a safer environment for residents.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	The improvement of infrastructure and environmental conditions can attract investment, create jobs, and boost the local economy, leading to greater economic well-being for the community. By mitigating wastewater-related risks, such as flooding and contamination, the community becomes more resilient in the face of natural disasters and environmental challenges.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Mitigating hazards related to wastewater issues increases community safety by reducing the risks associated with flooding, infrastructure failures, and water contamination.

Protect

Dedicated water storage

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

Coastal
× Erosion
✓ Flooding
× Tsunami

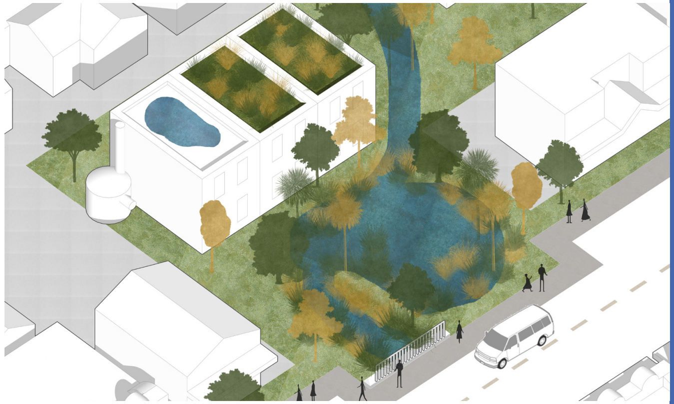
Seismic
× Earthquake
× Liquefaction
× Landslides

Description

Dedicated water storage areas include detention basins, ponds and wetlands that can be located at the coast or inland. They feature a permanent allocation of land/space for water storage, which typically incorporates a permanent body of water and a "live" storage component which fills during storms and is slowly released once the storm has passed. Storage can be on surface or underground, although the high groundwater levels associated with South Dunedin preclude considering underground storage further.

Dedicated water storage can be incorporated into broader "Sponge City" or "Blue-Green corridor" spatial planning and stewardship concepts and/or restoration projects to enhance environmental and cultural outcomes (e.g. restoring historic wetlands).

The dedicated water storage approach helps prevent other areas from flooding by focusing water towards the basins, ponds and wetlands.



Interdependencies

Best implemented alongside other approaches, but in particular "land elevation" (for the areas protected) and partial "retreat" to make space for new floodable infrastructure as well as inclusion in Preparedness and Response Plans. This approach is dependent on stormwater and wastewater renewal timing and is likely to require frequent pumping to discharge the excess water. It is also dependent on groundwater levels allowing for natural drainage after events or reduced volumes for storage due to infilling by groundwater.

Pros

- **Health of and connection to the natural environment:** Planted storage areas can provide habitats for aquatic and terrestrial species and promote biodiversity within urban areas. Provides more green space for the community.
- **Social co-benefits:** Planted storage areas can enhance the aesthetic value of an area, provide recreational spaces, and contribute to ecosystem services like carbon sequestration and temperature regulation. Greater access to the natural environment offers mental health and wellbeing benefits alongside recreational opportunities.
- **Emissions, materials and pollution:** Opportunity for carbon sequestration with the creation of planted storage. Detention basins can be planted and act as carbon sinks, absorbing carbon dioxide. Wetlands can also provide natural filtration improving air and water quality.
- **Generational, flexible solution:** Can provide long-term benefits by intercepting, temporarily storing and conveying water into dedicated storage areas in other locations. It has the potential for expansion or modification as climate conditions change over time. These solutions can also be integrated into the built environment.

Cons

- **Social co-benefits:** Housing may need to be cleared for the creation of storage. The selection of suitable locations for implementing these measures may face challenges related to land ownership and community acceptance. This can also increase the competition for land outside of the basin, pond, wetland area for other purposes.
- **Technical feasibility and efficacy:** The slow natural drainage from the storage areas may require combinations with other approaches (e.g. pump stations) to be effective.

Neutral

- **Maintained sense of place/identity:** Increased storage could change the sense of place in South Dunedin, but this accessibility of green spaces can be designed to enhance South Dunedin's identity and amenity. Also the restoration of the Kai Tuna wetland can help to reinstate community identity.
- **Material reuse:** Limited opportunity for these actions to provide for material reuse, but natural environment actions can require less materials overall.
- **Cost:** The cost is subject to the size, scale and complexity of the dedicated water storage feature. It is likely that most solutions would require significant funds and land purchases. The cost of implementing floodable infrastructure is likely high although it is currently unclear how this cost compares with the "do nothing" option. A maintenance programme will be required.

Dedicated water storage would be used to protect areas of South Dunedin from flooding by directing floodwaters (coastal or rainfall-induced) towards the "live" storage component of permanent water bodies. Utilising dedicated water storage features is likely to serve as an important component of a broad integrated flood management strategy. Implementing the approach requires careful design and planning to suit the local conditions (e.g. ground suitability and hydraulics) including how it may integrate with other urban planning and flood management aspects over time (e.g. land elevation raising or property level interventions).

There are enhanced opportunities to meet the outcomes desired for South Dunedin by incorporating significant planting into the dedicated water storage areas. Typically, temporary detention basins have fewer plants and plant diversity, whilst wetlands have the most. Choice of appropriate planting for the conditions is a key design criteria including how it may change overtime.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Dedicated water storage areas like the creation of detention basins, wetlands and planted water storage may help to improve urban form and the overall livability of South Dunedin by improving access to green space and recreational areas. This can have mental health benefits to the community and improve wellbeing.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Dedicated water storage features can be used to support water re-use and other sustainability-focused initiatives. Where diverse planting is incorporated into the design there are opportunities to enrich urban biodiversity by providing a variety of habitats for aquatic and terrestrial species and establishing corridors for wildlife. They can also enhance water quality by filtering stormwater runoff, and enhance carbon sequestration embracing the concept of kaitiakitaka and acknowledging the interconnectedness of the taiao. Dedicated water storage areas can also serve as educational spaces to raise awareness about the interaction between biodiversity, natural hazards, infrastructure and urban planning.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	The loss of amenity and/or loss of service from the land that is repurposed for dedicated water storage has the potential to increase some inequities, create tension and reduce community cohesion. However this is dependent on the location, the existing land usage, the proposed changes to the built environment and the process for engagement with affected parties.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Floodwater would be directed towards dedicated water storage areas whilst leaving other areas less exposed. Currently there are large proportions of South Dunedin that are exposed to flooding and incorporating dedicated water storage areas presents an opportunity to reduce some of the risk to South Dunedin properties and businesses.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Floodwater would be directed towards dedicated water storage areas whilst leaving other areas where people live and work being less exposed to the hazards. This tangible protection can provide a sense of security to residents and business owners.

SOUTH DUNEDIN FUTURE

Protect

Floodable Infrastructure

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

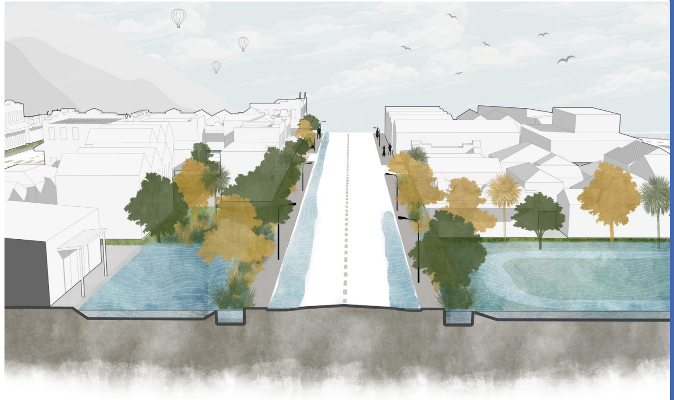
Coastal
✗ Erosion
✓ Flooding
✗ Tsunami

Seismic
✗ Earthquake
✗ Liquefaction
✗ Landslides

Description

"Floodable infrastructure" refers to open spaces, green spaces (e.g., parks, reserves), carparks, and roads being transformed into intentional temporary flood storage zones or overland flow paths to protect other areas from flooding.

Given the flat nature of South Dunedin, the floodable infrastructure would need to be at a lower level than the surrounding area it is intended to protect (e.g. by raising surrounding area or lowering floodable area). However, where there is gradient available (e.g. to the east and west of South Dunedin), there may be options to store stormwater runoff further upstream as a way to protect areas further downstream in South Dunedin. While primarily designed to protect from coastal flooding and pluvial/fluvial flooding, it may also reduce groundwater levels if used in combination with an appropriate planting regime.



Interdependencies

Floodable infrastructure is best implemented alongside other approaches that reduce pluvial flooding, in particular "land elevation" for the areas protected and partial "retreat" to make space for new floodable infrastructure. Understanding the likely frequency of future flooding for the floodable infrastructure will help determine the best land use when not flooded (e.g., frequent flooding of a car park may be less acceptable than flooding a park/reserve area at the same frequency). Any floodable infrastructure approaches will need to be addressed in the Preparedness and Response plans to forewarn the community and clean up following flooding events may be required.

Pros

- **Technical feasibility and efficacy:** Intercepting, temporarily storing, and conveying water through planned floodable infrastructure areas protects other areas from flooding provided large enough storage can occur, including for potentially heavier rain events in the future. Large land areas therefore potentially required. There may be technical challenges regarding the feasibility of effectively infiltrating sufficient water into the subsoil due to high groundwater.
- **Emissions and materials:** While there are embodied emissions and materials required in creating floodable infrastructure, once operational, measures such as floodable green spaces can act as carbon sinks, absorbing carbon dioxide.
- **Health of and connection to the natural environment:** Green floodable infrastructure can be aesthetically pleasing and enhance the urban landscape and biodiversity.

Cons

- **Social co-benefits:** Loss of amenity and/or service from the land or infrastructure that is temporarily flooded; variable impact dependent on land use (e.g. road, car park, reserve)
- **Cost:** The cost is subject to the size, scale and complexity of the floodable infrastructure solutions, including whether it makes use of existing spaces, or requires land purchases in addition to design, construction, and maintenance of new areas. Most solutions would likely require significant funds.
- **Pollution:** Floodwaters on roads can carry contaminants which can pose environmental and public health risks.

Neutral

- **Generational, flexible solution:** Creating floodable infrastructure provides some flexibility and allows for future changes. Floodable infrastructure can be retrofitted and upgraded to meet future requirements dependant on maintenance and upgrades.
- **Maintained sense of place / identity:** Can be designed to integrate with the local context, preserving and celebrating South Dunedin's identity. However, may disrupt normal activities and alter the landscape, reducing sense of place for some.

Planted floodable infrastructure offers opportunities to meet the desired outcomes for South Dunedin. Considerations between planted- and hard- floodable infrastructure solutions as part of wider integrated urban planning needs to ensure sufficient space for non-"green" land uses (i.e. if all floodable land is green, then there will be increased competition for space outside of the floodplain for all other land uses). Other key considerations include transport, evacuation, business continuity and loss of amenity value and/or service of flood storage areas during flood events.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Floodable infrastructure provides many opportunities to support this outcome, although it will be dependent on which areas are used for temporary storage and what the land is used for when it is not flooded. If these areas are sculpted to be lower to have sufficient detention volume, then these parks and open spaces will be more susceptible to groundwater rise and semi-permanent dampness. There are opportunities to align with the principle of waiora and prioritise ecological conservation and resilience. Well-designed green floodable infrastructure can contribute to the aesthetic appeal of an area, enhancing its sense of place. However it may reduce opportunities for some uses of the area to occur, albeit temporarily.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Floodable infrastructure, when implemented with a kaitiakitaka lens, goes beyond practical benefits. It can be used to support water re-use and other sustainability-focused initiatives. Planted floodable infrastructure can enrich urban biodiversity by providing a variety of habitats, creating space for plant species, and establishing corridors for wildlife. It can also enhance water quality by filtering stormwater and enhance carbon sequestration. This revitalizes urban spaces in culturally meaningful ways. If incorporating planting, floodable infrastructure increases the connection to nature, promoting a renewed sense of belonging and re-energizing whakapapa with the land.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Green floodable infrastructure solutions can provide opportunities for community working days to increase planting in neighbourhoods and private spaces. Native plants can be incorporated to transition towards a more natural environment. Some floodable infrastructure solutions may result in changes to the built environment, especially temporarily. Access to public spaces such as car parks and floodable greenspaces will be limited. This has the potential to increase inequities.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Floodwater would be directed towards floodable infrastructure areas whilst leaving other areas less exposed. This approach would be accompanied by community awareness allowing better preparedness and knowledge of those areas to stay away from (floodable areas). Recovery will be facilitated through post flood clean-up and a Response Plan.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Floodwater would be directed towards floodable infrastructure areas whilst leaving other areas where people live and work being less exposed to the hazards. This tangible protection can provide a sense of security to residents and business owners. However, they may also present a safety hazard if frequently used public spaces are flooded without community awareness programmes and advice on areas to avoid.

SOUTH DUNEDIN FUTURE

Protect

Increase permeability of ground surface

Groundwater	Rainfall
✕ Rising groundwater	✓ Flooding

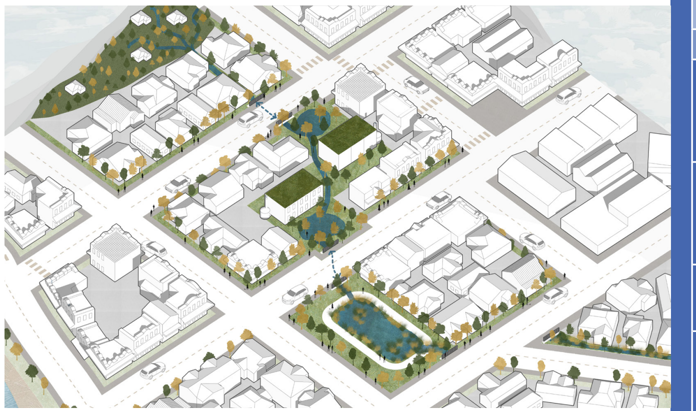
Coastal	Seismic
✕ Erosion	✕ Earthquake
✕ Flooding	✕ Liquefaction
✕ Tsunami	✕ Landslides

Description

Increasing permeability of the ground surface improves the receiving environment's ability to absorb and/or manage excess rainwater, reducing the volume and rate of runoff that would otherwise go through to the stormwater network. Reducing peak volumetric flows of water is important in reducing flooding in urban areas. This could involve various strategies such as implementing green roofs, reducing impervious area of carparks or other surfaces, introducing rain gardens and/or bioswales, or planting more trees. These elements are often referred to as components of a 'sponge city' that soaks in rainwater/excess stormwater, filters it, and releases it slowly like a sponge, thereby reducing flooding and regulating water levels. Their efficacy can be limited by groundwater levels and the ability for the substrate to absorb additional water.

The introduction of natural elements can improve water quality, removing pollutants and sediment from water before it flows into surface water or aquifers, contributing to environmental outcomes.

The options of green roofs, bioswales and planting trees were suggested during public engagement events in October 2023 during the 'what matters most' phase.



Interdependencies

Increased permeability should be considered alongside temporary and permanent flood storage solutions, conveyance, groundwater lowering and coastal protection options. Flood infrastructure should be included in preparedness and response planning.

SOUTH DUNEDIN FUTURE

South Dunedin Future - Long List of Generic Adaptation Approaches, Dec 2023

Pros

- **Health and connection to the natural environment:** Increasing permeability enhances local biodiversity, providing greater habitats for an array of plants, animals and microorganisms.
- **Social co-benefits:** Greater access to the natural environment offers mental health and wellbeing benefits alongside recreational opportunities. Green spaces, particularly more trees, also help with temperature regulation, noise reduction and providing shade for residents. Increased permeability in turn can help with amenity and desirability of the area.
- **Emissions, materials and pollution:** While there are emissions associated with the act of increasing permeability, once operational, rain gardens, trees and bioswales act as carbon sinks, absorbing carbon dioxide. They also provide natural filtration improving air and water quality.

Cons

- **Technical feasibility and efficacy over time:** While actions can begin to be implemented in the short term, planting trees, and similar actions, can take a long time to become established, meaning their full benefit can take some time to be realised. They are only considered suitable for the short-medium term. Longer term implementation will begin to become unviable with higher groundwater levels associated with an increasing sea level reducing the absorptive capacity of soil.
- **Cost:** The initial cost for public infrastructure would require council capital budget approval but is generally within normal council spending. There would be higher ongoing-maintenance costs over its lifetime. Increasing permeability of private assets would likely be a cost borne by the owner.
- **Social co-benefits:** Carpark removal could need management to avoid accessibility impacts.

Neutral

- **Generational, flexible solution:** Increasing permeability provides some flexibility and allows for future changes. Overall, generational efficacy is limited by rising groundwater and soil saturation levels. Ongoing maintenance is needed for the actions to remain at their optimal efficacy.
- **Material reuse:** Limited opportunity for these actions to provide for material reuse, but natural environment actions can require less materials overall.
- **Maintained sense of place/identity:** Increased green space could enhance sense of place through greater attachment to the environment but conversely the changing character of the area may adversely impact peoples existing sense of place.

This approach reduces risk through water management and enhanced drainage to promote soil and ecological health. As a result there are benefits for risk reduction and also biodiversity enhancement, resource stewardship and pollution management. The approach supports broader social, environmental, and cultural outcomes. In particular, the use of plants can have an added co-benefit of climate mitigation (greenhouse gas emissions sequestration) and therefore can contribute to wider climate action aspirations for Dunedin city. Utilising this approach alone would still result in flooding in extreme events, but it can be employed to enhance and complement other available approaches. Although yet to be explored with mana whenua, adaptation approaches that increase permeability and place the environment at the centre generally align more closely with a Te Ao Māori worldview.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Increasing permeability places the environment (Te Taiao) at the centre of the response, benefiting from the drainage capacity of plants and soil. These approaches can positively impact the wellbeing of the community through enhanced biodiversity including wildlife habitat and reduced pollution. They can also assist in achieving a vibrant and livable community given the enhanced connection and access to the natural environment and co-benefits of improved water quality and air quality.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Increasing permeability through rain gardens, green roofs and bioswales will directly contribute to environmental restoration. Planting of swales (bioswales) will have the added benefit of environmental enhancement through improved water quality and less pollution (air) and more green space. These practices honour the interconnectedness between humans and nature as well as our responsibility to enhance the mauri of the environment.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	An increase in permeability may result in changes to the built environment, such as decreasing the number of carparks or shifts to permeable pavements. These changes may present challenges for mobility potentially increasing inequities if not managed.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Local businesses could be involved in the initial implementation of additional green spaces and their ongoing maintenance. Increasing permeability will have limited impact on climate-resilient ventures/businesses in the long term. However enhanced amenity may attract more visitors to the area, potentially improving local economic opportunities.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Increasing permeability can improve natural drainage, making space for water while maintaining space for people and increasing access to natural resources. However, as the groundwater rises, there is less space below ground for rainfall to be absorbed naturally and, regardless of efforts to increase permeability, the effective permeability may be reduced as the soil becomes saturated. This limits the extent to which increased permeability can contribute to a safe and resilient community.

Protect

Coastal protection

Groundwater	Rainfall
✗ Rising groundwater	✗ Flooding

Coastal	Seismic
✓ Erosion	✗ Earthquake
✓ Flooding	✗ Liquefaction
✓ Tsunami	✗ Landslides

Description

Coastal protection comprises various tactics aimed at safeguarding coastal areas and can include 'hard' engineering options and 'soft engineering' options which each have their own strengths and drawbacks. For example, tsunami walls would need to be higher than sea walls to provide protection from coastal flooding (estimated 1-2m higher).

Hard options for coastal protection include sea walls, revetments, berms, dykes, tidal barriers, groynes, breakwaters and flap gates on stormwater networks. Some of these (seawalls, berms, dykes, tidal barriers and flap gates) can provide both erosion and flood protection while others (revetments, groynes and breakwaters) primarily provide erosion protection. Shoreline armouring (revetments, seawalls) to manage erosion may result in beach lowering in front of the hard structure while groynes and breakwaters interrupt the nearshore waves and currents to maintain sand on the beach. All types of shoreline armouring can result in end effects where the area downdrift of the structure erodes due to increased energy. Coastal structures would require other measures to protect against rain induced flood hazards and may exacerbate other flooding. This would require an understanding of the design life and residual risk of an over-design event or failure.

Engineering methods to reduce flooding are designed to create an impermeable barrier that keeps the sea from inundating land during a design event that would consider sea level rise, tide levels, storm surge and local wave effects. Soft engineering options like salt marsh, coastal wetlands, sand placement and dune restoration can be established at the coastal edge to reduce wave energy and surge effects and therefore erosion. However, such ecological methods do not act as barriers and are therefore unlikely to prevent inundation from sea level rise and astronomic tides.

Interdependencies

Should be used in combination with land elevation, drainage and conveyancing improvements.

SOUTH DUNEDIN FUTURE

Pros

- **Emissions, pollution and material re-use:** Structural components will have high embodied carbon but are expected to have low operational emissions. However, they involve use of materials. Soft engineering solutions have the potential to provide sequestration (e.g., salt marshes) or use recycled materials to reduce embodied carbon requirements.

Cons

- **Generational, flexible solution:** Structural solutions may result in lock-in of protection options and reduced capacity for future adaptation, particularly where changing environmental conditions result in engineered solutions no longer functioning effectively (e.g., overtopping of sea walls due to rising sea levels). However, they can be designed to allow for retrofitting over time to shift with community expectations.
- **Technical feasibility and efficacy:** Reduces risk to people, places and assets within the protected area, but can cause negative effects on drainage from rainfall-induced flooding and groundwater and can also increase the residual risk from overtopping, undermining or breaches if development behind the line of protection is intensified. There are many wider benefits to implement soft engineering solutions along the coast, particularly in regard to preventing erosion from wave effects. Soft engineering solutions do not mitigate the projected flooding or tsunami hazards. Permeable coastal protection measures are also ineffective from protecting South Dunedin from groundwater elevation due to sea level rise.
- **Cost:** The cost is subject to the size, scale and complexity of the coastal protection. However, the cost of implementing flood protection will be high.

Neutral

- **Natural environment:** Minimal direct environmental impact but may influence coastal processes (i.e., sediment transport) depending on solution selected.
- **Social co-benefits:** Positive and negative changes in area amenity and connection are possible dependent on protection measure (e.g., nature-based vs. structural). Physical barrier options may limit community access (e.g., sea access for recreation).
- **Maintained sense of place / identity:** Physical changes to space and ability to access areas surrounding protection measures, however soft engineering solutions may lead to an increased sense of place and a new identity through enhanced ecological outcomes.

Coastal protection for erosion or inundation caused by sea level rise, astronomic tides and storm events from the Otago Harbour could be achieved through hard or soft engineering measures such as sea walls or dykes and coastal wetlands. Tsunami risk reduction would require large seawall structures and will therefore be a visual barrier, reducing connectivity with the coast. Protection against erosion could include groynes and breakwaters and natural barriers such as dune restoration but the design will need to incorporate provision for rising sea levels to provide long term efficacy. Physical protection can provide a sense of security and safety for the community but may result in maladaptation if that sense of safety encourages further development behind the protection. The technical design and efficacy of coastal protection is linked to the height of the barrier and the ground conditions with residual risk associated with "over-design" events. Coastal protection can provide immediate and strong resistance, but their efficacy varies from place to place and their long-term sustainability and impacts on other coastal processes requires further investigation. Coastal flood protection only protects from the water coming in from the harbour and the Pacific South coast but does not address the pluvial/fluvial and groundwater flooding issues unless combined with other strategies. The use of hard protection options is discouraged in favour of soft engineering and longer-term strategic management in the New Zealand Coastal Policy Statement 2010. However, seawalls are presently in use along the harbourside managing some flood and erosion risk so are a familiar option to the community. Soft engineering options work with the environment and may be more aligned with a Te Ao Māori worldview.

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Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Coastal protection works by altering nature processes and as a result can dramatically change the environment including places enjoyed by people and natural habitat. Soft engineering options could have community wellbeing co-benefits through the creation of high amenity value spaces for the enjoyment of South Dunedin residents.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Implementation of nature-based protection approaches has the potential to result in enhanced environmental outcomes, such as increases in habitat for coastal nesting birds within and behind protective structures. Such initiatives can help to maintain the mauri of the taiao. Physical hard structures will impact coastal processes such as wave action and sediment transport and may result in landform changes, impact cultural sites and adversely impact the connection between urban areas and the water.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Coastal protection systems can be funded a range of different ways, including entire communities pay due to the communal use of the coast to beneficiaries pay. The cost of coastal protection may be borne by parts of the community that cannot afford a rates increase and do not directly benefit, potentially increasing existing inequities.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Coastal protection for both the Otago Harbourside and the South Pacific Coast will reduce the risk of damaging coastal inundation events for local people and businesses, limiting the cost of repair and replacement of assets. Coastal protection approaches will not address pluvial flooding and may exacerbate flooding issues for communities and businesses.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Coastal flood protection on the Otago Harbourside will reduce the risk of damaging coastal flood events for local people and businesses, helping people living and working in this area to feel safe and cared for. However, coastal protection will not improve safety from pluvial flooding and this will need to be considered in the design of coastal protection so that risks are not increased over time.

Accommodate

Behavioural / societal changes

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

Coastal
✓ Erosion
✓ Flooding
✓ Tsunami

Seismic
✓ Earthquake
✓ Liquefaction
✓ Landslides

Description

Resilience can be understood as the ability to prepare, respond, cope, and recover from natural hazard events, learning from past experiences and adapting accordingly. In the context of societal and behavioral changes, resilience strategies aim to reduce the impacts of hazards by emphasizing prevention and preparedness. Potential approaches to increase community resilience and understanding of climate hazards include:

- Mental health support
- Climate hazard safety education and awareness
- Financial incentives / disincentives (e.g. rates rebates to encourage resilient modifications or increases in insurance cost [not Council driven] reflective of increased risk)

Interdependencies

This approach can be used alongside all other approaches to increase social resilience of communities.

Pros

- **Time:** Behavioural/societal changes to increase community resilience can begin to be implemented within the current timeframe. These approaches are likely to be suitable in the short to medium term. The increasing risk of climate hazards in the longer term may make behavioural changes insufficient as an adaptation measure.
- **Cost:** Can be executed within Council operational budgets.
- **Social co-benefits:** Mental health support and flood safety education awareness can improve community wellbeing and may better equip people to make informed choices and deal with events when they occur.
- **Emissions, materials and pollution:** Focussed primarily on addressing the psychological and emotional impacts of flooding. Unlikely to generate substantial emissions.
- **Health of and connection to the natural environment:** Flood safety education and awareness can help people understand the impacts of flooding on the natural environment. Educating communities on the importance of preserving local ecosystems can foster a sense of kaitiakitaka.
- **Technical feasibility and efficacy:** These are 'no regrets' approaches - meaning that there will be benefits no matter what future level of climate risk is present. However, their effectiveness is limited by the degree of uptake.

Cons

- **Social co-benefits:** Behavioural/societal change may result in changes to insurance premiums and/or ability to insure which would likely have inequitable economic consequences. Affordability will be reduced and this may have flow on mental and physical impacts. Financial incentives/disincentives can also create economic inequities. Community tolerance for financial disincentives will vary and community members may get left behind. Such incentives can impact community cohesion and create tensions.
- **Maintained sense of place / identity:** There are no benefits to the acceptance of lower levels of service. This is likely to diminish people's sense of place and identity. Also likely to result in wellbeing and economic impacts.
- **Health of and connection to the natural environment:** Acceptance of lower levels of service may result in less of a connection to the natural environment as sense of place diminishes.

Neutral

- **Generational, flexible solution:** Providing mental health support is a generational strategy as it addresses the long term emotional and psychological impacts of climate change.

Behavioural / societal change responds to the existing vulnerabilities of the South Dunedin community to enhance community and individual resilience, contributing to South Dunedin having healthy, safe and connected people. While not reducing climate hazards exposure, by assisting the community in preparing for future events and giving resources to expand capacity by providing guidance, this could support 'learning to live' with water and making specific interventions that help to reduce the impacts on health, discomfort, and trauma from natural hazards. In turn, individual or community actions as a result of this approach could indirectly contribute to climate, biodiversity and other broader outcomes.

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Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	If the community is better prepared mentally for climate hazards it can contribute to improving overall waiora. These initiatives can help create a sense of community well-being by fostering community cohesion and social support networks.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Flood safety education and awareness can indirectly contribute to a more sustainable environment by helping the community understand how climate change can affect local ecosystems, water quality and wildlife habitats. This includes collaborating with Māori and iwi to incorporate matauraka Māori into education programmes. This approach does not directly enhance biodiversity or water quality.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Mental health support and flood safety education and awareness for all is an equitable initiative that will improve resilience providing there are the resources available to reach all members of the community. However, if insurance companies significantly raise premiums it will disproportionately affect low-income earners. Financial disincentives can also result in limited approaches for those who are constrained financially.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Behavioural and societal changes will enable people to develop adaptable resilient behaviours to manage the impact of hazards. It can result in the community being more mentally prepared. However, this approach does not reduce the physical risk to climate hazards.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	These approaches will not reduce the physical risk to climate hazards. Although greater awareness of flood hazards and potential risk to safety may better prepare communities, it will not be an effective long-term solution on its own in the face of increasing risks.

SOUTH DUNEDIN FUTURE

Accommodate

Readiness and Response

Groundwater
✕ Rising groundwater

Rainfall
✓ Flooding

Coastal
✕ Erosion
✓ Flooding
✓ Tsunami

Seismic
✓ Earthquake
✓ Liquefaction
✓ Landslides

Description

Readiness (also known as "preparedness") measures typically refer to the operational systems, capabilities and educational activities that are put in place before an acute event. Response refers to actions taken during or immediately after an emergency event like flood or earthquake. Readiness and Response planning generally falls within the responsibilities of Civil Defence Emergency Management (CDEM) – e.g. outside of the traditional PARA adaptation framework – and these responsibilities extend across a range of organisations, including Lifeline Utility Providers and critical infrastructure entities.

Readiness and response work would typically involve consideration of risk assessment and planning, early warning systems, public education campaigns, emergency response plans, including deploying temporary flood barriers (e.g. sandbags) and providing support services prior, during and immediately after an event. These approaches are not mutually exclusive of each other and readiness and response planning are essential across all the Protect, Accommodate, Retreat, and Avoid (PARA) approaches to effectively reduce risk. Readiness and response provide critically important short term benefits during and immediately following an emergency event, increasing the resilience of communities.

Interdependencies

Readiness and response are used in combination with other measures including long term adaptation (PARA) approaches to reduce risk (Reduction) and post-event Recovery (e.g. all 4R's of emergency management are recommended). Many approaches are multi-agency, requiring collaboration and coordination.

Pros

- **Technical feasibility and efficacy:** Readiness and response activities help minimise injury, loss of life, and property damage during an event/disaster whilst also supporting recovery after an event. Often these measures are dependent on the awareness and subsequent action of community members. Unlike many hard engineered measures, effectiveness is hard to measure pre-implementation, but success is driven by effective coordination and communication, along with appropriate, regular training and exercising of staff and communities.
- **Time and cost:** These measures may require additional funding from a range of sources including local, governmental, or public-private partnerships. It takes time to increase awareness within communities, to establish monitoring for decision making and to conduct assessments which underpin the readiness and response plans. While effective readiness and response planning takes time to develop and socialize, these are effective measures to enhance community resilience.
- **Emissions, pollution and material re-use:** This approach does not build anything (e.g. spend carbon).
- **Generational, flexible solution:** Readiness planning and emergency response can be adapted over time to changing conditions and human behaviours.

Neutral

- **Social co-benefits:** Fostering a culture of readiness within the community through coordinated education initiatives, community outreach, and public awareness campaigns is important. These programmes can lead to a centralization of power, or to a focus on technological solutions at the expense of more holistic and community-based approaches.
- **Health and connection to the natural environment:** The natural environment is not enhanced or altered by readiness measures, but education of communities on hazards may result in increased connection and respect for the environment.
- **Maintained sense of place / identity:** These measures focus on reducing risk to life during an event allowing communities to remain in place, but place less emphasis on reducing risk to property. Following hazard events there may be impacts to sense of place if buildings are flooded and temporary displacement may be required.

Developing Readiness and Response measures is standard practice across New Zealand for differing hazards and wider emergency events. Successful readiness and response activities help create broader community resilience, minimising injury, loss of life, and property damage during an event/disaster. Although this approach doesn't eliminate natural hazard risks, it can reduce the adverse effects on communities on an event-by-event scale. Feasibility of these approaches is less governed by geographic conditions, and more by the community, with human behaviours/decisions being key to successful outcomes. South Dunedin's unique challenges and hazard characteristics will serve as critical factors with implementation requiring coordination and a shared vision of resilience that involves local governing bodies, emergency services, and community.

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Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	These approaches will not result in improved urban form, but civil defence readiness can help to ensure South Dunedin has the capacity to withstand climate change hazards and reduce the potential damage caused.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	The role of CDEM could be extended to activities such as promoting and advocating kaitiakitaka, mātauraka and government policies and programs that support climate change readiness and response.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Effective "Readiness and Response" planning includes working with communities to develop and implement plans that are culturally appropriate and inclusive, supporting community-led initiatives, conducting equity assessments of policies and programs, targeting resources to communities that are most vulnerable to climate change impacts, and working with Māori/iwi to incorporate mātauranga Māori and cultural practices.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Readiness and response reduces risk to life and allows communities to prepare to cope with hazards; however, beyond having temporary measures ready (e.g. sand bags), there is limited reduction in risk to the built environment. Community resilience is strengthened through planning and readiness activities by developing a plan and promoting connections within communities and businesses to prepare for a response.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Readiness and response programs help communities feel prepared for hazard events through support for early-warning programs, training for community members and emergency responders, supporting community-led initiatives building resilience and social cohesion, and improving communication and engagement with community. The level of impact will be dependent on the type and magnitude of investment and therefore may not protect communities' well-being from long-term effects of natural disasters.

SOUTH DUNEDIN FUTURE

Accommodate

Property level interventions

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

Coastal
✓ Erosion
✓ Flooding
✓ Tsunami

Seismic
✓ Earthquake
✓ Liquefaction
✓ Landslides

Description

Property level interventions refer to adjustments or modifications that are made directly to individual properties to enhance their resilience against flooding. These could include raising homes, waterproofing first floors, raintanks, flood barriers, or other individual property level interventions.

Property level interventions are generally divided into two types:

Resistance measures are designed to mitigate the impact of external factors, acting as protective barriers against potential threats, such as bunding or small flood gates preventing flood water from entering a house.

Resilience measures focus on strengthening a system's ability to endure shocks, recuperate, and adjust, underlining its responsiveness and adaptability. For example, floodable first floors.

Typically, property level interventions are applied to residential properties although they may be applicable to commercial and industrial building types.

Interdependencies

Complements alternative adaptation approaches as a site-specific approach, requires preparedness plans, public awareness campaign, and may require regulatory changes or incentives to encourage uptake.

Pros

- **Social co-benefits:** Improves property level resilience. Likely to result in improved living conditions.
- **Maintained sense of place / identity:** Builds resilience and allows people to stay in their homes for longer. Maintained sense of place as the measures are unlikely to change the features of the wider area.
- **Time:** Relatively simple and quick to implement.

Cons

- **Emissions and pollutions:** Likely to be associated with high emissions due to reconstructed buildings and infrastructure. Also potential contaminants from sites that are flooded.
- **Costs:** Cost of property level interventions are likely to be borne, at least partially, by property owners and therefore may increase existing inequities.
- **Technical feasibility and efficacy:** While feasible to adapt some buildings, older buildings in the South Dunedin area may require a complete rebuild given their age and condition and any historic buildings will require authorisation for any significant modification. The options will also require property owner consent.

Neutral

- **Materials:** Opportunity for the use of recycled materials, especially for rainwater tanks.
- **Generational, flexible solution:** Waterproofing can enhance the durability of buildings, making them more resistant to flood damage and potentially extending their lifespan. Can also be applied to existing buildings, making it a flexible approach. Most property level interventions require ongoing maintenance and are not suitable to all types of buildings.
- **Health of and connection to the natural environment:** Rainwater tanks can raise awareness about the value of water as a natural resource. However, waterproofed buildings and floating buildings have limited opportunities to enhance the health of the natural environment unless they incorporate eco-friendly design features.

The property level interventions will improve the overall quality of the housing stock in South Dunedin and therefore have the potential to have wider strategic benefits than purely risk reduction. For example, the intervention measures may be complimented with other building resilience and improvement measures such as earthquake reinforcement and insulation to mitigate increasing temperatures and removal of mould, thereby creating healthier homes.

There may be opportunities for economies of scale in implementing particular property level interventions. However, the interventions may increase the value of the property and this could have implications for the Dunedin social housing policy of affordable housing.

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Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Property level interventions can enhance community wellbeing by improving property level resilience and improving living conditions. However, there are limited opportunities for property level interventions to improve urban form.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Rainwater tanks can promote water conservation and sustainable use and raise awareness of the local water cycle, the importance of water conservation, and the value of natural water sources. More structural property level interventions (e.g. raising houses) may provide little to no opportunity to restore and regenerate the natural environment but may renew urban spaces and cultural connections by increasing the resilience of the urban environment.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Could further exacerbate existing inequities as some property level interventions may not be suitable for all residents, including those with mobility issues. As the cost for the approach likely borne by the owners there is a risk that rental costs go up. Some residents might not be able to afford property level interventions even with government support.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Resistance and resilience measures support risk reduction by increasing the buildings resilience to flooding. This helps to support more climate resilient businesses and homes, which helps create a more vibrant and livable community. Property level interventions do not have much impact on infrastructure or amenities.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Whilst these approaches will reduce risk, a high residual risk remains (and will increase over time) and there is no reduction in risk outside of the properties (such as ground level assets and vehicles parked outdoors). This may provide an overly optimistic sense of security and may be perceived as delaying decisions for additional adaptation.

SOUTH DUNEDIN FUTURE

Retreat

Reactive Retreat

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

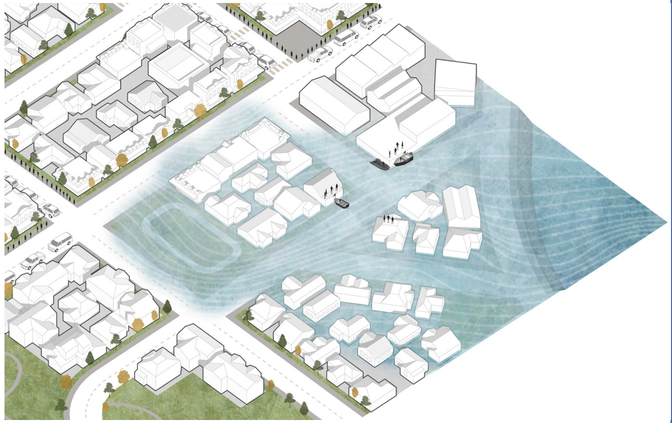
Coastal
✓ Erosion
✓ Flooding
✓ Tsunami

Seismic
✓ Earthquake
✓ Liquefaction
✓ Landslides

Description

Reactive retreat is the withdrawal, relocation or abandonment of private or public assets in response to immediate threats or after damage has already occurred. It involves a more reactive approach where decisions are made in direct response to acute events like storms, flooding, tsunami, earthquakes or rapid erosion. Reactive retreat tends to be more abrupt and often significant damage to infrastructure has already occurred. It may involve emergency evacuations or the relocation of affected communities and infrastructure due to sudden changes in conditions. Reactive retreat can include:

- Post-disaster buyouts or post-insurance withdrawal buyouts
- Emergency evacuation



Interdependencies

Retreat is an approach best implemented alongside other adaptation measures such as using vacated land for stormwater conveyance or storage opportunities.

Pros

- **Maintained sense of place/identity:** Allows people to stay in their homes until a significant damaging event occurs. .

Cons

- **Maintained sense of place/identity:** Retreat will result in a loss of sense of connection to place, and reactive retreat usually happens without much warning post hazard event. Retreating from important cultural spaces (e.g., rohe moana, urupā) will have significant impacts on Māori communities and may result in a sense of displacement and loss of cultural identity.
- **Cost:** Costs are likely to be very high and it is likely the long-term costs will be higher than pro-active retreat due to the compressed timelines for the retreat and regeneration process. There is future uncertainty associated with government funding assistance in the event of emergencies and availability of insurance to cover costs.
- **Natural environment:** As reactive retreat typically occurs in a post-hazard event scenario, there would likely be environmental degradation from pollution occurring during the hazard event (that would be a naturalised area if retreat was pre-emptive). However, there is the opportunity to regenerate natural processes and habitats on vacant land post retreat.
- **Social co-benefits:** Reactive retreat measures will disproportionately impact vulnerable populations who lack the resources or means to effectively adapt or recover. Without pre-planning there may not be any acceptable alternative accommodation if a community is forced to move unexpectedly. Reactive retreat leaves little time for planning and implementing comprehensive adaptation strategies which limits the ability to implement an equitable adaptation response.
- **Emissions, pollution and material re-use:** Reactive retreat will likely have more waste than proactive retreat as materials from damaged properties are likely to be less suitable for re-use. There will be carbon requirements associated with upgrading or providing new infrastructure in other locations as well as for clean up and emergency response.
- **Generational, flexible solution:** The retreat from an at risk area post-hard can result in long term benefits that serve multiple generations but places the burden possibly on future generations that will experience the hazard event and live with the costs. It is not flexible given the associated cost and infrastructure associated with reversing any retreat decision, and the compressed timeline may mean that property owners have fewer options during the retreat process.
- **Technical feasibility and efficacy:** Emergency services will first evacuate and potentially rescue communities. If the damage is widespread, communities may lack the resources to have an effective emergency response, and this may hinder relocation efforts. The retreat process can be very complex and have significant challenges (economic, social, cultural) for all partners and stakeholders to ensure a just transition, and the process is more challenging post-hazard when people do not have basic needs met or are not in a comfortable living environment.

Retreat is usually a voluntary process, driven through incentives or risk-based pricing penalisation (e.g. insurance) although aspects of retreat can be mandated (e.g. Public Works). There is likely to be further legislative reform in coming years that will consider retreat implementation. Retreat is primarily a planning and community centered approach although its success is inextricably linked to where people and property move to (e.g. designating new development zones and developing new infrastructure), and what is done with the hazard effected land in a post-retreat scenario. A reactive retreat may result in less community participation as decisions will need to be made quickly. Implementing retreat strategies (including potentially plans for post-hazard retreat) in South Dunedin would require careful planning, a deep understanding of local social and economic factors, and meticulous logistical coordination to manage land use transition towards safe zones.

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Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Post-hazard reactive retreat is often in response to widespread property damage. This will have negative impacts on the urban form of South Dunedin as the retreat and regeneration process will take some time, particularly if property owners are waiting for insurance payouts. This may result in temporarily poor conditions for people and ecosystems until retreat is actioned and cleanup is complete.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Waiting to retreat until following a hazard event is likely to have negative short term impacts on the natural environment and urban spaces; however, retreat provides an opportunity to enhance environmental outcomes through enhanced biodiversity within these spaces. Embracing the concept of kaitiakitaka, retaining these areas as public green space (where practicable) will allow continued access for those with strong connections to the impacted areas and create additional environmental and societal co-benefits through effective planning and design processes. Retreat will potentially significantly impact on cultural connections and ties to the area but could enable culturally appropriate environmental restoration.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	The rapid, ad-hoc relocation of residents into existing communities could lead to the loss of social cohesion due to spatial separation, and this would be enhanced if it was a larger scale post-hazard retreat compared to a transition over time. There is also the potential for economic inequities to be magnified as those who cannot afford insurance will be impacted more significantly and will have greater difficulties in finding somewhere affordable to live or reestablish. The delayed retreat response leaves little time for planning and implementing comprehensive adaptation strategies which limits the ability to implement an equitable adaptation response.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Retreat of people, property and assets away from hazardous areas in a reactive way following an event will have significant impacts on communities and businesses and they may not have the means or plans in place to be able to recover. Once retreated the resilience of the community in the long term will be increased primarily because people and business are less disrupted (both socially and economically). The areas that people and businesses relocate to are beneficiaries of retreat, therefore South Dunedin's resilience is enhanced when relocations within the South Dunedin area are maximized. Other areas outside of South Dunedin may also benefit. However, in the short term between the hazard event and completion of relocation and regeneration, it is likely that communities and businesses will be significantly negatively impacted.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Reactive retreat following a significantly damaging event will increase the risk to community safety and leaves people exposed to the natural hazard risk. Once relocated, the safety and security of individuals and families will be enhanced in the long term, reducing the risk of injury and loss of life from subsequent events. There will be considerable stress in the short term and often PTSD in the medium term. In the long term retreat from the area reduces the stress associated with living in hazardous areas although the social dynamics, psychological impacts and stress associated with reactive retreat are important considerations in both the short, medium and long term.

SOUTH DUNEDIN FUTURE

Retreat

Managed Relocation

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

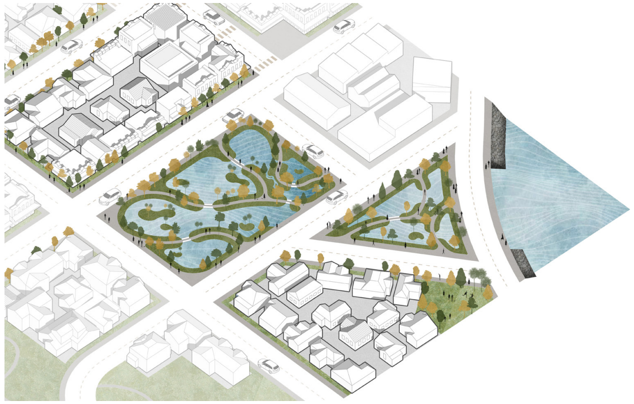
Coastal
✓ Erosion
✓ Flooding
✓ Tsunami

Seismic
✓ Earthquake
✓ Liquefaction
✓ Landslides

Description

Managed relocation (proactive retreat) is a strategic decision to withdraw, relocate or abandon private or public assets (including land and buildings) before significant damage occurs. It focuses on identifying areas at high or intolerable future risk of natural and climate hazards, thereby minimising long-term risk exposure by transferring people, property and assets away from these areas before the impacts of the hazard are experienced. It involves the methodical relocation of property, structures, communities, and vital infrastructure from areas susceptible to environmental threats. Regeneration of retreated areas is a key component to managed relocation. Targeted relocation or retreat involves the selective removal of assets/property from hazard-prone areas, often to make space for resilience or mitigation measures. At its most extensive, retreat can encompass the complete relocation of an entire community. Managed relocation can take a range of forms which can be phased overtime including:

- Voluntary buyouts on open market
- Buyouts with climate leases
- Targeted retreat of built environment
- Retreat of critical infrastructure from vulnerable sites



Interdependencies

Retreat is an approach best implemented alongside other adaptation measures such as using vacated land for stormwater conveyance or storage opportunities.

SOUTH DUNEDIN FUTURE

Pros

- **Efficacy:** Moving exposed assets, people and places from hazards is an effective way of reducing community risk.
- **Generational, flexible solution:** The generational characteristics are dependent on the retreat mechanism, however effective strategies focused on community wellbeing can result in long term benefits that serve multiple generations. It is not flexible given the associated cost and infrastructure associated with reversing any retreat decision.
- **Natural environment:** Minimal direct impact on environmental outcomes, however there is the opportunity to regenerate natural processes and habitats on vacant land post retreat.

Cons

- **Maintained sense of place/identity:** Retreat will result in a loss of sense of connection to place, particularly for those who have lived in the area for generations. Retreating from important cultural spaces (e.g., rohe moana, urupā) will have significant impacts on Māori communities and may result in a sense of displacement and loss of cultural identity. However, proactively planning for where relocated communities will go allows time to integrate and build attachments to a new location.
- **Cost:** Costs are likely to be very high, but it is unclear how the cost compares to the cost of inaction. Retreat of critical infrastructure and amenities will require upfront investment to enable relocation, however longer-term costs of repair and insurance considerations will be reduced due to decreased risk. Homeowners will require financial support. Greater clarity is expected on how the process can be supported by local/central government and private organisations (like insurers and banks). Given the current lack of clarity, there are risks associated with not having the right decision-makers engaged at the right stage of the process.
- **Social co-benefits:** Displaced people will need to relocate to areas that are available, acceptable and affordable.

Neutral

- **Social co-benefits:** Retreat will have a generally positive impact on economic and safety metrics; however, the social impacts of moving communities away from their homes cannot be understated, particularly for communities with strong social cohesion and ties to the area. Impacts on renters cannot be overlooked with engagement often only carried out with property or infrastructure owners.
- **Emissions, pollution and material re-use:** It is dependent on relocation strategy but could be low emissions if material re-use is optimised, particularly if existing dwellings can be relocated. There will be carbon requirements associated with upgrading or providing new infrastructure in other locations. However, there may be opportunities to regenerate vacated land to obtain carbon reduction benefits.
- **Technical feasibility and efficacy:** The retreat process can be very complex and have significant challenges (economic, social, cultural) for all partners and stakeholders to ensure a just transition. Addressing knowledge gaps relating to social dynamics and psychological impacts and finding suitable resettlement areas are crucial to facilitate transition. The complex social and economic factors inherent in relocating individuals, communities, or crucial infrastructures makes retreat a long-term strategy with its efficacy largely dependent on the success of the process, particularly the willingness of owners to sell land (assuming a voluntary process) and availability of suitable relocation areas, funding, and incentives to move. Pro-actively retreating allows time for this planning to occur.

Managed relocation is usually a voluntary process, driven through incentives or risk-based pricing penalisation (e.g. insurance) although aspects of retreat can be mandated (e.g. Public Works). There is likely to be further legislative reform in coming years that will consider retreat implementation. Pro-active retreat is primarily a planning and community centered approach although its success is inextricably linked to where people and property move to (e.g. designating new development zones and developing new infrastructure), and what is done with the hazard effected land in a post-retreat scenario. Implementing retreat strategies in South Dunedin would require careful planning, a deep understanding of local social and economic factors, and meticulous logistical coordination to manage land use transition towards safe zones. Pro-active retreat allows time for this strategic planning to occur.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Dependent on the mechanism of retreat, relocation of communities can create an opportunity to form more resilient urban and community spaces to promote wellbeing and positive environmental outcomes. However, the social and cultural impacts of non-voluntary retreat should not be understated, and effective community engagement and co-design is central to positive wellbeing outcomes.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Retreat from at-risk areas provides an opportunity to enhance environmental outcomes through enhanced biodiversity within these spaces. Embracing the concept of kaitiakitaka, retaining these areas as public green space (where practicable) will allow continued access for those with strong connections to the impacted areas and create additional environmental and societal co-benefits through effective planning and design processes. Retreat will potentially significantly impact on cultural connections and ties to the area but could enable culturally appropriate environmental restoration.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	The relocation of residents into existing communities could lead to the loss of social cohesion due to spatial separation. There is also the potential for economic inequities to be magnified as those who cannot afford to live elsewhere or reestablish will have challenges finding a suitable area to move to. However, pro-active retreat enables time to work to address historical injustices, provide economic opportunities in newly relocated areas, ensure access to education and training programs and address ongoing disparities to enable a just transition.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	Retreat of people, property and assets away from hazardous areas increases the resilience of the community primarily because people and business are less disrupted (both socially and economically). The areas that people and businesses relocate to are beneficiaries of retreat, therefore South Dunedin's resilience is enhanced when relocations within the South Dunedin area are maximized. Other areas outside of South Dunedin may also benefit.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Relocation enhances the safety and security of individuals and families, reducing the risk of injury and loss of life. In the long term it reduces the stress associated with living in hazardous areas although the social dynamics, psychological impacts and stress associated with retreat are important considerations in both the short, medium and long term.

Avoid

More restrictive building/development standards

Groundwater
✓ Rising groundwater

Rainfall
✓ Flooding

Coastal
✓ Erosion
✓ Flooding
✗ Tsunami

Seismic
✓ Earthquake
✓ Liquefaction
✓ Landslides

Description

These approaches involve controls on development to reduce exposure and vulnerability to hazards such as earthquakes and coastal flooding. They may include more restrictive standards, development guides, regional and district plan rules, resource consent conditions, bylaws, urban development or growth strategies to mitigate the impact of a hazard. The building code/building consent process could incorporate structural specifications to improve built environment resilience.

Planning provisions or building standards may be introduced on matters like building foundations, drainage systems, setbacks, floor heights, flood proofing, individual on-lot water detention and retention, non-permanent structures, land use coverage or reduced consent durations to regulate activities in areas exposed to hazards. Other areas could see no additional restrictions as a result of natural hazards.

Legend

- Restrictive Provisions
- No Additional Restrictions

Interdependencies

More restrictive planning rules or development standards would not reduce risk to existing development but may avoid exacerbating risk. To reduce risk to existing development, other approaches would be required in parallel.

SOUTH DUNEDIN FUTURE

Pros

- **Technical feasibility and efficacy:** Feasible to implement to maintain existing levels of exposure, though the plan change process (for change in rules) could be lengthy with hearings and possible appeals. Assuming they become operative in the short-term, their impact would likely not be felt until the medium – long term given delays in implementation through development activities.
- **Health and connection to the natural environment:** Restricting development would help prevent further degradation and avoid future pressures on the natural environment. Depending on the provisions proposed there could be opportunities to enhance the environment.
- **Generational, flexibility:** Planning rules provide flexibility and allow for future changes in scale or approach. By making new developments more durable and resilient, it could extend useable lifetime.

Cons

- **Social co-benefits:** Improves community resilience in future developments, and thereby future living conditions. There may be inequities in social outcomes dependent on who can afford to be developing land. The rules could result in flow-on impacts on livelihoods.
- **Time:** The ability for plan changes to reduce risk of housing stock over time is dependent on the frequency of the rollover of housing stock.

Neutral

- **Cost:** Changes to planning provisions would generally fit within normal council spending. However, rules may impose additional costs to community individuals/ landowners in complying with new provisions. By preventing inappropriate development, planning rules may avoid additional future costs in natural hazard event responses.
- **Emissions, pollution and material re-use:** Implementation of planning rules themselves have very little emissions, material or pollution impacts but there may be impacts based on the choice of provisions. This also provides an opportunity to integrate emissions, materials and pollution considerations in the design of adaptation measures.
- **Sense of place / identity:** While these rules would not impact the existing fabric of South Dunedin, it may see reduced desirability and future investment in the area which could degrade the current sense of place and/or identity. On the other hand, it allows the communities to continue to grow and function in a resilient, regulated way.

Introducing more restrictive planning conditions and rules can be a mechanism to introduce a broad scope of risk reduction options for a variety of natural hazards. The alignment with intended South Dunedin outcomes is largely dependent on the types of provisions implemented (e.g. floor heights, land use coverage, consent durations etc.). There can be a delay for the impact of planning provisions to be operationalized at a scale where it impacts overall risk as they would regulate new activities but not apply to the pre-existing built environment. The applicable areas over which provisions apply will need to be justified by hazard mapping or other evidence which may mean that this approach is better placed to provide resilience to more frequent return period events (with greater data) than preparing for larger scale natural hazard events.

The approach broadly supports social and environmental outcomes but has some challenges in shifting adaptation costs to the community which may exacerbate socioeconomic inequities.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Planning provisions would provide a more regulated and resilient way for the South Dunedin community to continue to grow and function in place.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	The types of provisions provided as examples are not directly aimed at promoting biodiversity and healthy ecosystems but may have indirect benefits. Restricting unsuitable development may avoid further pressures on the natural environment. Without additional considerations, planning provisions would not provide for Māori/iwi ownership, participation, and empowerment.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	An approach based off restrictions can feel more imposed on communities and would require additional work for it to be participatory and owned by the community. More stringent standards may contribute to gentrification pressures. This may displace longtime residents, disrupt community cohesion and perpetuate socio-economic disparities.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	This approach would assist in creating a more livable community through requiring new infrastructure and amenities to be more climate-resilient. This approach is less likely to have influence on climate-resilient ventures/businesses other than future infrastructure being more resilient.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	This approach avoids inappropriate future development that would put people at greater risk from natural hazards. Given that provisions would only be applicable for future activities, there may be inequities in outcomes.

Avoid

No new development/redevelopment or change of land use that may exacerbate risk

Groundwater
✗ Rising groundwater

Rainfall
✓ Flooding

Coastal
✓ Erosion
✓ Flooding
✓ Tsunami

Seismic
✗ Earthquake
✓ Liquefaction
✓ Landslides

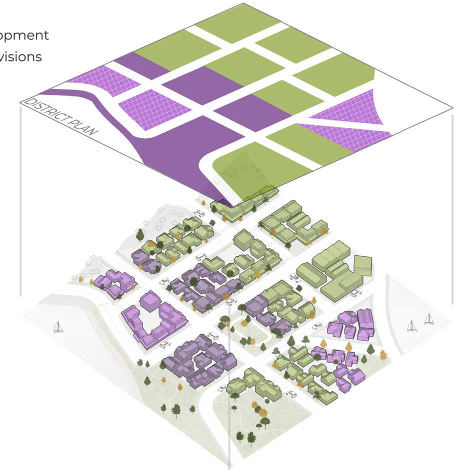
Description

Restricting development of land uses through planning rules, can prevent further development and, overtime, reduce exposure to hazards. The aim of this approach is to ensure that any change in the South Dunedin area does not increase risk. This approach may also identify that an area may not be viable for development in the longer term and change the land use in the district plan to enable retreat. This could involve permitting more development in areas of low risk (through intensification or traditional development including outside of South Dunedin), restricting new development and land use changes in high-risk areas, changing land uses to prevent rebuilding, prohibiting landowners from building in flood prone areas all of which could include district plan changes.

This involves several strategies, including the identification of areas at potential risk over the next century, refraining from development in high-risk zones (until / unless risk is sufficiently mitigated), planning provisions to enable retreat, and establishing buffer zones. It also entails zoning high-hazard land for less vulnerable purposes like open space recreation, conservation, or hazard management, with a long-term vision of adapting land-use zones to reduce vulnerability to hazards—such as transforming residential areas into water-compatible developments. Furthermore, it emphasizes avoiding activities that heighten risks and promotes redevelopment approaches that prioritize risk reduction through adaptive management.

Legend

- No New Development
- Restrictive Provisions
- No Additional Restrictions



Interdependencies

Avoiding new development would not reduce risk to existing development but would avoid increasing risk. To reduce risk to existing development, other options would be required in parallel.

SOUTH
DUNEDIN
FUTURE

Pros

- **Cost:** Restricting development in hazard prone areas would require the plan changes (which could be drawn out) but is generally within 'normal' council spend.
- **Emissions, materials, and pollution:** By avoiding new development or redevelopment in hazard-prone areas, there is a reduction in emissions and pollution associated with construction activities and potential ongoing repairs/eventual abandonment of infrastructure. Additionally, there is an opportunity to incorporate sustainable building practices and materials in an alternative location.
- **Health and connection to the natural environment:** Zoning high hazard land for open recreational green spaces can improve community physical and mental health and connection to nature by providing safe areas for outdoor activities and encouraging closer connection to nature.

Cons

- **Technical feasibility and efficacy:** Feasible but emotive option as it would restrict peoples' rights to redevelop their own property. In the absence of a Climate Change Adaptation Act, existing uses may make this difficult. Community may challenge the removal or restriction of existing use and lose confidence in planning and decision making. Difficult to define acceptable, tolerable and intolerable risks for land use categories.
- **Social co-benefits:** Retrofitting these changes in policy / approach with an existing community is difficult. Particularly when communities are less trusting of change and challenge the veracity of new information identifying a change in risk to that identified / provided for when the development was established.

Neutral

- **Maintained sense of place/identity:** Avoiding new development or redevelopment can help preserve the unique character and identity of an area as it prevents any new developments from replacing existing sites or landmarks. However, this is assuming proper upkeep of these areas over time to prevent them from losing value and deteriorating.
- **Generational, flexible solution:** No new development/ redevelopment suggests a long-term generational perspective. It also includes actions like allowing more development in safe areas and limiting it in risky ones, adaptable to changing regional conditions illustrating flexibility in the solution.

This approach, aimed at preventing new development or redevelopment in high hazard zones through effective land use planning, will contribute to a gradual reduction of overall risk to properties and human life within communities. By embracing risk-based planning, it provides an opportunity to move beyond mere preparedness for natural hazards to consider the broader consequences of such events. This approach can provide more holistic outcomes across social resilience, environmental sustainability, cultural preservation, and climate change mitigation and adaptation.

Mana whenua can actively participate in the South Dunedin Future programme, including development and assessment of adaptation approaches. The guiding principles in Te Taki Haruru (autaketake, autakata, autūroa, and auora) will be incorporated into the work in consultation with Aukaha and mana whenua to give rise to partnership commitments in the SDF Programme Strategy.

Strategic Objectives		Impacts of Approach
Sustainable urban development	Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Zoning high-hazard land for less vulnerable purposes like open space recreation and conservation will create thriving and regenerative spaces. Investment in areas of low risk could improve urban form, maximizing health and wellbeing outcomes for communities.
Environmental and cultural restoration	Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Restricting redevelopment in high-risk areas can provide opportunities for environmental and cultural restoration. These areas can be converted into green spaces, wetlands, or natural reserves, contributing to the preservation of ecosystems and biodiversity. Allocating resources to low-risk areas offers the potential to create new green spaces, restoring the existing environment and cultural heritage, and enhance water quality. Zoning high hazard land for less vulnerable land uses could create the opportunity of involving the community, including Māori/iwi in the planning and decision-making process for land use and development for shaping the future of these spaces.
Just transition	Respond to climate change in ways that empower communities and promote fairness and equity.	Prohibiting development in flood-prone areas in addition to population growth could limit the availability of housing and increase property prices, potentially making it less affordable for some community members. Rezoning land can devalue properties which can exacerbate inequities.
Social and economic resilience	Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and recover.	More development in low hazard areas could increase economic opportunities through investment in local businesses, employment opportunities and population growth in the area.
Promote community safety	Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	The restriction of development in high-risk areas and investment in development in low-risk areas could encourage more people to move to a safer environment, reducing exposure to hazards and contributing to an increased sense of security.

8.2. Overview of feedback received during community engagement on the draft Land and Water Regional Plan

Prepared for:	Council
Report No.	POL2314
Activity:	Environmental: Land Environmental: Water
Author:	Amber Smith, Policy Analyst, and Tom de Pelsemaeker, Team Leader Water and Land
Endorsed by:	Anita Dawe, General Manager, Policy and Science
Date:	6 December 2023

PURPOSE

[1] The purpose of this paper is to present an overview of feedback received during the most recent stage of community and stakeholder engagement on the draft Land and Water Regional Plan (LWRP) for Otago.

EXECUTIVE SUMMARY

[2] The most recent stage of community and stakeholder engagement on the draft Land and Water Regional Plan (LWRP) for Otago commenced on 9 September and concluded on 6 November 2023. Across the region 10 in person drop-in sessions were held, alongside two public online sessions and four targeted stakeholder sessions for specific interest groups.

[3] Written feedback on the draft LWRP provisions was received from approximately 570 individuals or organisations, either via email or via a survey tool on the Otago Regional Council's (ORC's) website.

[4] Over half of the respondents provided feedback on farming and forestry activities, while a quarter of respondents provided feedback related to water allocation and activities in the beds of lakes and rivers. Other topics to receive significant feedback were earthworks, damming, discharges of agrichemicals, wetlands, and outstanding waterbodies.

[5] The feedback received will inform further amendments to the draft LWRP, which is currently scheduled for notification by June 2024.

RECOMMENDATION

That the Council:

1) ***Notes*** *this report.*

BACKGROUND

[6] In 2019, Otago Regional Council (ORC) committed to develop and notify a new Land and Water Regional Plan (LWRP) by 30 June 2024, that gives effect to the relevant national direction and higher order planning instruments, including the National Policy Statement for Freshwater Management 2020 (NPS-FM) and the relevant Regional Policy Statement (RPS).

[7] The National Objectives Framework in the NPS-FM requires that regional council develops plan provisions for managing freshwater, including environmental outcomes and limits, through engagement with the community and active involvement of takata whenua. Three stages of community consultation were undertaken to meet the requirements of the National Objectives Framework:

Stage	Timeframe	Description
1	November 2021 to April 2022	Confirm values and discuss their characteristics (to inform setting environmental outcomes).
2	October to December 2022	Present and discuss environmental outcomes and management options to achieve outcomes.
3	September to October 2023	Present a preferred management option.
Notification	30 June 2024	Request to Council to approve notification of the Land and Water Regional Plan.

[8] After consultation stages 1 and 2, draft provisions managing regionwide provisions and Freshwater Management Unit (FMU)/rohe specific provisions (including target attribute states and limits) were developed with direction from ORC Councillors, and input from takata whenua.

[9] From 9 September until 6 November 2023, a third and final round of engagement on the draft LWRP was undertaken, with ORC staff seeking feedback on the draft provisions from the community and a range of external stakeholders.

[10] During this round of engagement, 10 drop-in sessions were held across all FMUs and rohe in the region, as well as two public online sessions and four targeted stakeholder briefings for specific groups (farming sector, forestry sector, territorial authorities, and environmental interest groups). Councillors and staff from various ORC teams (including policy, science, environmental implementation, consents, communications, and compliance) attended the sessions.

[11] By the end of the engagement period, written feedback on the draft LWRP provisions was received from approximately 570 individuals or organisations, either via email or via a survey tool on the ORC's website. A substantial proportion of respondents focused on the draft provisions in the primary production chapter (approx. 60%). Other parts of the draft LWRP that garnered a lot of feedback were the provisions in the water quantity chapter (approx. 25% of respondents) and the provisions for the management of activities in the beds of lakes and rivers chapter (approx. 25% of respondents).

[12] Finally, a considerable number of people and organisations also commented on the draft provisions in the damming and diversions, earthworks and drilling, other discharges, and wetlands chapters, as well as the provisions for managing outstanding water bodies. Approximately 10% of respondents commented on each of these topics.

[13] A "web traffic" report with respect to the LWRP-related webpages on the ORC website is appended to this report as Attachment 1. This report provides an overview of the

number of respondents providing feedback on various topics, as well as different FMUs and rohe. It also includes broader demographic information with respect to the respondents.

DISCUSSION

[14] The below paragraphs present a high-level summary of the feedback received, organised by main themes on each topic. While the summary may not capture every single point of feedback provided, staff have reviewed and considered all the feedback, to assist with informing the next stage of plan drafting.

[15] The feedback has been grouped by the following topics in the draft LWRP which are in alphabetical order as follows:

- Beds of Lakes and Rivers (paragraph 13)
- Damming and Diversion (paragraph 14)
- Earthworks (paragraph 15)
- Environmental flows and levels (paragraph 16)
- Other discharges (paragraph 17)
- Outstanding waterbodies (paragraph 18)
- Primary production (paragraph 19)
- Stormwater (paragraph 20)
- Waste (paragraph 21)
- Wastewater (paragraph 22)
- Wetlands (paragraph 23)

BEDS OF LAKES AND RIVERS

[16] The following key issues and comments were raised in the feedback received on the draft provisions for managing beds of lakes and rivers:

General concerns

- The draft LWRP provisions should acknowledge and address managed retreat and climate change.
- More clarity is needed about the content of, and the process for, developing the action plans referred to in the draft provisions.

Specific concerns: Consent requirement for suction dredge mining

- Various respondents considered that the permitted activity rule in the Regional Plan: Water for Otago (RPW) for suction dredging should be retained, with some stating that, rather than requiring resource consent for all suction dredge mining activities, Schedule 7 of the RPW, which details water bodies sensitive to suction dredge mining, should be expanded.
- Respondents opposing the draft LWRP provisions considered that the effects of suction dredge mining on the beds of lakes and rivers and aquatic ecology have been proven to be minor or are likely to cause no greater harm to aquatic life than existing strong currents. It was further considered that, in some cases, the effects of suction dredge mining on the river biota are positive, as sediment removal from suction dredge mining can restore and improve habitat for invertebrates and increase water flow and oxygen levels. Some also stated that in the 1990s it was agreed that suction dredge mining has minimal impacts on the water body and pointed out that, under the RPW provisions, no consent for suction dredge mining has been declined, even in Schedule 7 waterbodies.

- Some respondents expressed support for the consent requirement for suction dredge mining.

Specific concerns: Gravel extraction - 5m³/pa permitted activity threshold

- Various feedback responses expressed a preference for a rule framework for gravel extraction that is more lenient and a permitted activity volume threshold greater than 5 m³/yr, so it is easier to manage build-up of gravel around bridges and other structures. Others suggested that gravel extraction outside of spawning season should also be allowed in order to keep rivers/streams within banks and protect structures, particularly as more erosion occurs when water spreads out of the main stem.
- Others providing feedback requested a more nuanced approach to the management of gravel, suggesting that the volume thresholds for the permitted activity rule should be tailored to specific sites, with more targeted provisions for where gravel can and cannot be taken, or allow for extraction of greater volumes than 5 m³/yr in certain river types.

DAMMING AND DIVERSION

[17] The following key issues and comments were raised in the feedback received on the draft provisions for managing damming and diversion:

General concerns

- Various respondents sought more enabling or lenient provisions for both in-stream and off-stream damming. These respondents often expressed diverse views, with some requesting increased permitted volume thresholds for dams, and others wanting a more enabling approach towards the storage of water in gullies, including those with ephemeral or small water bodies. Others asked for the permitted activity rule in the RPW, allowing for the damming of smaller catchments (up to 50-hectares in size), to be retained; or contested the requirement to supply producer statements for new off-stream dams over 1,000 m³. The short consent durations were seen as an impediment for investment and some respondents considered that dams should be managed through Freshwater Farm Plans (FW-FPs). Finally, it was suggested that the threatened species habitat condition should only apply to new dams as existing dams may have created habitat for these species.
- Various respondents also commented that the provisions lacked clarity. Some expressed the view that the permitted activity conditions were unclear, while others requested greater clarity around specific matters such the management of inundation effects (how will inundation effects be managed?), accounting of stored water within the LWRP's take limits (how will water stored in off-stream dams be accounted for within the take limits?) or action plans (what's the process for developing action plans and what will they cover?).
- Some considered that the draft LWRP provisions should better recognise and provide for hydro-electricity generation, and others asked for greater recognition in the LWRP of existing dam and irrigation storage infrastructure and asked for more clarity around how the provisions will affect existing dam structures (for example, Falls Dam).
- A number of respondents also asked for the framework to be further strengthened by reducing the permitted volume thresholds for dams, setting tighter conditions to protect water bodies and ecosystems, setting maximum heights for off-stream dams and ensuring greater alignment with the Building Act, the guidelines for New

Zealand Society for Large Dams (NZSOLD Dam Safety Guidelines) and the Building (Dam Safety) Regulations.

- Finally, with respect to the removal of dams and weirs, it was considered that lawfully established dams or weirs that operate under a consent or other timebound authorisation should be required to be removed upon the expiry date, and that the impacts of dam or weir removal on fish spawning were insufficiently considered in the draft LWRP provisions.

In-stream dams

- Various parties opposed the draft LWRP provisions for managing in-stream dams, requesting greater lenience and flexibility for in-stream dams. Some stated that the framework for managing instream dams should consider the size of the water body, while others considered there to be a need for greater strategic direction in support of the establishment of in-stream storage as a means to allow for catchment-wide storage solutions and improving resilience to climate change.
- Some had more specific concerns: The framework for managing outstanding water bodies was considered to be an impediment to water storage and would stifle innovation. It was also considered that the draft provisions have unintended consequences for existing large-scale dams, such as Falls Dam, and that better provision has to be made for maintaining, upgrading, and replacing existing, ageing infrastructure. It was further stated that the permitted volume of 5,000 m^3 for existing in-stream dams is an arbitrary number and that non-classifiable dams[1] should be permitted under the LWRP (provided other conditions are met).
- Few comments were received with respect to the provisions for managing temporary damming activities. Some expressed support for a more stringent framework, asking for the consideration of temporary changes to flows and effects on fish spawning while others considered a consent pathway for temporary in-stream dams to be more appropriate. One respondent requested that military training activities be exempt from the time limits that apply to temporary dams.

Diversions

- Some responses expressed a need for greater clarity and practicality (including achievability) with respect to the provisions for managing diversions (for example, what does return to its natural course after a week mean?).
- Support was provided for clarifying that a diversion outside of the bed is a take and discharge.
- Some respondents requested further strengthening of the provisions by adding additional conditions to protect freshwater and ecosystem values (including fish spawning), not permitting land drainage, or expanding the management framework to include the management of sub-surface drainage.

EARTHWORKS

[18] The following key issues and comments were raised in the feedback received on the draft provisions for managing earthworks:

- A large number of respondents expressed concern about regulatory duplication. Many requested that earthworks be managed though FW-FPs or through the National Environmental Standards for Commercial Forestry (NES-CF). Others expressed concern that proposed provisions caused a double up with district plan provisions,

[1] Those that are less than four metres and storing less than 20,000m^3, or less than one metre and storing less than 40,000m^3.

leading to uncertainty for developers, additional consents and increases in costs/time resources required for undertaking earthworks.

- Some requested a more lenient regime: One respondent provided feedback that discharges from earthworks should be allowed to enter a wetland or Outstanding Natural Landscape or Outstanding Water Body, due to the temporary nature of earthworks.
- Other respondents suggested that any volume of earthworks on slopes less than 10 degrees should not require management if there are robust permitted activity performance standards in place.
- One respondent was concerned that the proposed rules are not sufficiently rigorous in establishing buffer zones to prevent any sediment from earthworks entering water bodies.
- A number of additional suggestions were made, which included: public access tracks should be enabled with fewer area and setback restrictions; sediment barriers which cross ephemeral streams should be permitted; archaeological sites should be protected from earthworks; earthworks in a path of overland flow should be managed by district councils as per the pORPS.
- The following clarifications were requested: how direct drilling of seed will be impacted by these rules; and what the definition of drain is in relation to these rules.
- Requests made included: retaining the existing bore provisions; using a council standard instead of the NZS4411:2001 due to availability/cost; and seeking provisions which allow the cleaning out or filling in of irrigation water races.
- Regarding the proposed rules managing site investigations on contaminated land, one respondent suggested that investigations that do not identify contaminated land should not need to be reported to council and another respondent suggested that small scale/low risk earthworks on contaminated land should be allowed while larger/high risk earthworks on contaminated land should be managed by the National Environmental Standard for assessing and managing contaminants in soil to protect human health.

ENVIRONMENTAL FLOWS AND LIMITS [WATER QUANTITY]

[19] The following key issues and comments were raised in the feedback received on the draft provisions for managing environmental flows and limits:

Metering of water use

- Comments were made requesting greater clarity on why metering or measuring requirements are proposed for takes and retakes of water (for the taking, use & damming of water) and discharges of water (for retaking of water) and how practical this will be i.e., for existing dams.

Water storage and water harvesting at high flows:

- Various respondents considered the taking of water during high flows to be critical to:
  - Incentivising and providing for water storage.
  - Adapting to new flow and allocation regimes (i.e., higher minimum flows and lower take limits for primary allocation).
  - Mitigating the potential effects of climate change.
- A number of respondents asked for greater clarity around the allocation framework for supplementary takes (i.e., takes at higher flows), including the following comments:
  - the framework for setting minimum flows for supplementary allocation and setting supplementary block sizes is uncertain, and it is not clear whether this

framework will enable or prevent water storage options in catchments where the total primary allocation is at or above allocation limits.
  - there should be restrictions in place to ensure that water harvesting is used to replace low flow water abstraction.
  - there is a need for strong policy direction for water harvesting on tributaries so that the quantity of water harvested at high flows is proportional to the size of the water body.
- There is support for a framework that enables water harvesting and storage during periods of high flow, rather than during low flow periods, but maintains flow patterns in river and stream that are reflective of their natural patterns of variability. Respondents acknowledged that care must be taken to ensure that such takes does not remove peak flows from these systems.

Efficiency
- Some of the feedback received indicated a concern around what the new framework for requiring efficient use will mean in practice. Respondents consider that the draft LWRP provisions should provide some flexibility for addressing situations where allocation is not fully exercised, recognising that full take is not always needed or possible, e.g., wet years, infrastructure failure or repair.

Transfers
- Concerns were raised regarding the risk of water trading and lack of clarity about how transfers would work.

Permitted activity takes
- The proposal will mean a consent will be required for many existing takes. Some of the feedback received requested that the LWRP considers different uses and how the restrictions set on permitted activity takes will work in practice.
- Some respondents expressed concerns about animal welfare.

Consent duration
- Concerns were raised with short consent durations, particularly around the implications for investment and financing. Some of the feedback indicated that short term consents would be more acceptable if easier pathways existed for replacement consents (as an amendment to the framework in that regard would be seen as less risky by banks). Other feedback pointed out that short consent durations do not encourage or support investment in certain risk mitigation strategies (e.g., water storage as a mitigation against climate change).

Phasing out of over-allocation
- The phased (i.e. 2-staged) approach for addressing over-allocation was generally supported, but different views exist on the appropriateness of the time frames for transitioning, and more certainty was sought around setting take limits and flows for affected consent holders.
- One party asked that council take a lead role in reducing over-allocation, rather than leaving it to communities, as asking for communities to make decisions on who can keep and who needs to give up water could affect social cohesion and cause tension within communities.

Bespoke catchment limits

- Respondents considered that the success of setting and implementing catchment limits will rely on setting clear goals and direction for the consent holders to work towards.
- Respondents also considered that, in addition to considering the maximum instantaneous rate of take to determine the adverse effects on water bodies and communities, other crucial information should be considered when setting allocation limits and phasing out over-allocation. This information includes:
  - How often the maximum rate of take is reached; and
  - What rate of take the abstraction normally operates at; and
  - When and for how long abstraction takes place.
- Feedback was received suggesting that the proposed changes will have big impacts on existing uses in some catchments (i.e., Manuherekia, Kakanui, Kauru, Pomahaka) and requests were made to phase-in new minimum flows and take limits in some catchments (i.e., Kakanui), similar to the proposed approach to minimum flows in the Manuherekia.
- More clarity was requested regarding the consent replacement process for existing water permit holders in some of the category 3 catchments (i.e., Bannockburn, Teviot, Coal Creek) and whether water will remain available in these catchments.
- General feedback was received requesting that the technical and supporting advice be made available to the public to inform consultation, particularly ahead of the formal submissions and hearing phase.
- Limited feedback was received on the allocation framework for the Clutha/ Mata-au main stem, although there was general support for the setting of environmental flows and take limits for the main stem.

OTHER DISCHARGES

[20] The following key issues and comments were raised in the feedback received on the draft provisions for managing other discharges.

Passive discharges from contaminated land

- Feedback was received that the rule framework in the draft LWRP requires all HAIL (Hazardous Activities and Industries List) sites in the region to have a resource consent. It was considered that, unless a detailed site investigation gives the all clear, the resource consent application process could turn out to be expensive and time-consuming. Overall, there was concern that the standards for sites with contamination above background level (not just those having significant adverse impacts on receiving environments) are too high across the region. Permitted activity status should be considered if sites meet certain environmental quality indicators (e.g., groundwater standards).

Agrichemicals and vertebrate toxic agents

- Respondents expressed support for reducing discharges to the aquatic environment and consideration of cumulative impacts from numerous pollutants and sustainable management within riparian and setback zones. However, there was an acknowledgment of the need to allow management using agrichemicals in some cases.
- Feedback included concern over pest management and biosecurity activities being limited by setbacks and need for permission to undertake currently normal practices. Some concern raised over setbacks for riparian zone management and implications for runoff.

Discharges of live organisms

- Feedback was that the rules for discharges of live organisms are an unnecessary duplication of the Conservation Act, and more work should be done alongside the Department of Conservation and Fish & Game in determining rules regarding wording of undesirable and pest species.

Discharges from spas and swimming pools

- Respondents suggested that spa and swimming pool owners are unlikely to wait 14 days after chemical treatment before cleaning out their home spa or swimming pool system.
- Some respondents also stated that the monitoring of cumulative discharges of pools, spas and filter backwash should be considered across urban catchments.

Dust suppressants

- Requests were received to define the term "dust suppressant", and it was considered that suppressing dust with water should be a permitted activity and encouraged.

OUTSTANDING WATER BODIES

[21] The following key issues and comments were raised in the feedback received on the draft provisions for managing outstanding water bodies (OWBs):

Policy framework for managing outstanding water bodies

- Various respondents commenting on the framework for managing outstanding water bodies considered that existing activities and structures (including the ongoing use of existing water take, storage, and conveyance infrastructure, upgrades to infrastructure to improve storage and conveyance, and biosecurity operations such as aquatic pest control) should not be restricted within OWBs. Others expressed concern about the identification of various artificial water bodies (e.g., reservoirs, streams used for conveyance) as an OWB and the potential impacts of this framework on their ongoing use (particularly where this involves long-established water take, storage, and conveyance structures).
- One respondent asked ORC to work with landowners and allow farmers to use FW-FPs to manage OWBs.

Identification and mapping of outstanding water bodies

- Various respondents provided feedback requesting the inclusion of additional water bodies as a potential OWB, the reconsideration of identification and mapping of specific waterbodies as an OWB or requesting amendments to the value description of OWBs.
- Others considered that the definition of OWB in the draft LWRP does not align with national definitions or that there is a lack of consistency in the way the criteria have been applied and/or they have been applied too liberally.
- Suggestions were made that the wetlands along the margins of OWBs should also be included, and that all waterbodies should be protected as OWBs.

- Some respondents also considered that the mapping is not clear. They stated that the maps do not clearly link specific areas to specific values and that, where there are sub-areas within a wider area, those sub-areas should be differentiated.

PRIMARY PRODUCTION

[22] The following key issues and comments were raised in the feedback received on the draft provisions for managing primary production:

General concerns

- Various respondents have expressed a general concern that the draft rules are overly prescriptive, will have significant economic and financial implications and set different requirements than the national regulations (National Environmental Standards for Freshwater, S360 Stock Exclusion Regulations), which is confusing and unnecessary. Respondents consider that the LWRP framework should be amended to achieve greater reliance on or alignment with national regulations and FW-FPs and apply a more effects-based or risks-based approach, that allows for consideration of individual farm characteristics and/or the characteristics of the receiving environment.
- Overall, respondents consider there should be a greater focus on incentivising and education and/or engagement with farmers, instead of introducing regulation. Feedback was that farmers should be involved in the design of regulations, so the plan provisions are practical and cost-effective and devised in a way that reduces or limits the number of consents needed by farmers.
- Many respondents were concerned about the consenting requirement for dairy and dairy support operations and about the practicability or robustness of the thresholds (threshold on synthetic nitrogen fertiliser used per hectare per year; threshold on the number of dairy cows per hectare) for determining the activity status for these farming types, while others raised the concern that restrictions on intensification may also impact farm viability and the ability of farms to diversify and/or adapt to market demands and climate change.

Setbacks and stock exclusion

- Concerns about the setbacks generally focus on two aspects: firstly, the lack of clarity in the LWRP around where the setback requirements apply and how these should be measured. Secondly, the restrictiveness of the setback requirements for a range of activities (cultivation, feedlots/feedpads, stockholding areas, sacrifice paddock, pasture-based wintering, silage storage, stock access) and discharges (fertiliser and agricultural waste application) which results in financial impacts (cost of moving existing infrastructure, loss in productivity/productive land) and increased risk of pest or weed proliferation.
- Concerns were also expressed about the increased setbacks for stock exclusion and the requirement to exclude sheep from rivers and streams in specific FMU or rohe. Various respondents argued that the LWRP should allow for exceptions to the requirements for increased setbacks for stock exclusion and the requirement to exclude sheep from rivers and streams where practical on-farm solutions exist (e.g., installation of troughs) or where stock numbers are below a specified stocking rate. Some respondents also pointed out that the requirement to move existing permanent fences that fail to meet the setback requirements penalises early

adopters of the national stock exclusion regulations and that the 10-year transition time to move existing permanent fences that do not meet the setback requirements is too short and should be aligned with the typical lifespan of a fence.

Pasture-based wintering, feedlots, stockholding areas and sacrifice paddocks

- Various respondents considered that the rule framework for pasture-based wintering is too restrictive and inconsistent with the requirements for Intensive Winter Grazing (IWG), and that this activity should be managed through an IWG consent or through FW-FPs.
- Another point of concern commonly expressed by respondents was that the rules for managing feedlots, feedpads, stockholding areas and sacrifice paddocks should be streamlined to recognise that these activities are characterised by similar environmental risks.

Silage storage, farm landfills and offal pits and agricultural waste

- Concerns regarding the draft provisions for managing farm landfills mainly revolved around the permitted activity conditions regarding the minimum distance from municipal landfills and the restrictions on disposal of stock carcasses.
- Some expressed concern about the restrictions on volume and location of silage and considered that the permitted activity rule should be amended to focus on management of leachate.
- Definitions need to clearly describe what animal and plant derived waste materials can be discharged to land under the proposed rule.

Fertiliser

- A large number of respondents considered that the setback requirements are confusing and need to be clarified or that a more nuanced approach is needed with respect to the setback requirements.
- A request was also made to amend the rule framework to provide for incidental windblown fertiliser dust.

Horticulture

- Feedback was received that horticulturalists should be given the ability to grow vegetables and should be provided with Good Agricultural Practice (GAP) schemes as an alternative pathway to meet LWRP regulations.
- A call was made for greater clarity around the management of discharges associated with horticultural activities (in particular, discharges from greenhouses and wash water).

Freshwater Farm Plans

- Concerns were raised about the level of regulatory duplication in terms of management of specific farming activities required under the LWRP and FW-FPs.
- Many respondents requested that more activities that do not meet the permitted activity conditions of the LWRP should be managed through FW-FPs, including stock access, farm landfills and offal pits, feedlots, feedpads, stockholding areas and sacrifice paddocks.
- Concerns were also raised about the additional information requirements for FW-FPs set by the LWRP.

Forestry

- Feedback was received opposing provisions that are additional to or more stringent than the national direction, particularly the setback requirements and other conditions that would trigger the need to apply for a resource consent. Specific requests were also made to ensure that vegetation clearance and earthworks for forestry purposes (such as roading and tracking) would continue to be managed in accordance with the NES-CF. Some of the respondents opposing the draft provisions stated that there are significant benefits to waterways from forestry, e.g. shading, cooling water, increasing oxygen levels, and that the setback requirements and other aspects of the framework in the draft LWRP would have a negative impact on productivity and land values as well as some unintended consequences, such as an increased likelihood of noxious weed and pest proliferation in unplanted riparian margins, and restricting opportunities for recreational fishing.
- Some of the opponents considered that there was a lack of equity between how forestry is proposed to be managed under the draft LWRP, compared to rural land uses – for example, fertilising allowed within 3m of a waterway; winter grazing allowed to 10m and no slope restrictions; 20m setback for discharge of agricultural waste.
- Clearer direction was requested regarding land preparation for planting and protections needed at harvest clarity, as well as clarity on what constitutes a water body large enough to trigger a 50m setback.
- Some respondents consider that re-vegetation should be required before logging can commence.
- Finally, a request was made to align the definitions of 'permanent forest' and 'indigenous forest' with the NES-CF definitions.

STORMWATER

[23] The following key issues and comments were raised in the feedback received on the draft provisions for managing stormwater:

- There was general support of the proposal to manage network and non-network discharges separately. Responses to draft provisions for non-network stormwater discharges were largely supportive of a permitted activity rule for discharges, subject to appropriate conditions.
- The Dunedin City Council noted that the level of upgrade for infrastructure in the Dunedin district is significant and a progressive plan to commence upgrades is underway. Further engagement was requested to clarify the requirements in the draft LWRP.
- Some feedback raises concern on the potential costs of the proposed rule framework (e.g., existing development not connected to the network will require retrospective consents) and noted that rules should be consistent with other three waters legislation, TA approaches, pORPS and design standards.
- Several responses sought further clarity on the policy and rule framework and clarification on the following issues: cumulative effects, definition of commercial land, inclusion of farm drains or artificial watercourses, NPS definition of "stormwater".
- Suggestions included no stormwater consent conditions regarding land use type, as this could create a framework that is not effects based. Heavy metals need to be managed and there should be more consideration of the receiving environment.

Also, there should be standards that permit small scale discharges and rules should require post-development flows to mimic predevelopment flows.

- Many respondents sought clarity on how the definition of 'stormwater' in the National Planning Standards and the rules will be applied to run off from surfaces that disperse to land, such as gravel roads and other modified surfaces on-farm. Proposed solutions included modifying the definition to specifically exclude modified surfaces on-farm.
- A number of responses raised concerns in relation to the ongoing discharges from Bullock Creek, Roys Bay & Alpha Series Development and effects on surface water bodies. There was concern that the Cardrona aquifer will not be sufficiently protected as a result of the LWRP, and more science was requested.
- One response noted that adverse effects from road runoff are evident in drinking water bores and sought that stormwater runoff from carparks and roads require treatment. Another respondent requested that stormwater attenuation from residential development should be regulated.
- Some responses requested water sensitive design be included as a requirement in the provisions. This includes the use of sponge cities, green roof buildings, wetlands.

WASTE

[24] The following key issues and comments were raised in the feedback received on the draft provisions for managing waste:

- Respondents expressed general support for increasing the accessibility to composting both organic and green waste (e.g., garden waste), but requests were made for alignment of the definition of organic waste with the definition in the NZ Waste Strategy and for more clarity around the permitted activity condition relating to the volume of organic waste (e.g., is this an annual volume?) and whether the rule applies to consolidation facilities or landfills or both.
- The provisions for managing clean fill should have a requirement that clean fill cannot slump if it is being piled or stockpiled and that no sediment should enter water, and monitoring of clean fill should be required to ensure compliance with permitted activity conditions related to contaminant concentration levels.

WASTEWATER

[25] The following key issues and comments were raised in the feedback received on the draft provisions for managing wastewater:

- The guidelines for the management of biosolids are currently being revised and ORC should ensure that the LWRP provisions refer to these 2024 guidelines.
- The provisions for managing industrial and trade waste should be amended to provide greater clarity around the types of industrial and trade waste that the LWRP seeks to manage, to remove the 50 m from boundary threshold, and to allow for the ponding of discharges, where the discharge occurs to a stormwater detention swale.
- Some respondents requested that the LWRP requires aerobic (secondary) treatment for any new on-site wastewater systems installed, while others requested that the permitted area requirement (2ha) for new on-site wastewater systems be amended to align with the subdivision rules in relevant district plans. Finally, some feedback was provided that the connection to reticulated wastewater systems should only be required if the providers agree to this.
- Various comments were made with respect to the requirement to phase out direct discharges from reticulated wastewater systems to water, and the associated cost

for upgrading these systems to allow for land-based discharge. Some suggested phasing out these direct discharges "to the greatest extent practicable", while other suggested prioritising phasing out direct discharge to specific water bodies (e.g., Manuherekia). Finally, further comments were received that the reticulation of wastewater should be required for all areas above a certain population threshold (e.g., 100 inhabitants).

WETLANDS

[26] The following key issues and comments were raised in the feedback received on the draft provisions for managing wetlands:

- A considerable number of respondents expressed opposition against the proposed management framework, especially where greater stringency or additional controls are proposed than those set in national regulations (such as the National Environmental Standard for Freshwater and the S360 Stock Exclusion regulations).
- Respondents consider that FW-FPs are a better tool for managing a broader range of wetlands than those defined as 'natural inland wetlands' in national direction or managing the access of stock beyond the requirements set by national regulations. This is because they consider more stringent stock access or fencing requirements are impractical and will potentially result in wetlands becoming overgrown with weeds and loss of their recreational uses.
- Other respondents expressed support for the protection or enhancement and restoration of wetlands under the LWRP, but requested the plan provisions go even further, for example by prohibiting any drainage of wetlands or setting a target to restore wetlands to 20% of their historic extent.
- The public should be able to access GIS data for wetlands and other exclusion zones so landowners can see how they are affected and identify which areas need to be excluded from flight paths for fertiliser/spraying.
- Ground truthing for wetlands is needed to ensure mapping is accurate and unintended consequences for landowners are avoided.
- Some feedback was also received opposing the inclusion of wetlands in the definition for 'critical source area'.

OPTIONS

[27] As this is a noting paper, there are no options.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[28] ORC is responsible for implementing national direction and regulations, including by notifying proposed policy statements and plans that will give effect to the relevant higher order documents. ORC has committed to a work programme with the Minister which includes notifying a new LWRP by June 2024.

[29] The new LWRP will contribute to fulfilling Council's objectives under ORC's Strategic Directions of leading environmental management in Otago, in partnership with mana whenua; promoting collaboration with territorial authorities and others to achieve resilient and sustainable communities; and promoting a healthy and resilient

environment whose capacity for sustaining life and ecosystem heath is enhanced and sustained.

Financial Considerations

[30] This paper does not have any financial implications for ORC. The development of the LWRP is a budgeted activity. The external costs associated with the community engagement drop-in sessions are estimated at around $66,000. Note that this does not include internal costs such as staff time or vehicle costs.

Significance and Engagement

[31] This noting paper in itself does not trigger ORC's *He Mahi Rau Rika: ORC Significance, Engagement and Māori Participation Policy.*

[32] The recently completed engagement to inform the development of the LWRP did require consideration of *ORC's He mahi rau rika: ORC Significance, Engagement and Māori Participation Policy*, as the LWRP is likely to have potentially significant impacts on communities. It should be noted that each stage and aspect of this engagement process was designed to be consistent with *He mahi rau rika: ORC Significance, Engagement and Māori Participation Policy.*

Legislative and Risk Considerations

[33] The development of a new LWRP will satisfy requirements in higher order documents, including but not limited to the National Policy Statement for Freshwater Management 2020 (NPS-FM). The engagement process that ORC has undertaken to inform the development of the LWRP has been designed in accordance with the First Schedule of the Resource Management Act 1991 (RMA) and the principles of consultation set out in section 82 of the Local Government Act 2002 (LGA) and has been planned to give effect to the relevant requirements of the NPS-FM.

[34] Interim reviews of Council's community engagement approach involving ORC's legal support team were undertaken to ensure that the engagement process would meet the requirements of the NPS-FM in terms of community engagement.

[35] Consideration of feedback received through engagement with communities and stakeholders during the development of the LWRP assists with ensuring that community concerns and expectations are accurately captured and addressed and reduces the risk of delays in the timely notification of the LWRP.

Climate Change Considerations

[36] Recognition of climate change and its effects on the health and wellbeing of the people and environment is one of the matters to which the LWRP needs to respond to give effect to the NPS-FM, in particular Policy 4 of the NPS-FM*: Freshwater is managed as part of New Zealand's integrated response to climate change.*

Communications Considerations

[37] Policy and Communications staff will ensure that the community and stakeholders are aware of the timing of future stages of the plan development process and are informed

about how and when they can take part in this, through the various media channels normally used by ORC.

[38] All respondents who provided feedback and an email address have received an email advising of the process going forward, and how their feedback will be used.

NEXT STEPS

[39] Direction was sought on issues raised in the feedback at two Environmental Science and Policy (ESP) Committee workshops held on 22 and 29 November 2023. Staff are currently working through the direction received from the ESP Committee which will inform amendments to the draft provisions.

[40] A further public excluded briefing on 14 December 2023 will set out the LWRP timeline from January 2024 to June 2024, including pre-notification consultation which is scheduled for early 2024.

[41] Council will be asked to approve the LWRP for notification in June 2024.

ATTACHMENTS

1. LWRP Round 3 web traffic report as of 27 November 2023 [**8.2.1** - 12 pages]

Land and Water Regional Plan Round 3 2023 Web Traffic Report

LWRP Web traffic

Between 9 September 2023 and 6 November

Link: https://www.orc.govt.nz/plans-policies-reports/land-and-water-regional-plan

Recorded metric	**Round 3**	**Round 2 Statistic** (Between 10 October to 31 December 2022)	**Notes**
Number of users/visitors	15,635	11,746	Users who have initiated at least one browsing session during the date range.
Pageviews	41,106	19,976	Pageviews is the total number of pages viewed. Repeated views of a single page are counted.
Average engagement time	01:36	02:11	The average length of time that the app was in the foreground, or the website had focus in the browser.
Bounce rate	65.84%	87.32%	This is the amount of single page sessions where users left without interacting with anything else. A bounce is calculated specifically as a session that triggers only a single request to the Analytics server, such as when a user opens a single page on your site and then exits without triggering any other requests to the Analytics server during that session. A bounced session has a duration of 0 seconds. The lower the bounce rate, the better.

During the period of multi-channel promotion (9 September to 6 November), there were at least 41,106 recorded pageviews to the LWRP section of the ORC website by at least 15,635 visitors.

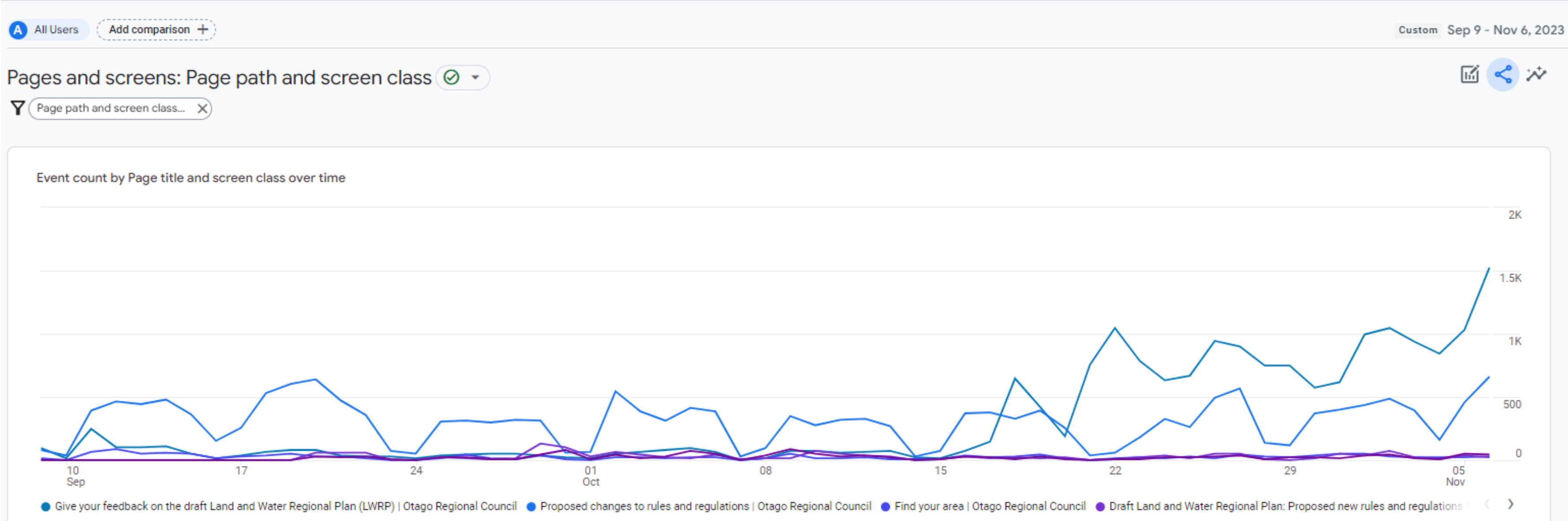
Visitors spent the most on the Rules and Regulations page, spending an average of 4 minutes and 57 seconds on the page. Significant time was also spent on the individual FMU/rohe pages as well, such as the Manuherekia page where visitors spent an average of 3 minutes and 31 seconds on the page.

Top 10 LWRP-related webpages

The table below shows the top visited LWRP pages.

	Page path and screen class	Views	Users	Views per user	Average engagement time	Event count file_download
		41,106 4.64% of total	15,635 10.57% of total	2.63 Avg -56.07%	1m 36s Avg -16.52%	1,279 0.06% of total
1	/plans-policies-reports/land-and-water-regional-plan	21,134	11,393	1.85	26s	122
2	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations	7,411	2,469	3.00	4m 57s	632
3	/plans-policies-reports/land-and-water-regional-plan/give-your-feedback-on-the-draft-land-and-water-regional-plan	6,949	3,981	1.75	21s	0
4	/plans-policies-reports/land-and-water-regional-plan/find-your-area	647	413	1.57	27s	0
5	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations/manuherekia-rohe	493	253	1.95	3m 31s	124
6	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations/taiari-taieri-fmu	492	249	1.98	3m 29s	47
7	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations/north-otago-fmu	438	235	1.86	3m 00s	37
8	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations/lower-clutha-rohe	415	199	2.09	3m 58s	27
9	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations/catlins-fmu	367	164	2.24	2m 54s	30
10	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations/dunedin-coast-fmu	295	156	1.89	2m 25s	18

The graph below shows the daily pageviews of the top LWRP pages. As the feedback was drawing closer to the end (6 November), there were more and more visits to the LWRP feedback page as illustrated below.



When some chapters had PDF versions of them created, some were actually downloaded and presumably read by people.

For example, the Primary Production chapter PDF was downloaded at least 170 times. The Bed and Rivers chapter PDF was downloaded 124 times.

The LWRP region-wide presentation PDF was downloaded 109 times.

The bounce rate is significantly lower than in Round 2. This means that people who go to a LWRP webpage are also visiting another webpage, instead of leaving immediately or just staying within the same page.

Between 9 September and 6 November, there were 523 feedback responses. After adding in the responses that were given to the policy team or emailed directly to the team instead, there were 566 responses in total.

12,508 pageviews were attributed to display/paid search regarding the main LWRP landing page (/plans-policies-reports/land-and-water-regional-plan), representing 59% of web traffic to the webpage.

3,716 pageviews were attributed to display/paid search regarding the LWRP feedback page (/plans-policies-reports/land-and-water-regional-plan/give-your-feedback-on-the-draft-land-and-water-regional-plan), representing 53% of web traffic to the webpage.

Where visitors came from

The table below shows the top visited webpages and the breakdown in terms of where the pageviews came from (such as paid, organic or direct).

/plans-policies-reports/land-and-water-regional-plan

Rows per page: 25 Go to: 1 1-25 of 261

	Session default channel group	Page path and screen class	Views	↓ Users	Sessions	Engaged sessions	Average engagement time per session	Engaged sessions per user	Events per session	Engagement rate
			41,106 4.64% of total	15,635 10.57% of total	27,222 7.41% of total	9,298 4.55% of total	55s Avg +18.99%	0.59 Avg -56.9%	3.90 Avg -34.25%	34.16% Avg -38.57%
1	Display	/plans-policies-reports/land-and-water-regional-plan	7,866	4,181	6,875	1,307	5s	0.31	2.94	19.01%
2	Paid Search	/plans-policies-reports/land-and-water-regional-plan	4,642	3,294	4,495	401	2s	0.12	2.81	8.92%
3	Organic Search	/plans-policies-reports/land-and-water-regional-plan	4,323	1,686	3,488	2,777	41s	1.65	3.14	79.62%
4	Paid Search	/plans-policies-reports/land-and-water-regional-plan/give-your-feedback-on-the-draft-land-and-water-regional-plan	1,646	1,186	1,539	147	1s	0.12	2.89	9.55%
5	Direct	/plans-policies-reports/land-and-water-regional-plan	1,838	1,177	1,468	739	32s	0.63	3.43	50.34%
6	Organic Search	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations	3,811	1,122	3,084	2,218	2m 10s	1.98	2.94	71.92%
7	Display	/plans-policies-reports/land-and-water-regional-plan/give-your-feedback-on-the-draft-land-and-water-regional-plan	2,070	1,108	1,795	340	4s	0.31	2.89	18.94%
8	Direct	/plans-policies-reports/land-and-water-regional-plan/proposed-changes-to-rules-and-regulations	1,890	913	1,413	802	2m 02s	0.88	3.45	56.76%
9	Direct	/plans-policies-reports/land-and-water-regional-plan/give-your-feedback-on-the-draft-land-and-water-regional-plan	1,158	739	1,039	324	14s	0.44	3.08	31.18%
10	Email	/plans-policies-reports/land-and-water-regional-plan	532	498	526	130	10s	0.26	3.23	24.71%
11	Organic Search	/plans-policies-reports/land-and-water-regional-plan/give-your-feedback-on-the-draft-land-and-water-regional-plan	1,001	437	887	683	40s	1.56	2.76	77%

Note: Google Ads Clicks and Google Analytics Sessions don't often match in reporting. If certain key analytic elements/settings are disabled, such as cookies and javascript, Google Analytics may not be able to record a session. The process to record a click is straightforward; however, recording a session involves requirements and checkpoints. The whole process from click to session should happen within seconds, but if latency is introduced at any of these checkpoints, then this can in turn reduce the click-to-session ratio (more clicks than sessions are recorded). Learn more here.

Jotform results

This year, the Jotform platform was utilised to create an online form where the public could feedback on the draft LWRP rules. Using Jotform is an interim solution regarding public engagement.

In total, there were 573 feedback responses. This was far higher than the responses received in LWRP Round 2 (83), representing a 590% increase in feedback in comparison.

Between 9 September and 6 November, there were 8,532 views of the form. The highest number of views came on Sunday evening – the night before feedback was due to close.

There was a 6% conversion rate, meaning of the total form views, 6% actually progressed to submitting their form.

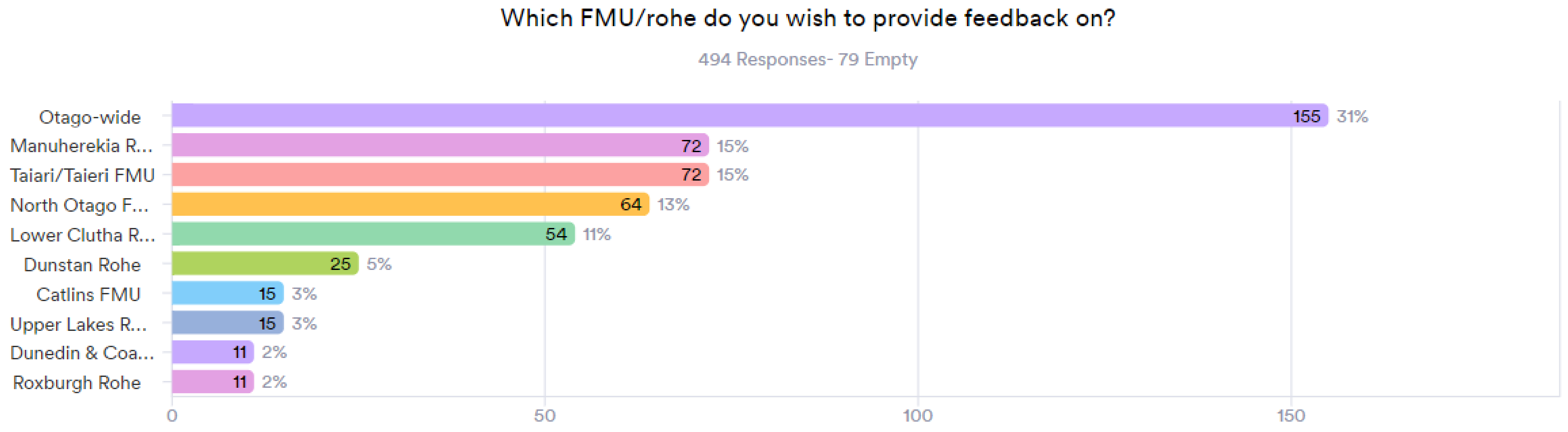
Most of the recorded views came from desktop computers with 2,724 views.

	Views	
Desktop	2,724	31.9%
iPhone	1,849	21.6%
Generic Smartphone	1,627	19.0%
iPad	265	3.10%
Samsung SM-A045F	84	0.98%

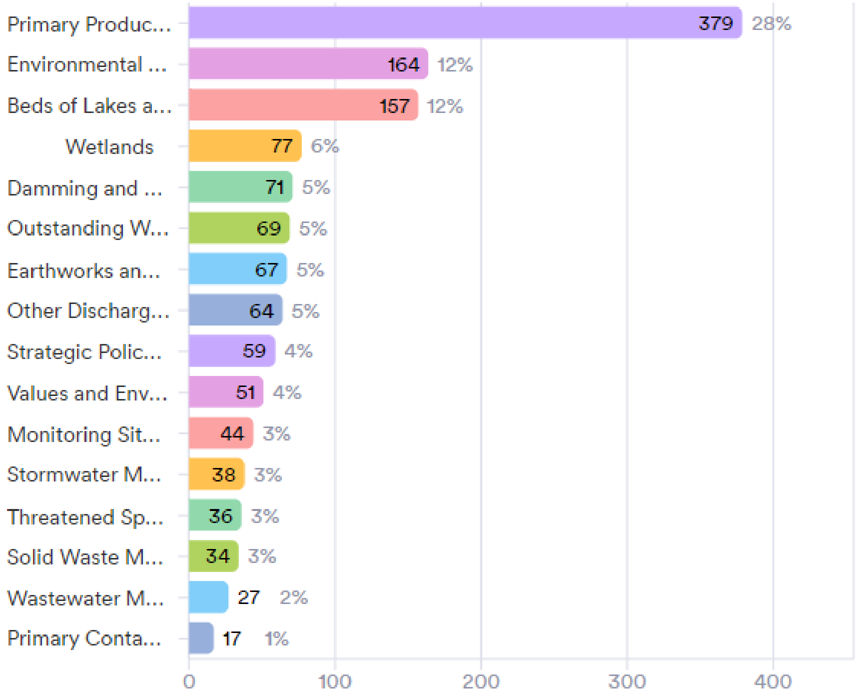
Screen sizes	Views	
1920x1080	934	10.9%
390x844	701	8.22%
414x896	494	5.79%
385x854	281	3.29%
1536x864	273	3.20%

Top level draft LWRP feedback results

Most of the feedback were for the Otago-wide region, with 155 (31%) responses. This is followed by feedback for the Manuherekia Rohe with 72 responses (15%).



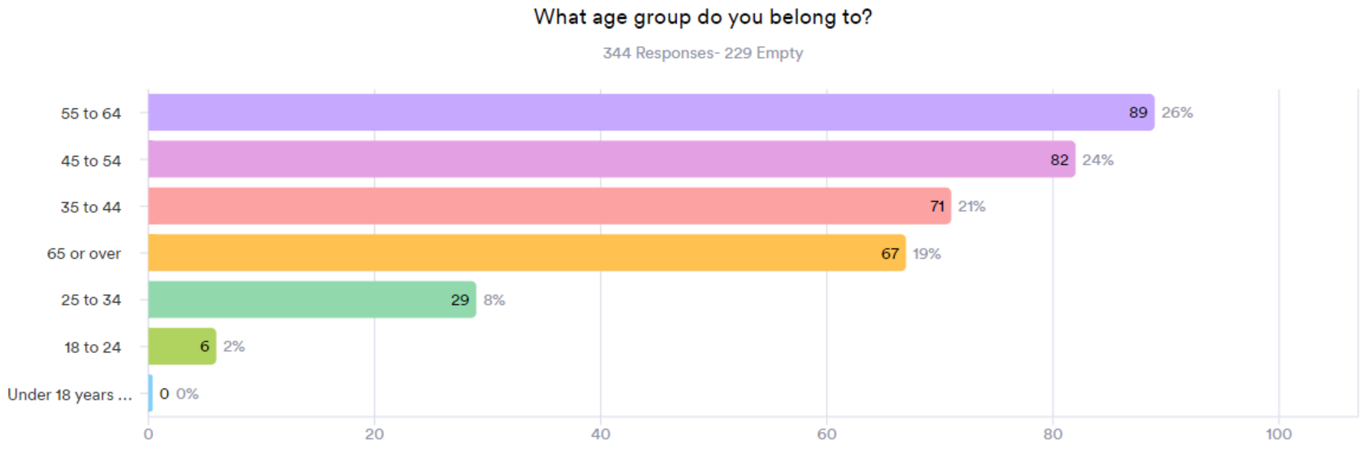
Regarding topics, the most responded topic/chapter was Primary Production with 379 (28%) responses. This is followed by Environmental Flows and Limits (Water Quantity) with 164 responses (12%) and Beds of Lakes and Rivers with 157 responses (12%).



Demographics

In general, most of the feedback came from the older age ranges. There were only 6 responses submitted as coming from people aged 18-24.

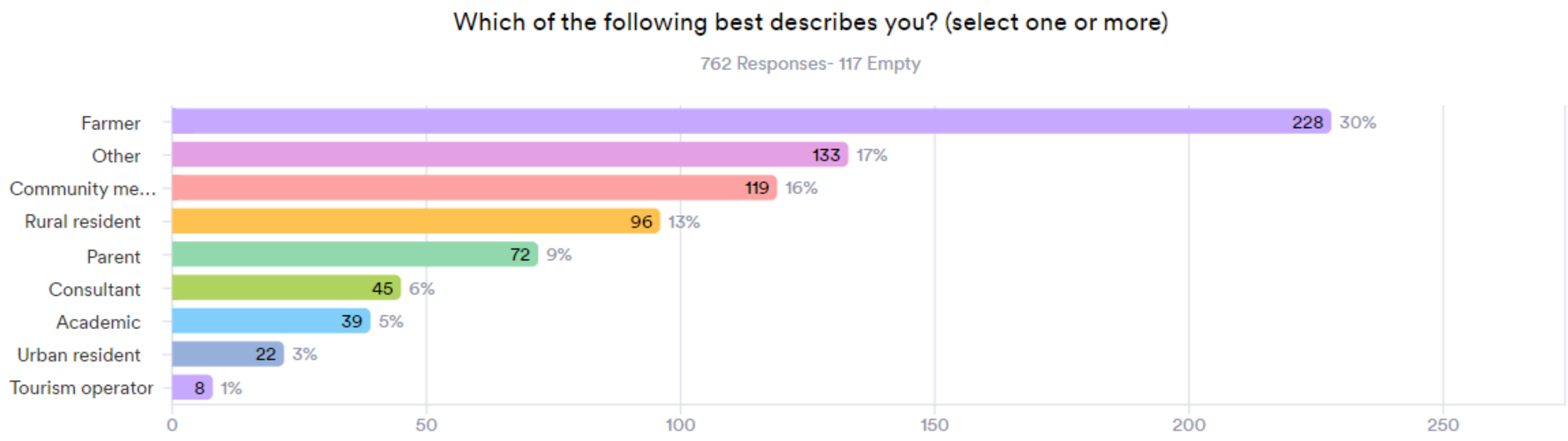
Most of the submitted feedback came from people aged 55-64 with 89 responses (26%), followed by people aged 45-54 years old with 82 responses (24%).



Occupation/self-description

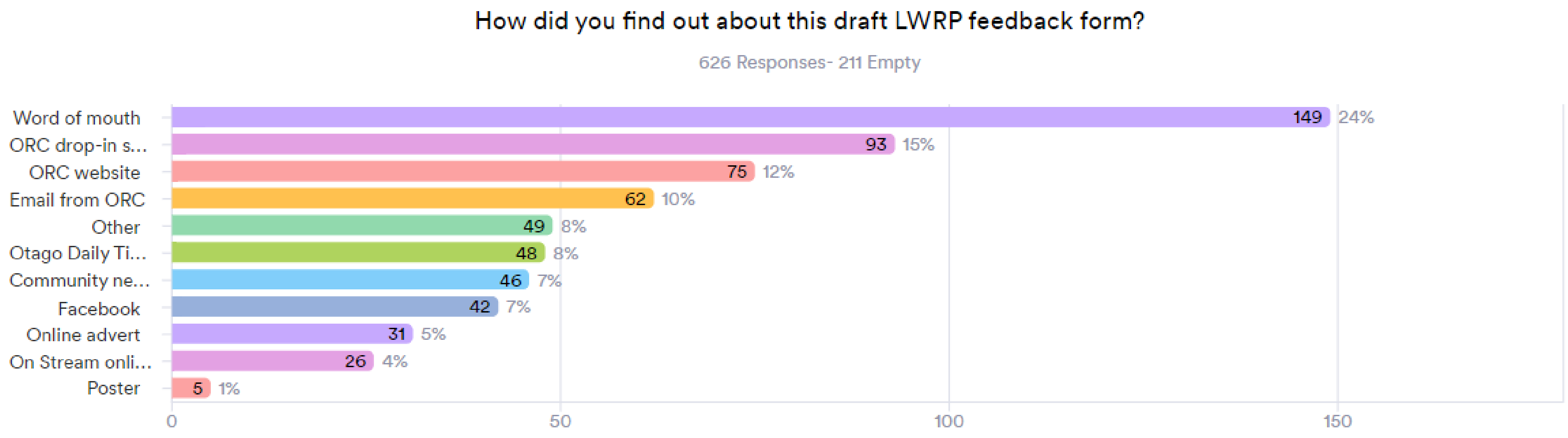
Most of the respondents identified themselves as Farmers with 228 responses (30%). The proposed rules would affect farmers (and their livelihoods) significantly – but it is not to say they are the only group of people affected, given the LWRP will affect everyone in some way or another.

Many responses came from 'Other' where it consisted of descriptions such as public organisations (such as Department of Conservation) and also private organisations, and ORC staff submitting responses on behalf of people.



Where people heard about the feedback form

Although interesting, but not surprisingly, most respondents heard about the LWRP feedback form (and most likely LWRP itself) through word of mouth with 149 responding with this channel, representing 24% of total LWRP responses. This is followed by responses for ORC drop-in session with 93 responses (15%).


How did you find out about this draft LWRP feedback form?
626 Responses- 211 Empty
Word of mouth
ORC drop-in s...
ORC website
Email from ORC
Other
Otago Daily Ti...
Community ne...
Facebook
Online advert
On Stream onli...
Poster
149
24%
93
15%
75
12%
62
10%
49
8%
48
8%
46
7%
42
7%
31
5%
26
4%
5
1%
0
50
100
150

8.3. Efficiency Review report back

Prepared for:	Council
Report No.	GOV2340
Activity:	Governance Report
Author:	Richard Saunders, Chief Executive
Date:	22 November 2023

PURPOSE

[1] To provide Council with the outcome of the efficiency review undertaken by Morrison Low and R B Robertson in July/August 2023.

EXECUTIVE SUMMARY

[2] On 22 February 2023, Council passed a resolution to direct the Chief Executive to commission an efficiency review to inform the upcoming Long-Term Plan 2024/2034 process. The review focused on the areas of financial management, timesheets, work planning, breaking silos, non-financial performance and provided additional 'general observations'.

[3] The Chief Executive requested that Morrison Low develop a set of recommendations for the Council to action to ensure fit for purpose systems and process that support efficient ways of working. This will enable ORC to work 'on the business' as well as 'in the business' and adopt more efficient ways of working after a period of substantial growth and accelerated work programmes.

[4] Despite significant growth in operating expenditure, Morrison Low highlighted that the Council still maintains one of the lowest spends per head of population across the regional council sector. However, there are a range of improvements that can be made to how the organisation operates.

[5] The efficiency review is one of three reviews currently underway to reflect on and strengthen Council's performance. Council will shortly participate in the CouncilMARK™ performance assessment and continuous improvement initiative aimed at improving service and value to communities. In addition, Te Kura Taka Pini are currently undertaking a Te Tiriti o Waitangi Audit to ascertain whether Council is operating in a manner consistent with its commitment to partner with mana whenua and demonstrating and practicing a bi-cultural approach within the organisation.

[6] In its review, Morrison Low identified ten short-term recommendations focused on strategic planning, financial management, corporate planning and reporting, programme and project management and procurement and five medium to long-term actions for Council to implement.

RECOMMENDATION

That the Council:

1) ***Notes*** *this report.*
2) ***Notes*** *that the Chief Executive will oversee a programme of business transformation, that will include the implementation, where appropriate, of recommendations contained in the Morrison Low Efficiency Review Report.*
3) ***Notes*** *that a progress update on the implementation of the review recommendations will be presented back to Council at the beginning of the next financial year (2024/2025).*

BACKGROUND

[7] At its meeting of 22 February 2023 and during discussions on the content of the Annual Plan 2023/34, Council made the following resolution (CM23-111):

Directs the Chief Executive to complete an independent efficiency review in the 2023/2024 financial year to inform the Long-Term Plan Process.

[8] The review was to focus specifically on:

- Assessment of work planning processes, including the identification of potential bottlenecks or inefficiencies.
- Evaluation of budgeting and reporting mechanisms to determine if they align with best practices and identify areas for improvement.
- Where possible, perform comparison of ORC's activities with other local government bodies to perform benchmarking to gauge efficiency levels.
- Other analysis as deemed necessary to achieve the objectives of this review.

[9] The overall aim of the work was to provide recommendations for consideration by the Council to support the organisation to work efficiently.

[10] Morrison Low, assisted by R B Robertson, were engaged by the Chief Executive to undertake the efficiency review to inform the development of the Long-Term Plan 2024/34.

[11] The review was carried out through a combination of desktop analysis, video interviews and on-site interviews between July 2023 and August 2023. The review focused on high level organisational efficiency, with actionable recommendations rather than a detailed examination of all budget lines and associated processes (Appendix 1).

[12] The review was undertaken within the context of the Council transitioning from a planned period of significant growth and change, with substantial increases in operating expenditure and employee headcount over the past four years. This growth was in response to increased responsibilities passed down from central government, political will and raised community expectations with respect to ORC's core role of environmental management.

[13] Morrison Low noted that "the growth has clearly been a deliberate response to a recognition that ORC was, at the time, insufficiently resourced to deliver on its statutory obligations and community expectations". This was evidenced in a series of reviews, including:

a. The Wynn Williams/Mitchell Daysh review of ORC's consent function, which was commissioned in March 2019. That review made a number of recommendations for improving the performance of ORC's consent function. Most notably in the context of this work, it identified that there was a need for two new roles to be established within the consents team, and that additional capacity in the science group would be ideal.
Note: All actions contained in this review have been actioned.

b. Professor Peter Skelton's review "Investigation of Freshwater management and allocation of functions at Otago Regional Council" commissioned by the Ministry for the Environment in October 2019 identified the need for ORC to undertake a "significant upgrade of the planning framework", and that the key areas of policy and planning, science, consenting and CME were "seriously under resourced" and needed "significantly more investment".
Note: Responses to this report are actioned or underway.

c. The review of ORC's science capability and capacity by Aquanet Consulting in 2019, which identified the need to double the resourcing of ORC's scientists from 9.4 FTE to 19.4 FTE.
Note: Science FTE sits at 22 in the 2023/24 Annual Plan.

[14] Morrison Low suggested that the level of growth was not unusual but rather reflected broader trends in the local government sector resulting from significant increases in responsibilities over time. This delegation of responsibilities to local government, typically from central government[1], has often come without accompanying funding, and was a key issue highlighted in the Future for Local Government Review Panel's final report[2].

[15] In its review, Morrison Low reflected that:

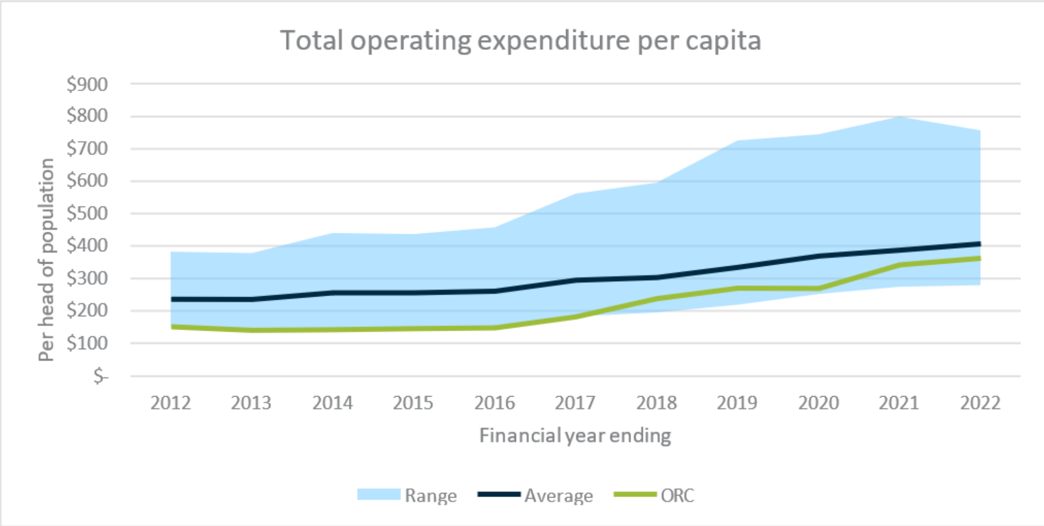
> "ORC is a different organisation than it was in 2019. Its increase in scale means that the processes and procedures that were in place for a relatively small organisation are no longer fit for its present size. This is not an indictment on the processes of the past, but a reflection of the changing nature of ORC's business".

[16] Despite significant increases to operating expenditure, Morrison Low's benchmarking exercise demonstrated that the Council still maintains one of the lowest spends per head of population across the regional council sector, as outlined in Figure 1.

Figure 1: Total operating expenditure per capita across NZ regional councils

[1] Central government has increased the expectations and regulatory functions and requirements for regional councils. The National Policy Statement for Freshwater Management, National Policy Statement for Highly Productive Land, and the National Policy Statement for Indigenous Biodiversity being three examples of this.

[2] https://www.dia.govt.nz/diawebsite.nsf/Files/Future-for-Local-Government/$file/Te-Arotake_Final-report.pdf



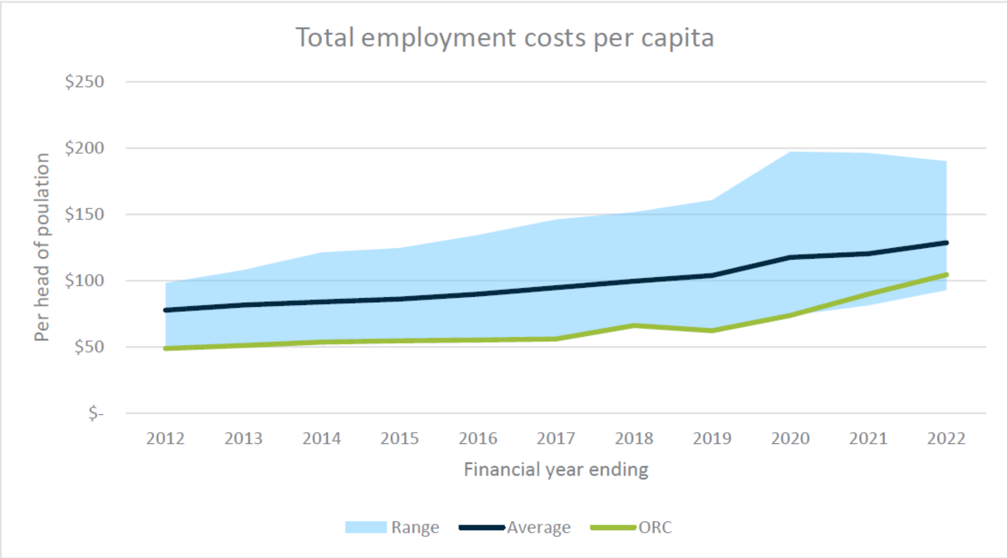
Source: Morrison Low, Otago Regional Council Efficiency Review Report, October 2023, pg. 1

[17] While the deliberate growth in ORC's size since 2019 is clearly reflected in benchmarking data, in many cases this increase in expenditure has been observed across the regional council sector so while ORC's expenditure has seen significant increases it still sits below the national average for operating expenditure per capita across many of its activities.

[18] Morrison Low suggested that overall, benchmarking[3] data highlight that ORC is likely to be operating economically. The authors believe there is no urgent need to react to finding efficiencies, but effort should be focused on improving internal systems and processes.

[3] The report outlines that benchmarking across the full group of regional councils is based on Statistics New Zealand's Local Authority Financial Statistics data. This data is not audited and is based on a self-completed questionnaire for each council. It does not include any unitary authorities.

Figure 2: Total employment costs per capita across NZ regional councils



Source: Morrison Low, Otago Regional Council Efficiency Review Report, October 2023, pg. 34

[19] In terms of total employment costs per capita, Figure 2 shows that ORC was at the lowest end of the range until the end of the 2020 financial year, when it began its deliberate growth path. Despite this growth, ORC remains under the national average for employment costs on a per capita basis.

[20] Based on available data, Morrison Low determined that ORC's average rates are the third most affordable across the regional council sector in Aotearoa/New Zealand.

DISCUSSION

[21] For the purposes of the review, Morrison Low defined efficiency as *maximising outputs with given inputs or functions performed*. Efficiency is closely aligned with the concept of productivity and encompasses the ability to do something well and without waste. It relates not just to the overall cost of delivering a service, but also to the underlying ways in which that work is carried out.

[22] The report noted that Councillors needed to reach consensus on what efficiency means and how it is best measured, as the review process identified varying interpretations of the concept and its value.

[23] The review recommendations focus primarily on the theme of establishing the discipline and systems to enable the organisation to better assess efficiency on an ongoing basis. The findings reflected the absence of clear and consistent systems that align planned effort with planned outcomes, which in turn made assessing efficiency difficult.

[24] Key **short-term** recommendations (to be implemented within 12 months) are as follows:

a. Develop a commonly understood definition and approach to efficiency which is used:

    i. At the planning and budgeting phases for ORC's annual and long-term planning.

    ii. In monthly financial management practice.

b. Support the proposed change to the allocation of overhead costs across ORC, and improve transparency by additionally:

    i. Providing the same level of visibility and reporting on "below the line" activities as is provided for the remainder of ORC activities both internally and externally.

    ii. Restricting the allocation of budget variances from below the line activities to an annual adjustment at year end.

c. Develop a common understanding of the budgeting process and financial management/financial reporting.

d. Further work on the development of a strategic and operational planning framework, including development of an approach to consolidate and escalate work programmes through the organisation to ensure coordination of resources.

e. Develop an organisational approach to project and programme management that includes clear definitions of roles, responsibilities, delegation, and reporting requirements and/or consider the introduction of a Project Management Office.

f. Review ORC's planned and existing projects across the organisation and considering where it may be appropriate to adopt a programme management, rather than project management, approach.

g. Ensure that the skills and competencies that exist within ORC are first considered before going to market to procure services for work which can otherwise be undertaken by existing ORC resources. In particular, this should be a key consideration when procuring work or services that is small in scale.

h. Undertake a review of non-financial performance measures (in particular those used internally) with a view to:

    i. Reducing the total number of actively monitored measures.

    ii. Ensuring that all measures provide useful information on organisational performance (output).

    iii. Ensuring that measures are all able to be measured and have clear targets.

iv. Aligning internal performance measures with those reported on externally, and with each activity's work plan.

i. Review the use of consultants to determine whether some services should be engaged internally.

j. Review revenue targets and charge out rates for all teams with a revenue target and that are cost recoverable, and in doing so consider all of the following in combination:

i. The expected volume of chargeable work that will be received during the year based on historical volumes and growth.

ii. The amount of recoverable time taken to undertake the specific chargeable task.

iii. The particular costs that are to be recovered through the charging mechanism (particularly as they relate to overheads, training time, etc). Costs that are not included in the charge out rate calculation should be similarly excluded from any calculation of percentage recovery targets.

[25] Further **medium to long-term** recommendations (longer than 12 months to implement) were also made:

a. Develop an integrated work planning process that is clearly aligned to resource planning and budget setting. This should include:

i. Clear alignment of the strategic plan, delivery plan and individual work plans.

ii. Alignment of budget, work plans and non-financial performance measurement to ensure all activities that are able to be influenced by managers are aligned.

iii. Preparing the 2025 annual plan budget on a zero-basis having consideration to individual work plans.

b. Formally embedding specific consideration of the use of internal and external resource into the work planning process.

c. Reduce the reliance on timesheets for budgeting and cost allocation purposes, by budgeting staff costs to activities based on activity work programmes.

d. Develop a data management framework and common data standards to ensure that data collected or produced by ORC is consistent across the organisation. This will enable better use of existing information across activities and avoid unnecessary duplication.

e. Explore opportunities to simplify the budget management and reporting processes, to enable managers to better understand their budgets, and to enable a better assessment of overall organisational efficiency. In particular, explore opportunities to align the internal reporting structure to the external reporting structure.

[26] A full list of recommendations is contained in Appendix 2.

[27] It is the view of Morrison Low, that by implementing these recommendations, the attention of the Executive Leadership Team can shift from understanding and analysing financial information and managing budgets, to better managing work programmes and outputs.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[28] There are no strategic framework considerations.

[29] The review recommendations may result in future internal policy or procedural changes. Where required under delegations, these will be presented back to Council for future consideration and/or approval.

Financial Considerations

[30] The total cost of the Efficiency Review was $112,125 (incl. GST).

Significance and Engagement

[31] N/A

Legislative and Risk Considerations

[32] The review report notes a number of areas for improvement. Failure to address these will add operational and reputational risk.

[33] The implementation of the recommendations will require reprioritisation of effort and, in some cases, additional resources which may impact on budget and other work programmes and initiatives.

Climate Change Considerations

[34] N/A

Communications Considerations

[35] The report will be available publicly on Council's website.

NEXT STEPS

[36] The Chief Executive will oversee the development of an implementation plan for each of the review recommendations. A progress update will be provided to Council at the beginning of the new financial year (2024/2025).

ATTACHMENTS

1. ORC Efficiency Review Final Report Oct 23 [**8.3.1** - 67 pages]
2. Summary of Review Recommendations [**8.3.2** - 3 pages]

Otago Regional Council

Efficiency Review

October 2023

Document status

Job #	Version	Written	Reviewed	Approved	Report Date
2849	DRAFT	B. Robertson & S.Cross	B. Robertson & D. Bonifant	D.Bonifant	12 September 2023
2849	FINAL	B. Robertson & S.Cross	B. Robertson & D. Bonifant	D.Bonifant	13 October 2023

Contents

rbrobertson MorrisonLow

Executive Summary

Morrison Low and R B Robertson were engaged by Otago Regional Council (ORC) to undertake an efficiency review in June 2023. The review was carried out through a combination of desktop analysis, video interviews and on-site interviews between July 2023 and August 2023.

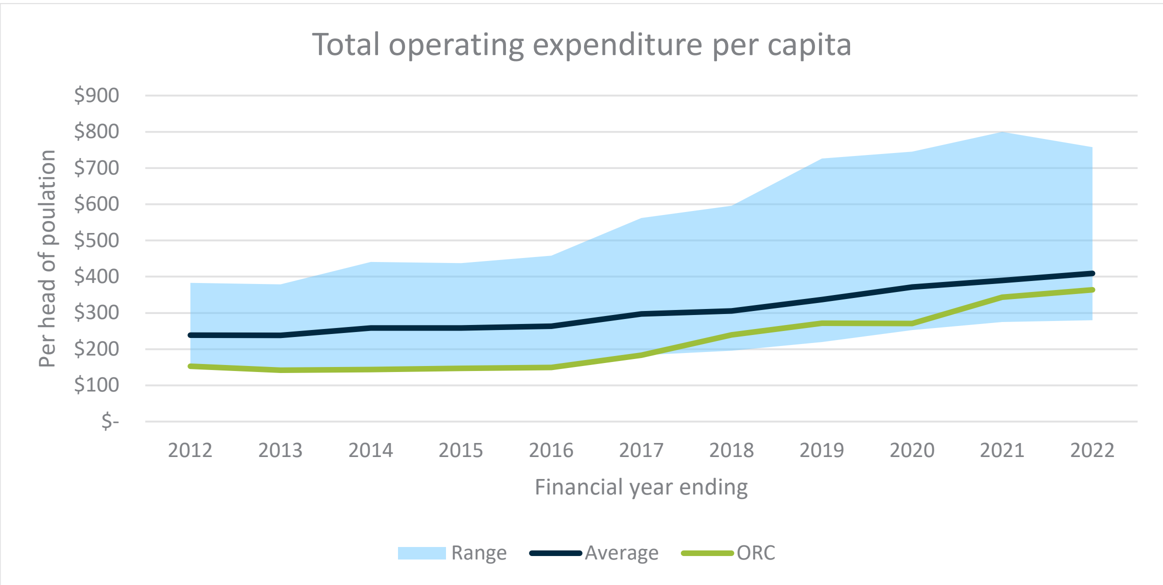
The review was not intended to be a detailed examination of all budget lines and associated processes. Instead, ORC indicated that it should focus on broader organisational efficiency and provide actionable recommendations.

In order to assess the efficiency of ORC, it has first been necessary to define what we mean by efficiency. In general, we say something is efficient when it maximises outputs with given inputs or functions performed by the agency. In other words, it's the ability to do something well and without waste. (This is also closely aligned with the concept of being productive.) This is the lens within which we have reviewed efficiency at ORC.

Our review was undertaken within the context of an organisation coming out of a period of significant growth and change. In the four years prior to our review ORC's operating expenditure had grown by over 50%, and its employee headcount by over 60%. Furthermore, at the time of our review, ORC's current Chief Executive had only been formally in his role for 1 or 2 months, although he had been employed by ORC for longer.

This growth is not unusual. The local government sector in general, has seen a significant increase in responsibilities over time. This delegation of responsibilities to local government, typically from central government, has often come without accompanying funding, and was a key issue highlighted in the Future for Local Government Review Panel's final report. Our benchmarking demonstrated that despite significant increases to operating expenditure across the organisation, ORC still maintains one of the lowest spends per head of population across the regional council sector (see Figure 1 below).

Figure 1 Total operating expenditure per capita across NZ regional councils



Growth at ORC took place following a clear mandate from the Otago community and was a challenge placed on ORC by elected members and through a number of independent reports. A changing economic environment, and the recent period of significant rates increases has meant that there is limited appetite to continue with large rates rises.

At the same time, we heard that councillors are often challenged to be able to describe what work and activities are undertaken by ORC. This link between input costs (which transpire as property rates) and the outcomes and outputs of ORC is part of the core efficiency equation. Effective communication of ratepayer value will only be possible by having clear and consistent approaches for translating strategy to action and delivery and a clear understanding of organisational efficiency.

ORC was unable to respond to that growth challenge while simultaneously developing new processes and systems to ensure that it continues to operate efficiently and effectively. As a consequence, many of the processes in place at ORC today are a reflection of the organisations past. Those processes and systems, while possibly appropriate for ORC when it was smaller, are no longer fit for purpose. They reflect an organisation that, through necessity, operated in silos and carried out activities independently of each other.

Our review identified a number of areas of improvement, with a focus on the development of efficient work planning and financial management processes. We found that:

- Managers often struggle to understand their activity budgets and the allocation of overhead cost adjustment throughout the year was a common source of frustration. There is a lack of common understanding about how budgets are put together, budget responsibility, and how costs are recovered.
- There are over 250 non-financial performance measures that require regular monitoring and reporting. In our view, this is too many measures to enable effective and meaningful reporting.
- The benefits of using timesheets across the organisation are not well understood. If timesheets are to continue to be used, the data captured by them should be put to a meaningful use beyond allocation of cost or overhead.
- Improving maturity in the translation of strategic and community objectives to work planning, and the processes that accompany that, will create opportunities to be more efficient in the future.
- The lack of commonly adopted clear, consistent project and programme management discipline across the organisation creates a risk of inefficient delivery or project delays. ORC has a greater reliance on external contractors or consultants (as suggested by benchmarking) which means project management disciplines have an increased level of importance.

Our recommendations from this review are summarised in the next section, and have been categorised into short and medium term actions. In our view, these recommendations will respond to the key findings of our review and enable ORC to operate more efficiently in the future.

Based on benchmarking in this review, the Statistics New Zealand dataset for regional councils would suggest that ORC is generally likely to be operating economically. Furthermore, ORC’s average rates are some of the most affordable across the regional council sector. There is no need at this time for any “knee-jerk” reaction, rather a purposeful and methodical improvement of systems and processes and developing a culture of financial management and scrutiny which includes considering performance with an efficiency lens.

Recommendations

Our findings and recommendations reflect the absence of clear and consistent systems that align planned effort with planned outcomes. Without efficient processes and systems, it is difficult for any organisation to assess its own overall efficiency.

On this basis, our recommendations focus primarily around the theme of establishing the discipline and systems to enable that efficiency question to be answered. In many cases, our recommendations may create an additional workload (at least on establishment) on the organisation.

It is our view, that by implementing these recommendations, the attention of the executive leadership team can shift from understanding and analysing financial information and managing budgets, to managing work programmes and outputs.

In order to achieve this, we have made a suite of recommendations that relate to the work planning and budgeting and reporting processes at ORC. These have been consolidated and grouped into short and medium term actions below.

Short term actions

We believe that the recommendations identified below can be implemented within the next 12 months.

- Develop a commonly understood definition and approach to efficiency which is used:
  - At the planning and budgeting phases for ORC's annual and long-term planning
  - In monthly financial management practice.
- Support the proposed change to the allocation of overhead costs across ORC, and improve transparency by additionally:
  - Providing the same level of visibility and reporting on "below the line" activities as is provided for the remainder of ORC activities both internally and externally
  - Restricting the allocation of budget variances from below the line activities to an annual adjustment at year end.
- Develop a common understanding of the budgeting process and financial management/financial reporting. This will require finance to work with managers to agree on an agreed budgeting and reporting framework that is fit for purpose and clearly aligned to the service delivery outcomes that managers are responsible for delivering.
- Further work on the development of a strategic and operational planning framework, including development of an approach to consolidate and escalate work programmes through the organisation to ensure coordination of resources.
- Develop an organisational approach to project and programme management that includes clear definitions of roles, responsibilities, delegation, and reporting requirements and/or consider the introduction of a Project Management Office.
- Review ORC's planned and existing projects across the organisation and considering where it may be appropriate to adopt a programme management, rather than project management, approach.

- Ensure that the skills and competencies that exist within ORC are first considered before going to market to procure services for work which can otherwise be undertaken by existing ORC resources. In particular, this should be a key consideration when procuring work or services that is small in scale.
- Undertake a review of non-financial performance measures (in particular those used internally) with a view to:
  - Reducing the total number of actively monitored measures
  - Ensuring that all measures provide useful information on organisational performance (output)
  - Ensuring that measures are all able to be measured and have clear targets
  - Aligning internal performance measures with those reported on externally, and with each activity's work plan.
- Review the use of consultants to determine whether some services should be engaged internally.
- Review revenue targets and charge out rates for all teams with a revenue target and that are cost recoverable, and in doing so consider all of the following in combination:
  - The expected volume of chargeable work that will be received during the year based on historical volumes and growth
  - The amount of recoverable time taken to undertake the specific chargeable task
  - The particular costs that are to be recovered through the charging mechanism (particularly as they relate to overheads, training time, etc). Costs that are not included in the charge out rate calculation should be similarly excluded from any calculation of percentage recovery targets.

Medium to long term actions

We consider that the following recommendations are likely to take longer than 12 months to be able to fully implement although in some cases work can start earlier.

- Develop an integrated work planning process that is clearly aligned to resource planning and budget setting. This should include:
  - Clear alignment of the strategic plan, delivery plan and individual work plans
  - Alignment of budget, work plans and non-financial performance measurement to ensure all activities that are able to be influenced by managers are aligned
  - Preparing the 2025 annual plan budget on a zero-basis having consideration to individual work plans.
- Formally embedding specific consideration of the use of internal and external resource into the work planning process.

- Reduce the reliance on timesheets for budgeting and cost allocation purposes, by budgeting staff costs to activities based on activity work programmes. Alternatively, consideration of reducing the time unit intervals in time sheets to 30 – 60 minutes and reducing the number of time codes, to enable information to be captured about workload and resourcing. In either event, retention of timesheets will be necessary for:
  - Capital projects
  - Activities that are externally funded through fees and charges, cost recoveries or third party grants
  - Overtime claims for determining time in lieu entitlements or monitoring organisational workload and stress.
- Develop a data management framework and common data standards to ensure that data collected or produced by ORC is consistent across the organisation. This will enable better use of existing information across activities and avoid unnecessary duplication.
- Explore opportunities to simplify the budget management and reporting processes, to enable managers to better understand their budgets, and to enable a better assessment of overall organisational efficiency. In particular, explore opportunities to align the internal reporting structure to the external reporting structure.

Introduction to this review

During its meeting on 22 February 2023, Otago Regional Council ("ORC") passed a resolution to direct the Chief Executive to complete an independent efficiency review of the organisation.

The resolution to undertake an efficiency review was set in the context of ORC having experienced significant growth over a 36 month period, which saw growth in staff from 170 to approximately 300 over that time period.

In its RFQ, ORC indicated that the review should encompass:

- Examination of the organisational structure and identification of areas for improvement or streamlining.
- Assessment of work planning processes, including the identification of potential bottlenecks or inefficiencies.
- Evaluation of budgeting and reporting mechanisms to determine if they align with best practices and identify areas for improvement.
- Where possible, perform comparison of ORC's activities with other local government bodies to perform benchmarking to gauge efficiency levels.
- Undertake other analysis as deemed necessary to achieve the objectives of this review.
- Provide key recommendations for consideration by the organisation.

The review was not intended to be a detailed examination of all budget lines and associated processes. Nor was it intended to be a "fit for the future" review. Instead, ORC indicated that it should focus on broader organisational efficiency and provide actionable recommendations.

Morrison Low and R B Robertson were engaged by ORC to undertake the review in June 2023. The review was carried out through a combination of desktop analysis, video interviews and on-site interviews between July 2023 and August 2023.

Subsequent to our engagement to undertake the review, it was agreed that our report would not specifically address ORC's organisational structure.

This report summarises the findings of that review.

What is efficiency

We interviewed all councillors who were available and senior management in starting this review. It is clear that there was no common understanding of what is meant by efficiency or, as a result, what the outcome of this review should necessarily be.

Ideas expressed in our interviews included:

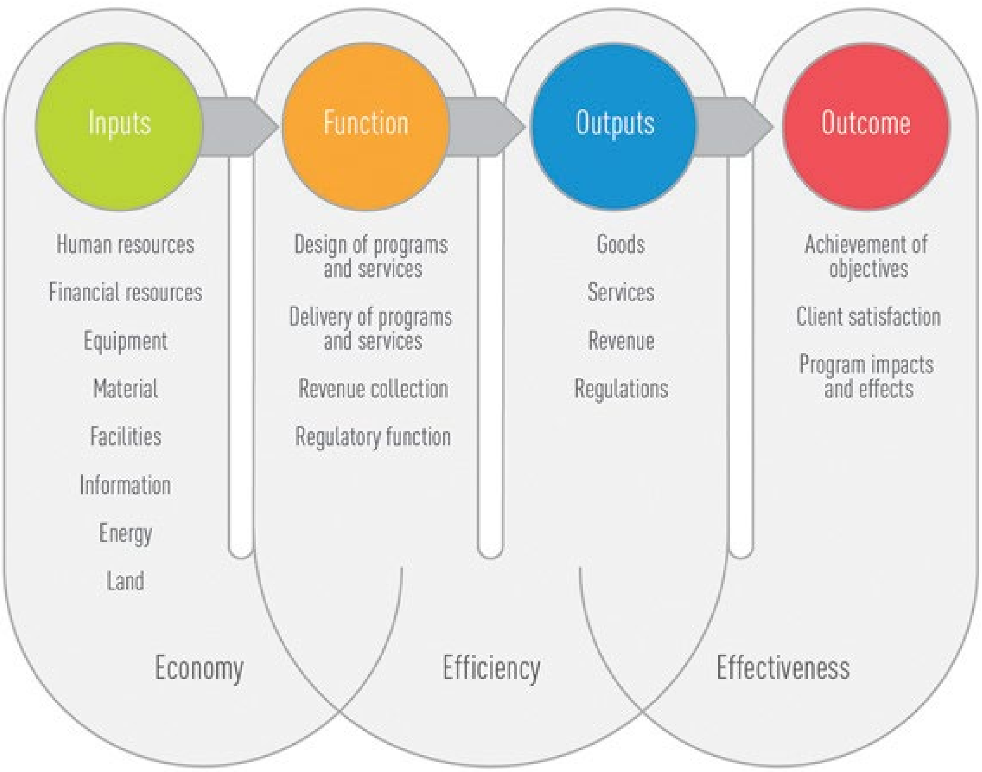
- Staff are productive
- There is a lack of waste
- Costs are cut to a minimum

- Minimising the rate requirement
- Avoiding cultural behaviours such as functions operating *in silos*
- Avoiding the business practice of external procurement *vs* looking for in-house ability
- Regular and comprehensive justification of spend through business cases
- Effective non-rate based funding of activities
- Effective scrutiny of financial performance – by management (and also by an internal audit function)
- The ratepayer receiving *value for money*

In many ways all perspectives are not unreasonable and in turn should be addressed by any public sector agency.

To define efficiency for the purposes of this review, we have looked toward established definitions from professional bodies. Figure 2 below is helpful in understanding the concepts of efficiency and the aligned concepts of economy and efficiency, and represents the definition of efficiency used in this review.

Figure 2 Visual representation of efficiency versus economy and effectiveness[1]



[1] Extracted from Canadian Audit and Accountability Foundation (https://www.caaf-fcar.ca).

In general, we say something is efficient when it maximises outputs with given inputs or functions performed by the agency. In other words, it's the ability to do something well and without waste. (This is also closely aligned with the concept of being productive.) It relates not just to the overall cost of delivering a service, but also to the underlying ways in which that work is carried out.

ORC reaching a common consensus on what efficiency is and how it is measured is important.

The context of this review notes ORC's acceptance of its necessary growth in response to the statutory responsibilities it must deliver on. But from this point focusing on efficiency (and the important concept of effectiveness) is valuable to:

- Enable management to marshal its resources in an optimum way and at a reasonable level relative to what they are required to do
- Provide governance with confidence that what it is asking the community to fund is reasonable.

Efficiency needs to be a regular discussion at both governance and management level and in discussion between the two groups.

What is efficient for a regional council is highly entity specific. We do provide a limited level of benchmarking in this report which, while helpful, still requires substantial riders to be able to draw effective conclusions.

The two key components of efficiency are inputs and outputs. The Foundation notes that key to efficiency is whether the agency:

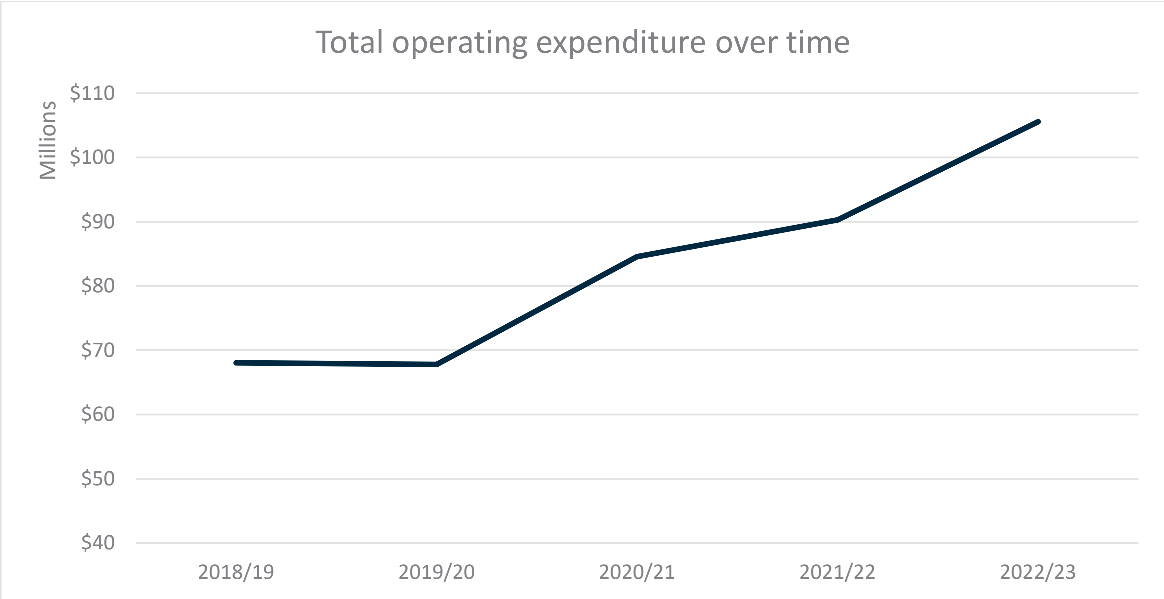
- follows sound procurement practices;
- acquires the appropriate type, quality, and amount of resources at an appropriate cost;
- properly maintains its resources;
- uses the optimum amount of resources (staff, equipment, and facilities) in producing or delivering the appropriate quantity and quality of goods or services on time; and
- complies with regulatory requirements that govern or affect the acquisition, maintenance, and use of its resources.

This has been the primary driver for this efficiency review.

Background

ORC has recently experienced a period of rapid and deliberate growth as illustrated in Figure 3. In the four years since 2019, ORC has increased its total operating expenditure by 55%, accompanied by similar growth in the number of full time equivalent (FTE) staff employed and total rates revenue.

Figure 3 Growth in total operating expenditure over time



The growth has clearly been a deliberate response to a recognition that ORC was, at the time, insufficiently resourced to deliver on its statutory obligations and community expectations. This was evidenced in a series of reviews[2], including:

- The Wynn Williams/Mitchell Daysh review of ORC's consents function, which was commissioned in March 2019. That review made a number of recommendations for improving the performance of ORC's consents function. Most notably in the context of this work, it identified that there was a need for two new roles to be established within the consents team, and that additional capacity in the science group would be ideal.
- Professor Peter Skelton's review "Investigation of Freshwater management and allocation of functions at Otago Regional Council" commissioned by the Ministry for the Environment in October 2019 identified the need for ORC to undertake a "significant upgrade of the planning framework", and that the key areas of policy and planning, science, consenting and CME were "seriously under resourced" and needed "significantly more investment".
- The review of ORC's science capability and capacity by Aquanet Consulting in 2019, which identified the need to double the resourcing of ORC's scientists from 9.4 FTE to 19.4 FTE.

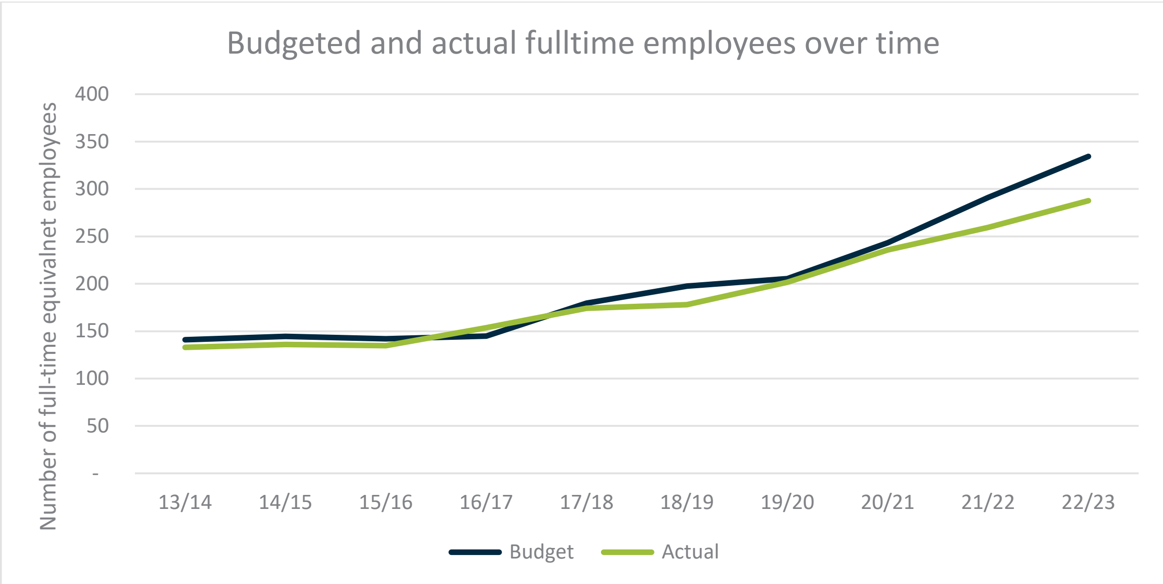
[2] Reference to these reviews within this report are used to highlight progress and provide historical context to our findings.

The various reports and reviews commissioned in 2019 were referenced in ORC's 2020-21 annual plan, which included additional resourcing for consents processing, and planning and strategy. The annual plan also highlighted that ORC was accelerating its efforts in State of the Environment reporting, and increases in the number of emergency management staff. This gave rise to a budgeted increase in expenditure of $12.55 million (or 19%) with a simultaneous reduction in rates revenue of $823,000 compared to its Long Term Plan (LTP). When compared to the 2019-20 annual plan, the 2020-21 annual plan included a $9.6 million increase in budgeted expenditure (or 14 %).

At the same time, central government has increased the expectations and regulatory functions and requirements for regional councils. The National Policy Statement for Freshwater Management, National Policy Statement for Highly Productive Land, and the National Policy Statement for Indigenous Biodiversity being three examples of this.

Since 2019, ORC has responded to the various reports into its resourcing and the above mentioned increasing delegated responsibilities from central government, and has increased its total resources by 62%, as illustrated in Figure 4 below.

Figure 4 Growth in planned and actual full time equivalent employees over time



The 2020-21 annual plan was developed in a highly uncertain economic environment that was impacted by various lockdowns and restrictions that were in place as part of New Zealand's response to the Covid-19 pandemic. This meant that rates rises in the 2020-21 year were restricted to an annual increase of 2.3%, as compared to an originally indicated 6.9% increase in ORC's long term plan. The funding gap that resulted from the combination of reduced rates revenue and increased operating expenditure was funded from reserves.

ORC's 2021-2031 Long Term Plan tackled the resourcing and funding issues head-on. In his foreword to the Long Term Plan, Andrew Noone (then Chair of ORC) noted community support for an increasing work programme and acknowledged the significant increase in rates proposed.

ORC included a number of options for "balancing the budget" in its 2021-31 LTP consultation document, with 62% of respondents signalling their support for an immediate, significant, rates rise. This gave rise to proposed rates rises of 48.5% in year one, followed by subsequent rates rises of 18% and 12%.

All of this is to say that growth in expenditure, resourcing and rates over the last four years was planned, signalled to the community and responded to the identified needs ORC. To date that growth has generally been supported by the community and elected members.

ORC is a different organisation than it was in 2019. Its increase in scale means that the processes and procedures that were in place for a relatively small organisation are no longer fit for its present size. This is not an indictment on the processes of the past, but a reflection of the changing nature of ORC's business.

The evolving role of local government

The role of local government, and particularly regional councils, has been constantly evolving over time. In the last 5 years, central government has increasingly delegated regulatory responsibilities to regional councils without providing additional funding (the so called "unfunded mandate").

At the same time, systemic reform programmes, including the Affordable Water reforms, and the replacement of the Resource Management Act with the Natural and Built Environments Act will see the functions and responsibilities of regional councils change further.

Much of this change was the focus of the Future for Local Government review, and there are strong recommendations within that report for further change to the structure of local government moving forward. This report does not attempt to identify the scale of the impact of that reform, however we are confident that the recommendations and findings of this review will lay the foundations to enable ORC to adapt to these changes more effectively.

Financial management

How this relates to efficiency

Sound financial management underpins the operational planning of any efficient organisation. Having access to high quality, timely, financial information allows management to make decisions about what activities they should stop, start, or alter.

A good financial management system ensures that financial information is:

- Accurate
- Timely
- Meaningful
- Easily understood by its users.

The absence of clear and consistent approaches to budget setting and linkage to the outcomes that ORC is seeking to achieve means assessment of efficiency (either externally or through self-assessment) is difficult. For that reason, we have also focussed on the processes, and particularly financial management processes, that would assist managers and ORC in making that assessment moving forward.

This section outlines our observations about the financial management processes and makes recommendations that, in our view, will enable managers to spend less time focussing on understanding their budgets and more time focussing on delivery and output.

Importantly, these recommendations and findings should not be considered in isolation. To be effective, they should be implemented alongside improvements to broader business processes and work planning.

Functions that are “below the line”

Overview

A number of management groups, or functions of ORC contribute solely to internal activities or overheads. These functions are referred to within the organisation as being “below the line”. These activities include:

- Chief Executive
- Executive leadership team costs
- Finance
- Health and Safety
- Human Resources
- Information Systems
- Records management
- Support services

These functions are not separately reported or disclosed to Council or its committees, nor are they separately reported on within ORC's published annual report. Instead the costs of these functions are allocated to the rest of the organisation through regular overhead allocations and adjustments.

Overhead costs are effectively allocated out to each business unit based on proportionate headcount. The way in which overhead costs are allocated has changed for the 2023/24 financial year, and a more detailed explanation of this process is contained in the section titled “Homebase and overhead allocation”.

Findings

This observation primarily relates to the historical (2023 financial year and earlier) approach to overhead allocation, as we understand that the approach has changed for the 2024 financial year, and at the time of our onsite work, managers had not seen the results of these changes.

The allocation of overheads, and regular adjustments to the amount allocated to various functions of ORC was cited as a regular source of frustration, and added to confusion regarding budget management. Overhead allocations were seen as an inevitable variance against a manager’s budget, that was often unable to be accurately explained by the managers themselves.

We understand that the approach to overhead allocations and regular variance adjustments was not well understood across the business.

The distractions created from this are time consuming and distract from focus on the wider financial performance against activity budgets.

Recommendations

We are generally supportive of proposed changes to the overhead allocation approach that has been proposed for the 2023/24 year. We understand that this approach will only result in variances against budget being allocated to activity budgets if the actual underlying overhead costs change.

In our view, this approach could be further improved through:

- Providing the same level of visibility and reporting on “below the line” activities as is provided for the remainder of ORC activities both internally and externally, such that they are effectively “above the line”.
- Restricting the allocation of budget variances from below the line activities to an annual adjustment at year end.

Homebase and overhead allocation

Overview

We understand that ORC utilises an activity within its account structure called “homebase” to account for its overhead and staff related costs. As we understand it prior to the 2023/24 financial year, the homebase activity operated as follows:

- Salary costs are allocated to homebase, along with additional employment related costs such as superannuation, ACC levy, and leave entitlements.
- Total organisational overheads for “below the line” activities (such as finance, IT, HR, etc) are allocated into the homebase activity.

- During the year, time may be charged into the homebase activity by staff. Typical time that may be charged to this activity during the year includes all forms of leave, and administration type activities such as corporate training. In the 2023 financial year 10% of staff time was coded to the Homebase activity.
- At the start of the year, budgets are set based on the average hourly rate for staff, and the estimated amount of time that staff will spend within an activity. In addition to a budget reflecting estimated time costs, overheads are allocated based on the estimated budget for overheads divided by total staff time across the organisation.
- Throughout the year time is charged to activities based on actual staff hourly rates (including allowances for superannuation and ACC levies etc) plus an allocation of the actual overhead costs charged to homebase.
- As the amount of staff hours coded to an activity throughout the year may fluctuate, and the underlying costs for overhead activities also fluctuates compared to budget, managers would experience regular "overhead adjustments" in their budget.
- At the end of the year, the intention is that the homebase activity has a zero balance remaining. However, due to time charges occurring throughout the year, an end of year wash up was typically carried out to allocate the remaining balance in homebase.

Findings

During our review we were advised that the previous process resulted in significant confusion for managers and was a regular source of frustration. Managers indicated that they often felt the need to justify overspend on corporate overhead, despite the cost being largely outside of their control. Concerns were also raised about the amount of staff time being coded to homebase, and the corresponding lack of controls.

We understand that for the 2023/24 financial year the process for allocating overheads and the use of homebase is intended to change, we understand that the new process includes:

- All staff time and associated employment costs being charged to the homebase activity, as was previously the practise.
- Staff costs being set in each activity's budget based on the average employment cost and estimated staff hours for the activity.
- Overhead costs being allocated on a fixed percentage basis across each activity. The percentage allocation will be based on the budgeted FTE across each activity and will not change throughout the year.
- Staff costs charged against each activity budget based on actual employment costs and hours worked within the activity.
- Staff being prevented from being able to charge time against the homebase activity at all (the cost of leave will still be allocated to homebase).

We also note that the amount of time that has been allocated to Homebase has been decreasing significantly over the past financial years. For example, the Wynn Williams report cited that up to 40% of time in the consents activity was charged to homebase in 2019, this has reduced to as little as 10% in the last financial year.

Recommendations

In our view, the recent changes to homebase and overhead allocations should result in improved comprehension of activity budgets, particularly as they relate to the allocation of overhead costs. We would still anticipate overhead adjustments to occur, however these adjustments will relate entirely to the underlying overhead costs rather than any differences in estimated resourcing of activities.

There may be scope for further improvement in the way that overheads and staff costs are allocated across activities, which relate to our other comments on the use of timesheets, work planning, and reporting of below the line activities. For completeness, these include:

- Allocation of staff costs directly against the activities to which they relate, based on reporting lines and work programmes or pre-agreed ratios where work programmes have not been developed.
- Reporting of below the line activities in a manner consistent with activities that are directly rates funded, both internally and externally.
- Allocation of budget variances for overhead activities occurring only as part of the year-end accounting process.
- Reducing the reliance on timesheets for general activities, which should create more certainty regarding staff cost budgeting for managers.

Ledger/account structure

Overview

ORC utilises what we have described as a matrix structure for its general ledger and budget management. This structure is designed to be able to match the internal management structure to the external reporting used in annual reports, long term plans, and annual plans and to ensure the appropriate use of targeted rates.

This may be best described in relation to ORC's science and state of the environment monitoring activities, which are illustrated diagrammatically below in Figure 5, however the structure applies to differing degrees across all of ORC's activities.

Figure 5 Visual representation of ORC general ledger structure

		Activity			
		Land and Water	**Air**	**Biodiversity**	**Total**
Management group	**Science**	Land and water science			Science total
	Environmental Monitoring				
	Implementation				
	Total	**Land and water total**			

The number of management groups that are involved in the delivery of individual activities varies significantly across ORC. Activities may be associated with as many as eight management groups, or as few as one.

Within ORC's ledger there were 36 different management groups and 13 different activities in the 2023 financial year. ORC currently employs 23 staff with the job title "Manager", meaning a number of managers are responsible for more than one "management group" within the ledger.

The matrix approach means that budgets can be viewed a number of ways. For example a manger could get reports on:

- The total budget for the "Land and Water" activity, which would include science, environmental monitoring and implementation costs across the business. In this instance, the total "Land and Water" budget would span two different groups (Policy and Science, and Operations) of ORC.
- The total "Science" management group budget, which would include all science related activities across the three activity areas. This would all be managed by a single manager within ORC's current corporate structure.
- The "Land and Water Science" activity, which would only incorporate work undertaken by the science team in the activity area of air.

For completeness, it is noted that the account structure includes a further "layer" of analysis, "programme", which has been excluded from the illustration and discussion above in the interest of simplicity. Programmes may often span different management groups, but will rarely span activities. There were 63 different active programmes recorded in ORC's general ledger in the 2023 financial year.

Findings

This ledger structure creates the ability to undertake rich reporting on budgeted and actual expenditure which may be useful for undertaking detailed analysis across the business. The structure also allows for the improved ability to monitor and track the use of targeted rates.

However it also adds a complexity.

During our onsite interviews the following issues were identified, which we believe have resulted, at least in part, from ORC's account structure:

- A lack of a common understanding across the organisation about the budgeting and financial reporting framework, such that we were provided with conflicting information throughout the review regarding the approach to budget management.
- Managers indicating that they can be provided with budget reports within days of each other which have significantly different financial results.
- Managers sometimes lacking clarity about which budget they are meant to be managing.
- A lack of clarity about how total activity budgets (for example the "Land and Water" activity) are managed when they span different management groups and group managers.

Recommendations

In our view, there may be opportunities to simplify the budget management and reporting processes, to enable managers to better understand their budgets, and to enable a better assessment of overall organisational efficiency. In particular, we recommend that ORC:

- Considers the grouping of activities for external reporting purposes, and whether there is any opportunity to group activities differently. For activities which are specifically targeted rate funded we recognise that it is unlikely that this will be possible.
- Develop a common understanding of the budgeting process and financial management/financial reporting. This will require finance to work with managers to agree on an agreed budgeting and reporting framework that is fit for purpose and clearly aligned to the service delivery outcomes that managers are responsible for delivering.

Timesheets

Overview

Timesheets are used at ORC to record time across the organisation. All staff across the organisation are required to complete timesheets detailing the activities that they have undertaken over the course of the week.

We understand that the intention is that the completion of timesheets, for the majority of staff across ORC, should be a straightforward exercise as they are likely engaged to perform work for only one or two activities within a management group.

Timesheet data is used for the purposes of:

- Allocating staff and organisational costs from Homebase to the relevant activity budget based on actual time.
- In the past, for the allocation of overhead costs through Homebase, based again on actual staff hours spent on each activity.
- Identifying the amount of staff time that can be capitalised against projects that are capital in nature (e.g. stop bank improvements).
- Identifying the amount of costs/time to be charged to resource consent applicants or other cost recovered activities (including activities funded by third party grants).
- Identifying instances where staff have worked long/excessive hours, or have worked additional hours and are entitled to time of in lieu under their collective employment agreement.
- Assisting managers and staff to identify the amount of resources required to undertake particular programmes of work/projects to enable improved budgeting.

Findings

We found that timesheets were generally viewed as an administrative burden with limited benefits for budget managers. In particular:

- We did not see any evidence that timesheet data was being used to determine potential resourcing requirements for new programmes of work or increases in levels of service.
- The time spent completing timesheets was, anecdotally, longer than intended.
- The practice of timesheets draws attention to hours worked for some staff and results in "clock watching" behaviour by some.
- The use of timesheets is a good way to shift the cost of using staff resources from one activity to another. However, this sometimes results in activity managers having staff costs charged to their budgets that they did not approve or were not aware of from the outset.
- The combination of the timesheet system with the allocation of overheads (a practice that we understand has now ended) resulted in confusion for budget managers.

In our view, data from timesheets are not currently put to fully effective use in ORC. Consequently, timesheets are creating unnecessary inefficiencies and distractions from focus on delivery.

Recommendations

Timesheets will be a necessity within local government for as long as ORC is involved in the issuance of resource consents or is involved in the construction of development of capital projects. We believe that timesheets could be restricted in their use to capture only time that:

- Relates to the development or construction of an asset and therefore may be able to be capitalised.
- Relates to a programme of work that receives external/third party funding, such as the Jobs for Nature programme.
- Relates to work that is cost recovered through direct charges (for example resource consent processing).
- Is in excess of an employee's standard contracted hours, for the purposes of determining time off in lieu.

ORC could also consider using timesheets on an exceptions basis to allocate costs across activities or increasing the time intervals for timesheet entries.

If timesheets continue to be used at ORC, it is important that people who are asked to complete timesheets are able to see the benefits from doing so. This may include ensuring timesheet data are used to inform work planning and decision making throughout the organisation.   Where this is the case, ORC should consider reducing the time unit intervals in time sheets to at least 30 minute blocks, or reducing the number of available time codes.

How ORC plans its work

How this relates to efficiency

Coordinated work planning, and project and programme management is one of the critical building blocks that allows an organisation to develop resource plans, budgets and deliver efficiently.

A comprehensive work planning approach helps to align ORC's strategic plan with its operational planning to ensure that it is undertaking the appropriate programmes of work, and engaging the appropriate resources, to deliver on its strategic goals and objectives.

This section highlights our observations and recommendations of ORC's current organisational planning. In our view, these recommendations will enable ORC to ensure that the work that it carries out is well aligned with its overall strategic goals and direction, and will enable it to communicate effectively regarding the work that it undertakes.

Operational plans and budget setting

Overview

When undertaking an assessment of how much to invest in the different activities carried out, ORC must take strategic direction regarding community outcomes and goals from its elected members and through community consultation processes such as its LTP. This process sets the high level targets and goals for ORC as an organisation, which must then be translated into work programmes and projects across the organisation.

As ORC has grown, it has not adopted new processes for planning its work across the organisation. Consequently, there appears to be a broad range of approaches to work planning.

In our review of the budget requests for the 2021 – 31 LTP there appeared to a range of approaches adopted for determining future budgets and workloads. These approaches varied in terms of sophistication and level of supporting analysis provided. In most cases it appeared as though future budgets were developed based on the existing activity budget with adjustments for planned changes in level of service.

Findings

The use of a range of different approaches to developing work programmes and budgets, used to varying degrees, is inefficient. It results in managers creating and adopting their own approaches, and creates a need for management accountants and executive leadership to understand the differences in approach to consolidate the outcomes. None of the budget requests that we reviewed showed a deliberate consideration of where expenditure may be reduced and savings made. However, the workpapers we reviewed represent the summarised outputs of what we would expect to have been a detailed process – it is possible that savings were considered earlier and are reflected in the workpapers that we have reviewed. Further, the 2021 -31 LTP was prepared on the basis of a clear signal that the organisation needed to increase its resourcing and delivery.

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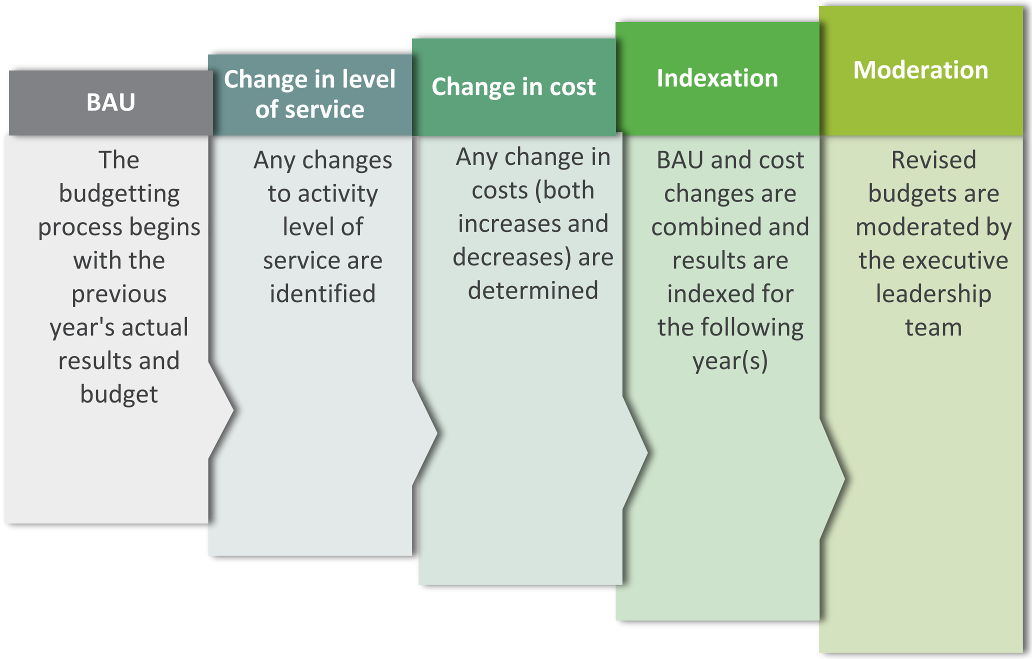
Through conversations with second and third tier managers, it was apparent that most managers within the organisation do undertake some level of work planning themselves. However, we saw no evidence that this work planning was:

- Consistent between managers or across the organisation
- Always carried out
- Used to identify and communicate where resources may be required from other activities
- Consolidated through second tier managers across their groups
- Consolidated at an executive leadership team level
- Deliberately aligned to any organisational strategy or plan.

We understand that the 2024 - 34 Long Term Plan budgeting process is about to commence, and will take an approach similar to that outlined in Figure 6 below.

Figure 6 Diagrammatic representation of 2024 LTP budgeting process



The proposed approach includes consideration of potential reductions in cost as a result of changes to the level of service being provided. However, it does not appear to specifically include any request to identify specific opportunities to identify efficiencies within the existing activity structure, or while maintaining levels of service.

Recommendations

We recommend that ORC develops an integrated work planning process that is clearly aligned to resource planning and budget setting. This would be beneficial for:

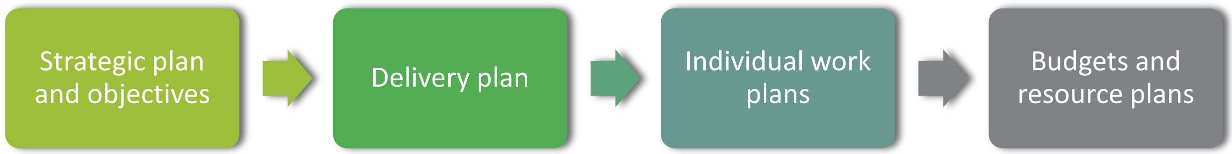
- Efficient delivery
- Assessing organisational efficiency
- Allocating staff costs and overheads in the absence of timesheets
- Breaking silos by requiring consideration of the use of internal resource.

In the first year of implementation (noting that we believe that it is likely too late to implement this for the Long Term Plan) we consider that ORC should consider undertaking a zero-base budgeting process to build activity budgets up based on first principles. This would require the development of clear work programmes and projects with accompanying resource plans.

In subsequent years, the process should only need to be followed if there is a proposed change in level of service, or a work programme or project is added/removed. Work plans and resource plans for business as usual should be reviewed, but not re-built.

ORC should also ensure that its organisational planning process follows a coordinated hierarchical approach, with strong alignment to resource planning and budget management. One example of how this could work is illustrated in Figure 7 and described below.

Figure 7 Overview of potential work planning hierarchy



- **The strategic plan** sets out the high level outcomes that ORC is seeking to achieve through its regular operations and programmes. We would expect this plan to be developed with significant input from elected members and the community and broadly reflect ORC’s LTP
- **The delivery plan** demonstrates the way that the organisation intends to respond to those strategic outcomes, and should include the establishment of performance measures that enable progress to be monitored. We would expect this plan to be developed mainly at the executive leadership team level, with some opportunities for input from elected members.
- **Individual work plans** include business as usual activity as well as bespoke programmes and projects (such as the development of policies and bylaws or capital works). We would expect individual work plans to be developed by third tier managers with support and leadership from the executive leadership team.

- **Resource plans** consider the level of internal (both directly employed by the activity and from other activities) and external resources required. As budgets are clearly linked to individual work plans, regular reporting on budget performance should also be aligned with work plans, such that budget overruns or shortfalls can be considered alongside delivery of planned work.

We recognise that ORC has recently increased its focus on strategic planning across the organisation. Furthermore, we also recognise that there is a clear link between desired community outcomes and level of service measurement in its annual plan and annual reports. In this regard, we see our recommendations above as a reinforcement of the general direction being taken by ORC.

Project and programme management

Overview

Project management and programme management are concerned with ensuring that organisational projects and programmes of work are delivered on time and budget and that they meet their original objectives. While the disciplines of programme and project management differ in some areas, they typically seek to achieve the same outcomes at different scales.

We understand that ORC currently does apply a project management approach to its large IT and capital works projects, as well as some of its significant operational projects such as the development of the land and water plan.

We were not provided with any evidence to indicate that ORC undertakes any programme management.

Findings

We understand that the project management approach adopted by ORC is not consistent across the organisation. More specifically, we understand that:

- The roles of the steering group, project sponsor, and project manager may not always be clearly defined, and may differ across projects
- The level of reporting provided to various project roles also differs across projects.

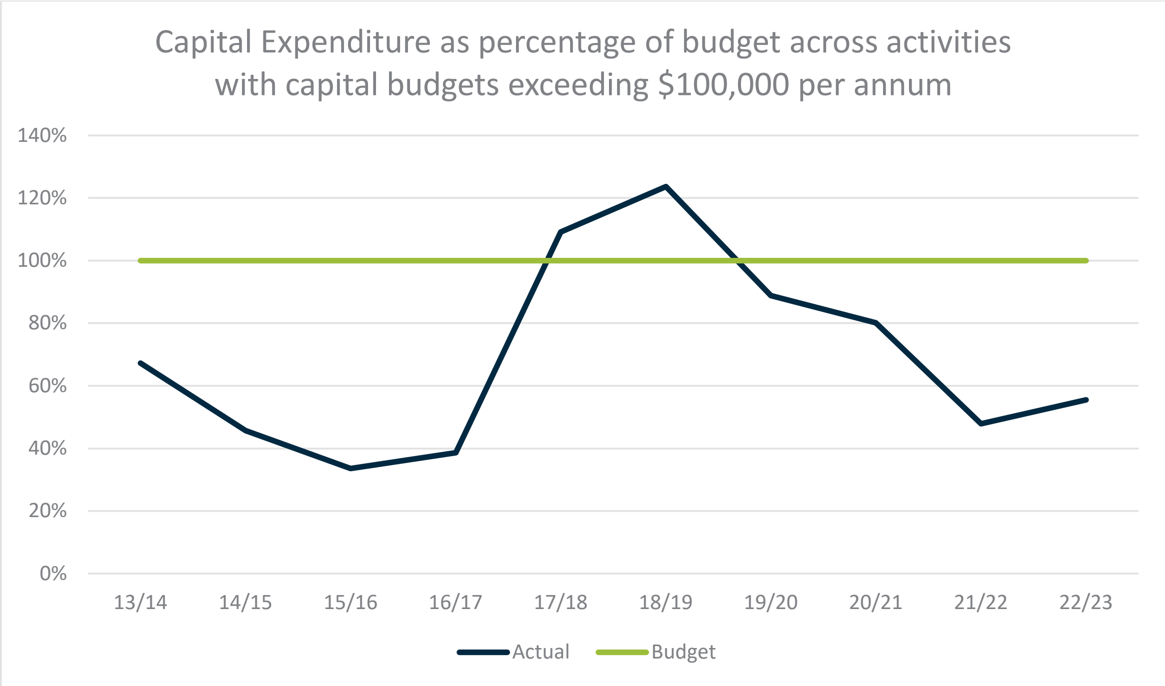
We also understand that ORC does not currently have a dedicated Project Management Office (PMO) function. This is largely due to the relatively low volume of capital projects initiated by ORC.

The lack of consistent project management processes may be reflected in ORC's overall capital works delivery. As illustrated in Figure 8 below, capital works delivery across activities with significant capital works programmes at ORC has historically fallen below budget in most of the last ten years. The comparison of actual versus budgeted capital expenditure in Figure 8 is a common metric used to measure capital works delivery across the sector, and is commonly used by the Office of the Auditor General in their reporting on Long Term Plans and Annual Report reviews.

During our review it was contended that efficient delivery of capital works (rather than under-delivery) was partially responsible for difference between actual and budgeted expenditure. In our view, if indeed efficiencies are able to be regularly achieved within ORC's capital works programmes, then project budget should be amended to reflect this.

Benchmarking against other councils also indicates that ORC appears to have less reliance than other regional councils on employees to deliver its work. As the use or reliance on contractors and consultants increases, so too does the complexity of managing resources regardless of whether they relate to capital works delivery or operational programmes. A stronger emphasis on good project and programme discipline would ensure that delivery of work by external resources is coordinated, and effective.

Figure 8 Capital works delivery for major projects



Recommendations

We recommend that ORC looks to strengthen its project and programme management practices, including:

- By developing an organisational approach to project and programme management that includes clear definitions of roles, responsibilities, delegation, and reporting requirements.
- By reviewing its planned and existing projects across the organisation and considering where it may be appropriate to adopt a programme management, rather than project management, approach.
- By considering the merits of introducing a PMO function into the organisation with overall responsibility for:
  - Embedding project and programme management discipline into the organisation
  - Providing expert project and programme management services across the organisation
  - Taking a cross-organisational view of projects and programmes to manage delivery timeframes and expectations, and to identify opportunities to utilise internal resources.

In addition to providing increased discipline around project and programme delivery, we would anticipate that the introduction of consistent project and programme management frameworks will assist with general work planning.

Breaking silos

Overview

As ORC has grown from 177 FTE in 2019 to 287 FTE in 2023, some of the practices and approaches from its past remain.

In particular, it was apparent that ORC continues to operate mainly within "silos" – that is, individual groups and functions typically focus only on the work that they are tasked to deliver.

This is likely a cultural hangover from the period when ORC had a lean compliment of resources. We were given examples from the past which indicated a shortage of resourcing resulted in resource hoarding and protectionary behaviour from activity managers.

More recently and more importantly, we have been provided with a number of examples where activity managers have worked effectively across the organisation. This includes identification of opportunities to deliver specialist resources more efficiently, or to make use of internal skillsets before commissioning contractors or consultants. However, the examples provided also demonstrated that this occurred primarily through good fortune and personal initiative than through design.

Findings

We found that ORC does not appear to have any deliberate processes to break silos across the organisation. As a result, it is likely that ORC is not always making efficient use of its internal resources. We were provided with examples where, through individual initiative, ORC was able to utilise internal resource, or structure its delivery approach, in a way that resulted in improved efficiency.

Staff were generally willing to work together, however identifying the opportunities to do so is currently challenging. To maximise the opportunities to break silos, ORC should seek to develop deliberate processes that encourage an organisational view of strategic and operational planning.

Recommendations

We recommend that ORC seeks to reduce silos across its organisation to enable staff to work together to achieve better outcomes. In order to achieve this, ORC will need to take a deliberate approach to work planning and procurement, including:

- Ensuring that work plans include specific consideration of the need to use outside resources, and clearly identify resources that need to be contracted.
- Ensuring workplans are consolidated and escalated through to the executive leadership team to enable consideration of opportunities to utilise the expertise of other groups within ORC.
- Embedding the consideration of "internal procurement" into ORC's procurement processes to ensure that ORC has first considered the use of internal resources before going to market.
- Where recruiting new FTEs, particularly where the skillset being recruited is generalist or outside of the typical skillset for an activity, ensuring that consideration has been given to the most appropriate directorate for that FTE to be employed.
- Ensuring that the budgeted costs for using resources from other groups or functions are appropriately transferred based on estimated utilisation at the work planning stage.

Non-financial performance measures

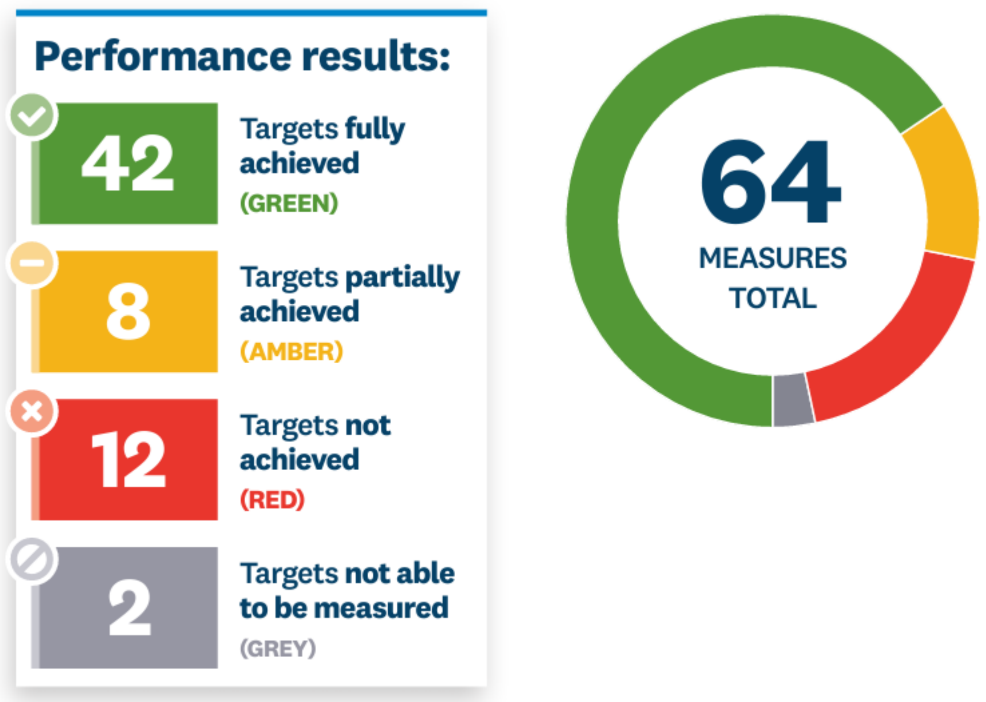
Overview

ORC measures the performance of its activities through a range of non-financial performance measures or level of service measures that are reported on externally in its annual report and long term plan, as well as internally to managers, executive leadership and ORC's finance committee.

ORC's 2022/23 annual plan contained 36 level of service statements across the organisation, with 62 measures and 69 targets. Below that, were 258 supporting non-financial performance indicators that were monitored in the 2023 financial year.

ORC's performance against its level of service measures, as summarised in its 2022 annual report is represented in Figure 9 below.

Figure 9 Non-financial performance from 2022 annual report



Findings

Established practice suggests that goals and objectives should be SMART (Specific, Measurable, Achievable, Relevant and Time-bound). While there are a range of arguments as to why SMART goals may not always be appropriate for all organisations[3], there is general acceptance that performance against goals should be able to be measured in some way, and that they should be specific, relevant and time bound.

[3] See, for example https://www.forbes.com/sites/markmurphy/2022/10/30/smart-goals-5-shocking-reasons-why-they-might-be-dumb/

Our review of ORC's level of service measures shows a broad range of measures applied across the organisation. While most of the externally reported measures appear to meet many of the requirements of SMART goals (noting that the nature of some activities mean only qualitative measures are possible), many of the internal non-financial performance indicators are not.

As some of the internal non-financial performance indicators do not contain clear targets, are not measurable, or are not specific, assessment as to whether these targets have been met is subjective, and open to interpretation by activity managers who must self-assess performance.

Clearly, monitoring and reporting across 258 measures is not efficient. Furthermore, some of the performance measures that are reported on internally relate to the regular activities of ORC. Many performance measures simply describe the overall function or activity being carried out and do not measure quality or quantity of output; these measures do not deliver a service to the community or improve organisational performance.

Recommendations

We recommend that ORC undertakes a review of its non-financial performance measures (particularly those used internally) with a view to:

- Reducing the total number of actively monitored measures
- Ensuring that all measures provide useful information on organisational performance
- Ensuring that measures are all able to be measured and have clear targets
- Aligning internal performance measures with those reported on externally, and with each activity's work plan.

Other observations

Through the course of our review and meetings with elected members and staff, a few additional matters were identified that may provide opportunities for ORC to work more efficiently. These are detailed below:

- Some comments were raised regarding the use of consultants across ORC. We understand that in some cases, due to resource shortages or vacancy, consultants have been used to undertake work that would normally be undertaken by staff members. We also understand that consultants are utilised across ORC to provide technical capability in areas where it may be impractical for ORC to engage the resource in-house. Benchmarking supports suggestions that ORC is less reliant than other councils are on employees to carry out certain activities. We recommend that ORC reviews its use of consultants to determine whether some services should be engaged internally. This is picked up in our resource planning recommendations.
- There appears to be confusion regarding funding of activities/management groups. We heard examples of where funding sourced appeared to be mixed and where there was a lack of clarity regarding the application of internal charges between management groups and activities. We also heard conflicting information from other managers. Despite review of Council's general ledger, we are unable to be definitive about whether examples provided to us are accurate or not. However, we note that the lack of a common understanding about the budget structure and funding mechanisms across Council's activities should be addressed.
- ORC is currently undertaking a number of significant IT projects, including the IRIS NextGen project which will transform a number of systems used by ORC. We understand that currently ORC has an immature data management framework and consistent data standards. Consequently, information that may be used for similar purposes, or have cross organisational utility, may be recorded in different ways. For example information about property may be recorded based on address, title number, or longitude/latitude. ORC may be able to make more efficient use of the data that it collects by implementing clear data standards and a data management framework.
- Our review of ORC's financial information and discussions with ORC staff both indicated that ORC has consistently been unable to meet its revenue targets for its cost recovered activities[4]. To improve the ability for the consents team to achieve revenue targets, and improve budgeting accuracy, we recommend that ORC reviews its revenue target and charge out rates for all teams with revenue targets and that are cost recoverable, and in doing so consider all of the following matters in combination:
  - The expected volume of chargeable work that will be received during the year based on historical volumes and growth
  - The amount of recoverable time taken to undertake the specific chargeable task
  - The particular costs that are to be recovered through the charging mechanism (particularly as they relate to overheads, training time, etc). Costs that are not included in the charge out rate calculation should be similarly excluded from any calculation of percentage recovery targets.

[4] We note that charging mechanisms for the resource consent processing activity were also raised in the Wynn Williams report (March 2019).

- We enquired about the efficiency of council meetings – their nature and ability to "tie staff up", particularly if Committees have no delegated authority and consider papers which are then "relitigated" at Council level. This has implication for staff and councillor time commitments. It seemed particularly relevant when we noted that none of the committees had delegated authority (other than the Regional leadership committee which has delegations relating to the Future Development Strategy). Each Committee's delegations start with the phrase "the Committee has no general decision-making or financial delegations". Committees can be an efficient (and effective) way of doing business. However it was explained that Committees only meet quarterly and appear more like a workshop setting and are "Committees of the Whole". As Council advances this triennium it may be worth considering if this is the most efficient and effective way of conducting its business.

Financial performance and benchmarking

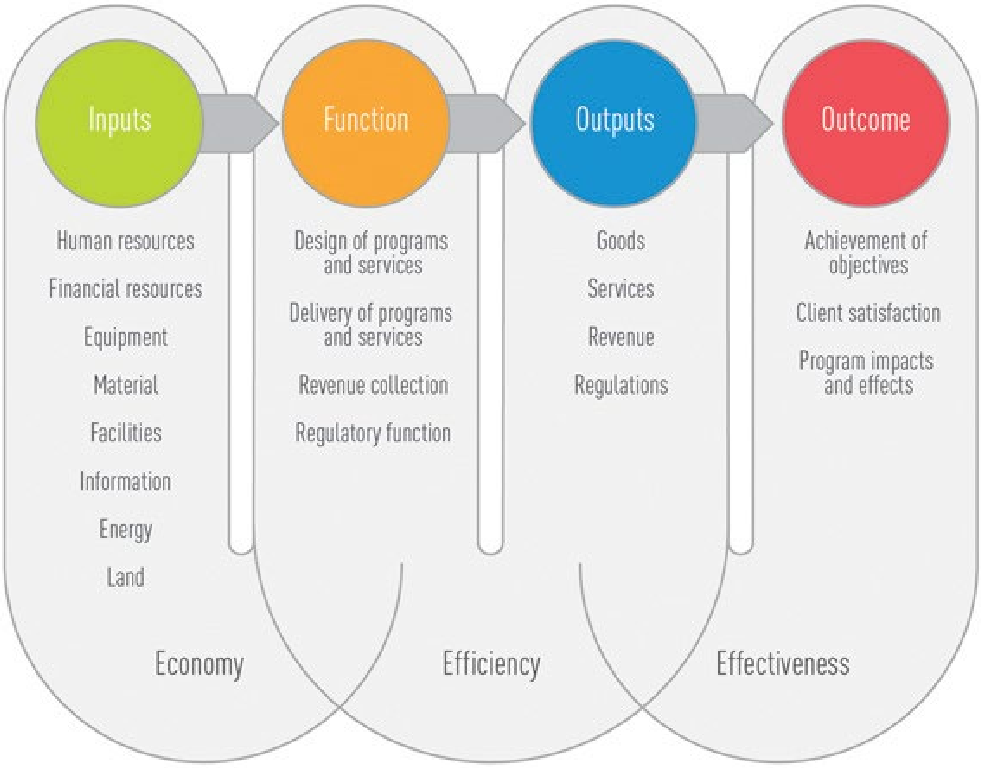
As part of our efficiency review, we have undertaken some cost and performance measurement analysis across ORC, the regional council sector, and against a selected group of regional councils that we consider share relevant features (such as settlement distribution, geography, etc).

In this section we present the results of that benchmarking. Where relevant, to assist with the consideration of efficiency, we have presented financial analysis alongside level of service outcomes and non-financial performance measures.

Findings

While measurement of ORC's financial performance and comparison of costs between councils is not able to directly address the question of ORC's efficiency it does provide us with a measure of economy. At the same time, non-financial performance measures are able to give us a sense of the outputs that are generated by the organisation. The gap between these two measures can give us some sense of efficiency as illustrated in Figure 10.

Figure 10 Diagrammatic representation of efficiency versus economy and effectiveness



Benchmarking against the Statistics New Zealand dataset indicates:

- Historically, ORC had some of the lowest operating costs per head of population (or indeed by other relevant metrics) across the majority of its activities. Based on ORC's geography, population, and settlement distribution, we would expect ORC to sit closer to the national average in order to deliver consistent levels of service as similar regional councils.
- Rates in ORC are amongst the most affordable across all regional councils.
- The deliberate growth in ORC's size since 2019 is clearly reflected in benchmarking data. However, in many cases this increase in expenditure has been observed across the regional council sector so while ORC's expenditure has seen significant increases it still sits below the national average for operating expenditure per capita across many of its activities
- Notable exceptions to the above include the Governance and Planning and Regulation activities, in which ORC sits above the national average on a per capita basis.
- Outside the planning and regulatory services and emergency management activities, ORC typically spends a lower proportion of its total operating expenditure on employees when compared to other regional councils. This may indicate a higher level of reliance on external resources.

Overall, benchmarking against the Statistics New Zealand dataset would suggest that it is likely that ORC is generally likely to be operating economically. It does suggest there is no urgent need to react to finding efficiencies but rather the methodical approach to improving systems as processes outlined in this report is appropriate.

Review of internal financial and non-financial data from ORC, as expected, highlights a significant uplift in operating expenditure across a range of activities. Notwithstanding limitation in the data, we also observed:

- The lack of a strong nexus between increases in budgeted or actual expenditure and changes in non-financial performance across activities. Specifically:
  - Some activities had increases in overall expenditure and/or overspent their operating budget but observed a reduction in the percentage of non-financial performance measures that were marked as "green" (achieved).
  - Some activities underspent their operating budget but were still able to meet the majority of their non-financial performance measures.

  In our view this likely evidences the need for better alignment between work programmes, level of service measures, and the budgeting/resource planning processes.
- A number of activities appear to regularly exceed or underspend their allocated operating budget year on year. In some cases, this may be the result of unexpected delegated work from central government (e.g. the wilding pines programme) that may come with or without attached funding. In other cases, this may indicate the need for budgets to be examined more closely by activity and group managers.
- Regular under recovery of cost recovery activities which indicates that further work is needed to establish an appropriate budget/target for resource consent recoveries.

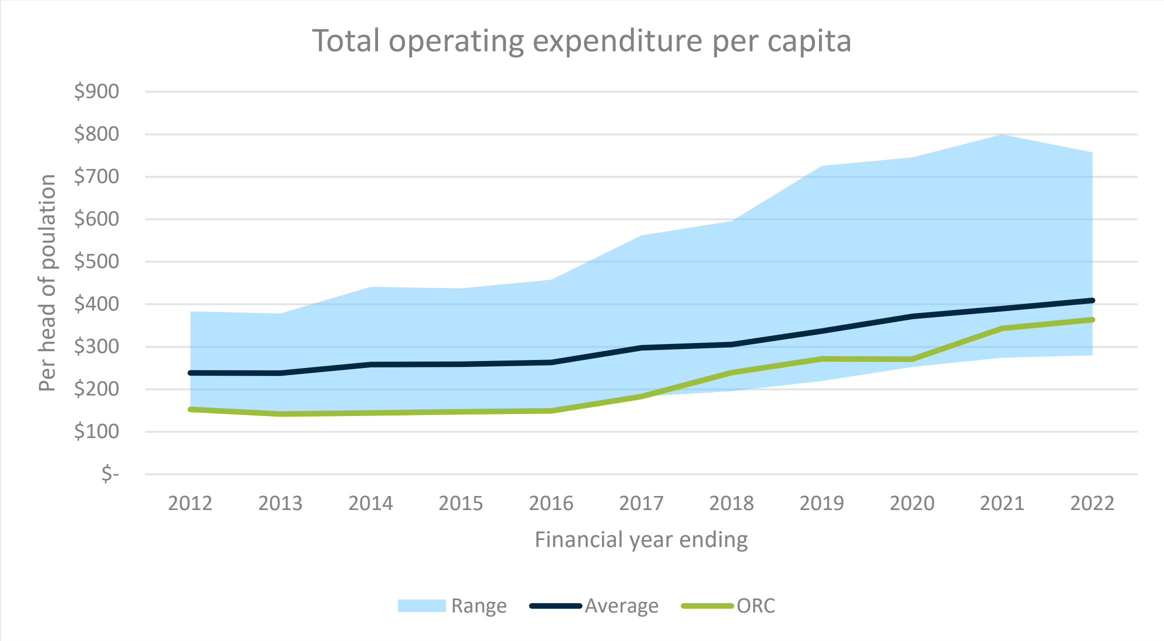
Caveats and assumptions

When reviewing the analysis presented in this section, it is important to consider the following matters:

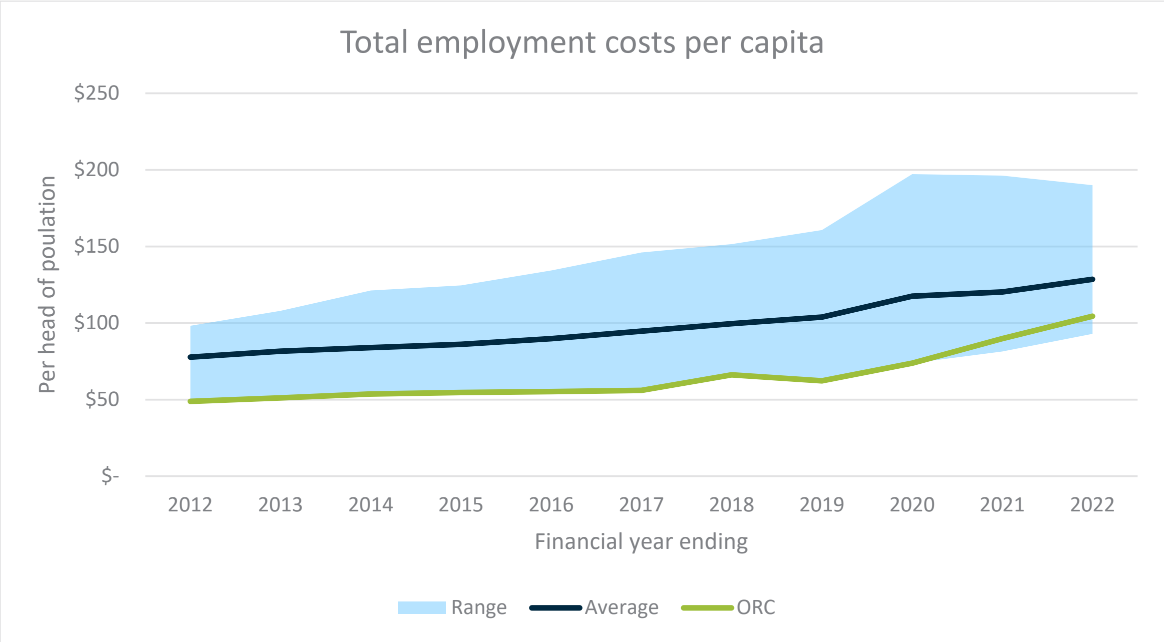
- Analysis of ORC's own financial performance should be considered within the context of this review, and the period of deliberate growth.
- Benchmarking across the full group of regional councils:
  - Is based on Statistics New Zealand's Local Authority Financial Statistics data. This data is not audited and is based on a self-completed questionnaire for each council.
  - Does not include any unitary authorities.
- Where appropriate we have attempted to normalise benchmarking data using relevant factors such as population or land area.
- Benchmarking can be useful for comparing ORC's costs relative to other councils that carry out similar activities. However, benchmarking is not an assessment of the overall efficiency of ORC – even in cases where ORC has the lowest cost per capita for an activity, there may still be scope for efficiencies and vice versa.
- Councils can choose to structure their activities in any way that they please. Accordingly, while we have tried to compare activities on a like for like basis, in some cases, the actual work undertaken by each council within activities that have similar descriptions may differ.
- The approach taken to delivery within similar activities may differ across councils. This may have an implication on cost and outcomes.
- Reporting on consultancy and contractor costs is based on our interpretation of ORC's general ledger accounts. It is possible that in some cases consultancy costs have been incurred which have not been captured in our analysis.

Total organisational measures

The chart below shows ORC's total operating costs per head of population as compared to other regional councils in New Zealand. Until the end of the 2017 financial year, ORC had the lowest operational cost per head of population across the group, and still remains under the national average.

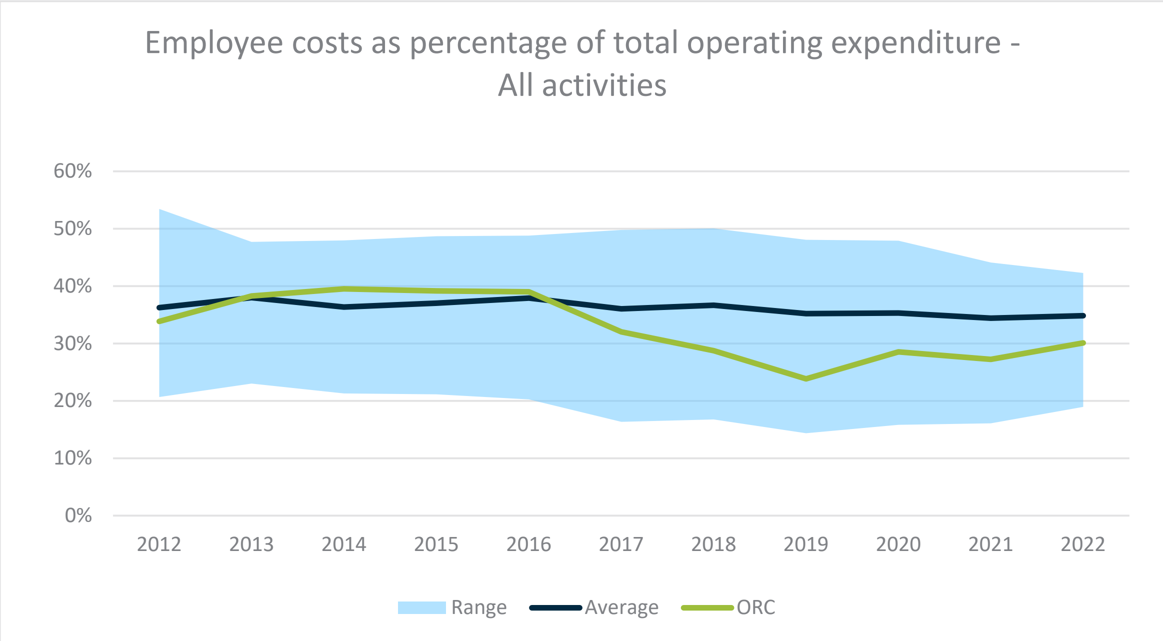


The chart below shows ORC's total employment costs per head of population. Again, ORC represented the lowest end of the range until the end of the 2020 financial year, when it began its deliberate growth path. ORC still remains under the national average for employment costs on a per capita basis.



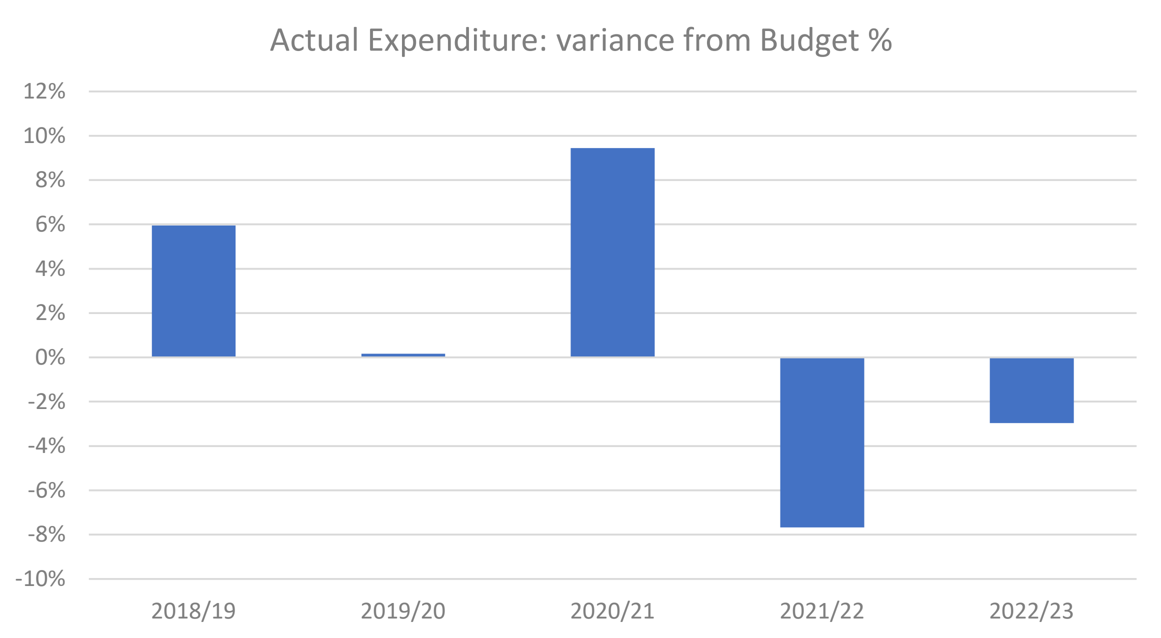
The chart below shows employment costs as a percentage of total operating expenditure across all activities for ORC. It shows ORC expenditure on employees as comprising a lower percentage of its total operating expenditure than the New Zealand average. This may reflect either:

- Average salary and wages being lower at ORC than other regional councils
- An increased reliance on work being outsourced to contractors or consultants than other regional councils.

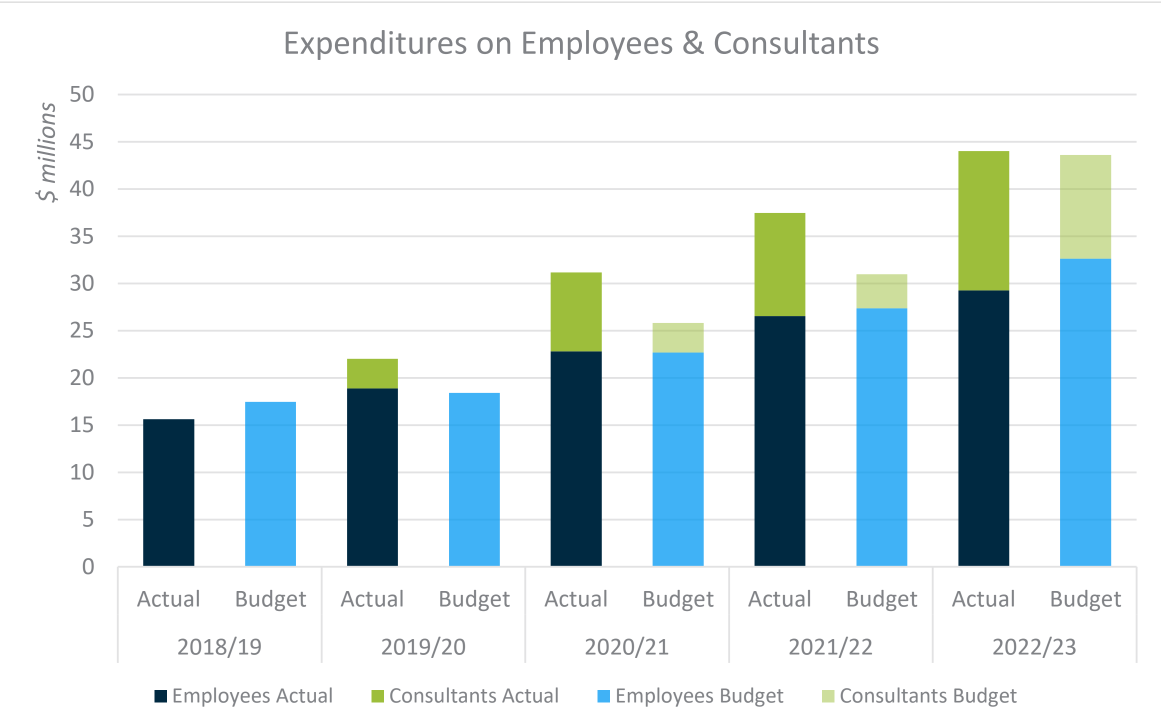


The chart below highlights the variance from budgeted expenditure across ORC. Percentages below zero represent actual expenditure being less than budgeted expenditure. In 2021 ORC overspent its budget for total operating expenditure by 9% (or $7.3 million).

In the following year, ORC underspent by 8% (or $7.5 million). Of note, the 2022 financial year included a budgeted increase in operating costs of 26%, and the underspend likely highlights the challenges associated with achieving that level of uplift in activity.



The following chart shows a comparison between budgeted and actual expenditure across employment costs and consultancy fees. It shows an increasing use of consultants to deliver services in recent years. In the 2021/22 and 2022/23 financial years, ORC did not spend its entire employment costs budget, and the chart shows a potential substitution of planned employment costs with the use of consultants.



Affordability

In the preceding section, we noted that ORC's operating costs per capita are currently lower than the average per capita operating cost across all regional councils in New Zealand. This indicates that ORC is currently economical.

We have also considered whether ORC's current rates are affordable. To do so, we have used two measures:

- Average (mean) rates as a percentage of average (mean) household income. The 2007 report of the Local Government Rates Inquiry (the Shand report)[5] notes that a threshold of 5% of gross household income applied to local government rates would indicate affordability issues. The 5% threshold refers to total rates, which include rates from territorial authorities.
- Average (mean) rates mapped against a combined housing affordability index. The combined housing affordability index brings together:
  - The mortgage serviceability index
  - The rental affordability index
  - Average home ownership rates in the region

  These indices measure average mortgage costs or rental payments against household disposable income, so balance higher incomes against higher costs of housing. A score above 100% in this combined index indicates that housing is more affordable than the New Zealand average, a score below 100% indicates housing is less affordable.

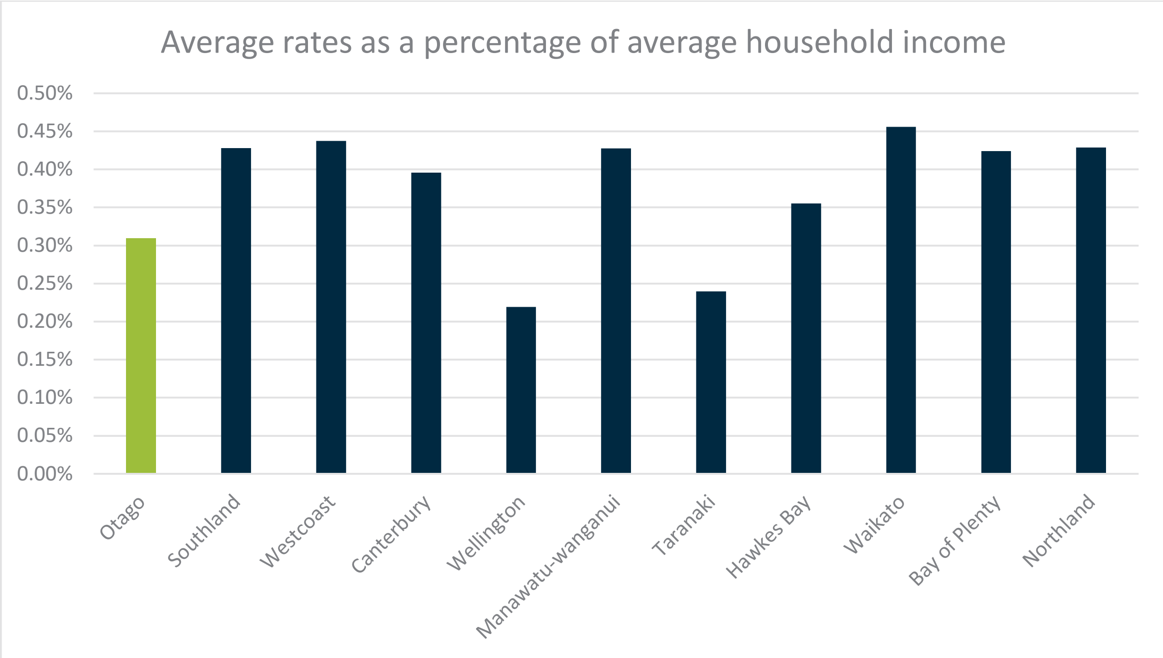
When assessing affordability using these metrics in this report, we note that regional measures of income and affordability may not reflect all groups or districts within the Otago region. Affordability may look very different at a territorial authority (or suburb) level than is presented in this high level information.

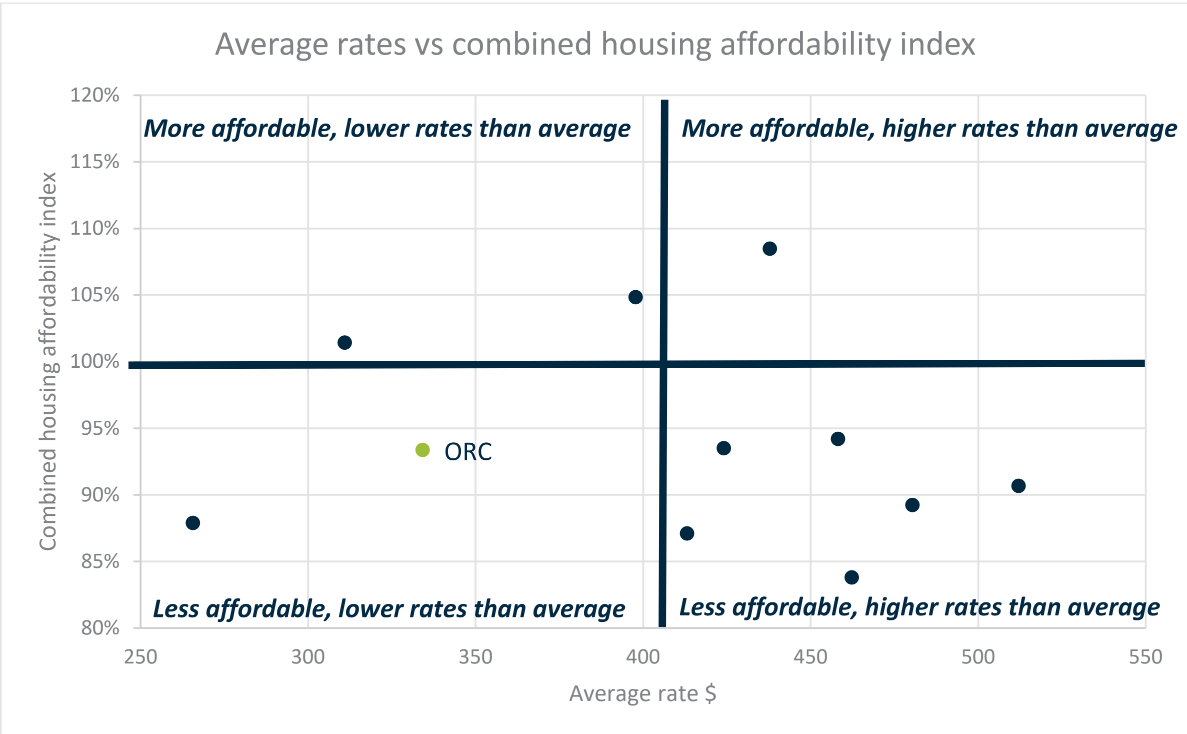
Findings

Both affordability measures show ORC's average rates as being the third most affordable, and in particular:

- Only Wellington (which has particularly high average household incomes and higher population density) and Taranaki have rates that form a lower percentage of household income than ORC
- Only Wellington and Taranaki have lower average rates than ORC, noting that Taranaki also has less affordable housing than ORC.
- ORC having lower average rates than four of the five councils that have less affordable housing.

[5] https://ndhadeliver.natlib.govt.nz/ArcAggregator/arcView/frameView/IE12126512/http://www.dia.govt.nz/Agency-Independent-Inquiry-into-Local-Government-Rates-Index, retrieved 11 October 2023.


Average rates as a percentage of average household income
0.50%
0.45%
0.40%
0.35%
0.30%
0.25%
0.20%
0.15%
0.10%
0.05%
0.00%
Otago
Southland
Westcoast
Canterbury
Wellington
Manawatu-wanganui
Taranaki
Hawkes Bay
Waikato
Bay of Plenty
Northland


Average rates vs combined housing affordability index
More affordable, lower rates than average
More affordable, higher rates than average
Less affordable, lower rates than average
Less affordable, higher rates than average
ORC
Combined housing affordability index
120%
115%
110%
105%
100%
95%
90%
85%
80%
250
300
350
400
450
500
550
Average rate $

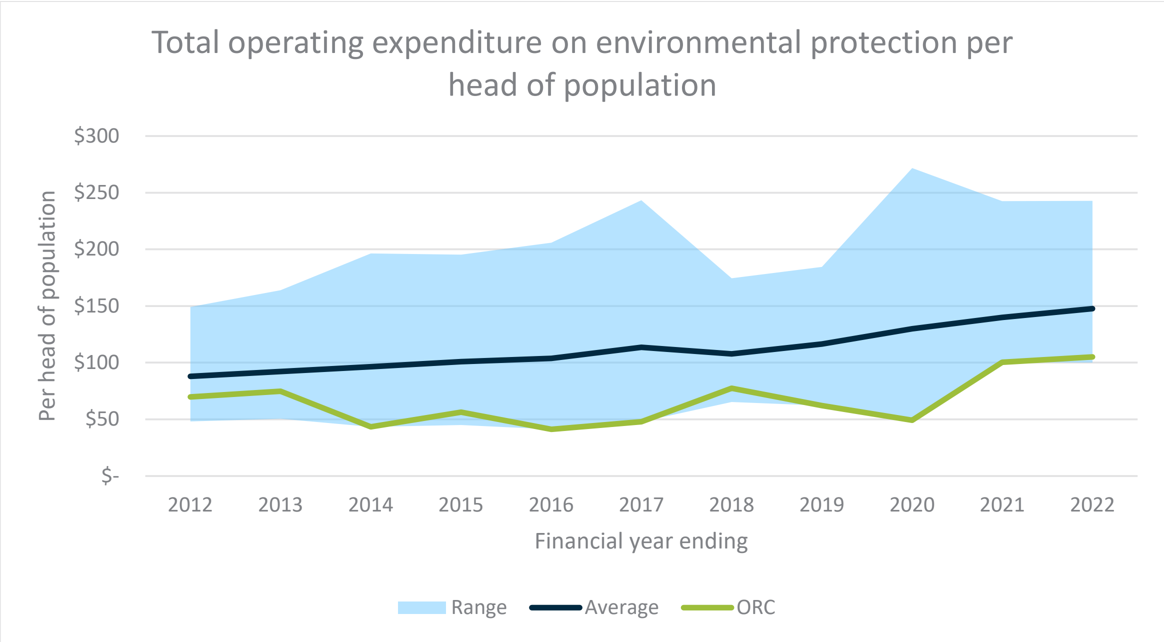
Statistics New Zealand comparisons

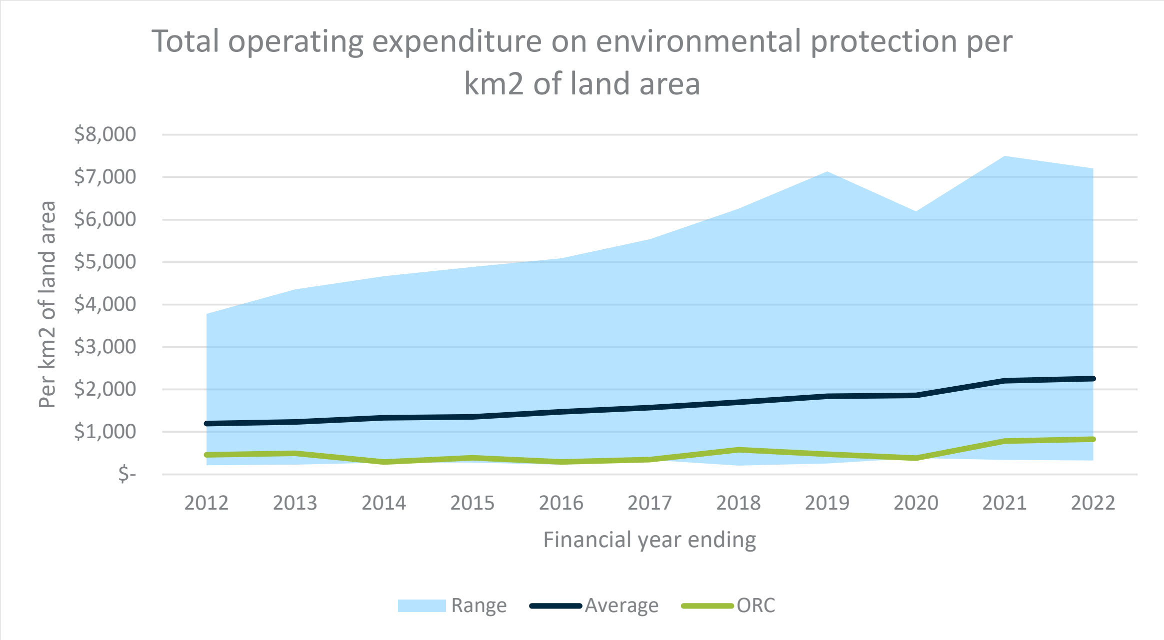
Environmental Protection

The Statistics New Zealand data groups the following activities under the broad heading "Environmental Protection":

- Air and Water quality
- Land and soil management
- Flood protection
- River control
- Pest management under

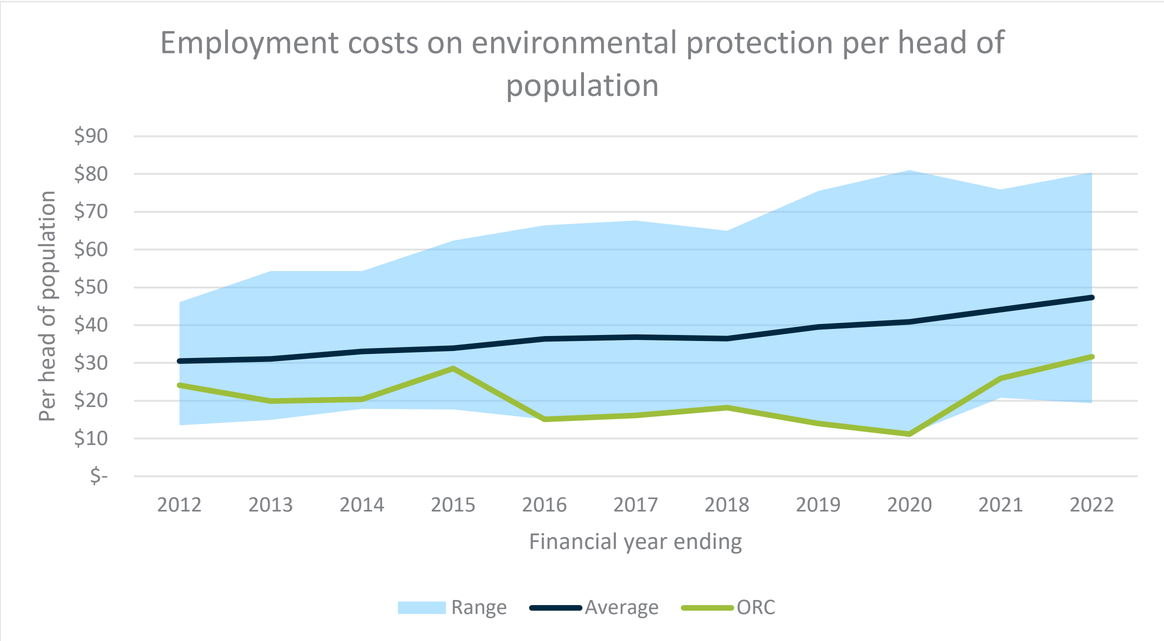
The following charts show total expenditure on environmental protection activities across all New Zealand regional councils, on a per capita and per km^2 of land area basis. Both charts show ORC expenditure being near the bottom of the range, with an uplift following the 2020 financial year.

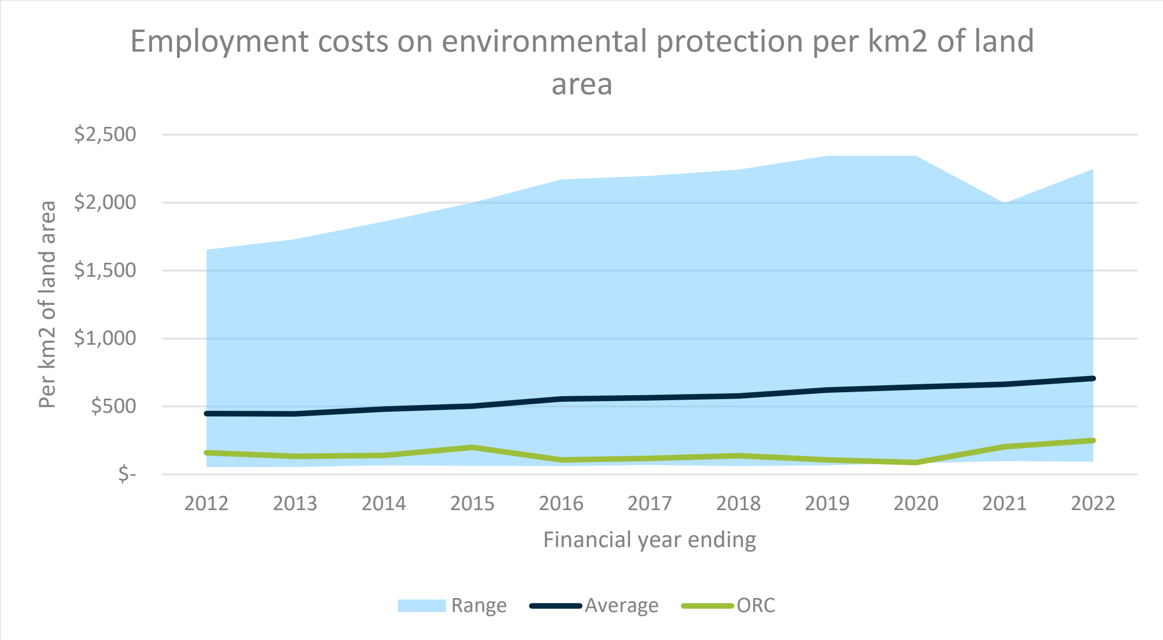




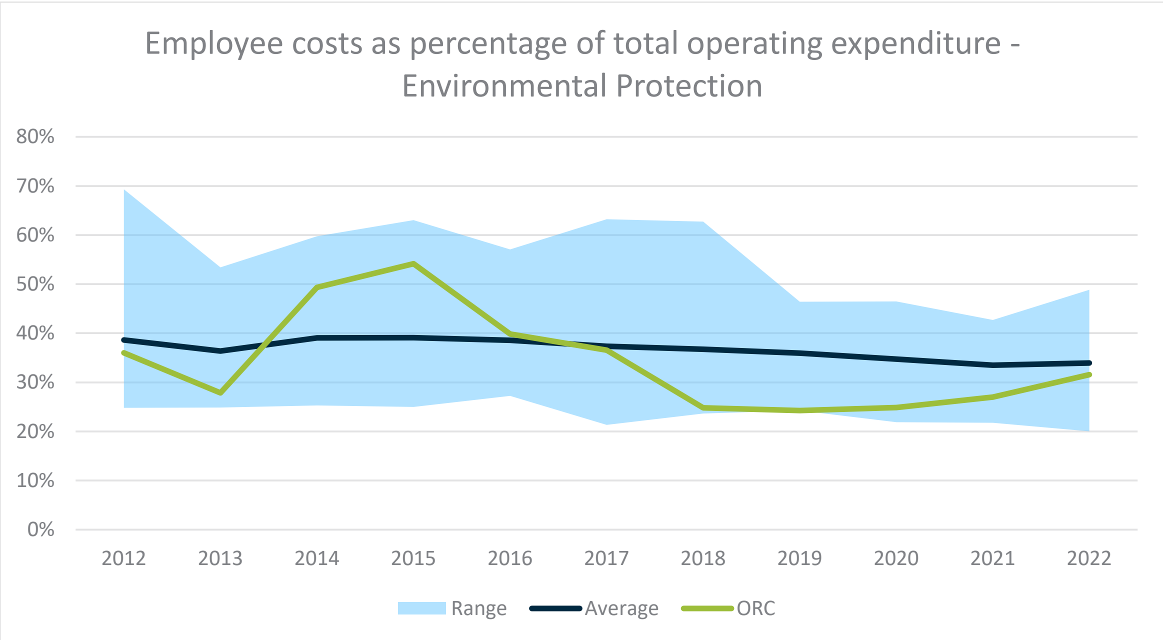
Employment costs on environmental protection broadly follow the same trend, with ORC typically sitting toward the bottom of the range for employment costs in environmental protection on both a per capita and per km^2 of land area basis.

Again, both measures show recent uplifts in expenditure in the 2021 and 2023 financial years.





The environmental protection activity at ORC has historically spent a lower proportion of its annual operating budget on employment costs than other New Zealand regional councils, although this increased towards the New Zealand average in 2022. This indicates that ORC currently resources its environmental protection activity consistently with other councils.



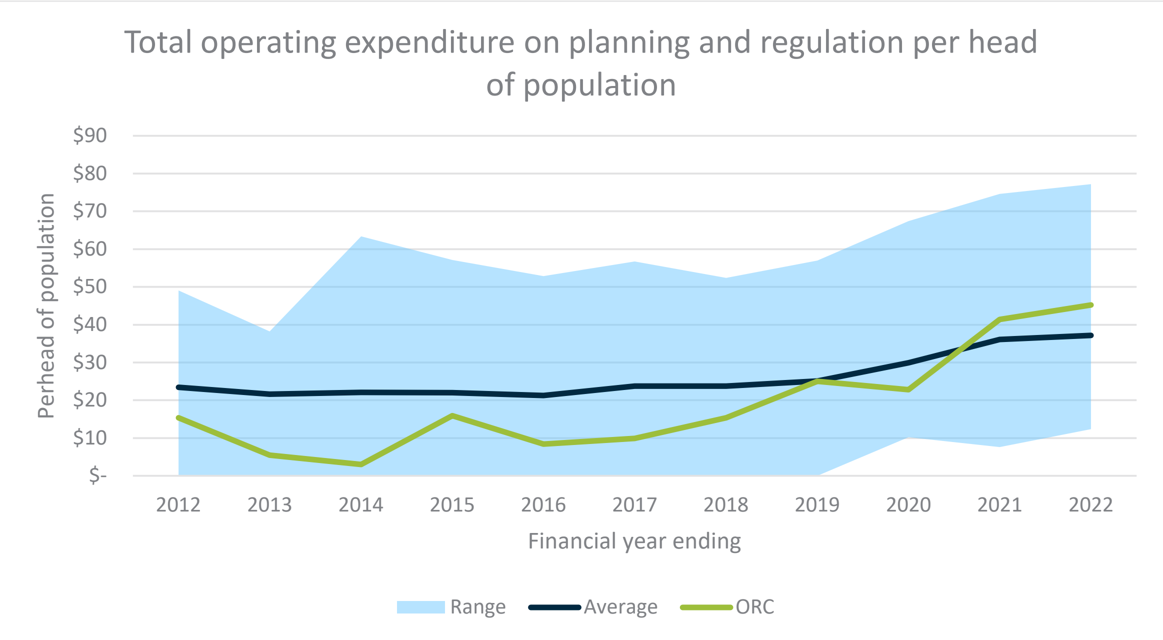
Planning and regulation

The Statistics New Zealand data groups the following activities under the broad heading "Planning and Regulation":

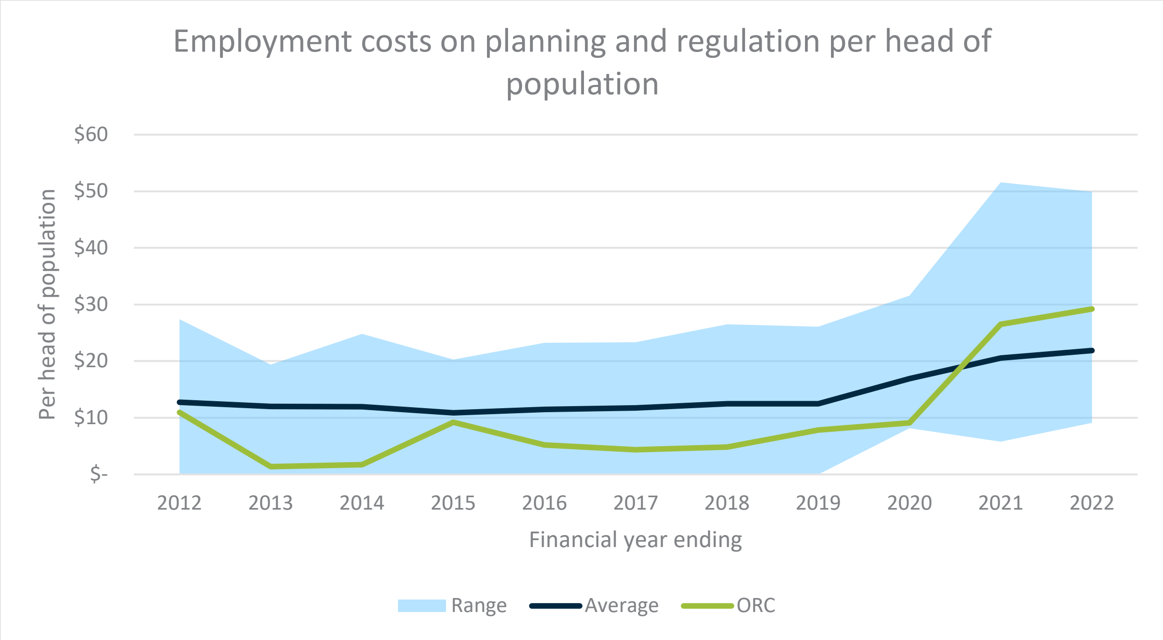
- Environmental Health
- Liquor licensing
- Marine Safety
- Resource consents
- "Other planning and regulation"

The chart below shows total expenditure on planning and regulation across the New Zealand regional councils. It shows expenditure on planning and regulation at ORC being below the national average on a per capita basis through to the 2021 financial year.

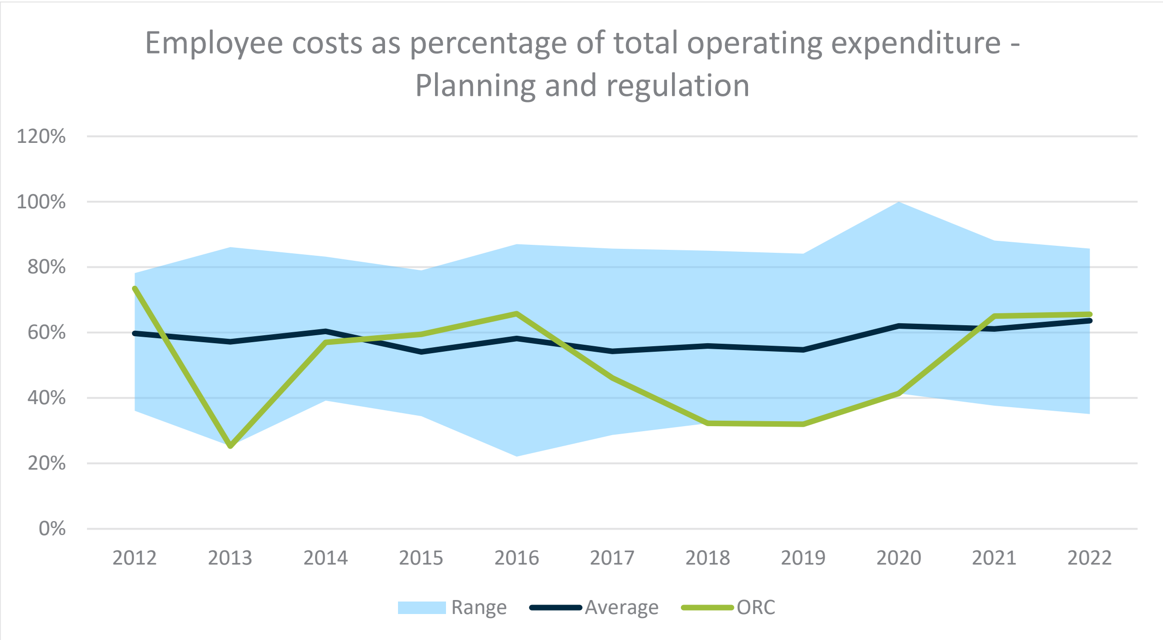
This is broadly consistent with the timing of the Skelton review, which was finalised during the 2019/20 financial year, and the consequential uplift in expenditure in the planning and regulatory space.



A similar theme is highlighted when looking only at employment costs for the planning and regulatory function. The chart below shows ORC sitting below the national average for employment costs in the planning and regulatory area until the 2021 financial year.



During the period from 2018 through 2020, ORC's employee costs as a proportion of total operating expenditure in the planning and regulatory activity were significantly lower than other regional councils, and this is reflected in the findings of the Wynn Williams and Skelton reviews. From 2021, expenditure on employees was on par with other regional councils in New Zealand, as a result of implementing the recommendations of those reviews.



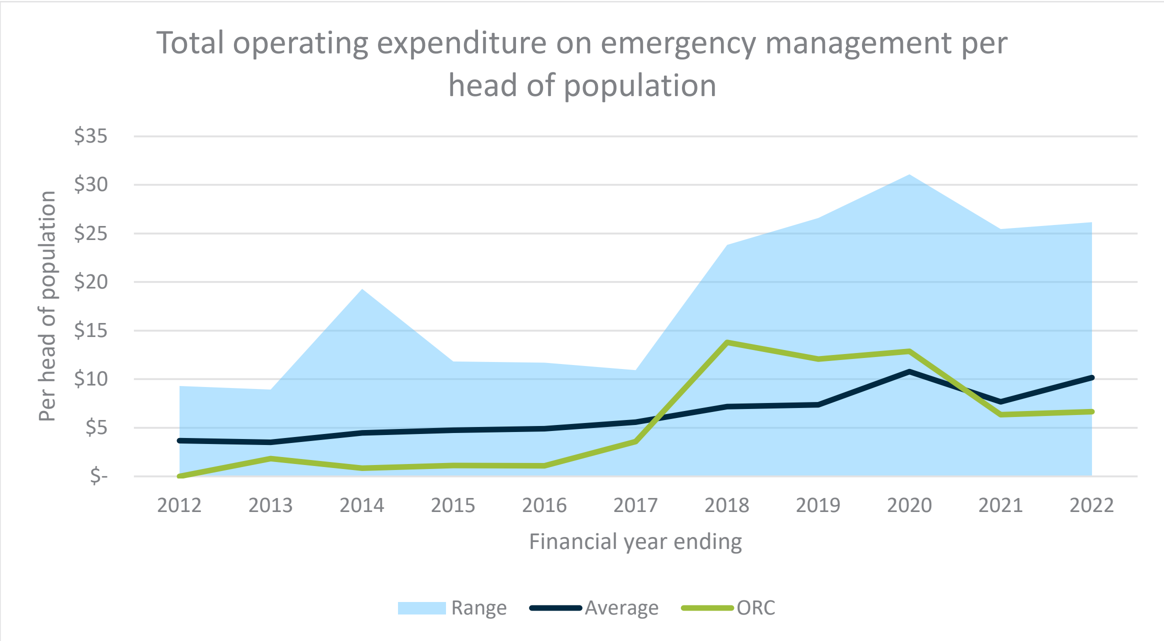
Emergency management

The Statistics New Zealand data groups the following activities under the broad heading "emergency management":

- Civil defence
- Emergency and disaster management
- Rural fire service

The chart below shows total expenditure on emergency management across the New Zealand regional councils. It shows expenditure on emergency management at ORC being above the national average on a per capita basis from 2018 through to the 2020 financial year. The chart shows this dropping below the national average in 2021, with a reduction on expenditure per capita of almost 50% in the 2021 financial year.

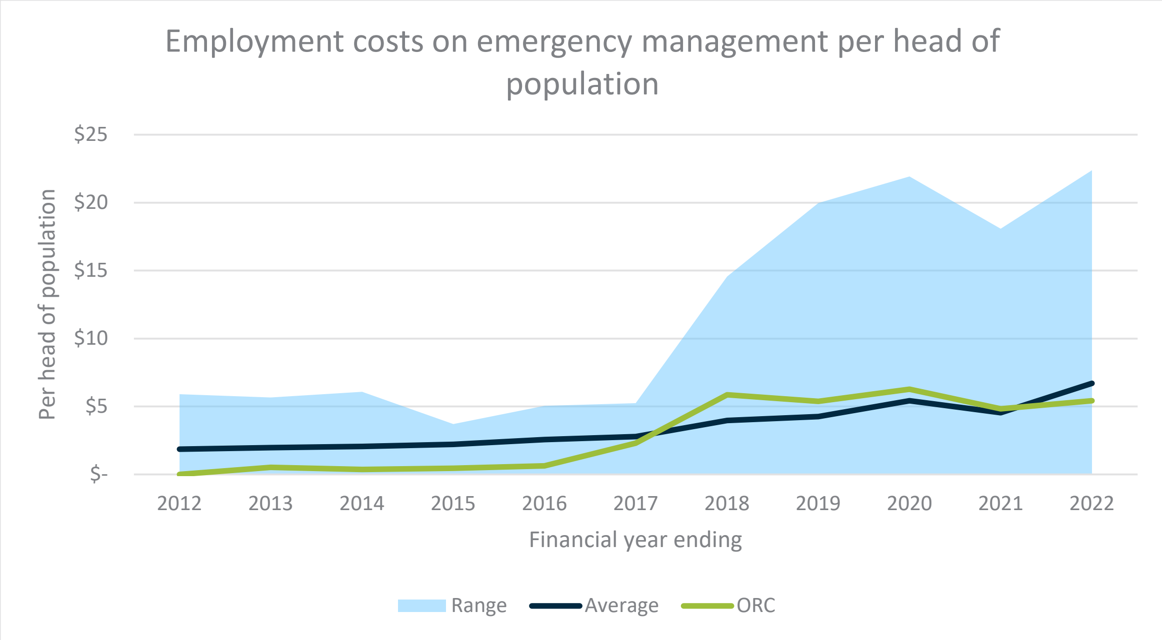
Total expenditure in the emergency management space fluctuates based on the frequency of response events. This may account for some of the change in spend over time.



A similar theme is highlighted when looking only at employment costs for emergency management function. The chart below shows ORC sitting above the national average for employment costs in the emergency management area from the 2018 – 2021 financial years despite a reduction in employment costs per capita of around 20% in the 2021 year.

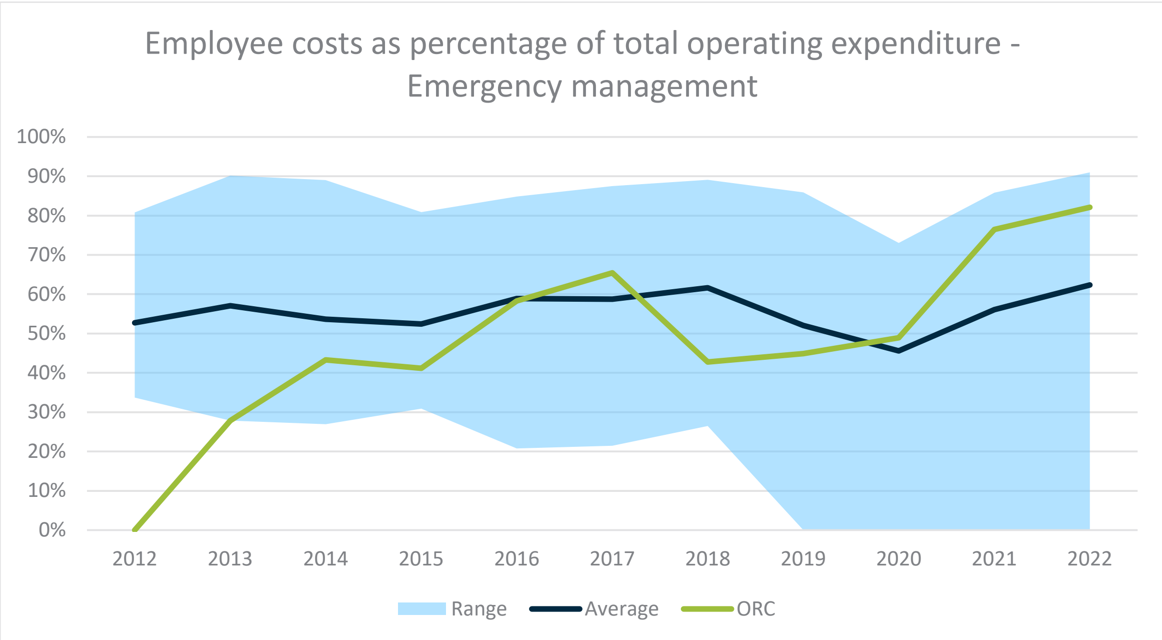
The reduction in emergency management spend on a per capita basis in 2021 coincided with a reduction across the regional council sector, likely due to the impacts of Covid-19.

While ORC increased its spend per capita on employment costs for emergency management in 2022, this was reflected elsewhere across the regional council sector.



While ORC historically appeared to have a similar proportion of total emergency management expenditure allocated to employee costs as other regional councils, since 2021 ORC has had one of the highest proportion of employee costs for this activity.

As there has been no significant uplift in employment costs (per capita) in this activity for ORC, this is likely indicative of reductions in other operating costs for the activity.



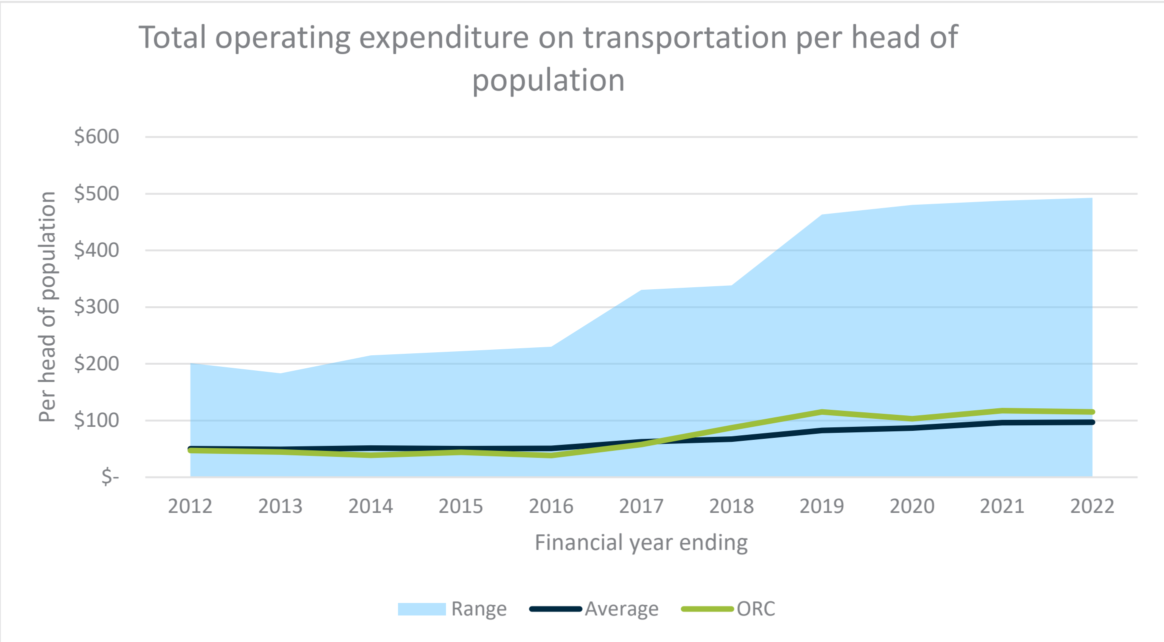
Transportation

The Statistics New Zealand data groups the following activities under the broad heading "Transportation":

- Airports
- Bus, ferry, rail and tram transport
- "Other" passenger transport
- Parking
- Transport planning

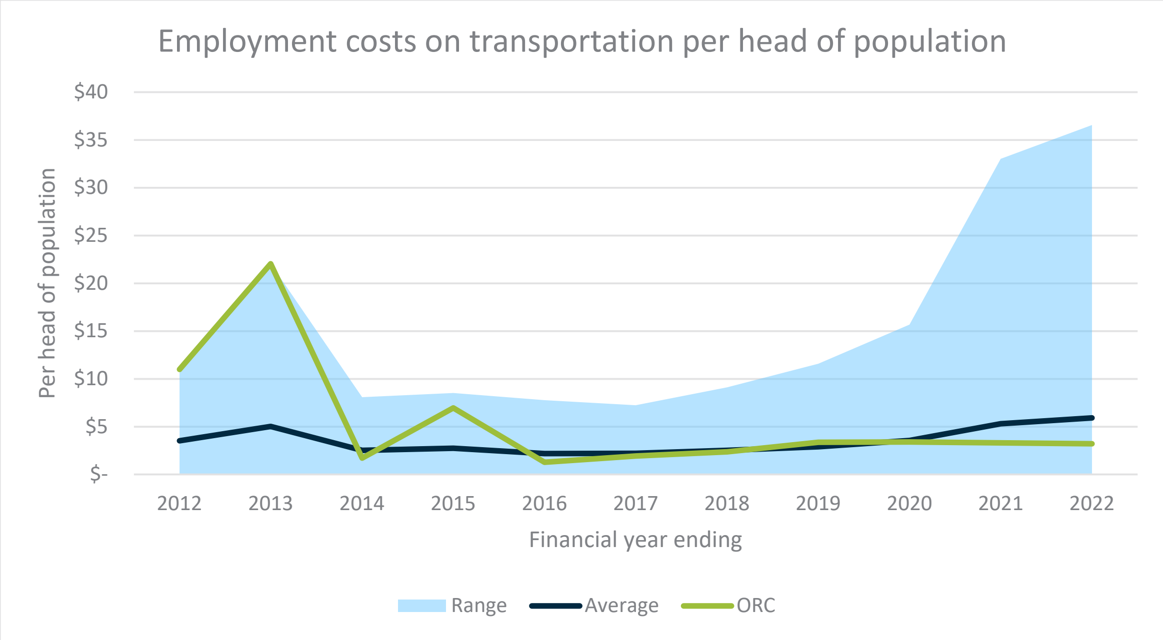
The chart below shows total transportation expenditure across all New Zealand regional council. It shows ORC typically spending around the national average per capita on transportation until 2018, when it experienced an uplift in expenditure.

When considering ORC's expenditure on transport, it is important to note that not all regional councils provide a public transport service, and amongst those that do there is significant variation in terms of the level of service provided.



The following chart shows only employment related costs for transportation on a per capita basis. Like total operating expenditure, ORC has typically followed the national average for employment related costs in the transportation space, with a reduction in spend in 2021 and 2022.

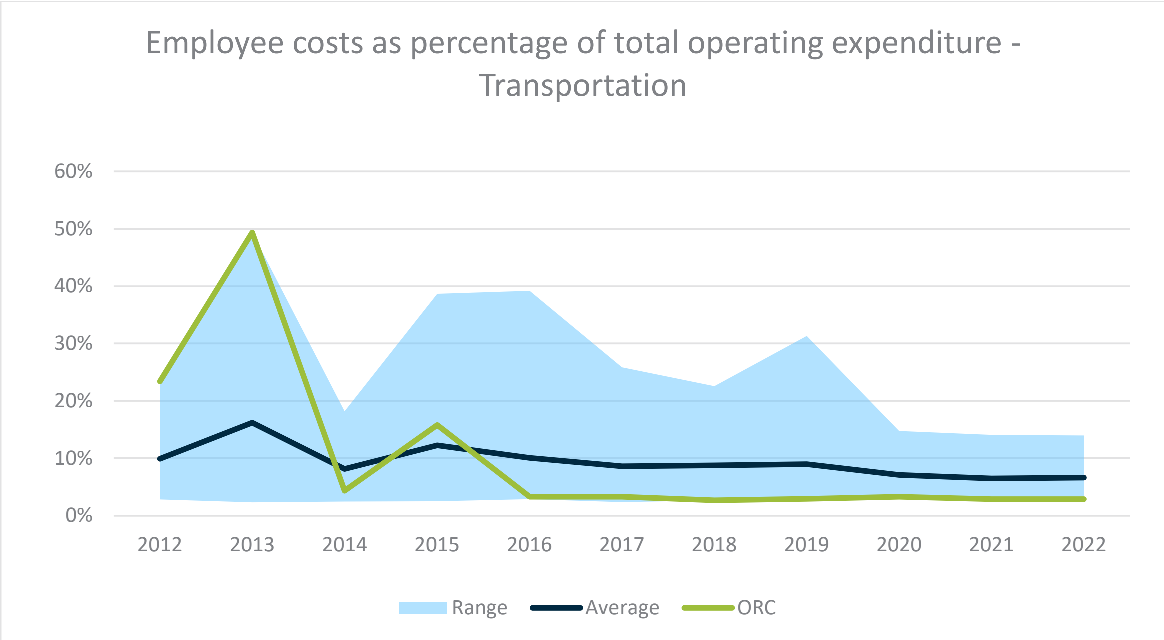
As public transport activities are typically provided through operating contracts, a comparison of employment costs is a better reflection of the administrative effort and time applied towards the delivery of transportation services and work undertaken in the transport planning activity.



The transportation activity has a heavy reliance on contracting public transport operators. Accordingly, employment costs typically only make up a small percentage of total operating costs in councils that provide public transport services.

Notwithstanding this, ORC has the lowest proportion of employee costs for transport activities across all of the regional councils. This may be indicative of ORC :

- having a low administrative cost for public transport contracts; or
- being under resourced for transport planning activities.



rbrobertson MorrisonLow

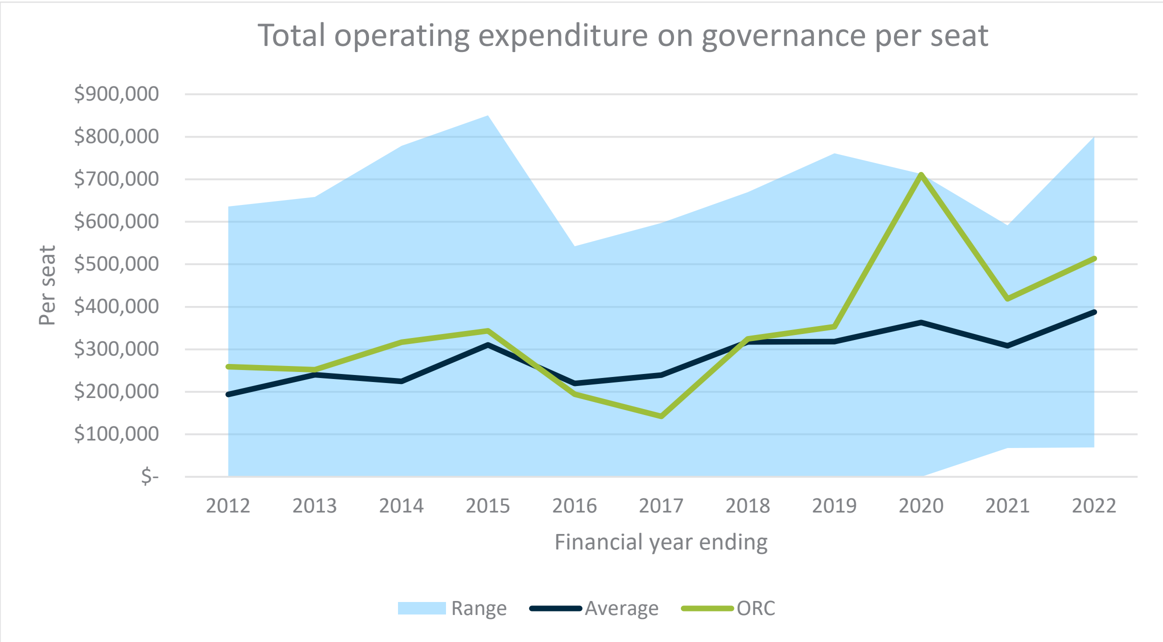
Governance

The Statistics New Zealand data groups the following activities under the broad heading "Governance":

- Elections
- Council committees
- Community boards
- Democratic support

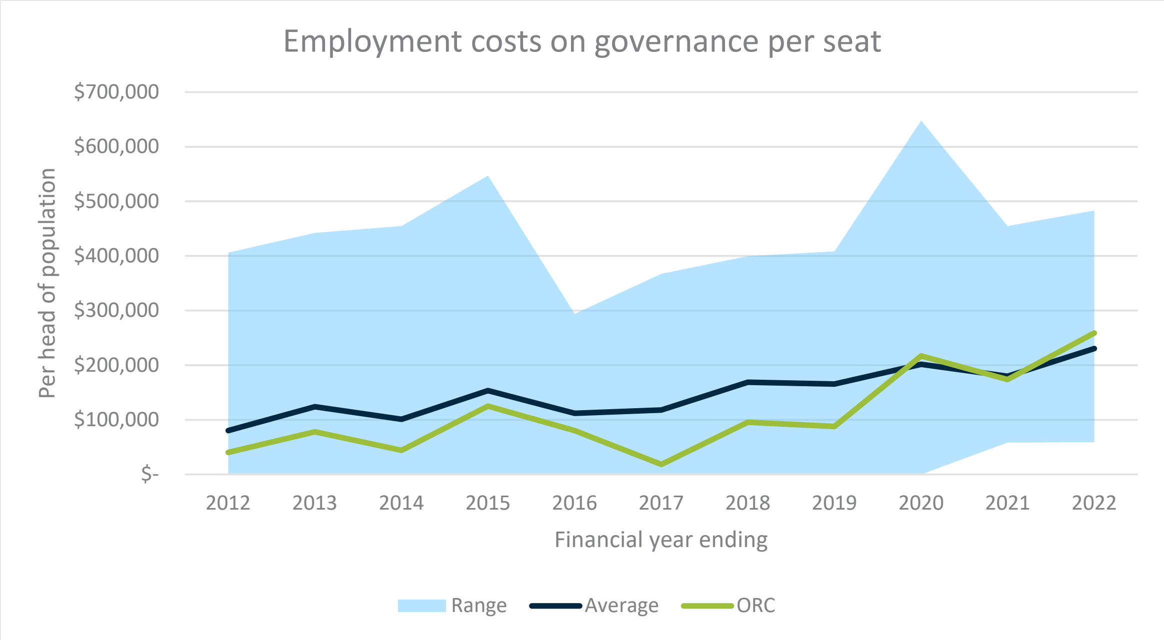
The chart below shows New Zealand regional councils' total expenditure on governance activities on a per seat/elected member basis.

The chart shows governance costs being near the national average until the 2020 financial year, which saw a significant increase in expenditure in the governance activity. For completeness, expenditure measured on a per capita basis follows this trend exactly.

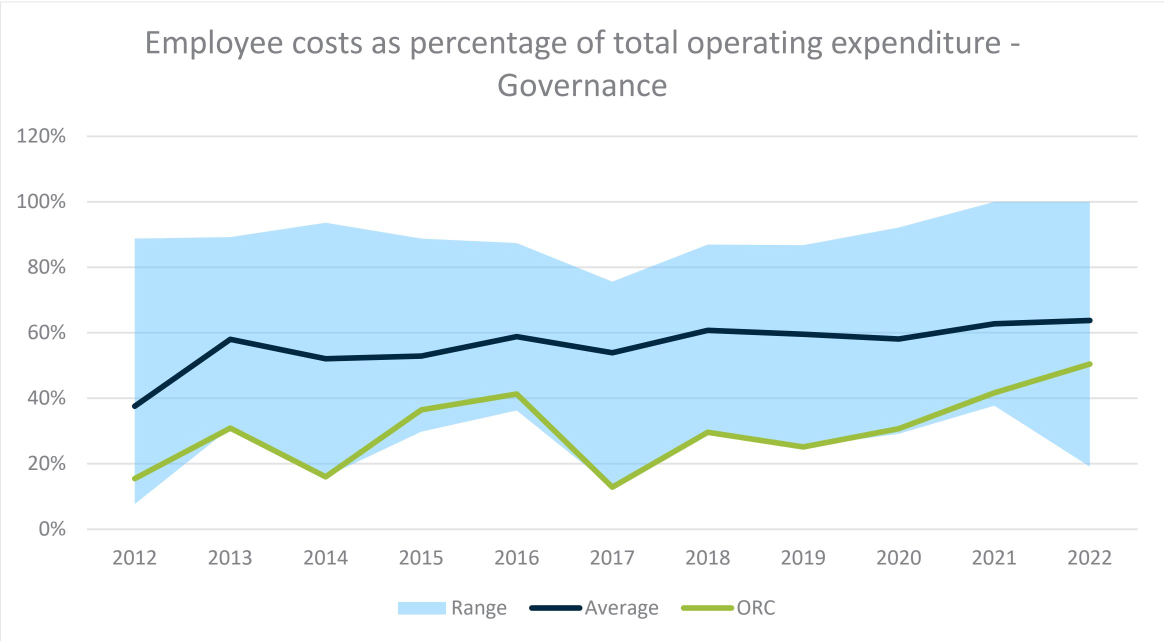


The trend is not consistently reflected when only employment costs for the governance activity are considered. The chart below shows that employment costs relating to the governance activity sat below the national average until the 2020 financial year. Expenditure on employees for governance increased to match the national average in 2020.

Again, we note that the expenditure measured on a per capita basis match the per seat trend exactly.



Despite having comparatively higher total operating costs per capita, and above average employee costs per capita in the governance activity, ORC spends a lower than average percentage of its total governance costs on employees.



ORC financial information and service level measures

As ORC groups its financial and service level measures differently to Statistics New Zealand, we have presented the information below relating to ORC expenditure and non-financial performance separately from the benchmarking information above.

Financial and service level measures have been grouped by activity within this section of the report. Due to changes in the way that activities are described, and differences between activity descriptions between financial and non-financial information:

- Some activities only have non-financial information dating back to 2022
- Non-financial information prior to 2021 may be incomplete as activities have been consolidated and redefined
- We have attempted to match activities from non-financial reporting to activities from financial information, but in some cases our mapping may not be accurate.

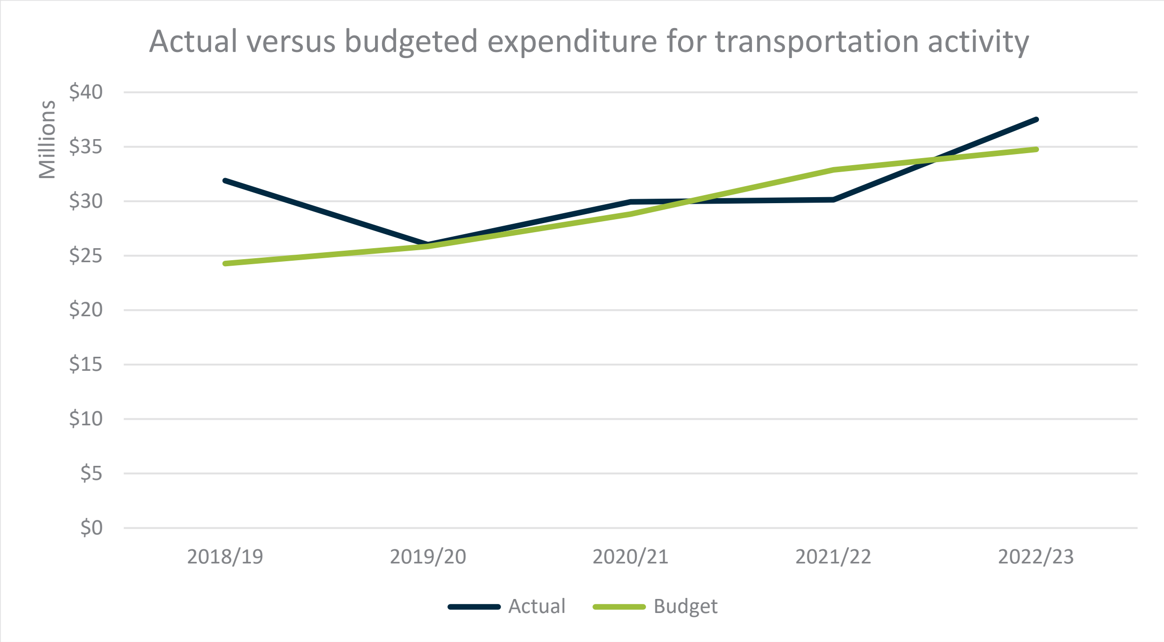
We also note that the number of measures being monitored has changed year on year for most activities. In order to improve readability, we have reported non-financial performance in percentage terms. This means that in some cases, there may be a change in the percentage of measures that have been met/not met, but not in the absolute number.

Transport

As shown in the chart below, the transport activity has seen a relatively consistent level of total expenditure since 2019, with the reduction in actual costs for the 2020 and 2021 financial years likely being a result of reduced activity due to the Covid-19 pandemic.

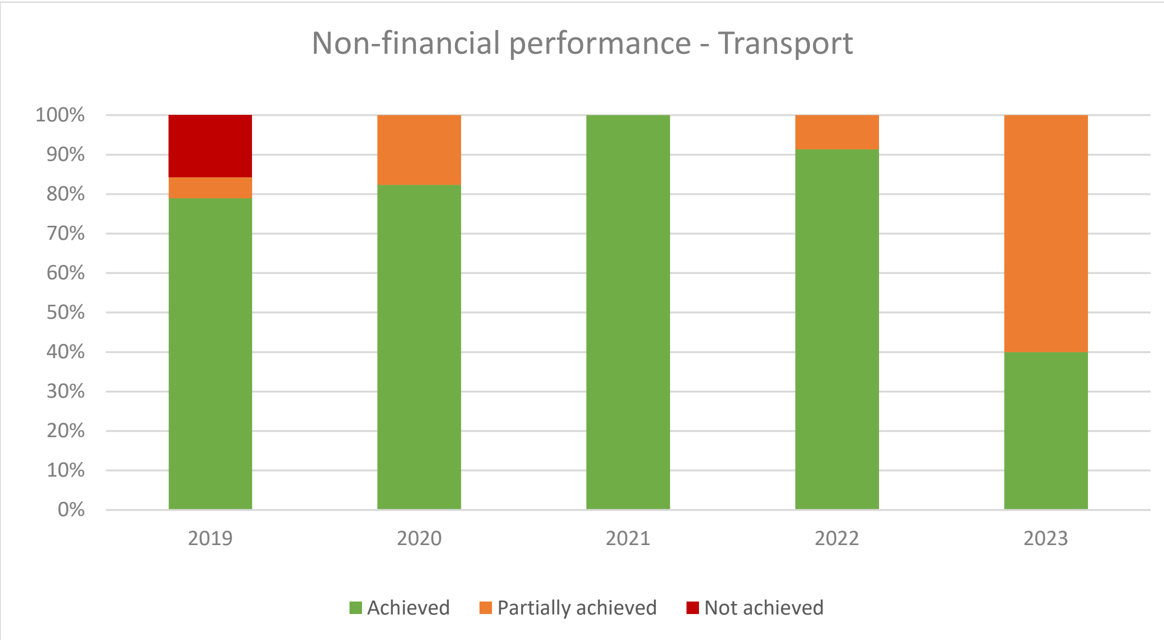
Actual expenditure in 2023 was 24% higher than 2022 and exceeded budget by $2.7 million.

Actual expenditure has typically exceeded budget across the five financial years, with the exception of 2022.



There was a significant reduction in the number of performance measures being monitored in the transport activity in 2023, reducing the total number of measures from 23 to 5. Consequently performance for this activity appears to have deteriorated more significantly than is likely the case in reality.

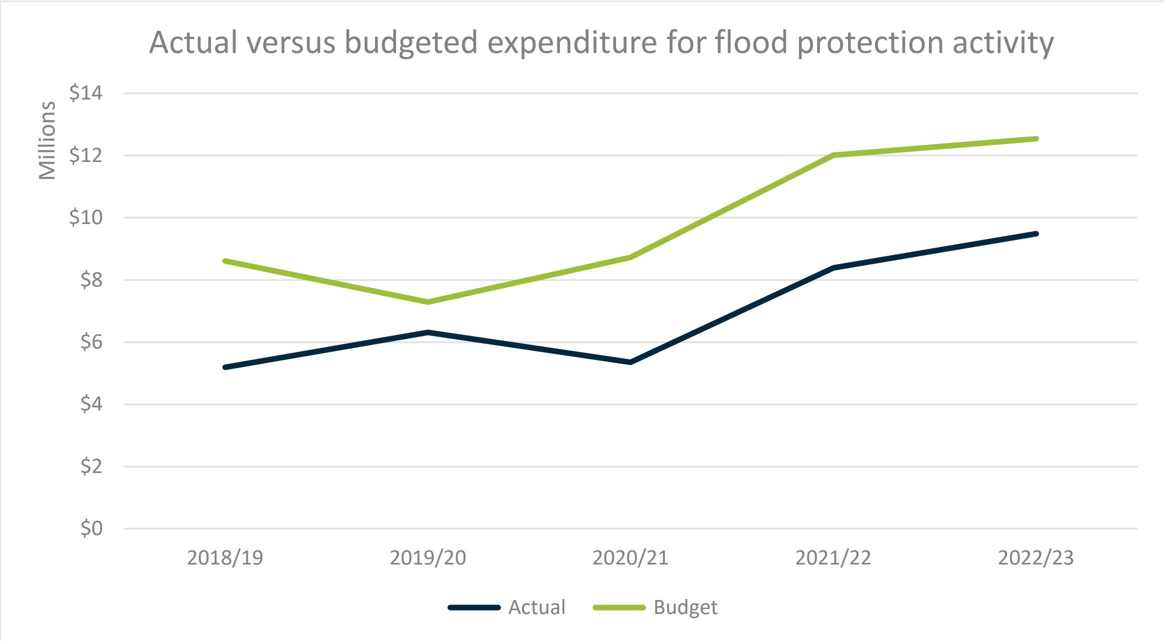
Performance measures rated amber in 2023 relate to the development of the RLTP (due to staff vacancies) and the Wakatipu public transport service.



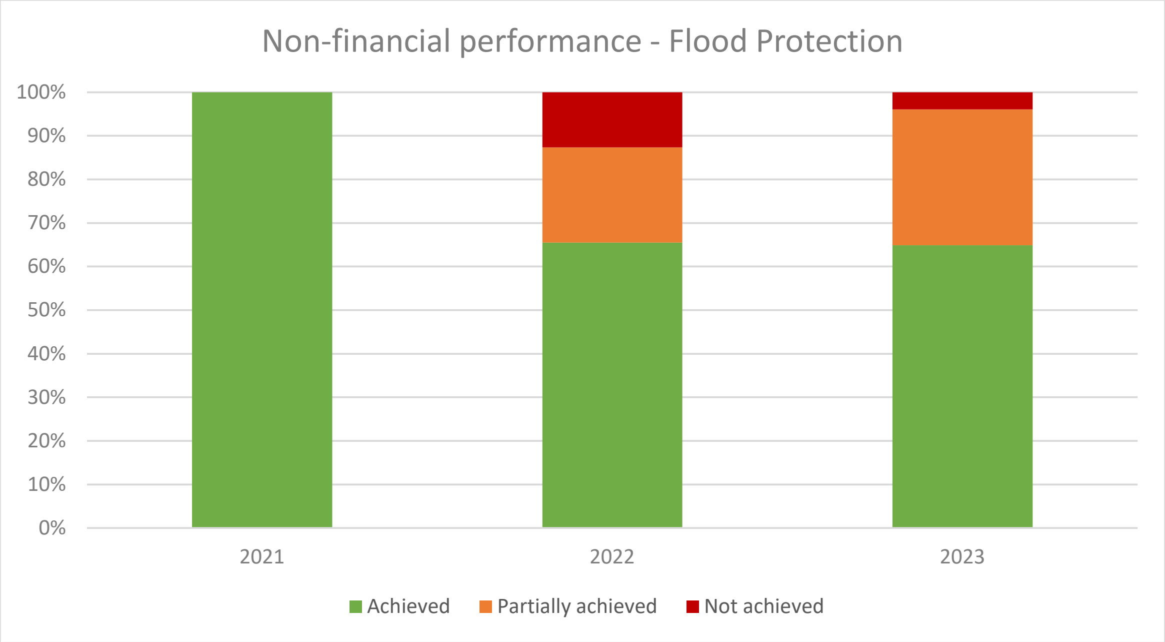
Flood protection

The flood protection activity includes flood protection, river management, and drainage activities across ORC.

As shown in the chart below, the Flood Protection Activity has consistently spent less than its budgeted expenditure since 2019, although total actual expenditure has grown 77% since 2021. In 2023 the flood protection group underspent its budget by $3 million (or 24%).



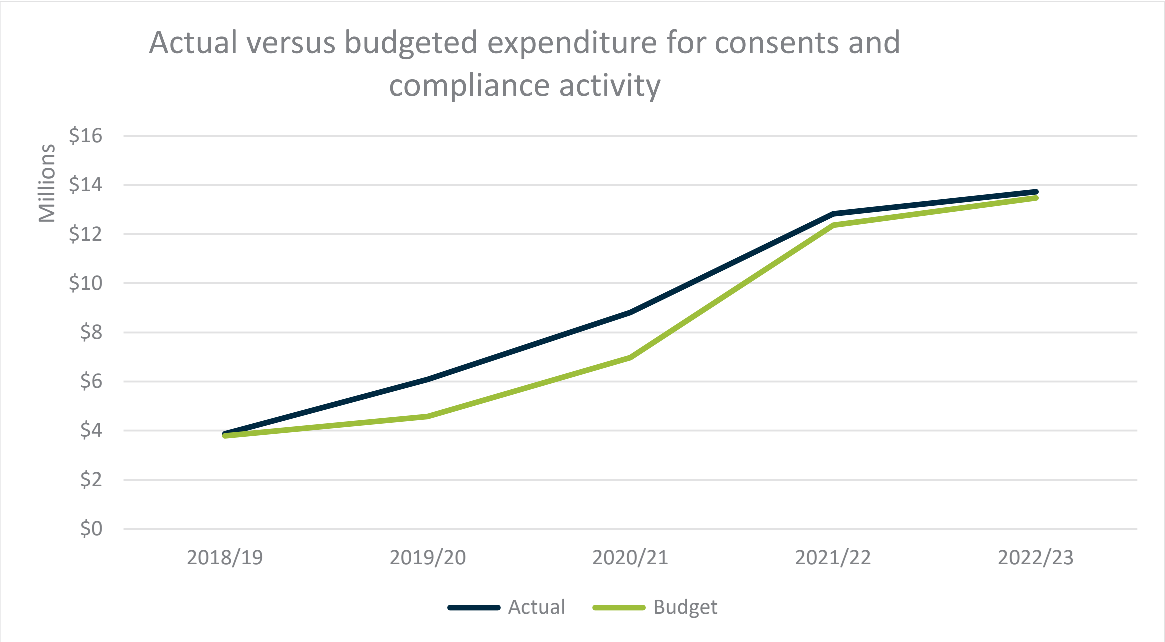
Overall non-financial performance in the flood protection activity improved in 2023, with the only measures marked as “red” relating to the Wakatipu, Wanaka and Waitaki river management programmes. All non-financial performance measures marked as “amber” met at least 80% of their planned target.



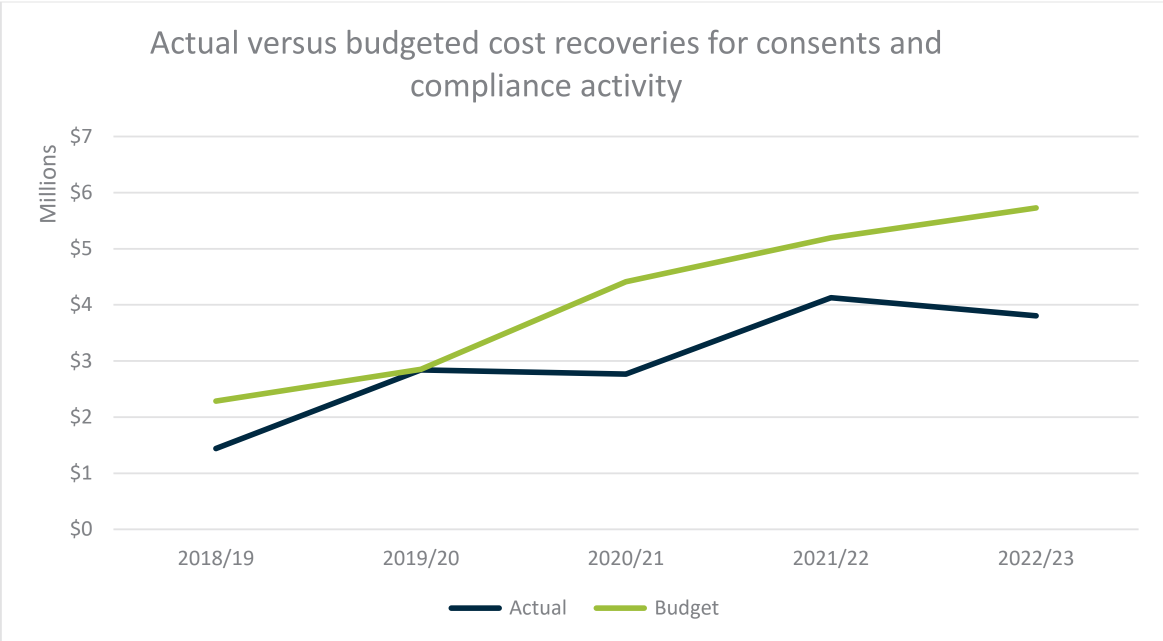
Consents and compliance

The consents and compliance activity at ORC includes consent processing, harbour management, compliance monitoring and incident response and enforcement. This activity receives a significant amount of its funding from third parties through application/processing fees, inspection fees and enforcement where applicable.

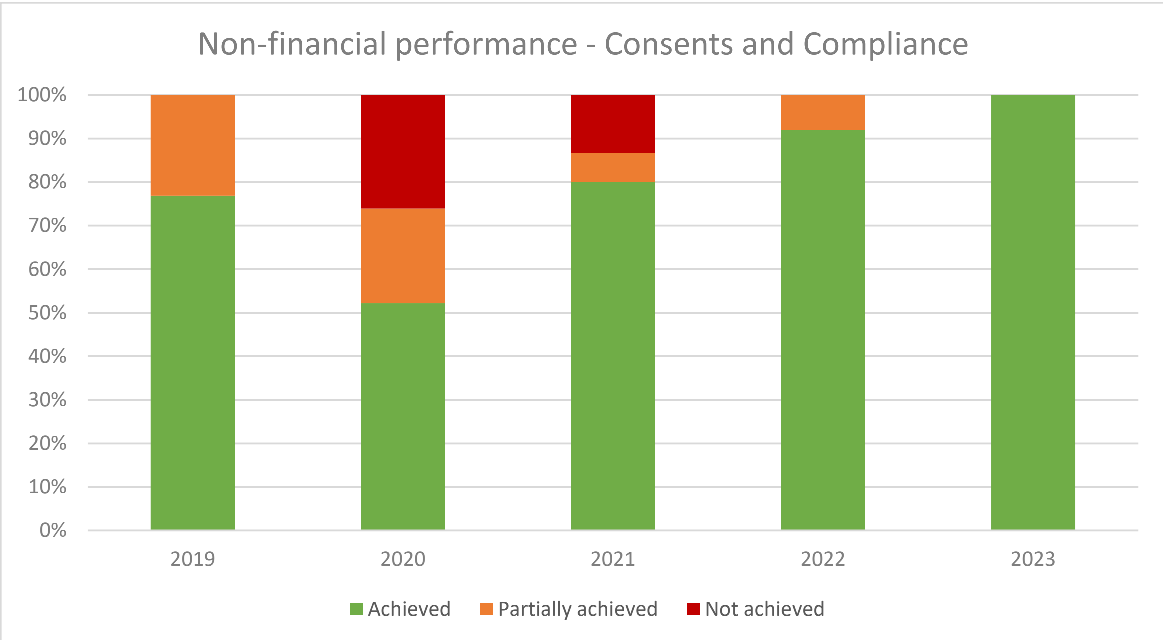
As shown in the chart below, the activity has seen a 255% growth in costs since 2019, with its budget increasing by almost $10 million over that time. The activity has historically overspent it's budget, although overspends in the last two financial years have been minor (less than 5%).



Since 2019, the consents and compliance activity has also typically been unable to achieve its budget cost recovery income targets. In 2023 total non-rates income for the activity was $1.9 million (or 34%) below its budget.



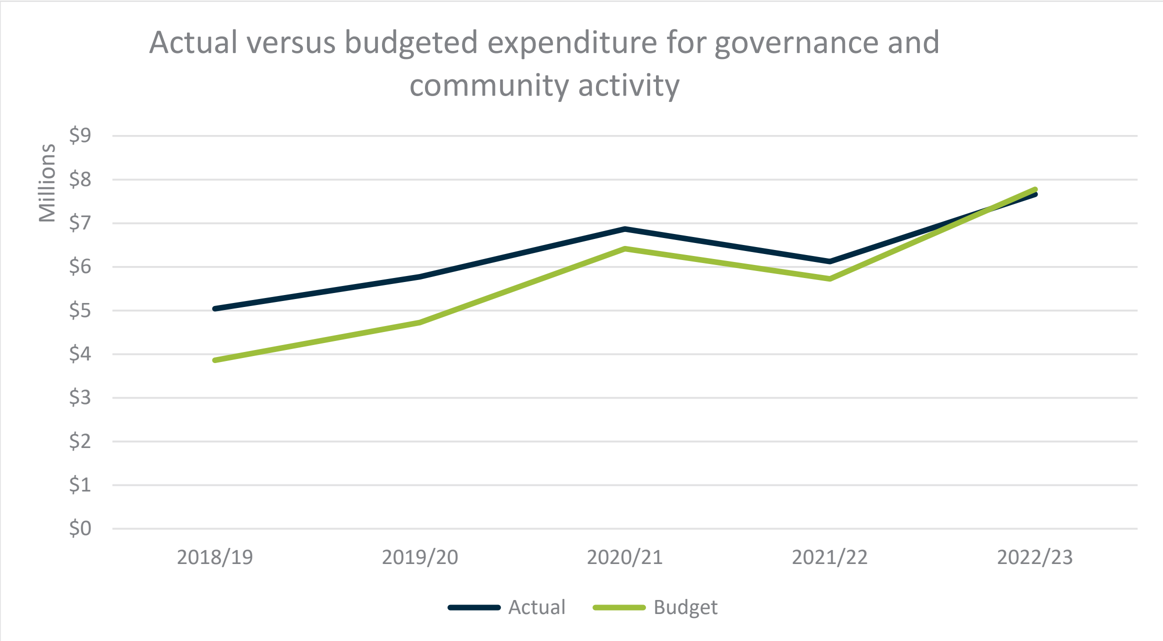
Over the same period, non-financial performance for the consents and compliance function has continued to improve. In 2023 the activity met all of its non-financial performance measures.



Governance and community

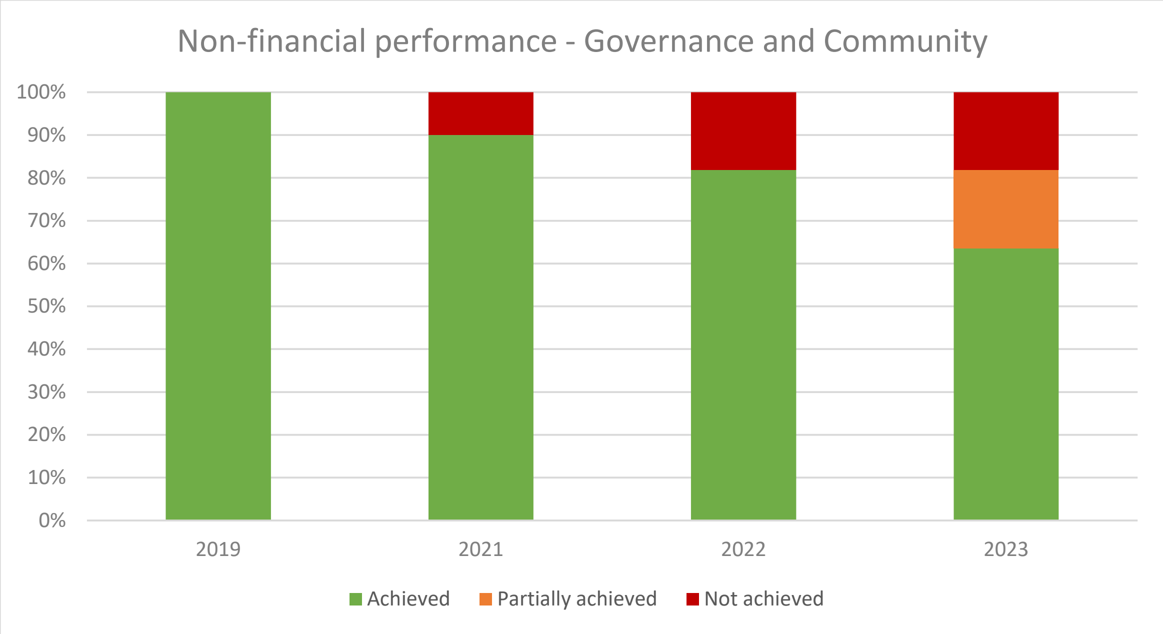
The governance and community activity at ORC includes communications and engagements and governance services.

As shown in the chart below, the activity has previously overspent its operating budget, however budget and actual expenditure were broadly aligned in 2023. The budgeted expenditure for the governance and community activity has grown by just over 100% since 2019.



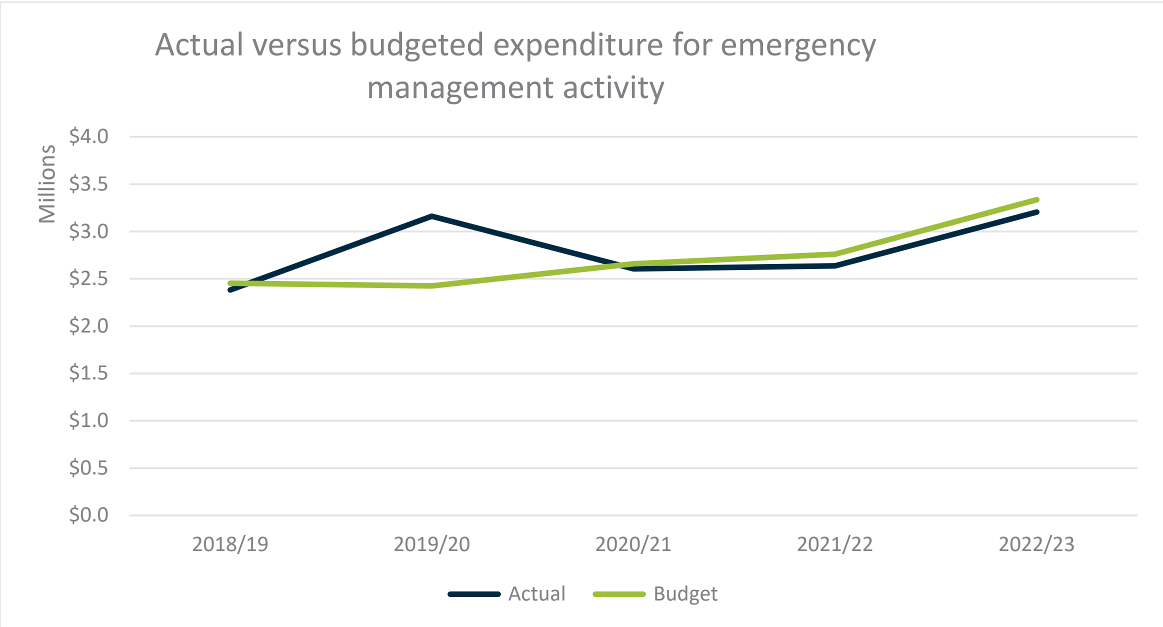
Over the same period, the governance and community activities appears to have met fewer of its non-financial performance measures. Non-financial performance measures marked as being red or amber in 2023 relate to response to LGOIMA requests within statutory timeframes (achieving instead 98.52%) and reporting on climate change information.

rbrobertson MorrisonLow

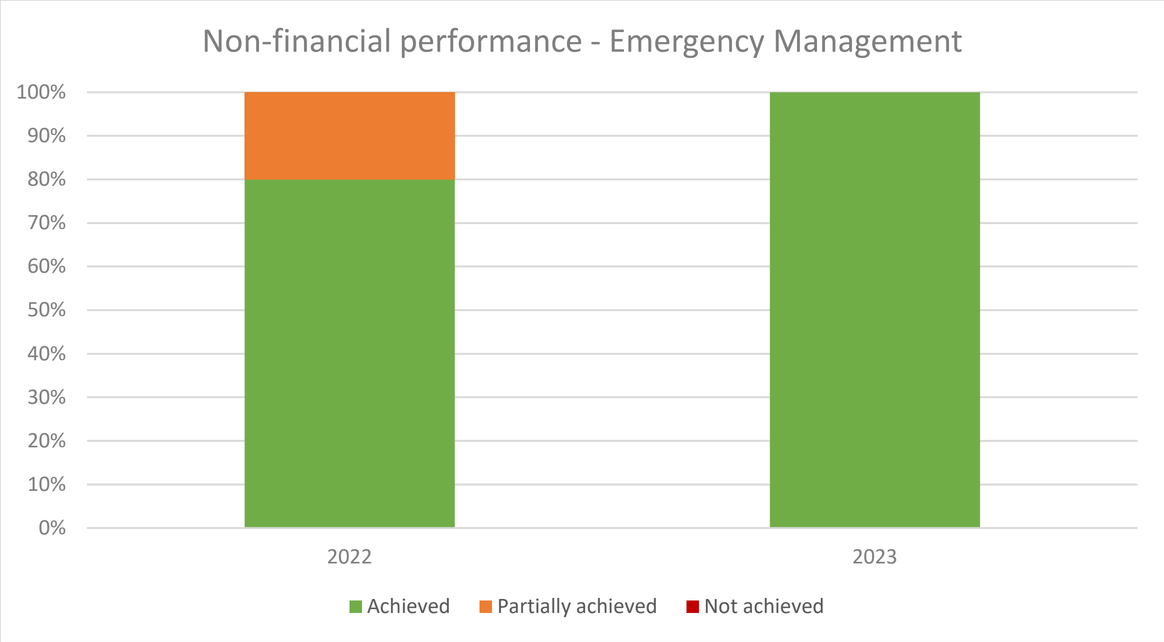


Emergency management

The cost of delivering the emergency management function has remained relatively consistent since 2019, as shown in the chart below. There has been a recent increase in both budgeted and actual expenditure in the activity, with actual expenditure in 2023 being 20% higher than 2022.



Non-financial performance information for the activity is only available for two years (prior to that period the emergency management activity non-financial performance measures were grouped differently). While the data show an improvement in overall performance, in 2023 only one non-financial performance measure was recorded against the activity.



Land and water

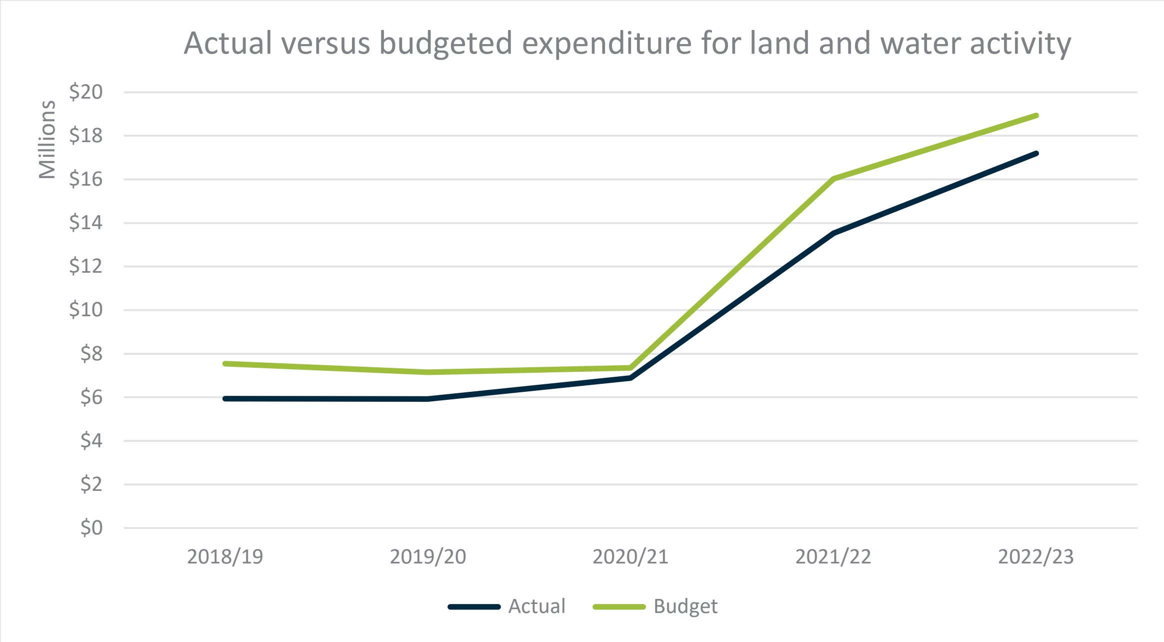
The land and water activity at ORC includes the following programmes:

- Land and water implementation
- Land and water planning
- Land and water science and monitoring.

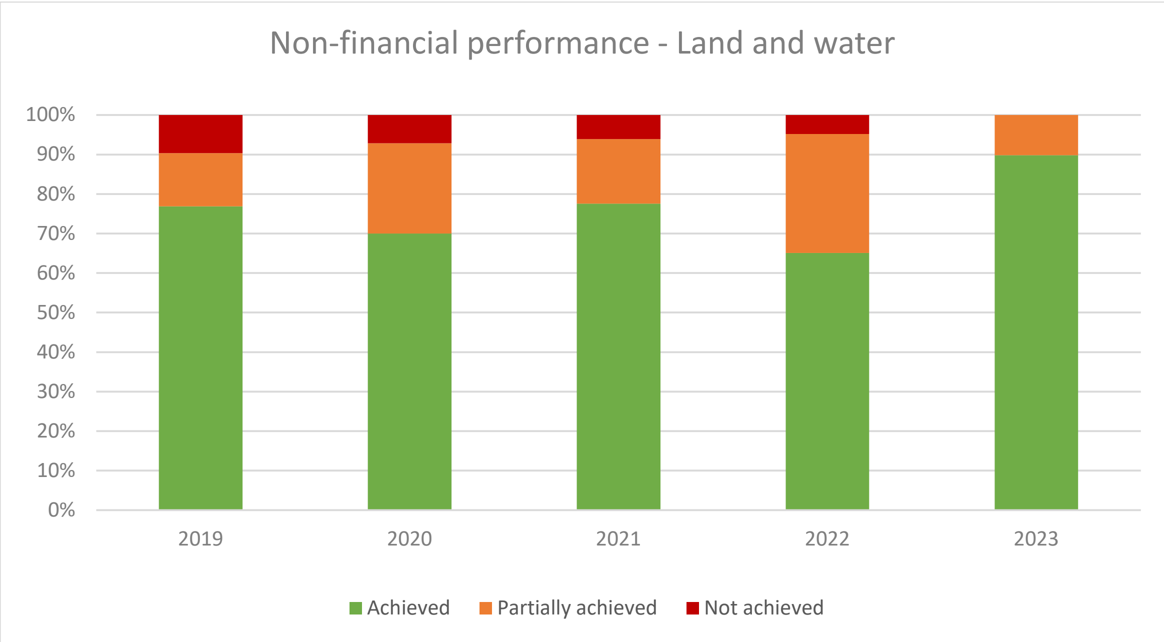
Prior to 2022, land and water science and monitoring was also grouped within an activity titled "State of the Environment". While "State of the Environment" also included other activities which have been grouped elsewhere, for the purposes of this report, we have grouped the activities "Land and Water" and "State of the Environment" together.

This means data prior to 2022 includes some costs and non-financial performance measures that relate to the LAWA and Air Monitoring activities.

The chart below shows the land and water activity consistently underspending when compared to budgeted expenditure since 2019. It also shows significant increases in expenditure of over $10 million (or 150%) since 2021 – a likely response to the Aquanet Consulting report.



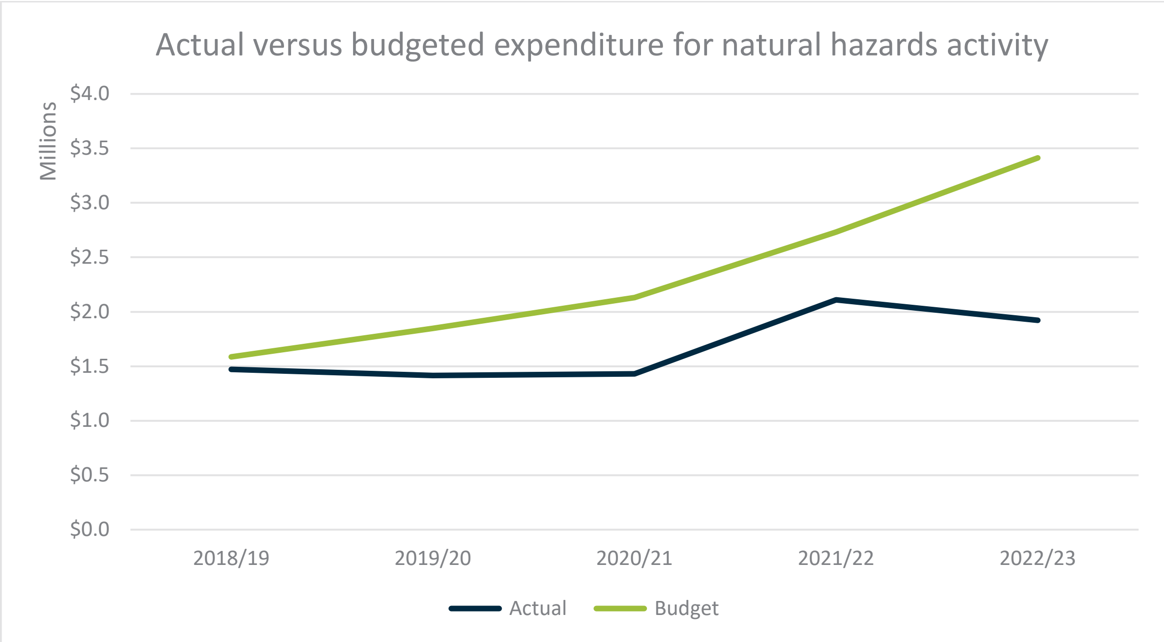
Non-financial performance in the activity has improved in 2023, with no non-financial performance measures being marked as being red.



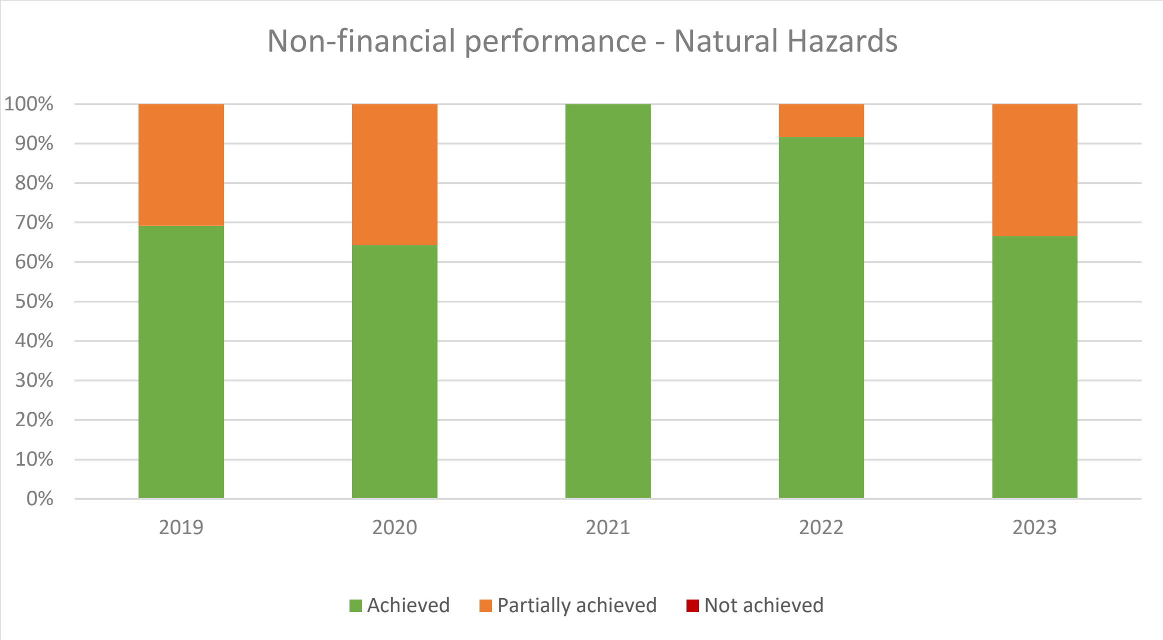
Natural Hazards

The Natural Hazards activity at ORC includes Climate Change adaptation, Flood and low flow risk management and natural hazards.

As shown in the chart below, despite significant increases in the budget (60% since 2021), actual expenditure in the activity has been unable to keep pace. In 2023 actual expenditure for the Natural Hazards activity was 43% (or $1.5 million) below budget.



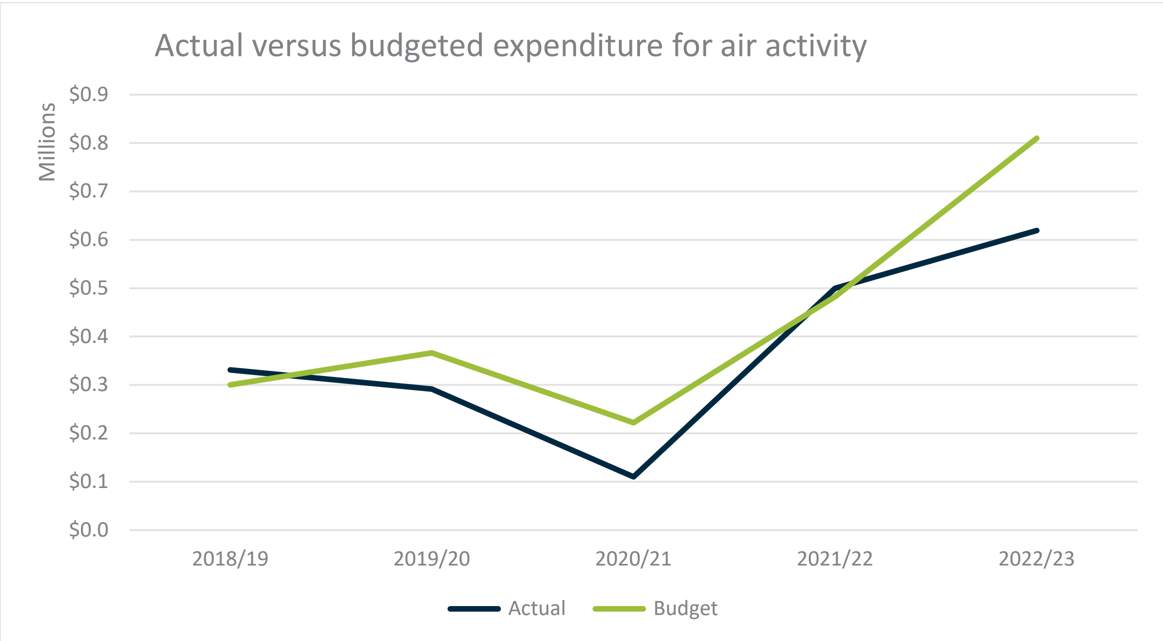
The activity has met fewer of its non-financial performance measures in 2023 as well. In 2023 there was a reduction in the total number of non-financial performance measure for the activity (from 12 to 6). The measures scored as “amber” in the natural hazards activity relate to the climate change and natural hazards programmes, with both being noted as “progressing well”.



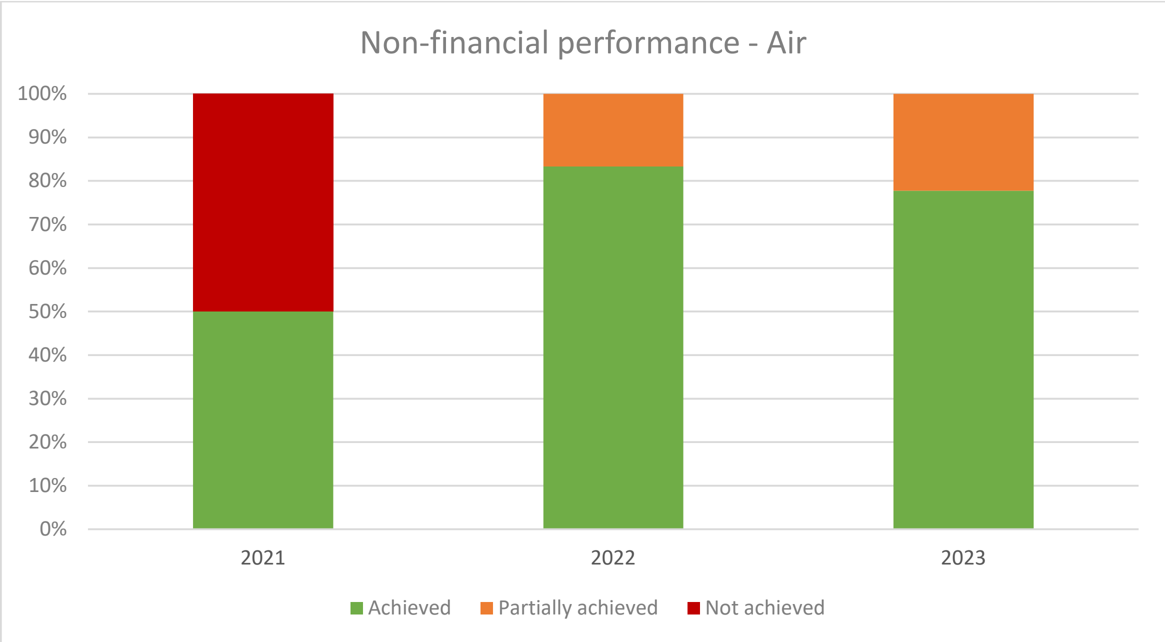
Air

The Air activity at ORC consists of air monitoring and regional planning. Prior to 2022 air monitoring was included as part of the "state of the environment" activity, and the information presented here does not include any of those costs (although this impacts the budget and actual equally).

As shown in the chart below, the Air activity has an annual operating budget of less than $1m. Actual expenditure increased in 2022 however some of this may be attributed to the reclassification of "Air monitoring".



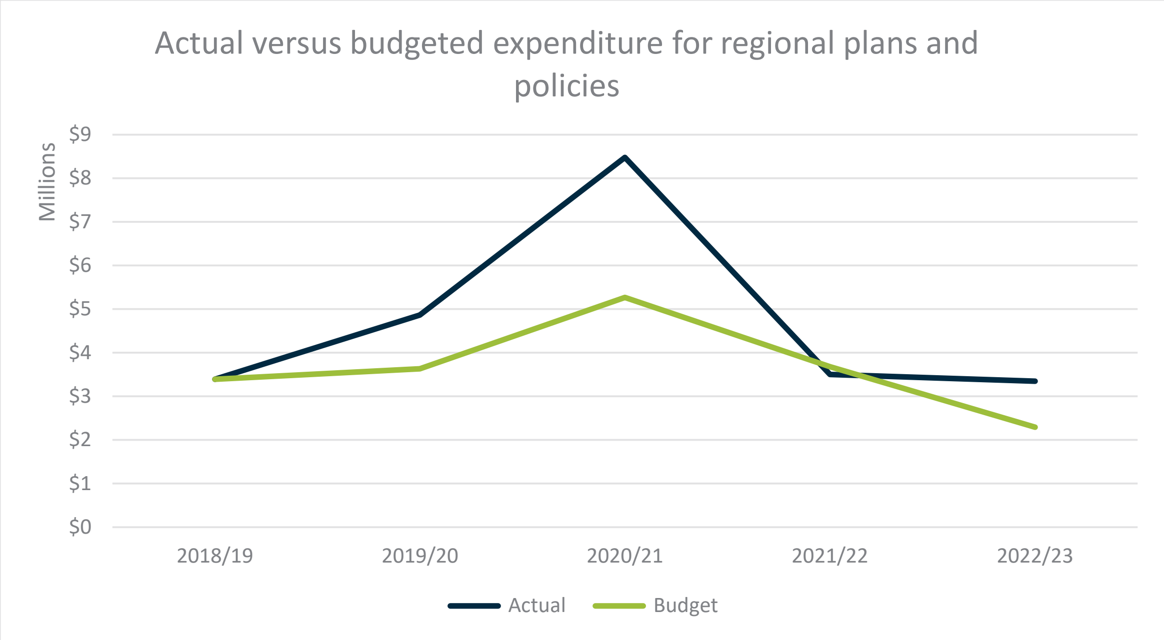
Non-financial performance in the air activity saw an overall improvement in 2022. However, we note that only two non-financial performance indicators are included in the 2021 data, compared to 12 in 2022.



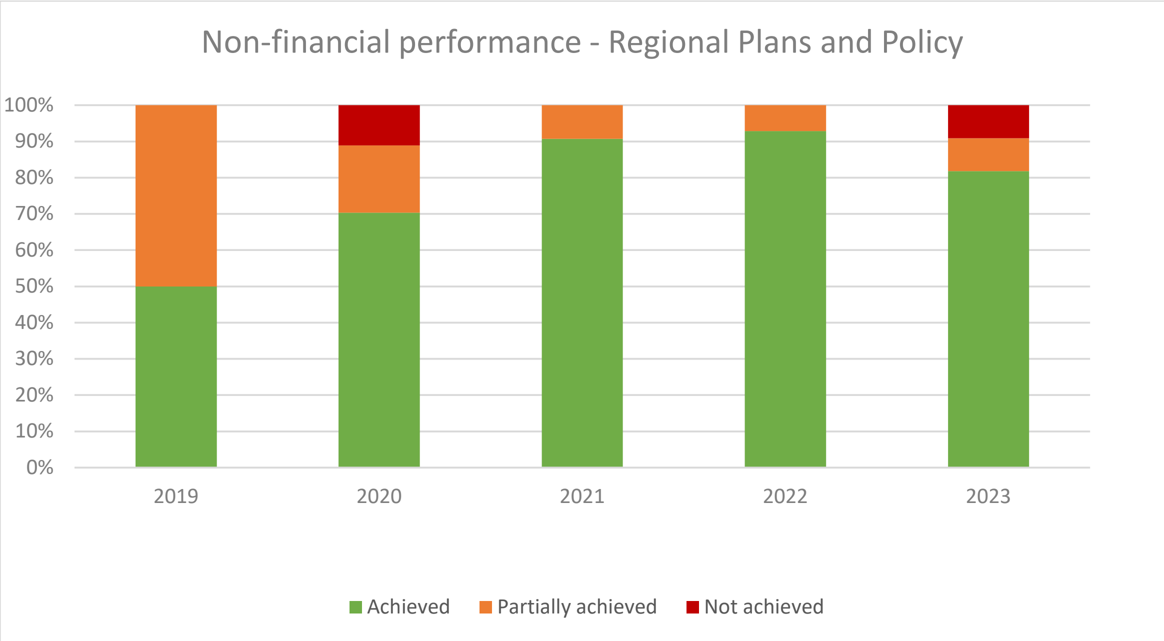
Regional plans and policies

The regional planning and policy activity within ORC includes the development of the RPS, as well as strategy development and the urban development strategy.

As shown in the chart below, the budget and costs have remained relatively consistent, with a reduction in budgeted expenditure in 2023. In 2021, actual expenditure in the activity was $3.2 million (or 60%) more than the operating budget, however the Land and Water Plan programme (W1) was included within the Regional Planning Activity general ledger code in 2021. The reduction in expenditure in 2022 reflects the transfer of the Land and Water Plan programme to the Land and Water activity.



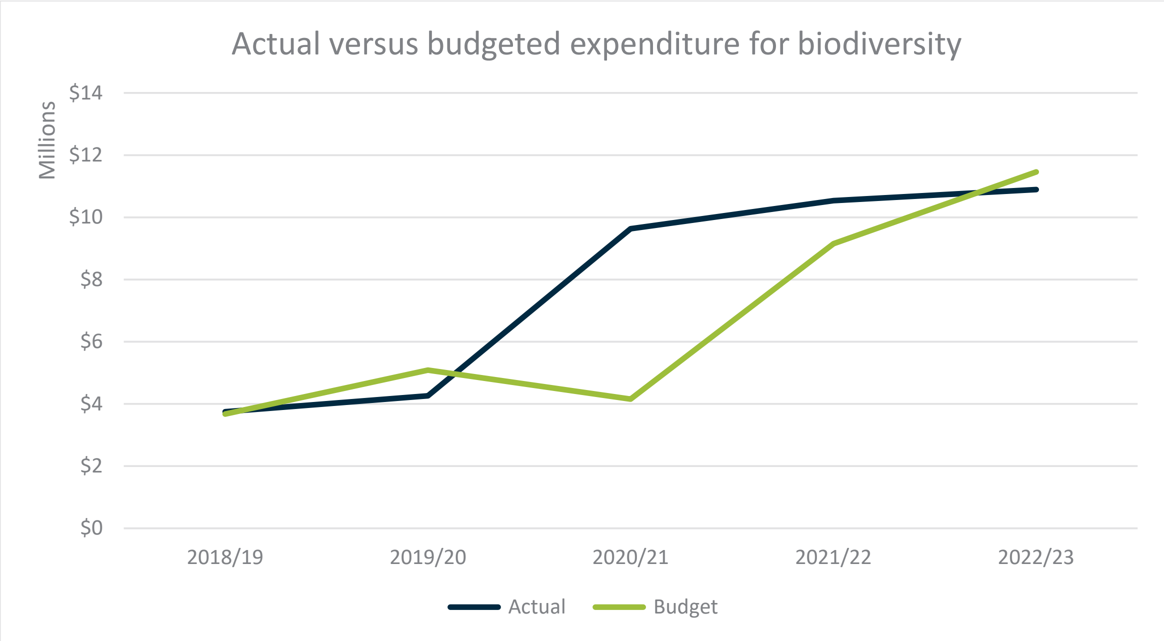
Non-financial performance in the regional plans and policies activity has remained broadly consistent. The red performance measure in 2023 related to the development of a draft Urban Development Strategy which had a target completion date of 30 June 2023. This was not achieved due to staff reprioritisation.



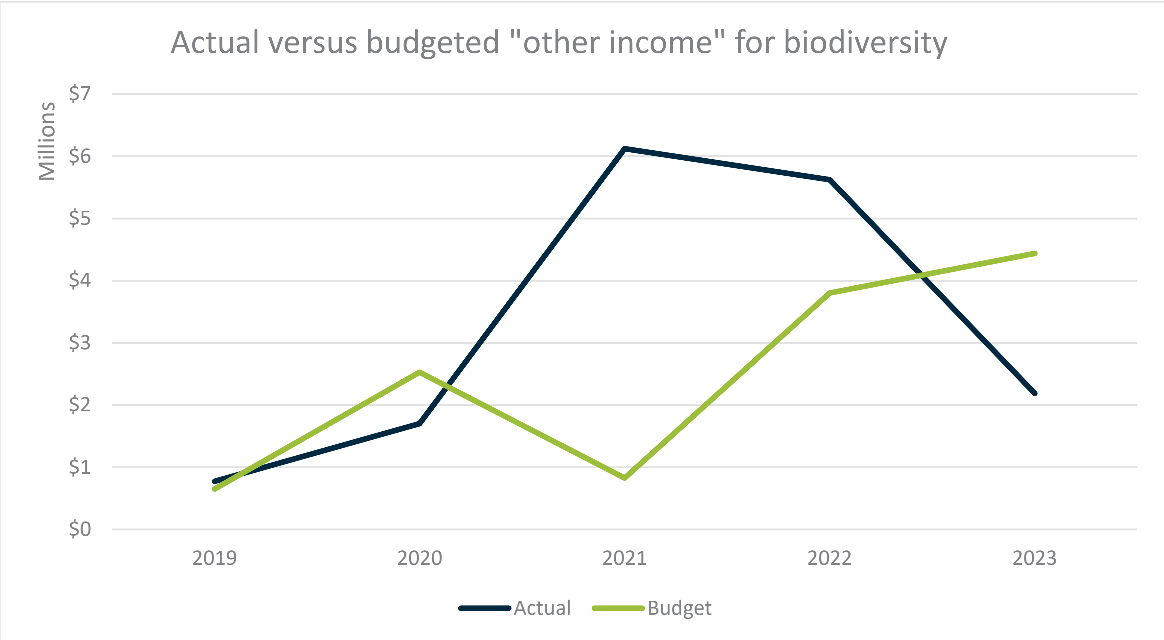
Biodiversity

At ORC the Biodiversity activity includes biodiversity implementation, biodiversity science and monitoring and biosecurity. Biodiversity activities receive a significant amount of grant funding, particularly for programmes such as Wilding Pine management, which is grant funded and largely outsourced by ORC.

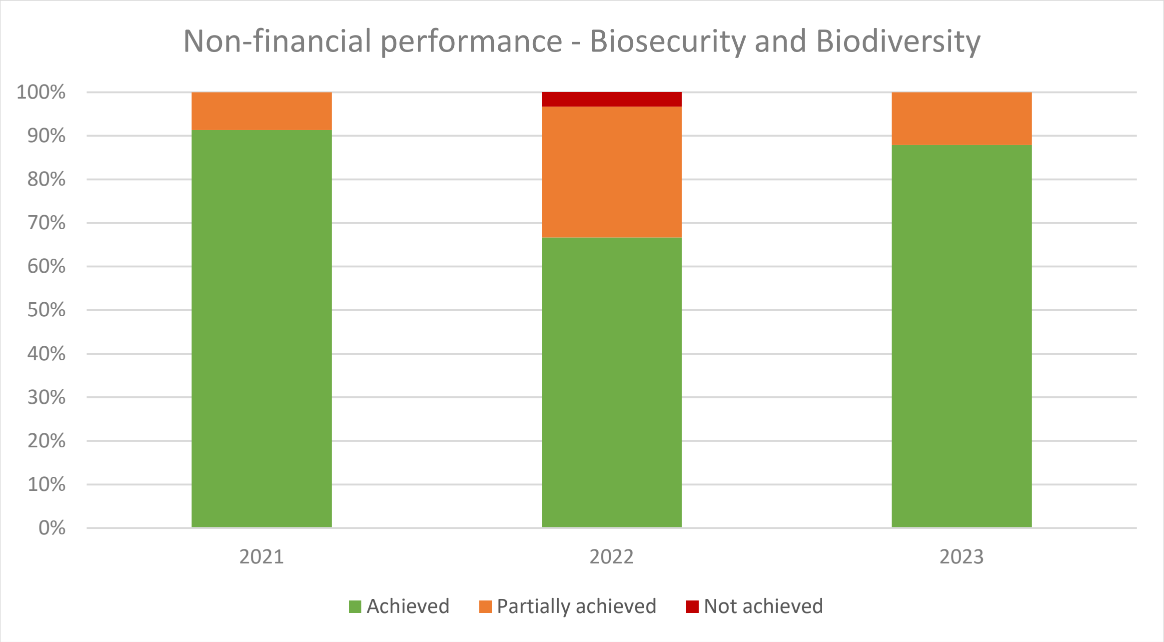
The chart below shows budgeted versus actual expenditure for the biodiversity activity, and shows a large amount of overspend when compared to budget in 2021. It also shows significant growth in overall expenditure of over 190% since 2019 (or $7 million).



The increase in expenditure in 2021 is accompanied with an increase in unbudgeted "other income", which in this case represents grant funding received for the wilding pines programme.



Non-financial performance in the biodiversity activity is broadly consistent with performance in 2021, although the total number of non-financial performance measures has increased over that time period.


Non-financial performance - Biosecurity and Biodiversity
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2021
2022
2023
Achieved
Partially achieved
Not achieved

Efficiency Review Recommendations

Theme	Timeframe	Detailed recommendation
Strategic planning	Short term	Develop a commonly understood definition and approach to efficiency which is used: * At the planning and budgeting phases for ORC's annual and long-term planning. * In monthly financial management practice.
Financial management	Short term	Support the proposed change to the allocation of overhead costs across ORC and improve transparency by additionally: * Providing the same level of visibility and reporting on "below the line" activities as is provided for the remainder of ORC activities both internally and externally *Restricting the allocation of budget variances from below the line activities to an annual adjustment at year end.
Financial management	Short term	Develop a common understanding of the budgeting process and financial management/financial reporting. This will require finance to work with managers to agree on an agreed budgeting and reporting framework that is fit for purpose and clearly aligned to the service delivery outcomes that managers are responsible for delivering.
Corporate planning and reporting	Short term	Further work on the development of a strategic and operational planning framework, including development of an approach to consolidate and escalate work programmes through the organisation to ensure coordination of resources.
Programme and project management	Short term	Develop an organisational approach to project and programme management that includes clear definitions of roles, responsibilities, delegation, and reporting requirements and/or consider the introduction of a Project Management Office.
Programme and project management	Short term	Review ORC's planned and existing projects across the organisation and considering where it may be appropriate to adopt a programme management, rather than project management, approach.
Procurement	Short term	Ensure that the skills and competencies that exist within ORC are first considered before going to market to procure services for work which can otherwise be undertaken by existing ORC resources. This should be a key consideration when procuring work or services that is small in scale.

Corporate planning and reporting	Short term	Undertake a review of non-financial performance measures (in particular those used internally) with a view to: * Reducing the total number of actively monitored measures * Ensuring that all measures provide useful information on organisational performance (output) * Ensuring that measures are all able to be measured and have clear targets * Aligning internal performance measures with those reported on externally, and with each activity's work plan.
Procurement	Short term	Review the use of consultants to determine whether some services should be engaged internally.
Financial management	Short term	Review revenue targets and charge out rates for all teams with a revenue target and that are cost recoverable, and in doing so consider all of the following in combination: * The expected volume of chargeable work that will be received during the year based on historical volumes and growth * The amount of recoverable time taken to undertake the specific chargeable task * The particular costs that are to be recovered through the charging mechanism (particularly as they relate to overheads, training time, etc). Costs that are not included in the charge out rate calculation should be similarly excluded from any calculation of percentage recovery targets.
Corporate planning and reporting	Medium term	Develop an integrated work planning process that is clearly aligned to resource planning and budget setting. This should include: * Clear alignment of the strategic plan, delivery plan and individual work plans * Alignment of budget, work plans and non-financial performance measurement to ensure all activities that are able to be influenced by managers are aligned * Preparing annual plan budget on a zero-basis having consideration to individual work plans.
Procurement	Medium term	Formally embedding specific consideration of the use of internal and external resource into the work planning process.

Financial management	Medium term	Reduce the reliance on timesheets for budgeting and cost allocation purposes, by budgeting staff costs to activities based on activity work programmes. Alternatively, consideration of reducing the time unit intervals in time sheets to 30 – 60 minutes and reducing the number of time codes, to enable information to be captured about workload and resourcing. In either event, retention of timesheets will be necessary for: * Capital projects Activities that are externally funded through fees and charges, cost recoveries or third party grants * Overtime claims for determining time in lieu entitlements or monitoring organisational workload and stress.
Data	Long term	Develop a data management framework and common data standards to ensure that data collected or produced by ORC is consistent across the organisation. This will enable better use of existing information across activities and avoid unnecessary duplication.
Financial management	Medium - long term	Explore opportunities to simplify the budget management and reporting processes, to enable managers to better understand their budgets, and to enable a better assessment of overall organisational efficiency. In particular, explore opportunities to align the internal reporting structure to the external reporting structure.

8.4. Infrastructure Strategy 2024 - 2054

Prepared for:	Council
Report No.	ENG2101
Activity:	Flood Protection & Flood Control Works
Author:	Michelle Mifflin, Manager Engineering Pam Wilson, Engineering Infrastructure Lead
Endorsed by:	Gavin Palmer, General Manager Operations
Date:	6 December 2023

PURPOSE

[1] To seek Council approval of the draft 2024-2054 Flood Protection, Land Drainage and River Management Infrastructure Strategy which will form part of the Draft 2024-2034 Long Term Plan (LTP).

EXECUTIVE SUMMARY

[2] Otago Regional Council (ORC) provides flood protection and land drainage to approximately 21,000ha of rural and urban land in Otago. This is achieved through infrastructural assets that include 218km of floodbanks, 12 pumping stations, 42 bridges, 369 culverts, and various river assets (e.g., Shotover delta training line, Albert Town riverbank rockwork, Lindsay Creek floodwalls and channel lining).

[3] The community is dependent on the effective performance of this infrastructure for their safety and economic wellbeing. This includes parts of the Dunedin Central Business District, University of Otago city campus, Dunedin International Airport and the townships of Balclutha, Alexandra, Milton, Outram and Mosgiel, including key transport routes such as state highways and the railway network. Approximately 7,462ha of land that relies on ORC's flood protection and land drainage infrastructure is less than one metre above current mean sea level.

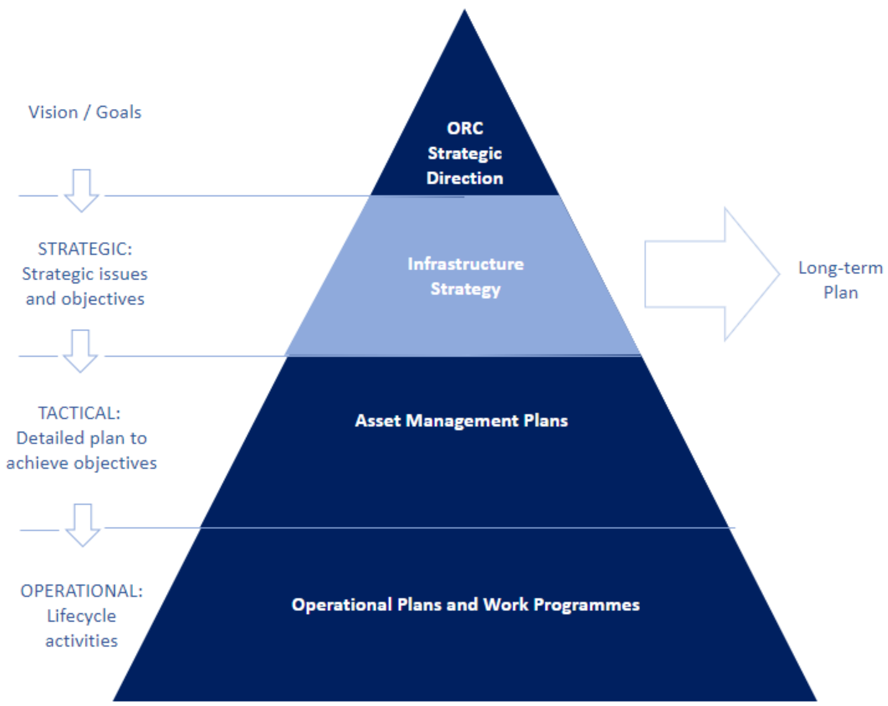
[4] The Local Government Act 2002 requires an infrastructure strategy to be developed which sets out the management and future considerations of flood protection, land drainage and flood control works. A draft infrastructure strategy has been prepared for the period 2024 to 2054 for ORC's flood protection, land drainage and river management infrastructure (attachment 1).

[5] The purpose of this strategy is to:

a. identify any significant issues the Council is likely to face during the thirty-year period; and
b. identify the principal options for managing decisions around those issues (and the implications of those mechanisms) along with the timing of when key decisions are required.

[6] The draft 2024-2054 Infrastructure Strategy is an update on the previous 2021 – 2031 Long Term Plan Infrastructure Strategy. The relationship between the Infrastructure Strategy and ORC's strategic directions and plans is set out in Figure 1.

Figure 1: Relationship of the Infrastructure Strategy with ORC's strategic directions and plans



RECOMMENDATION

That the Council:

1) ***Receives*** *this report.*

2) ***Approves*** *the draft 2024-2054 Infrastructure Strategy to be included in the information available for community consultation in the Long-Term Plan 2024-34 process, subject to any minor editorial changes made by staff.*

3) ***Notes*** *that the Infrastructure Strategy is to provide the framework (direction) for managing flood protection, land drainage and river management infrastructure and for informing future decisions that are identified by the significant issues.*

4) ***Notes*** *that the scheme maps attached as Appendix A to the draft 2024-2054 Infrastructure Strategy will be updated prior to commencment of the Long-Term Plan 2024-34 public consultation.*

BACKGROUND

[7] The Local Government Act 2002 ("LGA 2002") requires a 30-year strategy to be prepared for particular types of infrastructure assets managed by territorial authorities and regional councils.

[8] This Strategy has been prepared for flood protection, land drainage, and river management infrastructure as required under section 101B of the LGA 2002. It covers the types of infrastructural assets of ORC described in Figure 2.

Figure 2: Otago Regional Council infrastructural assets by general type.

Flood Protection

Assets that prevent or mitigate the impact of flood waters.

- Flood banks
- Flood pumps
- Gravity gates and locks
- Spillways
- Ponding areas and floodway's
- Culverts & Bridges

Land Drainage

Assets that facilitate the drainage of low-lying land

- Pump stations
- Scheduled drains.
- Culverts & Bridges

River Assets

Assets that exist within river systems to aid in channel management.

- Rock buttresses
- Groynes
- Flood banks
- Training lines
- Trees

DISCUSSION

[9] The main updates from Council's previous strategies include:

a. Major structural changes and development to the overall strategy document;

b. Update to the significant infrastructure issues, principal options, and their implications;

c. Adding key contextual considerations that are currently impacting, or are expected to impact, on all scheme infrastructure throughout the lifetime of this Infrastructure Strategy.

d. Introduction of the significance that the Protect, Avoid, Retreat, Accommodate (PARA) Framework (see paragraph 10) will have for implementing the Infrastructure Strategy 2024 – 2054.

e. Inclusion of River Management infrastructure section *(section 2.2 of the Infrastructure Strategy, Attachment A)*;

f. Inclusion of Third-Party infrastructure section *(section 2.3 of the Infrastructure Strategy, Attachment A); and*

g. An update to the Infrastructure Investment Programme *(section 4 of the Infrastructure Strategy, Attachment A),* to include key information around these areas of expenditure:

   i. Operational expenditure which outlines condition assessments, monitoring, and risk assessments, become business as usual activities early in the lifetime of the revised Strategy and are contributing to the formation of ongoing maintenance and renewal programmes, for example, in relation to culverts and bridges. More emphasis has been placed on this work as the foundation of future decision making and therefore there is an increase in operational expenditure in the first three years to further embed these programmes and maintain them into later years of the Strategy.

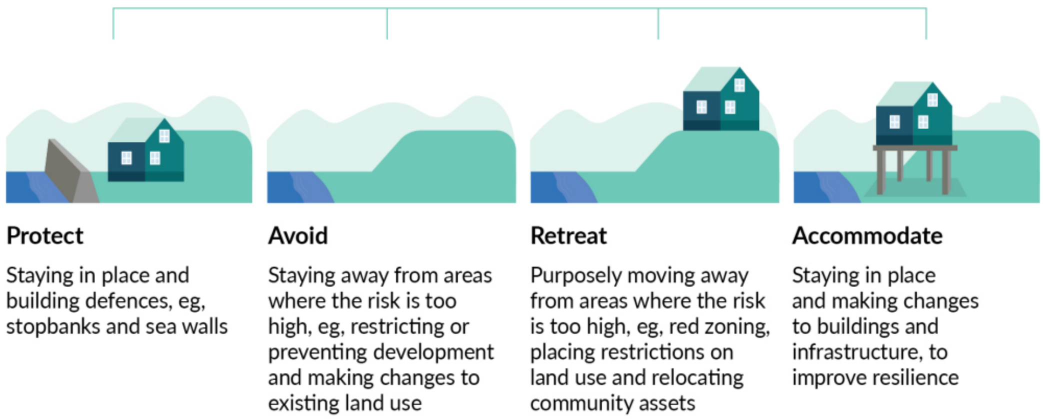
ii. Capital expenditure which sets out significant programmes of work which have been incorporated for adaptation of scheme infrastructure within the Lower Clutha Flood Protection and Drainage Scheme, and the Lower Taieri Flood Protection Scheme. This translates into a significant increase in capital expenditure across both schemes from Year 7 (Lower Clutha) and Year 8 (Lower Taieri), with high expenditure continuing into Years 11-30.

iii. Work to progress hazard mitigation work for Lindsay Creek, North Dunedin, has been advanced in the Strategy. This work was indicated in the previous Strategy as occurring in 2031 and later, however the revised Strategy brings preliminary works such as modelling and optioneering forward into Years 1-3, with flood mitigation works commencing from Year 5 onwards subject to public consultation on options and consenting. This is shown as a "provisional scheme" in the Strategy.

h. There is also focus within the Infrastructure Investment Programme on the significant decisions that Council will need to make within the lifetime of the Strategy and noting that these are big decisions in relation to cost and/or community or environmental impact, providing Council with time to make these decisions based on preliminary investigations and optioneering to be completed prior.

[10] The Protect, Avoid, Retreat, Accommodate (PARA) Framework has been introduced into the revised 2024 – 2054 Infrastructure Strategy (Ministry for the Environment, 2023). The PARA framework is internationally used to explain the types of adaptation actions that can be taken to build resilience to the current effects, and predicted impacts, of the increasing risks posed by natural hazards (Figure 3). The application of the PARA framework will be pivotal during the infrastructure strategy cycle, as key decisions are required upon the completion of investigation works that address the effects of climate change on current infrastructure functionality and the relationship it has with communities and other key stakeholders.

Figure 3. The Protect, Avoid, Retreat, Accommodate (PARA) Framework (Ministry for the Environment, 2023)



[11] The majority of the flood protection, land drainage, and river management infrastructure that Council owns and manages falls into the 'Protect' category. This

infrastructure acts as a form of defence against water and enables people, and their homes and businesses, to stay where they are placed. Historically this approach has resulted in rivers being constrained to a narrower floodplain that limits the flood carrying capacity of the river by denying it the opportunity to behave naturally and spread out across their floodplain during high flows.

[12] The application of the PARA framework as we meet the demands and/or expectations of our communities and challenges of our dynamic environment is a key aspect of how our rivers, communities and infrastructure intersect into the future. It is noted that ORC manages flood hazard risks and land drainage through a range of methods not limited to infrastructure. The methods include collaboration with territorial authorities on District Plans, the development of policies through the Regional Policy Statement, provision of information through the Otago Natural Hazards Database and participation in the Otago Civil Defence and Emergency Management Group.

[13] The Strategy outlines the key issues, implications, and most likely scenarios for how Council intends to manage its flood protection, land drainage and asset infrastructure over the next 30 years.

[14] The Strategy has a 30-year planning horizon and will be reviewed every three (3) years to align with Long Term Plan cycles. The planning horizon extends well beyond the more detailed planning included in the LTP as a longer time horizon is required to consider the whole life cycle of infrastructure. This helps the Council and the community to see the longer-term approaches planned and what can be expected for Otago up to 2054.

[15] The long planning horizon also recognises that some issues require long lead times. For example, addressing the effects that retreat of the Clutha delta shoreline and sea level rise induced rise in groundwater will have on the Lower Clutha Flood Protection and Land Drainage Scheme.

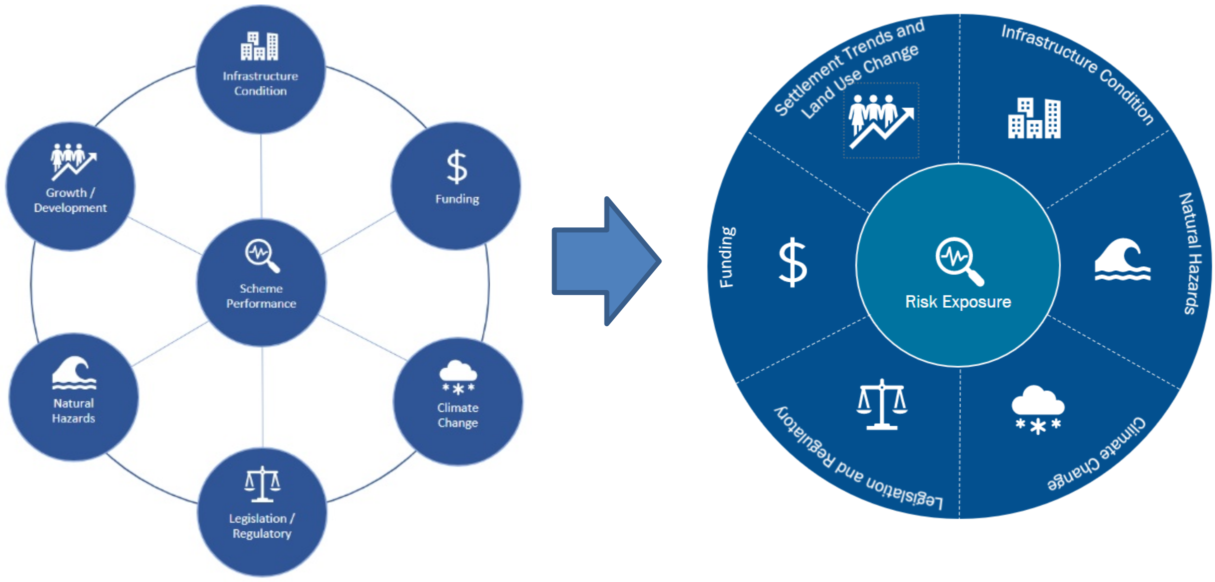
[16] The Infrastructure Strategy fits within a decision-making and operational framework that ultimately provides direction for the LTP. This is depicted in Figure 1.

[17] The significant issues facing flood protection, land drainage and river management activities for ORC have been reviewed and discussed in a series of Council Workshops held on the 13th September 2023, and the 24th October 2023 and 23 November 2023 respectively. These workshops discussed with Council the current significant issues and the evolution of the significant issues in conjunction with the review of the Infrastructure Strategy. The most recent workshop outlined the proposed investment programme for the first 10 years of the Strategy.

[18] These significant issues are summarised and presented diagrammatically in Figure 4. All significant issues are inextricably linked to one another, with the linking common denominator being ‘Risk Exposure’. There have been minor changes to the naming of two significant issues – ‘Growth/Development’ to ‘Settlement Trends’, and ‘Scheme Performance’ to ‘Risk Exposure’.

[19] The Infrastructure Strategy presents why these significant issues have been identified, the options for managing these issues, and a suggested preferred approach to aid in decision making that will be required over the term of the 30-year strategy.

Figure 4: Significant issues and association with each other (2021 – 2051 on left and LTP 2024 – 2054 on right)



Significant Issues Infrastructure Strategy 2021 - 2051

Significant Issues Infrastructure Strategy 2024 - 2054

[20] During the lifetime of the strategy, decision making may be influenced by unforeseen events, such as the example of increased weather events, where duration and severity is sustained. The strategy allows us to adapt our management and decision making in response to these events.

OPTIONS

[21] Council has two options in relation to the proposed strategy.

[22] Option 1: It can approve it in its current form presented in this paper with minor changes.

Advantages

We meet our obligations under the Local Government Act 2002 ("LGA 2002") which requires a 30-year strategy to be prepared for particular types of infrastructure assets managed by territorial authorities and regional councils.

The Draft Infrastructure Strategy 2034 – 2054 is able to be included in the Long-term Plan 2024 – 2034 Long-term Plan consultation documentation.

Disadvantages

There are no tangible disadvantages accepting this option. Staff will incorporate the minor changes within the timeframe to meet the Long-term Plan 2024 – 2034 Long-term Plan consultation documentation.

[23] Option 2: It can direct significant changes.
Advantages

Changes can be made to reflect Council requirements and early feedback ahead of the Long-term 2024 – 2034 consultation process.

Disadvantages

Staff will need to consider the impact of the changes requested and time required to make changes.

Dependent on the extent of changes we may be required to carry out special consultation to allow for the scale of changes, if they are significant.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[24] The Infrastructure Strategy helps deliver Council's Strategic Directions where our vision states: communities that are resilient in the face of natural hazards, climate change, and other risks.

Financial Considerations

[25] The financial considerations are detailed as part of the Financial Strategy and long-term planning process.

[26] Changes resulting from the Option that Council chooses to the proposed Draft Infrastructure Strategy 2024 – 2054 may have an impact on the financial strategy including the proposed expenditure forecast and funding model applied, and subsequent work programmes set in the long-term plan.

Significance and Engagement

[27] The proposal triggers Council's Significance and Engagement Policy. Under section 93C of the LGA 2002, the LTP consultation document must include the Council's proposed Infrastructure Strategy.

Legislative and Risk Considerations

[28] The Infrastructure Strategy is required to be prepared in accordance with the LGA 2002.

[29] Council has statutory functions and powers under the Soil Conservation and Rivers Control Act 1941 for river management, flood protection and soil conservation within Otago, and for land drainage under the Land Drainage Act 1908. The Infrastructure Strategy helps give effect to these functions.

[30] The 30-year infrastructure strategy helps manage flood hazard risks in Otago as part of the PARA framework.

[31] Infrastructure Resilience has been identified as a Strategic Risk for ORC. The Infrastructure Strategy helps manage this risk.

Climate Change Considerations

[32] The Infrastructure Strategy helps manage the effects of future climate change on flood risk and land drainage. It supports the delivery of place-based adaptation programmes.

Communications Considerations

[33] The Draft Infrastructure Strategy is provided for in the communications plan for consultation on the 2024-34 Long Term Plan.

NEXT STEPS

[34] Finalise the Infrastructure Strategy to be included as part of the consultation for the 2024 – 2034 Long Term Plan consultation process. The scheme maps attached as Appendix A to the Strategy will be updated prior to commencment of public consultation**.**

[35] Complete the supporting long term plan documentation to this Infrastructure Strategy which details scheme and river expenditure including key projects included, where required in the consultation documentation.

ATTACHMENTS

1. DRAFT Otago Regional Council Infrastructure Strategy 2024 2054 (4) [**8.4.1** - 66 pages]

Otago Regional Council

Infrastructure Strategy 2024 – 2054

DRAFT FOR CONSULTATION

Flood Protection, Land Drainage and River Management Infrastructure

Prepared by Engineering, Operations Directorate

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November 2023

Document ID:

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1. Introduction

Otago is situated in the southern half of the South Island, and with an area of approximately 32,000 square kilometres. Otago Regional Council (ORC) owns and maintains flood protection, land drainage and river management infrastructure across Otago, providing flood protection and land drainage to approximately 43,000 hectares of rural and urban land in Otago. This infrastructure plays a critical role in mitigating against the full consequences of damaging flood events. Figure 1 outlines the types of infrastructure owned and maintained by ORC.

Flood Protection

Infrastructure that mitigates the impact of floods

- Flood banks
- Pump stations
- Gravity gates and locks
- Spillways
- Ponding areas and floodways
- Culverts & bridges
- Flood walls
- Rock work
- Debris traps
- Trees

Land Drainage

Infrastructure that facilitates the drainage of low-lying land

- Pump stations
- Gravity outfalls
- Open drains
- Culverts & bridges

River Management

Infrastructure that exists within river systems to aid in channel management.

- Rock buttresses
- Training lines
- Groynes
- Trees

Figure 1. Types of flood protection, land drainage and river management infrastructure covered by this Infrastructure

The purpose of this Infrastructure Strategy (Strategy) is to identify significant infrastructure issues for Otago Regional Council over the 30-year period covered by this Strategy in relation to flood protection, land drainage and river management infrastructure, and identify the principal options for managing those issues and the implications of those options. This is a requirement as part of the preparation and adoption of Council's Long-term Plan, as required by Section 101B of the Local Government Act 2002. Further statutory requirements of the Local Government Act 2002 are detailed in Section 1.1. This Infrastructure Strategy fits within a decision-making and operational framework that ultimately provides direction for the Long-term Plan (LTP). This is depicted in Figure 2. The framework helps give effect to ORC's responsibilities under the Soil Conservation and Rivers Control Act 1941 and the Land Drainage Act 1908.

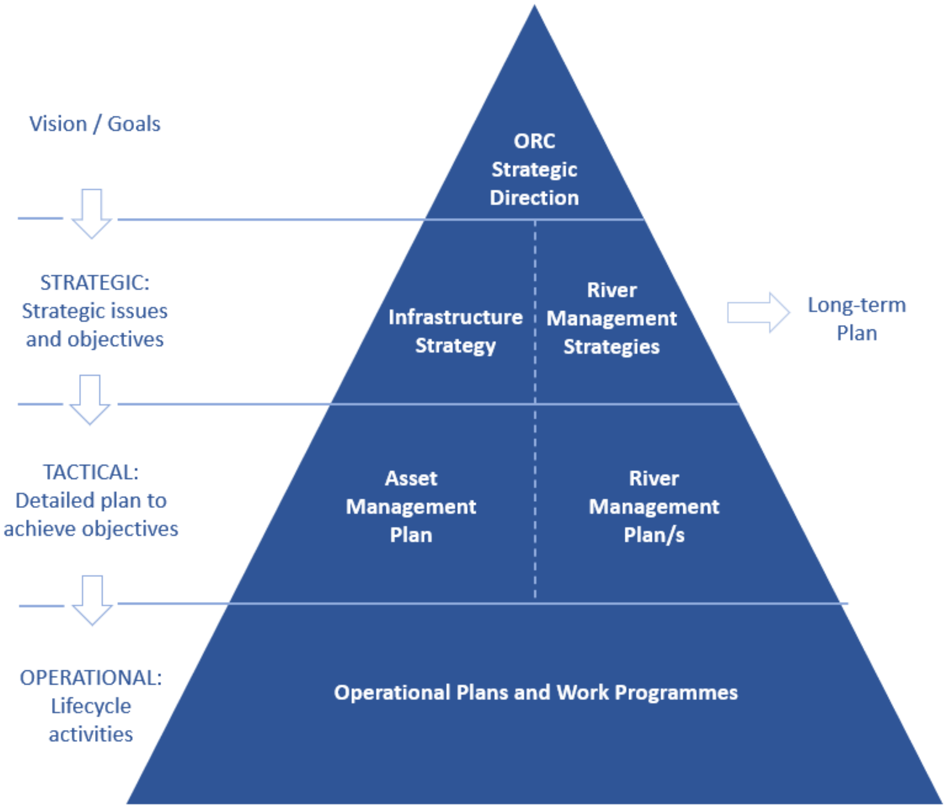


Figure 2. Linkages between the Infrastructure Strategy and other key Council documents. River Management Strategies (Morphology and Riparian Management) currently exist for the following rivers – Waianakarua, Pomahaka, Kakanui, Taieri (Strath Taieri), Shag/Waihemo.

Table 1 summarises the sections included in this Infrastructure Strategy and their content.

Table 1. Sections and content of this Infrastructure Strategy

Section	Content
Introduction	This section discusses the purpose of the Infrastructure Strategy, the minimum legislative requirements to meet and how the Infrastructure Strategy links with other key Council documents.
Infrastructure Overview	This section provides a summary of Council's infrastructure portfolio encompassing flood protection, drainage, and river management infrastructure.
Significant Issues and Options	Key significant issues are highlighted and discussed alongside various options considered to address the issues, the implications of each of those options, and the most likely scenarios for addressing each issue.
Infrastructure Investment Programme	The infrastructure investment programme derived from this Strategy, with its foundation in Council's asset management practices, is presented in this section. Council's key programmes of work and likely significant decision points are addressed, alongside the assumptions and uncertainties associated with this programme.

1.1 Statutory Requirements

The Local Government Act (Section 101B) sets out the requirements for infrastructure strategies, as summarised in Table 2. These requirements are addressed in this Infrastructure Strategy.

Table 2. Local Government Act (Section 101B) requirements for an Infrastructure Strategy

Clause	Detail	Section
1	A local authority must, as part of its long-term plan, prepare and adopt an infrastructure strategy for a period of at least 30 consecutive financial years.	1
2(a)	The purpose of the infrastructure strategy is to identify significant infrastructure issues for the local authority over the period covered by the strategy.	3
2(b)	The purpose of the infrastructure strategy is to identify the principal options for managing those issues and the implications of those options	3
3	The infrastructure strategy must outline how the local authority intends to manage its infrastructure assets, considering the need to: a. renew or replace existing assets; b. respond to growth/decline in the demand for services reliant on those assets; c. allow for planned increases or decreases in levels of service provided through those assets; d. maintain or improve public health and environmental outcomes or mitigate adverse effects on them; e. provide for the resilience of infrastructure assets by identifying and managing risks relating to natural hazards and by making appropriate financial provision for those risks.	3
4	The infrastructure strategy must outline the most likely scenario for the management of the local authority's infrastructure assets over the period of the strategy and, in that context, must:	3
4(a)	show indicative estimates of the projected capital and operating expenditure associated with the management of those assets: i. in each of the first 10 years covered by the strategy; and ii. in each subsequent period of 5 years covered by the strategy	4.2
4(b)	identify: i. the significant decisions about capital expenditure the local authority expects it will be required to make; ii. when the local authority expects those decisions will be required; iii. for each decision, the principal options the local authority expects to have to consider; and iv. the approximate scale or extent of the costs associated with each decision	4.4
4(c)	Include the following assumptions on which the scenario is based: i. the assumptions of the local authority about the life cycle of significant infrastructure assets: ii. the assumptions of the local authority about growth or decline in the demand for relevant services: iii. the assumptions of the local authority about increases or decreases in relevant levels of service	4.5
4(d)	if assumptions referred to in paragraph (c) involve a high level of uncertainty: i. identify the nature of that uncertainty; and ii. include an outline of the potential effects of that uncertainty	4.5

2. Infrastructure Overview

ORC owns and maintains infrastructure across two functions within its Engineering team:

- Flood protection, drainage, and river control schemes
- River management (outside of the schemes)

This section also contains narrative on third-party flood protection, land drainage and river management infrastructure that is not owned, controlled, or maintained by ORC.

2.1 Flood Protection, Drainage and River Control Scheme Infrastructure

Otago Regional Council owns and maintains flood, drainage and river control schemes across Otago. Schemes consist of infrastructure (Figure 1) that has been constructed and is being maintained to assist in the drainage of low-lying areas of land, and/or mitigate the risk of flooding to a particular area. This infrastructure was designed to provide a set performance level of service to the area/s that it serves.

Otago Regional Council owns and maintains the following schemes across Otago:

- Four flood protection schemes:
    - Alexandra Flood Protection Scheme
    - Leith Flood Protection Scheme
    - Lower Taieri Flood Protection Scheme
    - Stoney Creek Flood Protection Scheme
- Three drainage schemes:
    - East Taieri Drainage Scheme
    - West Taieri Drainage Scheme
    - Tokomairiro Drainage Scheme
- One combined flood and drainage scheme – Lower Clutha Flood Protection and Drainage Scheme
- One river control scheme – Lower Waitaki River Control Scheme (portion within Otago)

Figure 3 depicts the location of each scheme. Lindsay Creek Flood Mitigation Scheme is indicated in this figure as a provisional scheme as a programme of work exists to further investigate and implement a scheme following Council decisions within the lifetime of this Strategy (see Infrastructure Investment Programme).

Not all infrastructure is located within the schemes listed above. A smaller quantity of infrastructure exists outside of flood protection and drainage schemes and is managed as part of the river management infrastructure portfolio. This infrastructure is detailed in the following section.

This section provides more detail on each of the flood protection and drainage schemes across Otago, including the key contextual considerations associated with managing each scheme at a strategic level.

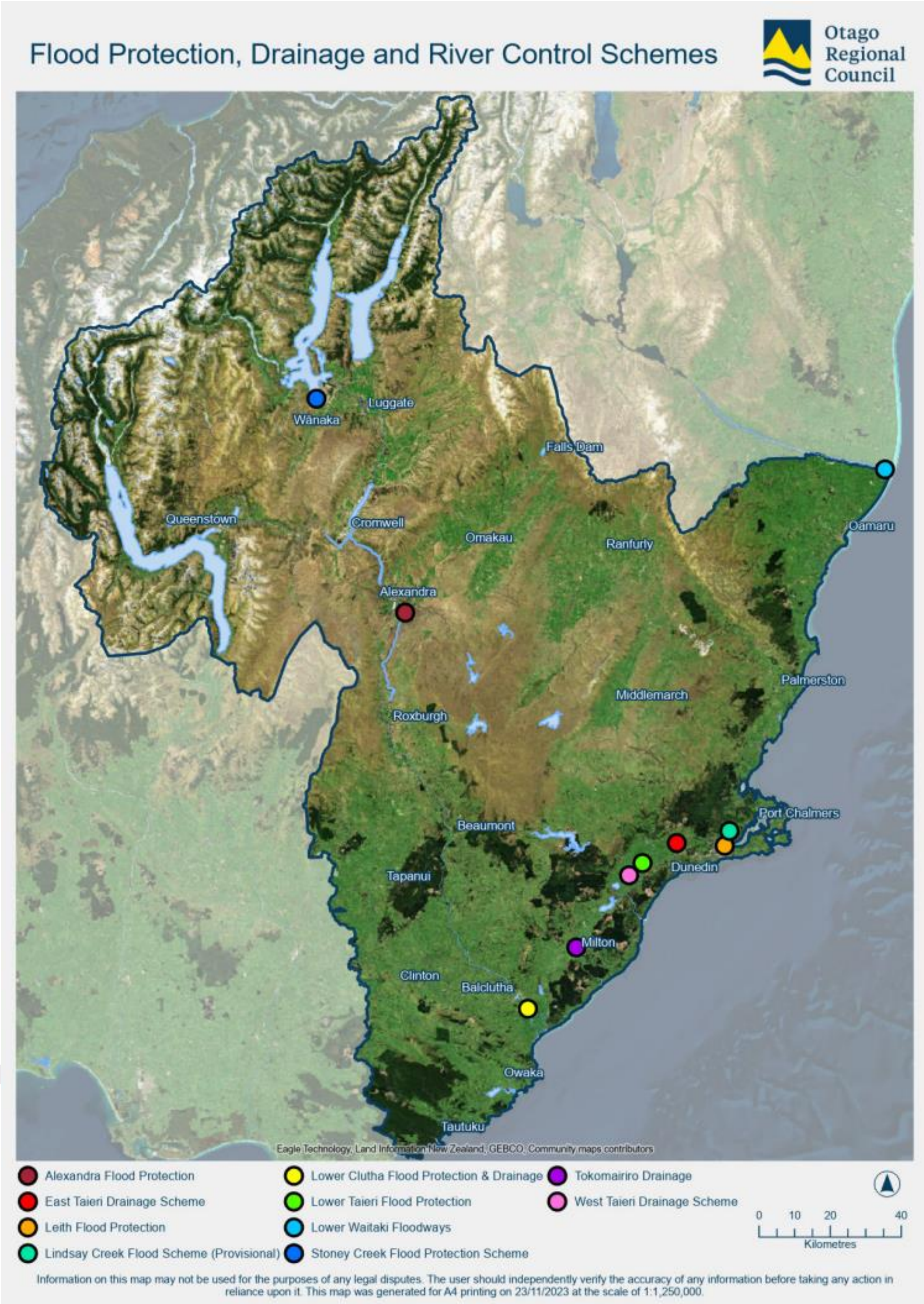


Figure 3. Location of flood protection and drainage schemes across Otago

Flood protection, river and drainage infrastructure, and the schemes it makes up, primarily consist of floodbanks, pump stations and culverts. Table 3 provides a high-level summary of the key flood protection and drainage infrastructure included within this strategy.

Table 3. Asset portfolio summary for flood protection and drainage schemes across Otago. This list is meant as a summary of the key infrastructure and is therefore not exhaustive.

Scheme	Catchment Area (,000 ha)	Area Protected (,000 ha)	Infrastructure Assets					
			Floodbanks (km)	Open Drains (km)	Pump Stations	Culverts	Bridges	Other
Alexandra Flood Protection Scheme	1,511	0.01	1	-	3	-	-	-
Leith Flood Protection Scheme	4	0.2	-	-	-	-	-	Concrete or rock weirs: 29 Debris traps: 2 Concrete/stone walls: 2.2 km Concrete/stone channels: 2.8 km Rock retaining walls: 1.7 km Gabion basket walls: 200 m
Lower Clutha Flood Protection and Drainage Scheme	2,110	9.3	110	153	5	189	4	-
Lower Taieri Flood Protection Scheme	565	13	107	-	-	-	-	-
West Taieri Drainage Scheme	8	8.1	-	144	3	22	20	-
East Taieri Drainage Scheme	17	4.8	-	128	3	84	1	-
Tokomairiro Drainage Scheme	40	7.7	-	110	-	74	17	-
Lower Waitaki River Control Scheme *	N/A	N/A	-	-	-	-	-	Groynes: 8 Cross-banks: 6 Trees: 22 km
Total	**4,256**	**43**	**218**	**535**	**14**	**369**	**42**	**N/A**

**Note that only a portion of the Lower Waitaki River Control Scheme is located within Otago. The floodways are managed as part of the river management infrastructure portfolio.*

There are some key contextual considerations that are currently impacting, or are expected to impact, on all scheme infrastructure throughout the lifetime of this Infrastructure Strategy. These issues provide further context for the overarching significant issues, decision-making timeframes and investment programme detailed later in this Infrastructure Strategy. Table 4 details those contextual considerations that are common across all schemes, while the following sections detail more specific contextual considerations pertaining to individual schemes.

Table 4. Contextual considerations that are common across all schemes

Description of Contextual Consideration
Residual flood risk posed by the proximity of waterways, flood protection, drainage, and river management infrastructure, to sensitive land use activities.
Community and infrastructure adaptation may be required over the lifetime of this Infrastructure Strategy to address the climatic changes that result from increasing frequency and intensity of rainfall events.
Safe and reliable handing of super design rainfall events and flows.
Managing natural processes, for example gravel movement and sediment transport processes, to balance protection and environmental significance of our natural and built environments.
Schemes consist of hard engineering infrastructure that is not always conducive to allowing rivers room to move and better enable environmental benefits and the natural management of flood waters.

2.1.1 Alexandra Flood Protection Scheme

The Alexandra Flood Protection Scheme mitigates the risk of flooding, caused by high flows in the Clutha and Manuherikia Rivers, to approximately 10 hectares of the Alexandra township, including residential and commercial properties.

Three major floods entered the town and flooded residential and commercial areas in 1994, 1995 and 1999, exacerbated by sedimentation caused by the Roxburgh Dam. The Alexandra Flood Protection Scheme was subsequently built in 2001 and consists of approximately 1.1km of floodbanks and three pump stations. The design philosophy of the scheme is to provide protection for a conservative flood water level (matching the largest flood event on record) at the Alexandra bridge over the Clutha River, just upstream of the confluence with the Manuherikia River.

The stormwater drainage system in Alexandra drains to each of the three pump stations. The pump stations allow stormwater and seepage water to drain under gravity conditions while river levels in the Manuherikia and Clutha Rivers are low, or pump when river levels are high. Two roads penetrate the floodbanks, so these roads are closed and stoplogs installed during severe floods.

Table 5 outlines some of the key contextual considerations that are currently impacting, or are expected to impact, on the Alexandra Flood Protection Scheme throughout the lifetime of this Infrastructure Strategy.

Table 5. Contextual considerations impacting, or expected to impact, on the Alexandra Flood Protection Scheme.

Description of Contextual Considerations
Management of the sediment and the changing characteristics to the lakes and rivers (including confluence of Manuherikia and Clutha), which is through Contact Energy Limited's resource consents.
Sediment deposition within Lake Roxburgh and the Clutha Mata-Au / Manuherikia River confluence and its contribution to flood hazard at Alexandra.
Flood damage compensation conditions in Contact Energy Limited's resource consents for damming of the Clutha River at Lake Roxburgh. This resource consent expires in 2042.
Renewal of Contact Energy Limited's resource consents for the Clutha Hydro Scheme in 2042.

2.1.2 Leith Flood Protection Scheme

The Leith Flood Protection Scheme mitigates the risk of flooding to an area of approximately 200 hectares extending from Malvern Street in Glenleith to the north, to Rattray Street in the Dunedin CBD to the south.

The Water of Leith catchment is located to the north of the Dunedin Central Business District (CBD) and has a catchment area of approximately 42 square kilometres. Key Dunedin infrastructure such as the existing and new Dunedin Hospitals, University of Otago, Otago Polytechnic Te Pūkenga, and Forsyth Barr Stadium are afforded some level of protection protected by the scheme. The upper section of the catchment and its tributaries, that include Lindsay Creek that flows through North East Valley, are relatively steep hydraulically compared to the flatter lower reaches. These catchment characteristics allow floodwaters to rise quickly.

Table 6 outlines some of the key contextual considerations that are currently impacting, or are expected to impact, on the Leith Flood Protection Scheme throughout the lifetime of this Infrastructure Strategy.

Table 6. Contextual considerations impacting, or expected to impact, on the Leith Flood Protection Scheme

Description of Contextual Considerations
The proximity of the lower reaches of the Water of Leith to Dunedin Central Business District, as well as to University of Otago and Otago Polytechnic Te Pūkenga, means that there is public interest and opportunities to provide public access and amenity value, particularly from Forth Street to the harbour where previous work to improve flood resilience and amenity did not reach.
Historically, substantial lengths of the Water of Leith were channelised using concrete and stone walls to minimise bank erosion and facilitate urban development of the floodplain. Due to their age, the walls likely require replacement during the lifetime of this Infrastructure Strategy. This also provides an opportunity to improve environmental and amenity qualities of this waterway.

2.1.3 Lower Clutha Flood Protection and Drainage Scheme

The Lower Clutha Flood Protection and Drainage Scheme mitigates the risk of flooding and facilitates land drainage to the Lower Clutha Delta, which extends from 4km north of Balclutha to the sea. The flood and drainage scheme covers an area of approximately 9,300 hectares (flood and drainage scheme combined).

This scheme combines both flood protection and drainage works. Construction of this scheme started in 1960 and was completed in 1991. The Clutha is the second longest river in New Zealand, and the largest by mean flow. The Clutha's headwaters are in the Southern Alps above lakes Wakatipu, Wānaka, and Hāwea. The Clutha River bifurcates (splits into two) just downstream of Balclutha. Between 60% and 70% of the flow goes down the Koau Branch and 30% to 40% down the Matau Branch. The island formed between the branches is called Inch Clutha. There is a floodway (area designed to carry floodwaters when the river level rises) at the top of Inch Clutha. As well as the Clutha River/Mata-Au, water flows into the delta from several other sources including Lovells Stream and Lake Tuakitoto; Waitepeka River; Puerua River and Barrata Creek. Land drainage is provided by a network of 153 km of drains in four regions: Barnego; Stirling/Kaitangata; Inch Clutha; and Otanomomo/Paretai. Drainage in Balclutha and Finegand is not owned or operated by the ORC.

Coastal erosion and shoreline retreat is a known issue to be impacting the flood protection and drainage infrastructure within the scheme and is projected to expose more of this coastal infrastructure to the impacts of sea level rise and coastal inundation well into the future, directly impacting on training lines and floodbanks, as well as impacting the functionality land drainage within the scheme. The southern training line at the Koau mouth of the Clutha Mata-Au River is already suffering damage from such exposure which in turn impacts on the culverts within the structure to drain the Puerua River and subsequently the drainage component of the scheme. Significant decisions will need to be made in the near future about adaptation of the scheme in this area.

Table 7 outlines some of the key contextual considerations that are currently impacting, or are expected to impact, on the Lower Clutha Flood Protection and Drainage Scheme throughout the lifetime of this Infrastructure Strategy.

Table 7. Contextual considerations impacting, or expected to impact, on the Lower Clutha Flood Protection and Drainage Scheme

Description of Contextual Considerations
Shoreline retreat affecting the functioning of flood protection and drainage infrastructure in the Lower Clutha delta. As the shoreline naturally migrates inland, there is increasing exposure of this infrastructure to coastal hazards such as storm surge and wave action.
Rising sea and groundwater levels impacting on drainage infrastructure such as drains and pump stations.
Residual flood risk posed by the proximity of the Clutha River and its tributaries to Balclutha and its surrounding townships and industries.
Contact Energy Limited funding, under their resource consent conditions, contributes towards riverbank/coastal erosion reporting (50%), remedial actions from reporting/inspections (50%) and maintaining efficient egress (90%). Contact Energy Limited Consents expire in 2042.
Renewal of Contact Energy Limited’s resource consents for the Clutha Hydro Scheme in 2042.

2.1.4 Tokomairiro Drainage Scheme

The purpose of the Tokomairiro Drainage Scheme is to ensure the provision of effective and reliable land drainage for the Tokomairiro area surrounding Milton, and to reduce flooding impacts on Milton and its surrounds.

The Tokomairiro Drainage Scheme is situated in the flat basin surrounding Milton, surrounded on three sides by inland hills, and by coastal hills to the southeast. The scheme consists entirely of open drains, with associated culverts and bridge crossings, designed to assist in the drainage of relatively low-lying farmland in this area. It has no pumps or control structures. Many of the drains were originally creeks that have been realigned.

The contextual considerations that are current impacting, or are expected to impact, on the Tokomairiro Drainage Scheme throughout the lifetime of this Infrastructure Strategy are outlined in Table 4 (contextual considerations common across all schemes).

2.1.5 Lower Taieri Flood Protection Scheme

The Lower Taieri Flood Protection Scheme mitigates the risk of flooding to the Taieri plains, including the townships of Mosgiel, Outram and Henley, as well as critical infrastructure such as key transport routes (state highway and railway networks), Dunedin airport and power and three waters utility infrastructure.

The Lower Taieri Flood Protection Scheme was the first scheme to be developed in Otago, alongside the East and West Taieri Drainage Schemes, when works commence in 1870. It is a complex network, with multiple rivers affecting the scheme. The scheme makes use of ponding areas that act to detain peak flows and ease pressure on downstream portions of the scheme, subsequently minimising the risk of failure of the scheme. Silver Stream, Waipori River and the Ōwhiro Stream are also tributaries to this lower portion of the Taieri River.

Table 8 outlines some of the key contextual considerations that are currently impacting, or are expected to impact, on the Lower Taieri Flood Protection Scheme throughout the lifetime of this Infrastructure Strategy.

Table 8. Contextual considerations impacting, or expected to impact, on the Lower Taieri Flood Protection Scheme

Description of Contextual Considerations
Known structural deficiencies with existing Taieri River floodbanks.

2.1.6 West Taieri Drainage Scheme

The West Taieri Drainage Scheme facilitates the effective and reliable drainage of the land in West Taieri, the area bounded by the floodbanks and Contour Channel that form part of the Lower Taieri Flood Protection Scheme.

The West Taieri Drainage Scheme covers the area bounded by the Taieri River, Lake Waipori, and the West Taieri Contour Channel. A small part of the scheme lies within the Henley Floodway. The West Taieri area differs from the other drainage schemes in that water cannot drain out of the scheme under gravity: it must be pumped out. A significant portion of the scheme lies at or below 1m of sea level. There are three pump stations in the West Taieri Drainage Scheme: Waipori; Henley; and Lake Ascog.

Table 9 outlines some of the key contextual considerations that are currently impacting, or are expected to impact, on the West Taieri Drainage Scheme throughout the lifetime of this Infrastructure Strategy.

Table 9. Contextual considerations impacting, or expected to impact, on the West Taieri Drainage Scheme

Description of Contextual Considerations
Increasing pressure for land drainage schemes to manage urban stormwater runoff, resulting from increased demand for urban development (Outram).
Vulnerability of floodbank along edge of Lake Waipori to seismic event leading to “sunny day” flooding of parts of West Taieri and damage to the Waipori Pumping Station.
Potential for rising groundwater due to sea level rise.

2.1.7 East Taieri Drainage Scheme

The East Taieri Drainage Scheme facilitates the effective and reliable drainage of the land in East Taieri.

The East Taieri Drainage Scheme is physically divided into two areas by the Silver Stream, which flows across the Taieri Plain in a south-westerly direction. Drains on the northern side of the Silver Stream generally flow toward what is called the Upper Ponding area. Drains on the Southern side of the Silver Stream flow toward the Lower Ponding area. When the Taieri River is at low flow these drains flow out to the river by gravity, whereas when the Taieri River is at high flows, gravity gates close and pump stations are used.

Table 10 outlines some of the key contextual considerations that are currently impacting, or are expected to impact, on the East Taieri Drainage Scheme throughout the lifetime of this Infrastructure Strategy.

Table 10. Contextual considerations impacting, or expected to impact, on the East Taieri Drainage Scheme

Description of Contextual Considerations
Land use changes to allow for more residential development and increasing pressures for land drainage infrastructure to manage urban stormwater runoff.
Increasing pressure for land drainage schemes to manage urban stormwater runoff, resulting from increased demand for urban development.

2.1.8 Lower Waitaki River Control Scheme

The purpose of the Lower Waitaki River Control Scheme is to maintain the system of braided river channels within defined fairway and active riverbed widths, and to limit erosion of the active bed vegetated margins.

The Lower Waitaki River Control Scheme is made up of groynes and riparian plantings that aid in the limiting the position of the fairway. Most of this infrastructure was initially established by the former Waitaki Catchment Commission in the 1960s and 1970s. The Otago Regional Council owns this infrastructure within its boundary on the right back of the lower portion of the Waitaki River. The management of this infrastructure is contracted to Environment Canterbury as part of their overall management of the Lower Waitaki River Control Scheme[1] that falls predominantly within the Canterbury region. Flows in the river are moderated by a series of dams that were constructed on the river, starting with the Waitaki Dam in the 1920s and 1930s. In 2023 Meridian Energy applied for consents for the continued operation of the Waitaki Hydro Scheme.

There are also three floodways that assist in conveying flows from the foothills, across low lying farmland to the Waitaki River, however these are managed separately as river management infrastructure.

Table 11 outlines some of the key contextual considerations that are currently impacting, or are expected to impact, on the Lower Waitaki River Control Scheme throughout the lifetime of this Infrastructure Strategy.

[1] Lower Waitaki River Control Scheme Operation Agreement, Otago Regional Council and Canterbury Regional, signed 2023.

Table 11. Contextual considerations impacting, or expected to impact, on the Lower Waitaki River Control Scheme

Description of Contextual Considerations
Ongoing community expectation to manage funding of repair and maintenance works that result from repeated flood events typical within the dynamic braided environment of the Waitaki River.
Meridian Energy fund 30% of the operation and maintenance costs of the Lower Waitaki River Control Scheme. The funding is not recorded in a formal agreement.
Joint management and funding of scheme with Environment Canterbury. Agreement in place to document respective rights and responsibilities.

2.1.9 Stoney Creek Flood Protection Scheme

Stoney Creek has a steep alpine catchment that discharges into Lake Wanaka across an alluvial fan. Increased urban development of the alluvial fan in the early 2000's led to the need for infrastructure to be established to mitigate the risk of alluvial fan migration and flood risk. The work consisted of developing a system of natural and engineering features, including channel modifications and debris traps, as part of Stage 1 of the work. Stage 2 of this work is planned to be completed within the lifetime of this Strategy.

The contextual considerations that are current impacting, or are expected to impact, on the Stoney Creek Flood Protection Scheme throughout the lifetime of this Infrastructure Strategy are outlined in Table 4 (contextual considerations common across all schemes).

2.2 River Management Infrastructure

Otago Regional Council also owns and maintains river management infrastructure across Otago. This includes several smaller schemes and isolated pieces of infrastructure outside of the main flood protection and drainage schemes discussed previously. Figure 4 depicts the location of key river management infrastructure across Otago and is summarised as follows:

- Shotover Training Line, Queenstown – Guides flows and sediment in the Shotover River.
- Matukituki Training Line, Matukituki River – Training line structure that deflects flood waters to the true left of the Matukituki River so that the downstream floodplain on the right bank could be re-established as farmland.
- Albert Town Rock Buttress, Albert Town – Mitigate the risk of erosion and land movement.
- Lower Waitaki Floodways, North Otago – Conveyance of flows from foothills to the Waitaki River.
- Lindsay Creek, Dunedin – Some rockwork and concrete walls exist to minimise erosion and help retain the creek within its existing channel.
- Trees and vegetation that is planted and maintained along river channels and margins to mitigate the risk of erosion and manage channel migration.
- Placed rock to mitigate the risk of erosion.

Some of these assets are not fully captured in the asset management database and work will be ongoing to ensure this infrastructure is accurately recorded in the database.

There are some key contextual considerations that are currently impacting, or are expected to impact, on Council infrastructure within river management areas, outside of the flood protection, drainage and river control schemes. These issues provide further context for the overarching significant issues, decision-making timeframes and investment programme detailed later in this Infrastructure Strategy. Table 12 details those contextual considerations within each river management area.

Table 12. Contextual considerations impacting, or expected to impact, on Council infrastructure within each river management area

Description of Contextual considerations
General
Residual flood risk posed by the proximity of waterways to their surrounding land use activities.
Community and infrastructure adaptation will be required over the lifetime of this Infrastructure Strategy to address the climatic changes that result from increasing frequency and intensity of rainfall events.
Dunedin River Management Area
Sections of Lindsay Creek have insufficient channel capacity to convey flood flows, increasing the risk of flows breaking out into nearby properties and roads. A higher and more uniform standard of flood protection will need to be considered to provide a standard of flood protection that is more comparable with other urban areas across New Zealand. It is envisaged that a works will be required for flood risk management during the lifetime of this Strategy which is noted as a provisional Lindsay Creek Scheme which may consist of natural built and built features.
Debris flow and flood risk mitigation for the Middlemarch area – Rainfall events in recent years have caused streams to rise and break out of their channels, resulting in flooding in and around the Middlemarch area. Further work is required, alongside the Dunedin City Council, to investigate and put appropriate measures in place to mitigate these risks.
Whakatipu River Management Area
Ongoing river management activities in relation to Dart and Rees River floodplains and Glenorchy, as related to the Head of Lake Whakatipu work programme led by Natural Hazards.
Wānaka River Management Area
Alluvial fan migration and flood risk management for Stoney Creek. Stage 2 works are envisaged during the lifetime of this Strategy.

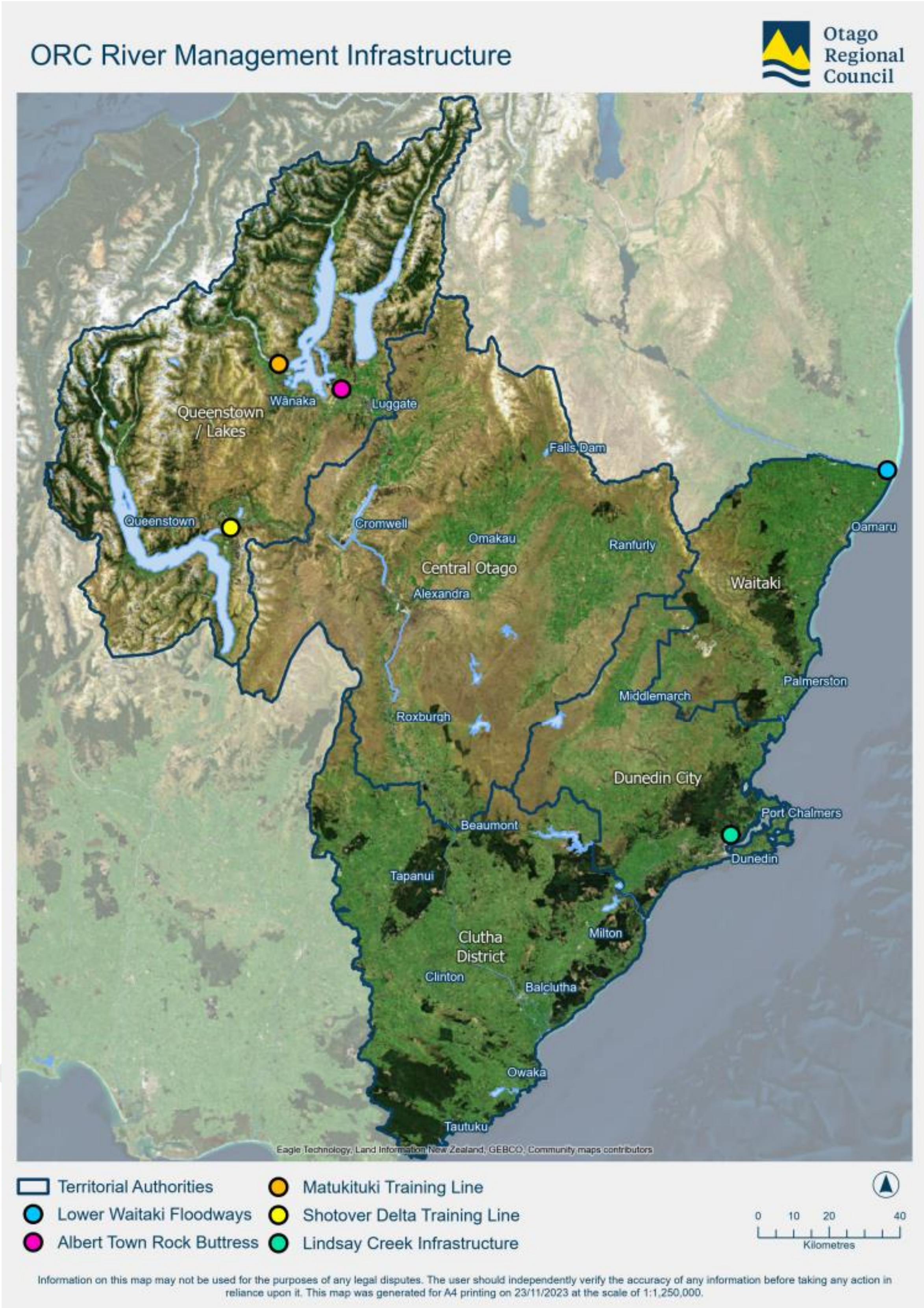


Figure 4. Location of key infrastructure within river management areas

2.3 Third-Party Infrastructure

Not all flood protection, land drainage and river management infrastructure in Otago is owned, controlled or maintained by ORC. Third parties including territorial authorities, government agencies and private landowners also construct, own, control and maintain such infrastructure. Notable examples include (but are not limited to):

- Hospital Creek floodbank, Balclutha (Clutha District Council)
- Tokomairiro River floodbank and stormwater pumping station, Milton (Clutha District Council)
- Milton diversion swale, Milton (Clutha District Council)
- Tuapeka Creek Channel Lining, Lawrence (Clutha District Council)
- Glenorchy floodbank, Glenorchy (Queenstown Lakes District Council)
- Horne Creek channel, sports field detention area and bund and detention dam, Queenstown (Queenstown Lakes District Council)
- Shotover delta revetment attached to ORC's training line, Queenstown (Queenstown Lakes District Council)
- Shotover Country subdivision rock revetment, Queenstown (Queenstown Lakes District Council)
- Reservoir Creek channel lining, Roxburgh (Central Otago District Council)
- Abbotsford landslide stormwater control and dewatering infrastructure, Dunedin (Dunedin City Council)
- Clutha River/Mata-Au rockwork, Bendigo (adjacent private landowners)
- Karitane estuary rock groyne (abandoned)
- Lindsay Creek, Dunedin (some infrastructure along Lindsay Creek is owned, controlled and maintained by Dunedin City Council and adjacent private landowners)

This Infrastructure Strategy assumes that ORC does not take on ownership, control or maintenance of this infrastructure.

ORC is also not responsible for infrastructure that forms part of other utility networks such as power conduits, water/wastewater pipework, or road and rail bridges. These come under the jurisdiction of the utility or network owner. Where appropriate the ORC liaises with territorial authorities and utility owners to align work programmes in proximity to this infrastructure where practicable.

3. Significant Issues and Options

This section summarises the significant issues that the Otago Regional Council faces in the management of flood protection, drainage and river management infrastructure, and the principle options and implications available to Council in the management of these issues throughout the lifetime of this Strategy and beyond. These issues are presented diagrammatically in Figure 5. All significant issues are inextricably linked to one another, with one common denominator being 'Risk Exposure'.

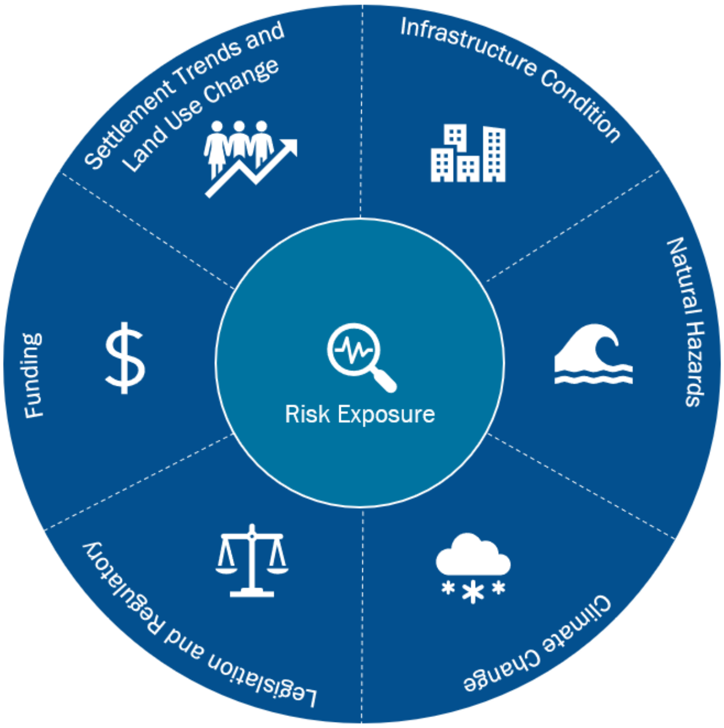


Figure 5. Significant issues and associated links

The following pages in this section provide detail on why each issue has been identified, Council's preferred approach to managing the issue and the alternative approaches identified. While Council has a preferred approach to managing the issues, the alternative scenarios are sometimes dependent on external factors such as unforeseen environmental or economic factors outside of Council's control.

3.1 Significant Issue: Risk Exposure

Risk exposure is at the core of the significant issues identified. This is because Council's response to all the other issues identified will always impact on the level of risk to which Council's infrastructure, people and their communities and lifelines are exposed. The Council's response to all other issues will ultimately impact on the risk associated with the operation of Council's flood protection, drainage, and river management infrastructure. In turn, the operation of the Council's infrastructure will subsequently impact on the overall risk and resilience of communities and their awareness of such.

Extreme weather events that have occurred in New Zealand in recent times (for example, Cyclone Gabrielle's impact on parts of the North Island in February 2023) have illustrated the impact such extreme events can have on flood protection infrastructure and its criticality for providing lifelines and community resilience. Over the last five years Otago has experienced several flood events, most notably in November 2019, February 2020, January 2021, July/August 2022, and September 2023. With the occurrence of recent and ongoing extreme weather events comes expanding community interest in the performance of flood protection infrastructure and the associated vulnerabilities and resilience of communities.

The modern approach to flood risk management is to take greater account of residual risk and consider how schemes and infrastructure perform beyond design up to Probable Maximum Flood or Maximum Credible Event. Infrastructure should be designed to fail safely under super design (overdesign) events. ORC is incorporating this approach into the way it manages its schemes and infrastructure.

Over time several factors may affect the ability of flood protection, drainage, or river management infrastructure to meet the standards it was designed to, including:

- Changes in the climate that impact on the intensity of rainfall events and their duration.
- Changes in community tolerance and vulnerability.
- Changes in the geomorphology of the landscape within river catchments that prompts changes in river behaviour, such as increased build-up of sediment in the lower lying reaches of the schemes, that in turn leads to a reduction in capacity of a flood protection scheme during a flood event.
- Improved hydrological analyses and understanding of the behaviour of the natural environment in response to the environmental and geomorphological changes outlined above.

Understanding risk exposure associated with living, working, and playing around Otago's rivers is an important consideration in future decision making about the levels of service provided by flood protection, land drainage and river management infrastructure. It is vital that communities are part of longer-term decision making around risk tolerance and associated costs.

Principal Options and Implications

Table 13 summarises the principal options that Council has considered to address risk as a significant issue. It also summarises the potential implications identified for each option and identifies the preferred option/s selected.

Table 13. Principal options for managing the significant issue of risk, and the associated implications of those options

Principal Options	Implications	Preferred Option/s
Undertake periodic risk assessments of scheme condition and performance to inform risk analysis. Incorporate analysis of super design events to further inform understanding and communication of risk.	• Improved and ongoing understanding of risk and associated implications of that risk on infrastructure and communities. • Ability to share information with communities to improve their understanding of risk and resilience, to better enable their decision making around what this may mean to them. • Alignment with what New Zealanders are experiencing, and will continue to experience, in relation to extreme rainfall/flood events across the country.	✓
Increased community engagement about risk and resilience. Share learnings with affected communities to involve them in decision making about potential changes to levels of service.	• Communities are better informed about risk and resilience in relation to how it may impact on them and their livelihoods. • Community involvement in decision making process about future changes to levels of service that may impact on them.	✓
Incorporate resilience improvements into maintenance and renewals where appropriate.	• Proactive approach to incorporating resilience where appropriate, leading to improved resilience over time. • Improved community resilience over time. • Ability to incorporate design considerations for Probable Maximum Flood or Maximum Credible Event, including designing infrastructure to fail safely.	✓
Maintain or increase current levels of service in response to risk analysis.	• Existing level of flood mitigation is provided to communities. • Maintains status quo while risks are better understood in relation to this significant issue and others. • Enables incorporation of resilience measures as part of the toolbox to mitigate the risk of flooding and enable recovery.	✓
Incorporate learnings from community engagement and response to other significant issues into decision making when considering potential changes to levels of service.	• Acknowledgement that some changes to levels of service may be necessary based on increased understanding of risk and community and Council direction. • Ability to programme and plan expenditure around any potential changes to levels of service.	✓

Examples of the Preferred Option/s in Practice

The following are examples of the types of work programmes that would be implemented by adopting the most likely scenario for managing infrastructure in response to risk as a significant issue:

- Routine condition and risk assessments.
- Ongoing community engagement to share information about risk and gather feedback on possible future changes to levels of service.
- Forward planning and prioritisation for increases to levels of service where these are appropriate based on risk and community feedback.
- Where possible provide for super design events up to Probable Maximum Flood/Maximum Credible Event and ensure communities understand the implications and impacts of residual risk.
- Use infrastructure as just one component of the wider PARA framework.
- Utilise ORC's Natural Hazards Risk Framework (in preparation) to inform prioritisation.

3.2 Significant Issue: Infrastructure Condition

Otago Regional Council's flood protection, drainage and river infrastructure has been constructed over a period of 150 years. This means that construction records for some of the older flood protection, drainage, and river infrastructure do not exist or are not up to today's quality standard in terms of construction method or materials. Floodbanks alone have several potential failure modes including overtopping during flood conditions, slope and foundation stability (under flood, non-flood and seismic conditions), and seepage through the floodbank or its foundation.

Also, as infrastructure ages the condition can degrade, the technology becomes redundant, or the principle of Te Mana o te Wai changes the way we consider the ongoing use of some structures in proximity to Otago's waterways. Factors such as installation, operational environment and manufacturing defects can also reduce the useful life of infrastructure. Continuing to maintain assets beyond their intended useful life:

- can increase the frequency and cost of operation and maintenance activities, including the risk of failure,
- does not enable forward planning to design and construct fit for purpose solutions with longer term environmental outcomes, and
- can lead to a lengthy amount of time while decisions are made, and the infrastructure can be replaced or adapted.

Principal Options and Implications

Table 14 summarises the principal options that Council has considered to address infrastructure condition as a significant issue. It also summarises the potential implications identified for each option and the preferred option/s selected.

Table 14. Principal options for managing the significant issue of infrastructure condition, and the associated implications of those options

Principal Options	Implications	Preferred Option/s
Take a risk management approach to prioritise and schedule infrastructure renewals and subsequent investment over the lifetime of the infrastructure.	• Planned approach that enables multiple benefits to be realised where relevant. • Reduced operational risk with increased reliability of performance during flood events and increased confidence in resilience. • Planned expenditure. • Some programme flexibility should there be a flood event that reprioritises programme or expenditure.	✓
Replace infrastructure at point of failure.	• Heightened operational risk and decreased confidence in resilience. • Unreliable infrastructure with unknown performance during flood events. • Unplanned expenditure.	✗

Examples of the Preferred Option/s in Practice

The following are examples of the types of work programmes that would be implemented by adopting the most likely scenario for managing infrastructure in response to infrastructure condition as a significant issue:

- Ongoing maintenance and inspection programmes for infrastructure, for example bridges, culverts, floodbanks, drains and pump stations.
- Renewals being scheduled based on identified risks and prioritised accordingly. Programme of renewals managed to balance risk and funding availability where possible.
- Assessment and analysis of floodbank condition and integrity for a range of potential failure modes.
- Control external activities that may impact on infrastructure condition through the Designations and Bylaw approval processes, avoiding activities that increase residual risk.

3.3 Significant Issue: Natural Hazards

The Otago region comprises a diverse and dynamic environment ranging from flat coastal lowlands and intensively used alluvial floodplains, through to large sparsely populated and steep mountainous areas. As such Otago is exposed to a broad range of natural hazards, including flooding, landslides, debris flows, seismic activity, coastal erosion, tsunami, storm surge and wind.

These natural hazards all present hazards to flood protection, drainage and river management infrastructure. For example, major earthquakes could result in cracking, slumping and/or settlement of floodbanks.

Principal Options and Implications

Table 15 summarises the principal options that Council has considered to address natural hazards as a significant issue. It also summarises the potential implications identified for each option and identifies the preferred option/s selected.

Table 15. Principal options for managing the significant issue of natural hazards, and the associated implications of those options

Principal Options	Implications	Preferred Option
Maintain current hazard readiness, response and recovery processes.	• Learnings established from observations during flood events (both in Otago and nationally) will not be incorporated into hazard readiness, response, and recovery processes. • Heightened risk of poor planning and associated impacts on people and wider communities if practices are not updated to reflect learnings. • Resiliency of communities diminishes over time.	✗

Principal Options	Implications	Preferred Option
Maintain and improve current practice around hazard readiness, response and recovery, as Council continues to learn from past events across the region and New Zealand.	• Learnings incorporated into processes to improve readiness, response, and recovery. • Ability to work with communities to develop further resilience.	✓
Align with readiness and response to natural hazard events within ORC and external stakeholders.	• Support Civil Defence Emergency Management. • Development of consistent response and recovery plans across ORC and external stakeholders.	✓

Examples of the Preferred Option/s in Practice

The following are examples of the types of work programmes that would be implemented by adopting the most likely scenario for managing infrastructure in response to natural hazards as a significant issue:

- Up to date preparedness for flood response and recovery that contributes to community preparedness and resilience, and enables an efficient response and recovery in relation to infrastructure damage.
- Co-ordinated response to flood response across Otago Regional Council and external stakeholders.
- Where possible, design infrastructure to be resilient to the effects of natural hazards.

3.4 Significant Issue: Climate Change

Otago's climate is changing, and with increases in temperature come other impacts, such as changes in precipitation and wind patterns. These in turn can increase the intensity and frequency of rainfall events, and wind patterns, leading to increased flows in rivers and changes in coastal shoreline brought on by sea level rise and coastal erosion processes.

In 2019 the National Institute of Water and Atmospheric Research (NIWA) analysed projected climate changes, including hydrological change, for the Otago region and reported that changes to Otago's future climate are likely to be significant with extreme, rare events projected to become more severe, and average annual flows expected to increase across the region, with floods expected to become larger.

The effects of climate change will impact the environment both regionally and nationally. There will be sea level rise, and changes in wind and weather patterns, higher water tables, and the frequency of extreme weather events will increase. These climatic changes will put increased pressure on flood protection, drainage, and river management infrastructure, and challenge the levels of service they can provide. The uncertainty associated with the rate of future climate change will require an adaptive approach that will require infrastructure to be relocated, modified, or created.

Principal Options and Implications

Table 16 summarises the principal options that Council has considered to address climate change as a significant issue. It also summarises the potential implications identified for each option and identifies the preferred option/s selected.

Table 16. Principal options for managing the significant issue of climate change, and the associated implications of those options

Principal Options	Implications	Preferred Option/s
Little investment in understanding future climate change effects on flood protection, drainage and river management infrastructure.	• Reactive approach to climate change and potential increases or changes to levels of service. • Changes to levels of service may be costly in terms of capital expenditure and or personal costs to communities.	✗
Investment in understanding future climate change effects on flood protection, drainage and river management infrastructure.	• Incorporation of this knowledge into decision-making processes to enable informed decisions, alongside communities, on changes to levels of service where appropriate. • Allows for time to make decisions around levels of service, and ability to prioritise changes where necessary.	✓
Incorporation of climate change learnings into wider community led adaptation planning.	• Working with communities to understand the critical role of infrastructure and the impact of climate change. • Active engagement on information to provide communities with knowledge of how infrastructure adaptation may impact future considerations and decisioning.	✓

Examples of the Preferred Option/s in Practice

The following are examples of the types of work programmes that would be implemented by adopting the most likely scenario for managing infrastructure in response to climate change as a significant issue:

- Work programmes would take account of the Otago Climate Change Risk Assessment.
- Incorporation of impacts into risk assessments and analysis of future scheme performance. This in turn would further enable risk-based prioritisation of renewals or changes in levels of service, including the timing of such renewals. These decisions could utilise Toka Tu Ake EQC's Risk Tolerance Methodology.
- Community engagement on climate change and impacts on levels of service to support planning and decision-making around adaptation.
- Adopt the Dynamic Adaptive Pathways Approach (DAPP) to management of infrastructure.

3.5 Significant Issue: Legislation and Regulatory

Otago Regional Council's flood protection and drainage schemes were designed and built at various times over the past 150 years and reflect the values, knowledge and understanding of the time that they were designed and constructed. Most of these schemes were developed and constructed in an era when economic growth and development were the primary focus. Flood protection and drainage infrastructure enabled farmland and agricultural initiatives to develop and prosper.

Community values and expectations have changed, and will continue to change, in relation to environmental outcomes and the legislation that regulates associated standards and performance. The following are examples of such changes that will impact on the management of flood protection, drainage, and river management infrastructure:

- Three Waters Reform.
- Resource Management Reform, including the proposed Climate Change Adaptation Act.
- The outcomes of the government inquiry into climate adaptation.
- Regional Policy Statement and Land and Water Regional Plan implementation.
- Future District Council planning initiatives and the development of District Plans.
- Emergency Management Bill and increase in resilience of critical infrastructure (Government led response).
- The proposed National Policy Statement on Natural Hazards.
- The outcome of the government's Inquiry into Community-Led Managed Retreat.
- Changes to the Flood Protection Management Bylaw during periodic review.

Changes in government and legislation are expected throughout the lifetime of this Infrastructure Strategy as it can be expected that environmental performance and increasing interest in enabling co-benefits, for example biodiversity and environmental benefits, will be a constant driver of change in this space. Opportunities exist to provide for environmental enhancement, for example fish passage or establishment of wetlands, through decisions that Council make about the renewal or replacement of its infrastructure throughout the lifetime of this strategy.

Principal Options and Implications

Table 17 summarises the principal options that Council has considered to address legislation and regulatory as a significant issue. It also summarises the potential implications identified for each option and identifies the preferred option/s selected.

Table 17. Principal options for managing the significant issue of legislation and regulatory, and the associated implications of those options

Principal Options	Implications	Preferred Option
Engagement with territorial authorities and central government		
Take a reactive approach in terms of engagement with territorial authorities and central government on the development of policies and plan implementation.	• Low level of awareness associated with incoming changes that may affect operations. • Shorter timeframe to make operational changes. • Unplanned expenditure associated with implementation of operational change.	✘

Principal Options	Implications	Preferred Option
Engagement with territorial authorities and central government		
Engage proactively with territorial authorities and central government (where appropriate) on the development of policies and plan implementation.	• Increased awareness and opportunity to lead in this space. • Participation in decision making in the earlier stages of policy development and plan implementation. • Better enablement of transition through change and opportunities to incorporate into internal operations.	✓
Environmental performance and outcomes		
Limited improvement to environmental performance or outcomes.	• Shorter-term outcomes for the environment and communities. • Multiple benefits not realised.	✗
Seek improved environmental performance and seek to achieve multiple outcomes by incorporating nature-based solutions where possible.	• Sustainable and longer-term outcomes for the environment and communities. • Multiple benefits realised. • Alignment with Council's strategic direction, with the principle of ki uta ki tai and with Te Mana o te Wai.	✓

Examples of the Preferred Option/s in Practice

The following are examples of the types of work programmes that would be implemented by adopting the most likely scenario for managing infrastructure in response to legislation and regulatory as a significant issue:

- Ongoing engagement with territorial authorities and central government on the development of policies and plan implementation to increase awareness and better enable any transitions to new ways of operating.
- Updated work programmes and operating procedures to incorporate improved environmental outcomes.
- Incorporation of nature-based thinking into options considered for renewal or replacement of infrastructure, while working alongside other Otago Regional Council teams and stakeholders where appropriate to achieve multiple outcomes.
- Development of interface agreements with Otago territorial authorities to record how interface issues will be managed.
- Demonstrate alignment with Council's strategic direction and the principles of ki uta ki tai and Te Mana o Te Wai, through better enabling fish passage and other environmental enhancements in renewal or replacement of flood protection, drainage, or river management infrastructure.
- Alignment with Integrated Catchment Management (ICM) Catchment Action Plans (CAPs).

3.6 Significant Issue: Settlement Trends and Land Use Change

Settlement trends and land use changes can place pressure on existing infrastructure to continue to perform and in some instances places a greater number of people, including their health and livelihoods, at risk in the event of underperformance or failure of flood protection, drainage and river management infrastructure.

Settlement trends and land use changes will continue to occur throughout the lifetime of this strategy. This can place pressure on scheme and river management infrastructure in relation to the level of service it provides, particularly where different flow patterns and the scale of stormwater runoff may impact on the performance of drainage schemes, or where the level of flood mitigation provided may need to be increased in response to land use change. This is often coupled with improving the environmental and amenity values of the area where any work may be undertaken.

Principal Options and Implications

Table 18 summarises the principal options that Council has considered to address settlement trends and use change as a significant issue. It also summarises the potential implications identified for each option and identifies the preferred option/s selected.

Table 18. Principal options for managing the significant issue of settlement trends and land use change, and the associated implications of those options

Principal Options	Implications	Preferred Option
Take a reactive approach to development and associated land use change.	• Low level of awareness associated with potential changes that may affect operations. • Shorter timeframe to consider impacts of potential developments and provide input to enable better outcomes.	✗
Utilise planning controls to mitigate the impact of development.	• Status quo approach that will be maintained. • Implementation of the PARA Framework.	✓
Be proactive in collaborating with territorial authorities, communities, and stakeholders.	• Maintain key relationships with all stakeholders to better enable information sharing and knowledge building (in relation to hazards and impacts) over time. • Participation in consideration of impacts in advance of needing to provide feedback or make decisions under existing regulatory timeframes.	✓

Examples of the Preferred Option/s in Practice

The following are examples of the types of work programmes that would be implemented by adopting the most likely scenario for managing infrastructure in response to settlement trends and land use as a significant issue:

- Proactive engagement with territorial authorities, communities, and stakeholders regarding land use changes. This will include early engagement where possible and will include inputs to Future Development Strategies and district plan development, along with attendance at pre-application meetings and review of consent applications as appropriate.
- Utilisation of the PARA framework to appropriately balance land use controls and infrastructure solutions.

3.7 Significant Issue: Funding

The potential impact of natural hazards events (including flood events) on the Otago Regional Council's financial position is dependent on the scale, duration, and the location of the event. The unpredictable nature of such events means that the funding needs of any recovery are also difficult to predict and provide for at short notice. Funding needs are large for significant pieces of infrastructure to be renewed or replaced; however, some of these, such as floodbanks, have an exceptionally long useful life and therefore provide intergenerational benefits. Otago has had some notable rainfall/flood events affecting different parts of the region in recent years (e.g., February 2020, January 2021, July/August 2022, September 2023) which also leads to overlapping recovery programmes that need to be funding, often at the expense of planned work. Some financial reserves are built up over time to assist in funding response and recovery to such events, however these can be depleted following major events.

Funding sources may include:

- Central Government – Otago Regional Council has previously been successful in obtaining funding under the 'Shovel Ready' Climate Resilience Funding (Ministry of Business, Innovation and Employment Provincial Growth Fund), and has had more recent input into a co-investment case submitted to Central Government as part of a second tranche of Climate Resilience funding in December 2022[2]. This has so far been unsuccessful in securing funding; however, the Otago Regional Council continues to pursue funding in this space.
- National Emergency Management Agency (NEMA) to repair essential infrastructure following emergencies. This includes a 60% subsidy from Central Government above 0.002% of net capital value for regional councils.
- Potential for other funding sources for projects that also provide for nature-based solutions.

Principal Options and Implications

Table 19 summarises the principal options that Council has considered to address funding as a significant issue. It also summarises the potential implications identified for each option and identifies the preferred option/s selected.

Table 19. Principal options for managing the significant issue of funding, and the associated implications of those options

Principal Options	Implications	Preferred Option
Do nothing in terms of seeking out additional funding sources.	• Funding for ongoing work will need to be predominantly provided for by ratepayers (contributions to reserves). • Reduced level of service if funding is unable to match expenditure required to operate and maintain infrastructure to desired standard. • Increased risk of exposure to flooding should level of service be reduced. • Trade-offs in levels of service and risk.	✗

[2] *Central Government Co-investment in Flood Protection Schemes – A report to request for Budget 2023 funding to build community climate-change resilience against flood risks, Te Ura Kahika – Regional and Unitary Councils Aotearoa, December 2022.*

Principal Options	Implications	Preferred Option
Continue to engage through sector to source Central Government co-funding.	• Funding to support ongoing works that are required to maintain levels of service.	✓
Seek out co-benefits and subsequent alternative funding sources e.g. biodiversity.	• Collaboration with territorial authorities and third parties provide opportunities to leverage funding and increase co-benefits.	✓

Examples of the Preferred Option/s in Practice

The following are examples of the types of work programmes that would be implemented by adopting the most likely scenario for managing infrastructure in response to funding as a significant issue:

- Improved confidence in ability to delivery key programmes of work to improve resilience and incorporate nature-based solutions with lesser financial impact on ratepayers should funding come to fruition.
- Accelerated work programmes with the ability to move key programmes of work forward if funding is successful, increasing resilience faster.
- Planning for scenarios with and without central government co-investment.

4. Infrastructure Investment Programme

This section aims to address the significant issues, options and implications that have been highlighted in the preceding section through the infrastructure investment programme presented here. This investment programme is founded on Council's growing maturity in its asset management practices and a management approach that provides the overarching principles of Council's decision making in relation to flood protection, drainage and river management infrastructure.

This section also identifies the significant decisions Council expects to make over the lifetime of this Strategy in relation to this investment programme and outlines the options that are likely to be presented in relation to each of these decisions. Current assumptions and uncertainties are also presented here.

4.1 Infrastructure Management Approach

Further to the significant issues and preferred options for managing each issue discussed in the previous section, Council must also account for the need to renew its infrastructure, respond to growth or decline (including changes in levels of service), and achieve environmental outcomes and resilience, as required by the Local Government Act 2002. While Council has some key work programmes and principles that separately underpin decision making in relation to each of these areas of infrastructure management, there are also some key principles that span decision-making in all areas. These include the application of Council's Strategic Direction and taking catchment-based and 'room for river' approaches across all areas where infrastructure management decisions are required. Figure 6 provides a diagrammatic summary of each area and their relationship. Each of these areas is described in more detail below.

Figure 6. Key areas of infrastructure management and their relationship.

4.1.1 Strategic Direction

ORC's Vision for Otago sets the direction for improving the social, economic, environmental, and cultural wellbeing for the Otago communities now and into the future, through a single articulated vision:

Our environment and communities are healthy and connected ki uta ki tai (from the mountains to the sea).

ORC will ensure that infrastructure management decisions are in alignment with this vision and the six key community outcomes related to climate, resilience, transport, environment, partnerships, and communities.

4.1.2 Catchment-based Approach

Through a catchment-based approach it is expected that Council will examine possible solutions that consider the wider catchment for potential interventions where practicable. Throughout the lifetime of this strategy, we also expect to see increasing engagement with communities and tangata whenua on giving effect to ki uta ki tai and Te Mana o Te Wai when making decisions about current and future flood protection, drainage, and river management infrastructure.

Council also takes an Integrated Catchment Management (ICM) approach that is based on a holistic, natural resource management philosophy that recognises that all elements of an ecosystem, including the people are connected. This involves facilitating the development and implementation of Integrated Catchment Action Plans that are developed in collaboration with iwi and community. Future decision-making in relation to flood protection, drainage and river management infrastructure will therefore be aligned through this approach.

4.1.3 Room for River Approach

The Protect, Avoid, Retreat, Accommodate (PARA) Framework (Ministry for the Environment) is internationally used to explain the types of adaptation actions that can be taken to build resilience to the current effects, and predicted impacts, of the increasing risks posed by natural hazards (Figure 7).

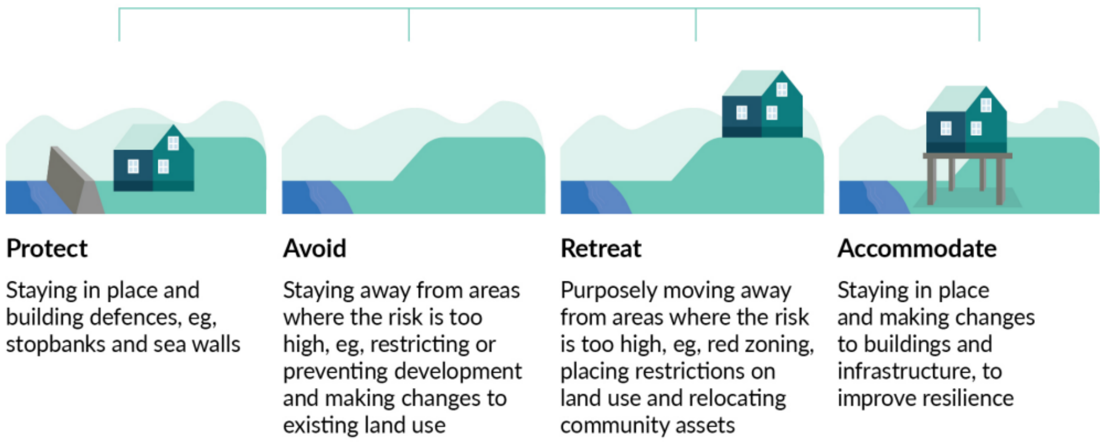


Figure 7. The Protect, Avoid, Retreat, Accommodate (PARA) Framework (Ministry for the Environment, 2023)

The flood protection, drainage, and river infrastructure that Council owns and manages falls into the 'Protect' category. This infrastructure acts as a form of defence against water and enables people, and their homes and businesses, to stay where they are placed. Historically this approach has resulted in rivers being constrained to a narrower floodplain that limits the flood carrying capacity of the river by denying it the opportunity to behave naturally and spread out across their floodplain during high flows.

Increasingly Council is looking to diversify its infrastructure to include more nature-based solutions that allow rivers room to move within their natural floodplains. The subsequent adaptation of flood protection, drainage, and river management infrastructure, and communities alongside, will lead to solutions being adopted that fall more appropriately into the Avoid, Retreat and Accommodate categories of the PARA Framework. This approach is also more aligned with Te Mana o Te Wai and the catchment-based approach discussed below.

4.1.4 Infrastructure Renewals

Council carries out a routine programme of inspections and condition assessments of its flood protection, drainage, and river management infrastructure, annually or as otherwise programmed in Operations and Maintenance Manuals. This programme is complemented by a programme of more significant structural audits of key infrastructure. Incorporating a risk-based approach, these inspections and assessments may lead to recommendations to remediate or replace a piece of infrastructure, and overall, this contributes to the ongoing performance and resilience of an asset.

4.1.5 Demand and Levels of Service

Settlement trends and land use changes are expected to impact on the demand for flood protection, drainage, and river management infrastructure to perform. This will require decisions about maintaining or increasing levels of service throughout the lifetime of this Strategy.

A risk-based approach is expected to be adopted in relation to these decisions, alongside consideration of other key principles discussed in this section.

4.1.6 Environmental Outcomes

It is expected that environmental outcomes will be achieved through the application of the above principles, including Council's Strategic Direction, 'Room for River' and catchment-based approaches. This will involve the consideration and incorporation of more nature-based solutions in place of hard infrastructure where practicable, or steps taken in the longer term to establish nature based solutions through the adaptation and application of the PARA Framework.

4.1.7 Resilience

Throughout the lifetime of this Strategy, it is expected that Council will:

- Continue to undertake periodic risk assessments of infrastructure condition and performance to further inform understanding and communication of risk.
- Understand the impact of super design (over design) events on scheme infrastructure and incorporate into risk assessments and subsequent decision-making.
- Incorporate resilience improvements into maintenance and renewals where appropriate. This may involve maintaining or increasing current levels of service in response to risk analysis.
- Increase community engagement about risk and resilience, and increased involvement of community in decision making.

4.2 Operational and Capital Expenditure Summary

Figures 8 and 9 summarise the estimated distribution of operational and capital expenditure over the lifetime of this Strategy for all scheme and river management infrastructure respectively. Table 20 further breakdowns these costs by expenditure type to give the overall expenditure estimated over the lifetime of this Strategy.

The following general assumptions have been made regarding estimated expenditure:

- Staff time and overheads have been excluded.
- Inflation indices have not been applied.
- Depreciation is not included.
- Best efforts have been made in relation to construction assumptions and associated estimates. Where opportunities exist, Council will endeavour to take the most optimal financial solution.

In general, there is a higher degree of certainty in the first ten years of the investment forecast, however projects and programmes identified in the subsequent two decades may change in response to new information and changes in demand and future needs. There remains some uncertainty within the first ten years, particularly where investigations and design are to commence.

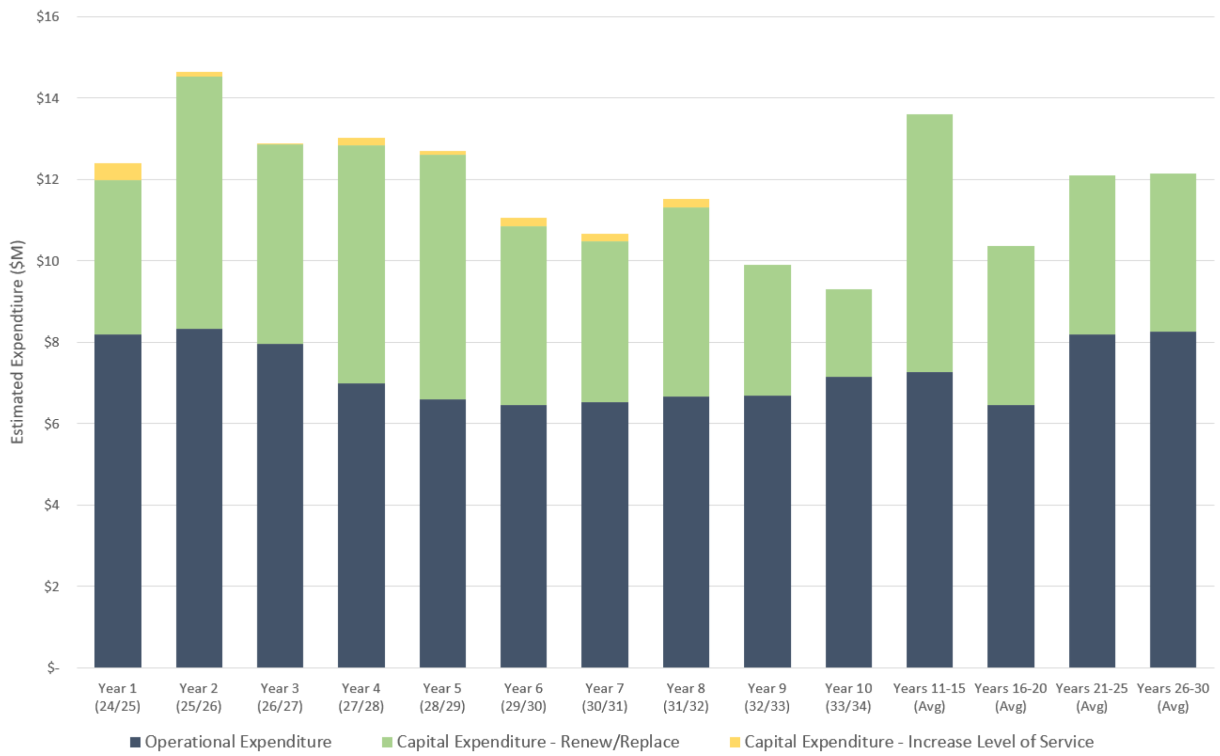


Figure 8. Breakdown of estimated operational and capital expenditure for flood protection and drainage infrastructure

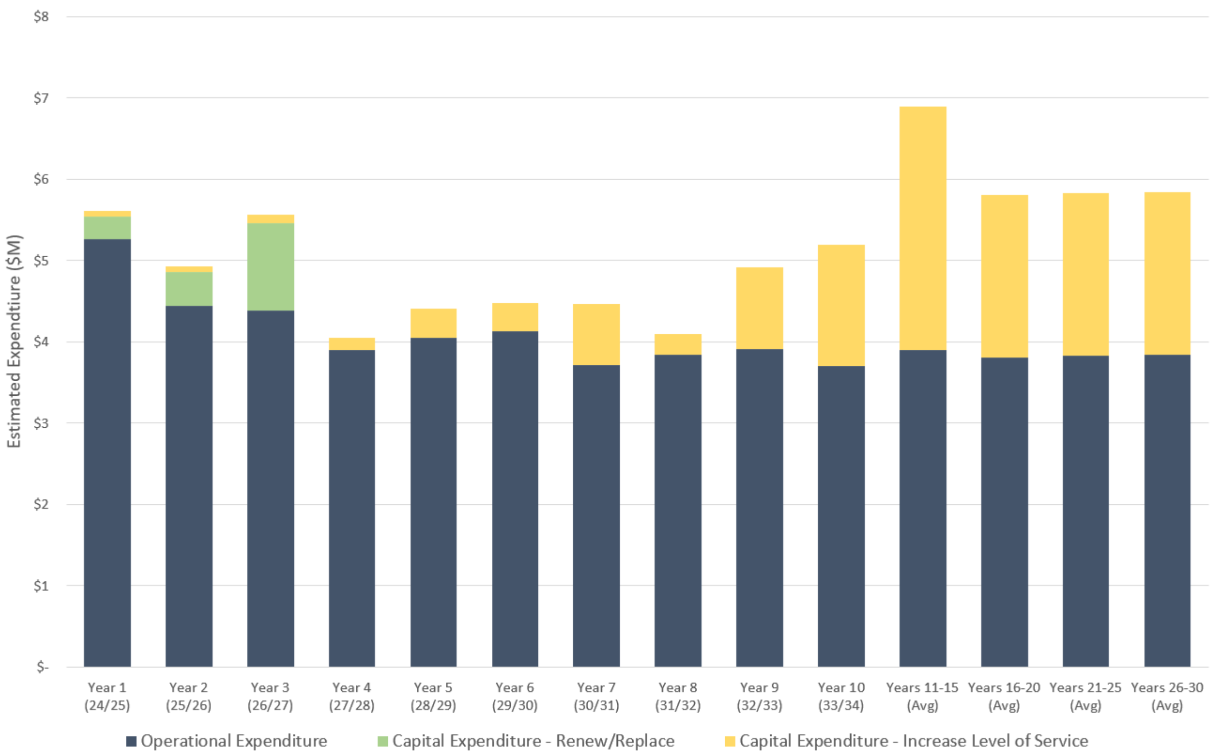


Figure 9. Breakdown of estimated operational and capital expenditure for river management infrastructure. Note that the operational expenditure represented above also includes expenditure for riparian and channel management that is not directly related to infrastructure.

Table 20. Summary of capital and operational expenditure by category

Expenditure Type	Year 1 (24/25)	Year 2 (25/26)	Year 3 (26/27)	Year 4 (27/28)	Year 5 (28/29)	Year 6 (29/30)	Year 7 (30/31)	Year 8 (31/32)	Year 9 (32/33)	Year 10 (33/34)	Years 11-15 (Average)	Years 16-20 (Average)	Years 21-25 (Average)	Years 26-30 (Average)
Flood Protection and Drainage Scheme Infrastructure														
Operational Expenditure	$8.18M	$8.32M	$7.95M	$6.99M	$6.60M	$6.45M	$6.52M	$6.67M	$6.69M	$7.14M	$7.26M	$6.45M	$8.19M	$8.25M
Capital Expenditure – Renew/Replace	$3.80M	$6.20M	$4.90M	$5.85M	$6.00M	$4.40M	$3.95M	$4.65M	$3.20M	$2.15M	$6.34M	$3.90M	$3.90M	$3.90M
Capital Expenditure – Increase Levels of Service	$0.43M	$0.13M	$0.03M	$0.18M	$0.10M	$0.20M	$0.20M	$0.20M	-	-	-	-	-	-
Sub-total (Scheme Infrastructure)	**$12.4M**	**$14.7M**	**$12.9M**	**$13.0M**	**$12.7M**	**$11.1M**	**$10.7M**	**$11.5M**	**$9.9M**	**$9.3M**	**$13.6M**	**$12.5M**	**$12.5M**	**$12.5M**
River Management Infrastructure														
Operational Expenditure	$5.26M	$4.45M	$4.38M	$3.90M	$4.05M	$4.13M	$3.71M	$3.84M	$3.91M	$3.70M	$3.89M	$3.81M	$3.82M	$3.85M
Capital Expenditure – Renew/Replace	$0.28M	$0.41M	$1.08M	-	-	-	-	-	-	-	-	-	-	-
Capital Expenditure – Increase Levels of Service	$.07M	$.07M	$.10M	$.15M	$.35M	$.35M	$.75M	$.25M	$1.00M	$1.50M	$3.00M	$2.00M	$2.00M	$2.00M
Sub-total (River Management Infrastructure)	**$5.6M**	**$4.9M**	**$5.6M**	**$4.1M**	**$4.4M**	**$4.5M**	**$4.5M**	**$4.1M**	**$4.9M**	**$5.2M**	**$6.9M**	**$5.8M**	**$5.8M**	**$5.9M**
Total Expenditure	**$18.0M**	**$19.6M**	**$18.4M**	**$17.1M**	**$17.1M**	**$15.5M**	**$15.1M**	**$15.6M**	**$14.8M**	**$14.5M**	**$20.5M**	**$18.1M**	**$18.1M**	**$18.1M**

4.3 Investment Programme

The following diagrams provide a further breakdown of the indicative estimates of the projected capital and operating expenditure associated with the management of Council's flood protection, drainage, and river management infrastructure in each of the first ten years and subsequent periods of five years up to the 30-year lifetime of this Strategy.

Throughout the lifetime of this Strategy, it is expected that Council will reach several decision points related to key projects and programmes of work that may come with significant implications in terms of cultural, environmental, social and/or economic impact. The estimated timing of these decisions is highlighted in the following diagrams, with further discussion on the decision drivers, options and assumptions in the section that follows.

The diagrams are ordered as follows:

Diagram 1	Alexandra Flood Protection Scheme
Diagram 2	Leith Flood Protection Scheme
Diagram 3	Lower Clutha Flood Protection & Drainage Scheme
Diagram 4	Lower Taieri Flood Protection Scheme
Diagram 5	West Taieri Drainage Scheme
Diagram 6	East Taieri Drainage Scheme
Diagram 7	Tokomairiro Drainage Scheme
Diagram 8	River Management Infrastructure (including Lindsay Creek Flood Mitigation Scheme – a provisional scheme within this Strategy)

Diagram 1: Alexandra Flood Protection Scheme

	Estimated Expenditure $,000's													
	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11-15	Y16-20	Y21-25	Y26-Y30
Year	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**2028/29**	**2029/30**	**2030/31**	**2031/32**	**2032/33**	**2033/34**	**2035-39**	**2040-44**	**2045-49**	**2050-54**
Routine / Business as Usual Activities														
Scheduled Maintenance and Inspections	2,110										1,140	1,140	1,140	1,140
Pump Maintenance	88													
Pump Renewals											3,000			
Contact Energy Consent Renewal												30		
Projects														
Public Safety Assessment	10													

Diagram 2: Leith Flood Protection Scheme

	Estimated Expenditure $,000's													
	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11-15	Y16-20	Y21-25	Y26-Y30
Year	**2024/25**	**2025/26**	**2026/27**	**2027/28**	**2028/29**	**2029/30**	**2030/31**	**2031/32**	**2032/33**	**2033/34**	**2035-39**	**2040-44**	**2045-49**	**2050-54**
Routine / Business as Usual Activities														
Scheduled Maintenance and Inspections	1,430										850	850	850	850
Designation / Bylaw Renewal										50	50	50	50	50
Projects														
Leith Model Build	200													
Public Safety Assessment	10													
Leith Historic Walls: Feasibility	200										50	50	50	50
Leith Historic Walls: Construction			A	1,100							2,500	2,500	2,500	2,500
Leith Amenity: Feasibility	750										50	50	50	50
Leith Amenity: Construction				B	2,250						2,500	2,500	2,500	2,500

Key
Operational Expenditure
Capital Expenditure
Significant Decision Point

Diagram 3: Lower Clutha Flood Protection and Drainage Scheme

<table>
<tr><th></th><th colspan="14">Estimated Expenditure $,000's</th></tr>
<tr><th></th><th>Y1</th><th>Y2</th><th>Y3</th><th>Y4</th><th>Y5</th><th>Y6</th><th>Y7</th><th>Y8</th><th>Y9</th><th>Y10</th><th>Y11-15</th><th>Y16-20</th><th>Y21-25</th><th>Y26-Y30</th></tr>
<tr><th>Year</th><th>2024/25</th><th>2025/26</th><th>2026/27</th><th>2027/28</th><th>2028/29</th><th>2029/30</th><th>2030/31</th><th>2031/32</th><th>2032/33</th><th>2033/34</th><th>2035-39</th><th>2040-44</th><th>2045-49</th><th>2050-54</th></tr>
<tr><td colspan="15">Routine / Business as Usual Activities</td></tr>
<tr><td>Scheduled Maintenance and Inspections</td><td colspan="10">4,830</td><td>2,400</td><td>2,400</td><td>2,400</td><td>2,400</td></tr>
<tr><td>Reactive Maintenance</td><td colspan="10">500</td><td>250</td><td>250</td><td>250</td><td>250</td></tr>
<tr><td>River Channel Maintenance</td><td colspan="10">3,700</td><td>1,950</td><td>1,950</td><td>1,950</td><td>1,950</td></tr>
<tr><td>Routine Condition Assessments and Monitoring</td><td colspan="10">1,010</td><td>150</td><td>150</td><td>150</td><td>150</td></tr>
<tr><td>Risk Management (Ongoing Performance and Risk Assessments)</td><td></td><td></td><td></td><td></td><td colspan="2">150</td><td></td><td colspan="3">250</td><td>250</td><td>250</td><td>250</td><td>250</td></tr>
<tr><td>Flood Preparedness and Response Plan</td><td colspan="2">80</td><td></td><td colspan="2">80</td><td></td><td colspan="2">80</td><td></td><td></td><td>125</td><td>125</td><td>125</td><td>125</td></tr>
<tr><td>Designation / Bylaw Renewal</td><td></td><td></td><td colspan="2">200</td><td></td><td></td><td></td><td></td><td></td><td>200</td><td>200</td><td>200</td><td>200</td><td>200</td></tr>
<tr><td>Culvert Renewal Programme</td><td colspan="10">1,000</td><td>500</td><td>500</td><td>500</td><td>500</td></tr>
<tr><td>Crest Levelling Programme</td><td></td><td></td><td colspan="8">400</td><td>250</td><td>250</td><td>250</td><td>250</td></tr>
<tr><td>Contact Energy Consent Renewal</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>30</td><td></td><td></td></tr>
<tr><td colspan="15">Projects</td></tr>
<tr><td>Fish Passage Adaptation</td><td colspan="10">500</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Puerua Outfall Tactical Maintenance</td><td colspan="3">300</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Public Safety Assessment</td><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pump Station Weed Management - Research and Development</td><td></td><td colspan="2">150</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Balclutha Township Relief Well Replacements</td><td></td><td></td><td>250</td><td></td><td></td><td>250</td><td></td><td></td><td>250</td><td></td><td></td><td></td><td>750</td><td></td></tr>
<tr><td>Pump Station Communications Upgrade</td><td colspan="3">250</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Puerua Outfalls Culvert (Training Line) Adaptation</td><td>C</td><td colspan="4">1,400</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lake Tuakitoto / Robson Lagoon Trail Reinstatement</td><td colspan="4">100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lower Clutha Drain 222 Bridge Improvements</td><td colspan="3">600</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lower Clutha Drainage Model Build</td><td>100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Provision for Floodbank Track Development Contribution</td><td></td><td></td><td></td><td></td><td></td><td colspan="3">600</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Scheme Performance and Risk Assessments</td><td colspan="3">400</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Scheme Impacts and Options</td><td></td><td></td><td colspan="3">250</td><td>D</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Managed Relocation of Infrastructure</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">3,500</td><td>5,000</td><td>5,000</td><td>5,000</td><td>5,000</td></tr>
<tr><td>Clutha Delta Split Lagoon Enhancement: Feasibility</td><td colspan="2">200</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Clutha Delta Split Lagoon Enhancement: Construction</td><td></td><td></td><td>E</td><td colspan="2">1,000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Floodbank realignment: Feasibility</td><td colspan="2">100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Floodbank realignment: Construction</td><td></td><td></td><td>F</td><td colspan="4">1,500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pump Station Upgrades (Pumps)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5,500</td><td>7,000</td><td>7,000</td><td>5,500</td></tr>
</table>

Key

Operational Expenditure | Capital Expenditure | Significant Decision Point

Diagram 4: Lower Taieri Flood Protection Scheme

<table>
<tr><th></th><th colspan="14">Estimated Expenditure $,000's</th></tr>
<tr><th></th><th>Y1</th><th>Y2</th><th>Y3</th><th>Y4</th><th>Y5</th><th>Y6</th><th>Y7</th><th>Y8</th><th>Y9</th><th>Y10</th><th>Y11-15</th><th>Y16-20</th><th>Y21-25</th><th>Y26-Y30</th></tr>
<tr><th>Year</th><th>2024/25</th><th>2025/26</th><th>2026/27</th><th>2027/28</th><th>2028/29</th><th>2029/30</th><th>2030/31</th><th>2031/32</th><th>2032/33</th><th>2033/34</th><th>2035-39</th><th>2040-44</th><th>2045-49</th><th>2050-54</th></tr>
<tr><th colspan="15">Routine / Business as Usual Activities</th></tr>
<tr><td>Scheduled Maintenance and Inspections</td><td colspan="10">2,150</td><td>1,080</td><td>1,080</td><td>1,080</td><td>1,080</td></tr>
<tr><td>Reactive Maintenance</td><td colspan="10">250</td><td>130</td><td>130</td><td>130</td><td>130</td></tr>
<tr><td>River Channel Maintenance</td><td colspan="10">3,200</td><td>1,700</td><td>1,700</td><td>1,700</td><td>1,700</td></tr>
<tr><td>Routine Condition Assessments and Monitoring</td><td colspan="10">1,170</td><td>150</td><td>150</td><td>150</td><td>150</td></tr>
<tr><td>Risk Management (Ongoing Performance and Risk Assessments)</td><td></td><td></td><td></td><td></td><td colspan="2">150</td><td></td><td colspan="3">250</td><td>250</td><td>250</td><td>250</td><td>250</td></tr>
<tr><td>Designation / Bylaw Renewal</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>100</td><td>100</td><td>100</td><td>100</td><td>100</td></tr>
<tr><td>Flood Preparedness and Response Plan</td><td colspan="2">300</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>100</td><td>100</td><td>100</td><td>100</td></tr>
<tr><td>Crest Levelling Programme</td><td></td><td></td><td colspan="8">400</td><td>250</td><td>250</td><td>250</td><td>250</td></tr>
<tr><th colspan="15">Projects</th></tr>
<tr><td>Silver Stream Capacity Maintenance*</td><td colspan="4">800</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Geotechnical Investigations</td><td colspan="3">300</td><td></td><td>50</td><td></td><td></td><td>50</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Flood Preparedness and Response Plan</td><td colspan="2">300</td><td></td><td></td><td>50</td><td></td><td></td><td>50</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Public Safety Assessment</td><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Upper Catchment Investigations (Scheme Impacts)</td><td></td><td></td><td colspan="2">500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Contour Channel Resilience Upgrade: Completion of Current Programme</td><td>1,000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Contour Channel Resilience Upgrade: Continuation of Programme</td><td colspan="10">8,000</td><td>5,000</td><td>5,000</td><td>5,000</td><td>5,000</td></tr>
<tr><td>Lower Pond Gravity Gates Renewal</td><td colspan="3">1,500</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Scheme Performance and Risk Assessments</td><td colspan="3">550</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Climate Adaptation (Scheme Impacts and Options)</td><td></td><td></td><td></td><td colspan="3">250</td><td>G</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lower Taieri Climate Adaptation (Flood Protection)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">1,500</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Climate Adaptation: Ongoing Asessment</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>100</td><td>100</td><td>100</td><td>100</td></tr>
<tr><td>Climate Adaptation & Resilience: Ongoing Implementation</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1,500</td><td>1,500</td><td>1,500</td><td>1,500</td></tr>
<tr><td>Riverside Spillway: Investigations and Planning</td><td colspan="2">200</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Riverside Spillway: Construction</td><td></td><td></td><td>H</td><td>1,000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Outram Floodbank Resilience Improvements: Feasibility</td><td>200</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Outram Floodbank Resilience Improvements: Construction</td><td></td><td>I</td><td colspan="6">4,800</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Taieri/Waipori Confluence Floodbank Realignment: Construction</td><td>J</td><td colspan="4">1,050</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Taieri/Waipori Confluence: Morphological Modelling</td><td></td><td></td><td></td><td></td><td>100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Taieri/Waipori Confluence: Nature-based Solution</td><td></td><td></td><td></td><td></td><td></td><td>K</td><td></td><td></td><td></td><td></td><td>500</td><td></td><td></td><td></td></tr>
</table>

* Ongoing capacity maintenance incorporated as routine activity from Year 5 onwards (River Channel Maintenance).

Key
Operational Expenditure | Capital Expenditure | Significant Decision Point

Diagram 5: West Taieri Drainage Scheme

	Estimated Expenditure $,000's													
	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11-15	Y16-20	Y21-25	Y26-Y30
Year	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2035-39	2040-44	2045-49	2050-54
Routine / Business as Usual Activities														
Scheduled Maintenance and Inspections	2,400										1,200	1,200	1,200	1,200
Reactive Maintenance	300										150	150	150	150
Routine Condition Assessments and Monitoring	365										250	250	250	250
Designation / Bylaw Renewal										100	100	100	100	100
Culvert Renewal Programme	1,000										300	300	300	300
Projects														
Fish Passage Adaptation	500													
Pump Station Communications Upgrade	400													
Scheme Performance and Risk Assessment	250													
Lake Ascog Pump Station: Pump Renewals	500													
Bridge Renewals	2,000													
Public Safety Assessment	10													
West Taieri Drainage Model Build	250													
Waipori Pump Station Capacity & Seismic Improvements: Assessment	250													
Waipori Pump Station Capacity & Seismic Improvements: Implementation			L	500										
Pump Station Upgrades (Pumps)											5,000	5,000	5,000	

Key
Operational Expenditure | Capital Expenditure | Significant Decision Point

Diagram 6: East Taieri Drainage Scheme

Estimated Expenditure $,000's

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11-15	Y16-20	Y21-25	Y26-Y30
Year	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2035-39	2040-44	2045-49	2050-54
Routine / Business as Usual Activities														
Scheduled Maintenance and Inspections	2,170										1,050	1,050	1,050	1,050
Reactive Maintenance	280										175	175	175	175
Routine Condition Assessments and Monitoring	370										250	250	250	250
Culvert Renewal Programme	1,000										380	380	380	380
Designation / Bylaw Renewal										100	100	100	100	100
Projects														
Fish Passage Adaptation	500													
Pump Station Communications Upgrade	350													
Scheme Performance and Risk Assessment	250													
Owhiro Drainage Impovements								1000						
Silver Stream Pump Station Condition/Environmental Improvement	1600													
East Taieri Model Build	250													
Public Safety Assessment	10													
Weir and Detention Gate Investigations	40													
Pump Station Upgrades (Pumps)											5,000	5,000	5,000	

Diagram 7: Tokomairiro Drainage Scheme

Estimated Expenditure $,000's

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11-15	Y16-20	Y21-25	Y26-Y30
Year	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2035-39	2040-44	2045-49	2050-54
Routine / Business as Usual Activities														
Scheduled Maintenance and Inspections	1,030										5,130	5,130	5,130	5,130
Reactive Maintenance	200										100	100	100	100
Routine Condition Assessments and Monitoring	365										250	250	250	250
Designation / Bylaw Renewal										100	50	50	50	50
Culvert Renewal Programme	1,000										375	375	375	375
Projects														
Bridge Repairs	600													
Tokomairiro Drainage Scheme Model Build				250										
Public Safety Assessment	10													

Key

Operational Expenditure | Capital Expenditure | Significant Decision Point

Diagram 8: River Management Infrastructure

<table>
<tr><th></th><th colspan="14">Estimated Expenditure $,000's</th></tr>
<tr><th></th><th>Y1</th><th>Y2</th><th>Y3</th><th>Y4</th><th>Y5</th><th>Y6</th><th>Y7</th><th>Y8</th><th>Y9</th><th>Y10</th><th>Y11-15</th><th>Y16-20</th><th>Y21-25</th><th>Y26-Y30</th></tr>
<tr><th>Year</th><th>2024/25</th><th>2025/26</th><th>2026/27</th><th>2027/28</th><th>2028/29</th><th>2029/30</th><th>2030/31</th><th>2031/32</th><th>2032/33</th><th>2033/34</th><th>2035-39</th><th>2040-44</th><th>2045-49</th><th>2050-54</th></tr>
<tr><td colspan="15">Routine / Business as Usual Activities</td></tr>
<tr><td>Dunedin Area: Channel and Riparian Management*</td><td colspan="10">5,940</td><td>2,700</td><td>2,750</td><td>2,700</td><td>2,750</td></tr>
<tr><td>Clutha Area: Channel and Riparian Management*</td><td colspan="10">6,630</td><td>3,400</td><td>3,250</td><td>3,350</td><td>3,250</td></tr>
<tr><td>Central Otago Area: Channel and Riparian Management*</td><td colspan="10">4,840</td><td>2,575</td><td>2,525</td><td>2,575</td><td>2,575</td></tr>
<tr><td>Wakatipu Area: Channel and Riparian Management**</td><td colspan="10">4,380</td><td>2,230</td><td>2,180</td><td>2,180</td><td>2,280</td></tr>
<tr><td>Wanaka Area: Channel and Riparian Management***</td><td colspan="10">2,745</td><td>1,340</td><td>1,320</td><td>1,290</td><td>1,340</td></tr>
<tr><td>Waitaki Area: Channel and Riparian Management*</td><td colspan="10">4,240</td><td>2,075</td><td>2,075</td><td>2,075</td><td>2,075</td></tr>
<tr><td>Lower Waitaki River Control Scheme: Contribution to Scheme Operation</td><td colspan="10">2,300</td><td>1,150</td><td>1,160</td><td>1,150</td><td>1,160</td></tr>
<tr><td colspan="15">Dunedin Area Projects - Infrastructure Related Only</td></tr>
<tr><td>Middlemarch: Hazard Mitigation Investigations</td><td></td><td colspan="2">150</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Middlemarch: Tactical Maintenance</td><td colspan="3">150</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Middlemarch: Hazard Mitigation Improvements</td><td></td><td></td><td></td><td>M</td><td colspan="3">300</td><td></td><td></td><td></td><td>5,000</td><td></td><td></td><td></td></tr>
<tr><td>Lindsay Creek / North East Valley Resilience: Flood Response Plan</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lindsay Creek: Legalisation of land ownerhsip</td><td colspan="2">100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lindsay Creek: Identification of flood mitigation options</td><td colspan="3">150</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lindsay Creek: Hydraulic Modelling</td><td colspan="3">440</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lindsay Creek: Implementation of Flood Mitigation</td><td></td><td></td><td></td><td>N</td><td colspan="6">3,000</td><td>10,000</td><td>10,000</td><td>10,000</td><td>10,000</td></tr>
<tr><td>Lindsay Creek: Quarry Bridge</td><td>1,000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Kaikorai Stilling Basin: Resilience and Environmental Enhancement</td><td colspan="4">2,000</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Kaikorai Stream: Improvements</td><td colspan="3">150</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>River Mouth Monitoring Technology Installation</td><td colspan="3">120</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="15">Clutha Area Projects - Infrastructure Related Only</td></tr>
<tr><td>River Mouth Monitoring Technology Installation</td><td colspan="2">40</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="15">Wanaka Area Projects - Infrastructure Related Only</td></tr>
<tr><td>Stoney Creek: Investigation</td><td colspan="2">40</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Stoney Creek: Staged Improvements</td><td></td><td></td><td colspan="2">100</td><td></td><td></td><td>500</td><td></td><td></td><td>500</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="15">Waitaki Area Projects - Infrastructure Related Only</td></tr>
<tr><td>Completion of Waitaki Designation</td><td>100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="15">All Areas - Infrastructure Related Only</td></tr>
<tr><td>All - Public Safety Assessment</td><td>75</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

* Channel and Riparian Management is the total estimated expenditure for routine works within each river management area. Note that only a portion of this expenditure relates to river management infrastructure.

** Includes Shotover Training Line and Dart/Rees (Head of Lake Whakatipu Natural Hazards Adaptation), related works.

*** Includes Albert Town Rock Buttress.

Key
Operational Expenditure | Capital Expenditure | Significant Decision Point

4.4 Significant Decisions

The Infrastructure Investment Programme in the preceding section identifies several significant decisions that Council is expected to consider over the lifetime of this strategy.

This section provides more detail about each significant decision point, including the decision drivers, options, and assumptions (Tables 21 to 25).

The anticipated scale of costs has been included to meet the requirements of the Local Government Act; however, it is noted that there are other values that will need to be considered at the time of any decision making including, environmental, social, and cultural values. Risk exposure will also require consideration. The scale of costs has been given a low to high rating that is defined as follows:

- Low – Costs estimated to be in the order of tens of thousands.
- Moderate – Costs estimated to be in the order of hundreds of thousands.
- High – Costs estimated to be in the order of millions.
- Very high – Costs estimated to be in the tens of millions.

Note that the options presented in Tables 21 to 25 are subject to change based on investigation and optioneering work that will precede each decision.

Table 21. Leith Flood Protection Scheme – Significant decision points, decision drivers, options, and assumptions.

Decision/Project ***Decision Timing***	**Principal Options** **Options**	 **Scale of Costs**	**Assumptions**
A **Leith Historic Walls** *Year 3 (2026/27)* Decision Drivers (Key Significant Issues):	Continue to maintain historic walls in current state.	Low to moderate (ongoing operational costs, increasing with time) Moderate (unplanned capital, in event of damage or failure)	No increase to scheme levels of service anticipated through the replacement of the historic walls. Assumes some alignment with amenity work (Significant Decision B) where practicable.
	Replace historic walls within Leith Flood Protection Scheme.	Very High (initial capital combined with amenity works) Low (ongoing operational costs)	
B **Leith Amenity** *Year 4 (2027/28)* Decision Drivers (Key Significant Issues):	Do nothing. Ongoing maintenance of concrete structures and no change in amenity value.	Low to moderate (ongoing operational costs)	No increase to scheme levels of service anticipated through this work, however opportunities to increase levels of service would be explored during design process.
	Undertake amenity works from Forth Street to Harbour.	High (initial capital combined with historic walls work) Low (ongoing operational costs)	

Table 22. Lower Clutha Flood Protection and Drainage Scheme – Significant decision points, decision drivers, options, and assumptions.

Decision/Project ***Decision Timing***	**Principal Options**		**Assumptions**
	Options	**Scale of Costs**	
C **Puerua Outfalls Culvert (Training Line) Adaptation** *Year 1 (2024/25)* Decision Drivers (Key Significant Issues):	Do nothing. Continue to undertake tactical maintenance to retain Puerua River outlet and training line.	Moderate (ongoing reactive operational costs)	No increase to levels of service. Managed retreat would be a staged and long-term approach to be implemented alongside other scheme wide adaptation measures. Changes to levels of service anticipated through adaptation measures, however scale to be determined.
	Retain and improve resilience of existing training line and culverts.	High (capital and ongoing reactive operational costs)	
	Managed retreat from area.	High (initial capital) Low (ongoing operational costs)	
D **Managed Relocation of Infrastructure** *Year 6 (2029/30)* Decision Drivers (Key Significant Issues):	Do nothing. Ongoing maintenance and repair of critical flood protection infrastructure.	Moderate to High (ongoing operational costs and capital for repairs)	No increase to levels of service. Staged adaptation of the coastal area consistent with 'C' above will require infrastructure modifications to continue to provide flood protection and land drainage. Changes to levels of service anticipated through adaptation measures, however scale to be determined.
	Planned and staged relocation of infrastructure.	Very High (initial capital) Low to moderate (ongoing operational costs)	
E **Clutha Delta Split Lagoon Enhancement** *Year 3 (2026/27)* Decision Drivers (Key Significant Issues):	Do nothing.	Low to moderate (ongoing operational costs)	No increase to levels of service. Work will be carried out in collaboration with other interested parties and stakeholders.
	Replace culverts.	Moderate (initial capital) Low (ongoing operational costs)	
	Replace culverts and integrate nature-based solution.	Moderate to high (initial capital) Low (ongoing operational costs)	
F **Floodbank Realignment** *Year 3 (2026/27)* Decision Drivers (Key Significant Issues):	Retain current floodbank alignment at location downstream of Riverbank Road.	Moderate to high (ongoing operational costs and capital costs associated with ongoing repair)	No changes to current levels of service.
	Realign floodbank downstream of Riverbank Road to improve resilience of floodbank and retain current level of service.	High (initial capital) Low to moderate (ongoing operational costs)	

Table 23. Lower Taieri Flood Protection Scheme – Significant decision points, decision drivers, options, and assumptions.

Decision/Project	**Principal Options**		**Assumptions**
Decision Timing	**Options**	**Scale of Costs**	
G **Climate Adaptation** *Year 7 (2030/31)*	Do nothing. Make no changes to scheme to adapt to changing climate.	Low to moderate (operational costs, escalating costs as exposure to climate changes impacts on maintenance/repairs)	Assumes climate adaptation work will be staged.
	Adapt scheme to changing climate.	High to very high (capital costs)	
H **Riverside Spillway** *Year 3 (2026/27)* Decision Drivers (Key Significant Issues):	Do nothing. Maintain current spillway and operational protocols.	Low to moderate (ongoing operational and repair costs)	No increase to levels of service. Assumes that removal of spillway gates will be considered.
	Modify spillway to operate at fixed level (or alternative as determined by investigations).	High (initial capital) Low to moderate (ongoing operational and repair costs)	
I **Outram Floodbank Resilience Improvements** *Year 2 (2025/26)* Decision Drivers (Key Significant Issues):	Do nothing.	Low (ongoing operational costs)	No increase to levels of service.
	Improve resilience of floodbank in proximity to Outram.	High (initial capital cost)	
J **Taieri/Waipori Confluence Floodbank Realignment** *Year 1 (2024/25)* Decision Drivers (Key Significant Issues):	Repair floodbank on current alignment.	Low to moderate (ongoing operational costs for repairs and maintenance)	No increase to levels of service.
	Realign floodbank to maintain performance and improve resilience of this portion of the scheme.	High (initial capital cost)	
K **Taieri/Waipori Confluence: Nature-based Solution** *Year 6 (2029/30)* Decision Drivers (Key Significant Issues):	Do nothing.	Low (ongoing operational costs)	No increase to levels of service.
	Contribute to environmental value of the area by incorporating a wetland into adjoining wetlands.	High (initial establishment)	

Table 24. West Taieri Drainage Scheme – Significant decision points, decision drivers, options, and assumptions.

Decision/Project ***Decision Timing***	**Principal Options** **Options**	 **Scale of Costs**	**Assumptions**
L **Waipori Pump Station Capacity and Seismic Improvements** *Year 3 (2026/27)* Decision Drivers (Key Significant Issues):	No capacity improvements.	Low (ongoing operational costs)	Potential increase in levels of service depending on outcome of assessment and available solutions. Climate change adaptation will be incorporated.
	Improve capacity by addition of a new pump.	Moderate (initial capital)	

Table 25. Dunedin River Management Area – Significant decision points, decision drivers, options, and assumptions.

Decision/Project ***Decision Timing***	**Principal Options** **Options**	 **Scale of Costs**	**Assumptions**
M **Middlemarch Hazard Mitigation Improvements** *Year 4 (2027/28)* Decision Drivers (Key Significant Issues):	Do nothing. Ongoing maintenance of waterways.	Low to moderate (ongoing operational costs) Moderate to high (costs associated with major events)	Increase in levels of service as a result of improved hazard mitigation.
	Undertake hazard mitigation improvements.	Moderate to high (capital costs) Low to moderate (costs associated with major events)	
N **Lindsay Creek Flood Mitigation Implementation** *Year 4 (2027/28)* Decision Drivers (Key Significant Issues):	Do nothing. Ongoing maintenance of waterway and existing infrastructure.	Low to moderate (ongoing operational costs) Moderate to high (costs associated with major events)	Increase in levels of service as a result of implementing flood mitigation options. A comprehensive flood protection scheme has been assumed for cost estimate in later years of this Strategy. Levels of service and tolerable residual risk to be determined.
	Implement flood mitigation options that focus on nature-based solutions where practicable.	High to very high (initial capital and implementation costs)	
	Build a flood protection scheme that consists of hard engineering infrastructure.	Very high (initial capital cost)	

4.5 Scenarios, Assumptions and Uncertainty

The Local Government Act 2002 requires identification of the most likely scenario impacting infrastructure requirements along with assumptions, uncertainties, and potential impacts of these uncertainties. These have been set out below in Table 26.

Table 26. Likely scenarios, assumptions, level of uncertainty and reasons and effects of that uncertainty.

Likely Scenario	Assumptions	Level of uncertainty	Reasons and effect of uncertainty
Climate change including increased weather events and other Natural Hazard events			
Consideration and response to Climate change will be consistent with current national and regional projections. Increased significant weather events, or other natural hazard emergencies will continue to occur. Infrastructure Strategy assumes there will be an average of (1) significant event[3] per financial year within Otago.	If climate change effects occur more quickly than anticipated in the investment programme there may be an increased adaption and response to climate change. Future sea level rise does not exceed that projected by current climate science within the 30-year planning horizon. Council cannot accurately predict when and where large flood events will occur, or the damage that may result from any flood event. There will be increased frequency of weather events that cause damage to infrastructure assets.	Medium	The effects of increased weather events that cause damage and potential other natural hazard events, on Councils financial position is dependent on the scale, duration, and location of the event. Potential climate change impacts are being considered through scheme performance and detailed investigation as prediction and adaptation information becomes available. The Council will manage the effect through its reserves to repair or replace infrastructural assets that are damaged and/or destroyed. The infrastructure strategy will focus on self-insurance reserves that are built up over time to ensure funding up to 40% of the expenditure is available across the schemes.4 Within 50 years, climate changes will start to become more significant and will require response and or implementation of adaptation strategies within the 30-year timeframe. The infrastructure strategy allows for this, noting that there are 'known and unknown' effects. The key to appropriate planning and response is the investigations and planning to implement adaptation strategies. The infrastructure considers climate change and provides to investigate the impact on the management of flood protection and land drainage scheme assets.

[3] Significant event is defined as flood protection trigger levels are reached or exceeded in a scheme and the event reaches repair cost threshold in accordance with NEMA guidelines.
[4] The Council has access to the National Emergency Management Agency (NEMA) which provides 60% funding of expenditure required to repair assets damage. This is dependent on the Council reaching its threshold which is 0.002% of the Rateable Value of Council infrastructure in the financial year in which the damage occurred.

Likely Scenario	Assumptions	Level of uncertainty	Reasons and effect of uncertainty
Legislative Change			
Legislative changes will change marginally, however current forecast allows for adaptation.	There will be no major changes to key legislation that effects the ORC's strategy or has funding implications. Key legislation under this Infrastructure Strategy includes; Local Government Act 2002, Resource Management Act, and Soil Conservation and River Control Act 1941.	High	There is a high level of uncertainty because legislative change is highly likely over the next 30 years. The potential effect of any new changes environmental or resource management will be determined on the response required, and the timing to effect such changes. Legislative changes may result in additional required expenditure to comply with new standards.
Asset Lifecycle			
Council will invest in its owned infrastructure relating to flood protection, land drainage and river assets to ensure resilience and level of service to be provided by the infrastructure. Information contained in this Infrastructure Strategy is based on current known information which has been used to determine issues and understand the asset management requirement for a 30-year horizon.	The Council has sufficient funds to replace significant assets at the end of their useful lives. The Council has sufficient known information to support its asset lifecycle costs.	Medium	The continued development of asset management systems including forecasting and modelling tools will continue through Years 1 to 10. It is expected that maturity in asset management systems and consolidation of known information will provide Council an improved basis of determining capital renewals (increased levels of service) costs. Asset lifecycle costs are based on useful remaining lives, condition assessments and replacement values as of 30th June 2023, which has been drawn from known information available in Councils current systems.
Demand for Level of Service			
Territorial Authorities through their respective planning processes will indicate growth across some areas of Otago in the short and long term, 30-year horizon.	That there will be a demand for flood protection, land drainage and river management and an associated level of service changes due to continued investment and land use change in both urban and rural areas.	Low	That communities and other utility providers (rail, airport and roading networks) will expect the same (or increased) level of service in the future as to meet demand. Communities and other utility providers will be able to pay additional costs to maintain or (increase) that level of service.

Likely Scenario	Assumptions	Level of uncertainty	Reasons and effect of uncertainty
Natural Disaster			
Events across New Zealand have shown that natural disaster through prolonged weather events has had a destructive effect on infrastructure and communities. No allowance has been made in investment programmes for repairs to scheme assets resulting from natural disasters.	Natural disasters occur and exceed forecast expenditure and compromise infrastructure functionality.	Medium	Responding to major weather events or other natural disasters is funded through insurance (where insurable) and scheme reserves in response to events. Increased renewals or maintenance due to natural disasters will be funded through reserves. Council also will have the ability to raise funding for the cost of unexpected works in response to weather events and natural disasters such as floods or earthquakes. The Infrastructure Strategy invests in analysis of flooding and disaster readiness and preparedness.
Giving 'rivers room to move' and PARA Framework			
The principles of 'giving rivers room to move' including Te Mana o Te Wai and investigating the inclusion of nature-based solutions to adapt to climate change and increased weather patterns within the PARA Framework will be a Council priority. The ORC's approach to flood protection, land drainage and river management has been transitioning to consider whole of river and catchment approach with effect to giving rivers room to move and Te Mana of Te Wai. It is anticipated that the Council will continue to support the progress to take an integrated approach and align flood protection, land drainage and river management infrastructure to not only understanding these principles but implementing in our work activities.	Progress towards incorporating and considering the PARA framework with regard to how our rivers, communities and infrastructure intersect will continue. National direction including regional planning framework will develop in the 30-year horizon that allows the PARA framework which to be implemented by giving effect to giving rivers room to move.	Low	The impacts of national direction, including Te Mana o Te Wai, climate change adaptation and changes to regional planning frameworks, have yet to be given effect. These changes may give greater recognition and protection of a range of values in rivers, including biodiversity and those of mana whenua, which may change priorities and outcomes. It is likely some changes will impact the current approach and rate of transition with infrastructural investment, if the changes do not have an appropriate transition period. This will reinforce the strategic directions that Council has set to proactively revive the mauri of rivers, ki uta ki tai including creating a landscape alignment to revive these critical ecological corridors from the mountains to the sea and restore the connections between communities and rivers, which enables adaption to proceed with connection as opposed to an intersection of communities and rivers.

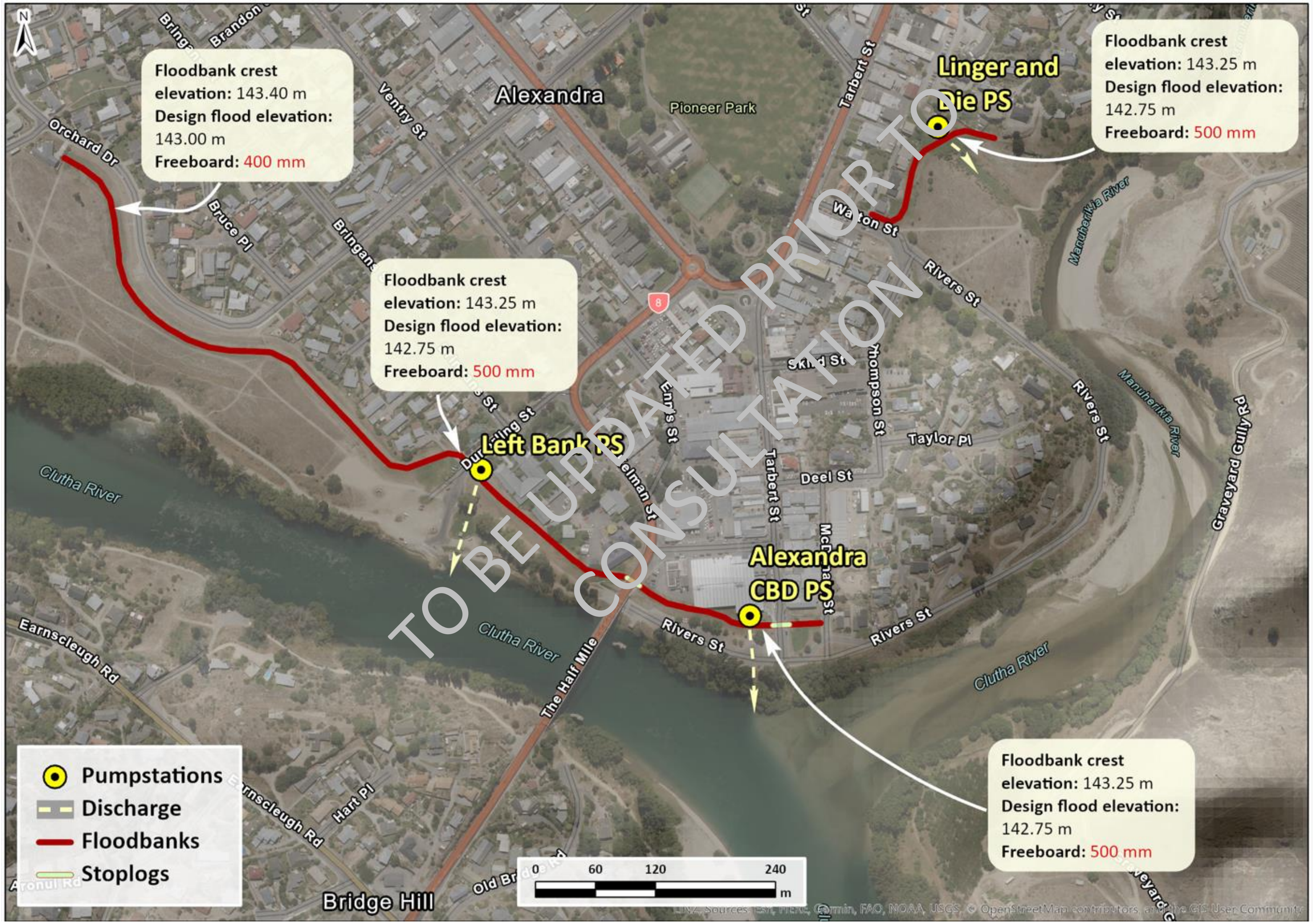
Appendix A: Scheme Maps

Note that the maps in this section will be updated prior to public consultation commencing.

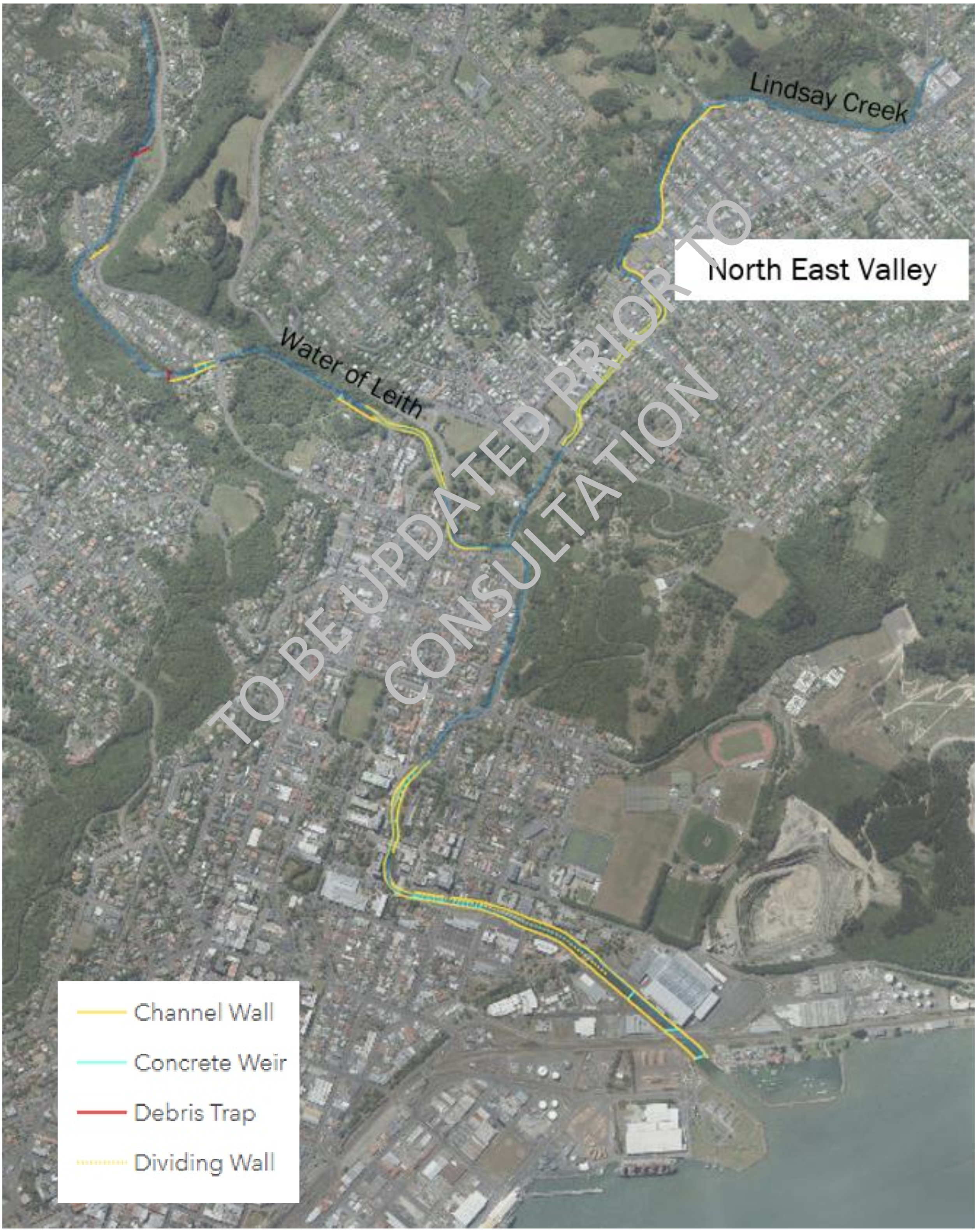
Scheme maps are ordered as follows:

- Alexandra Flood Protection Scheme
- Leith Flood Protection Scheme
- Lower Clutha Flood Protection and Drainage Scheme
- Tokomairiro Drainage Scheme
- Lower Taieri Flood Protection Scheme
- West Taieri Drainage Scheme
- East Taieri Drainage Scheme
- Lower Waitaki River Control Scheme
- Stoney Creek Flood Protection Scheme

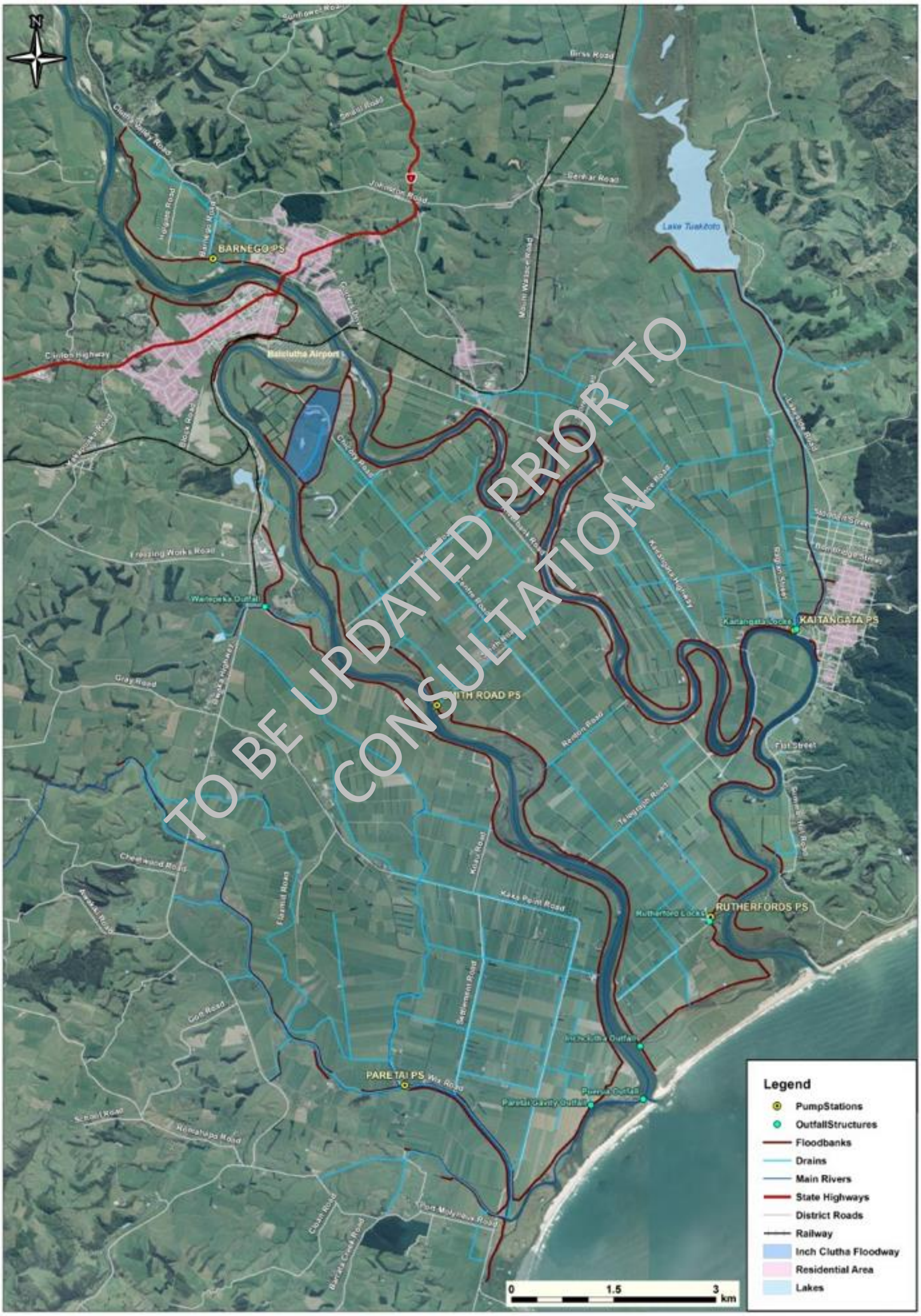
Alexandra Flood Protection Scheme



Leith Flood Protection Scheme

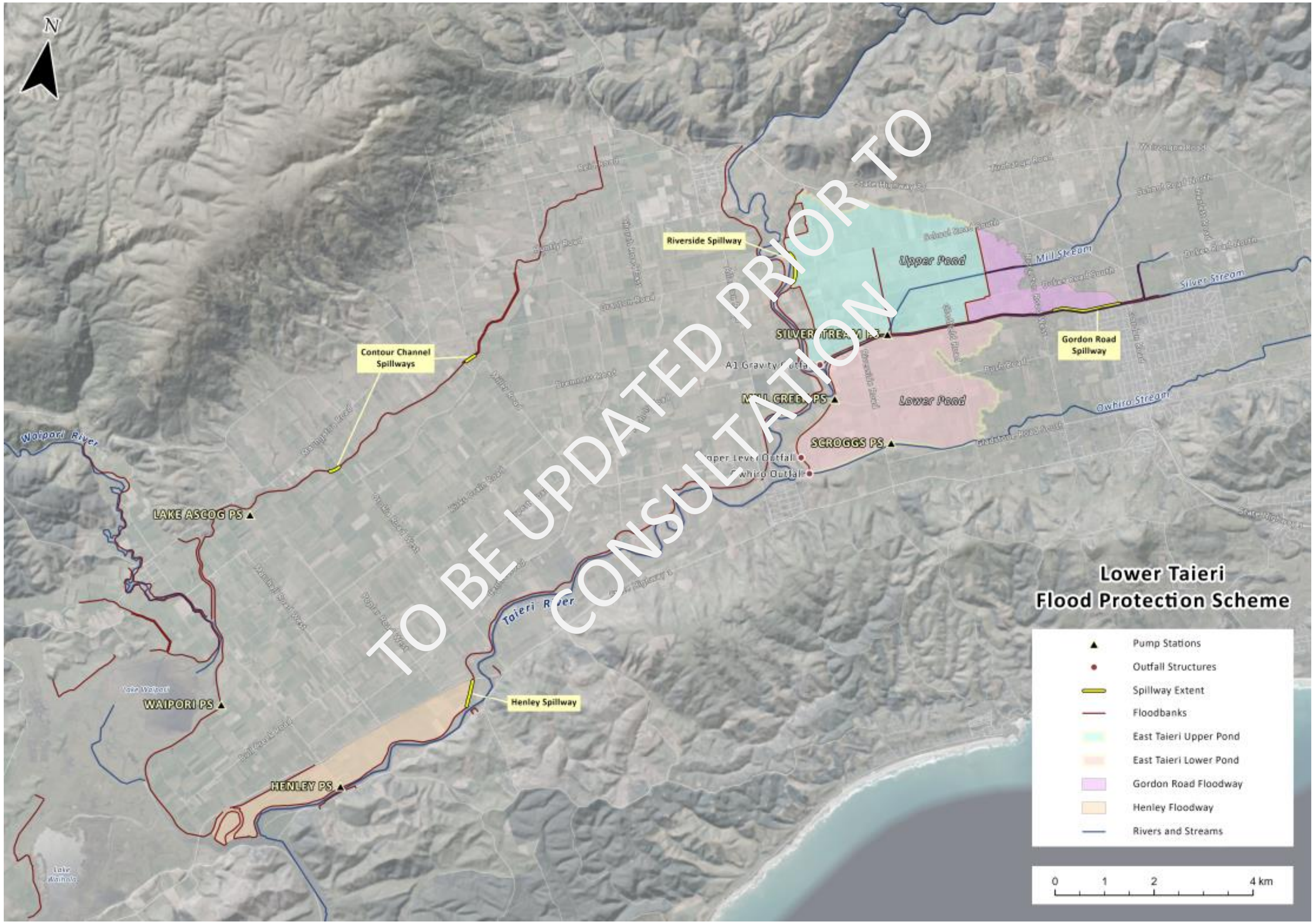


Lower Clutha Flood Protection and Drainage Scheme

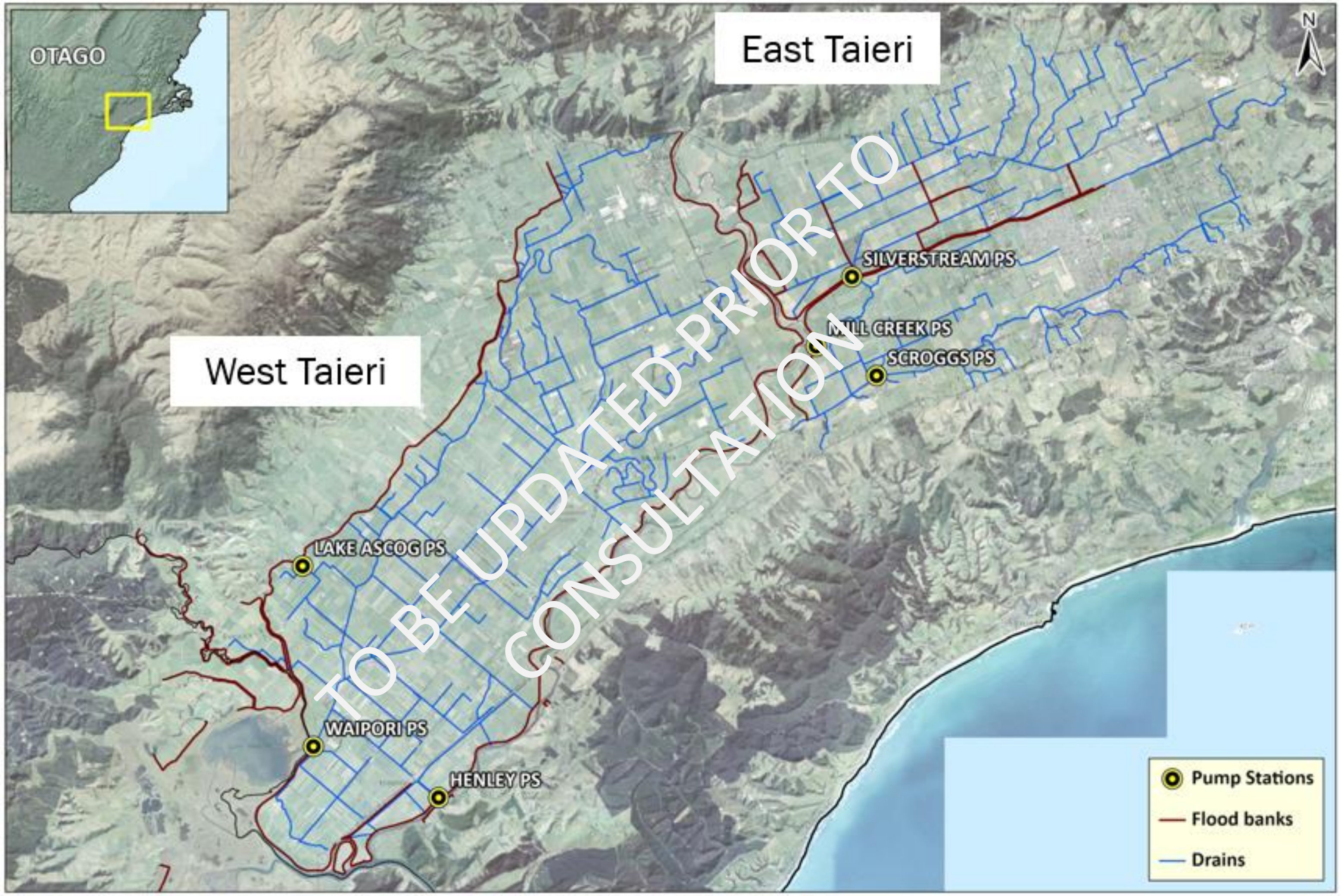


Tokomairiro Drainage Scheme

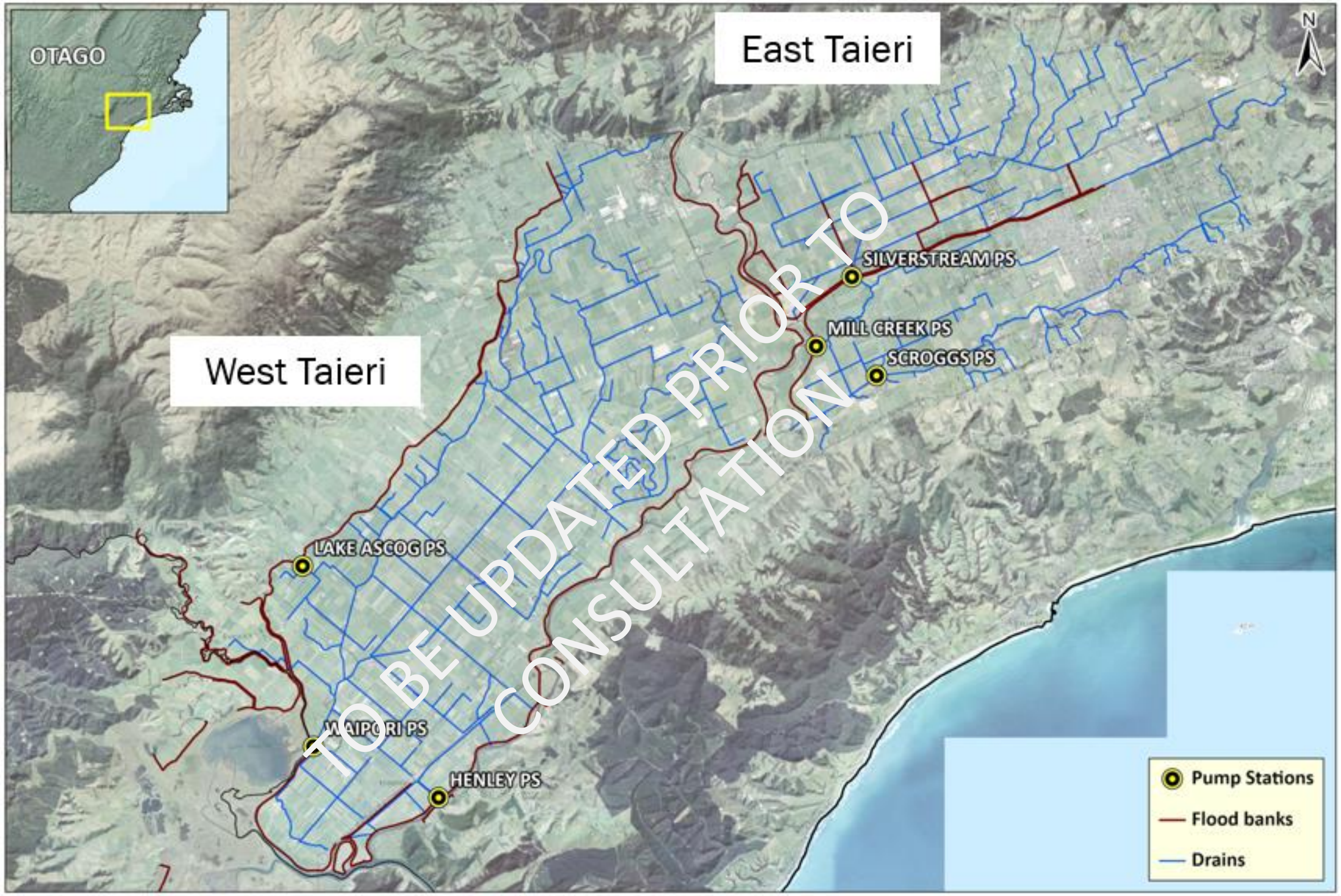
Lower Taieri Flood Protection Scheme



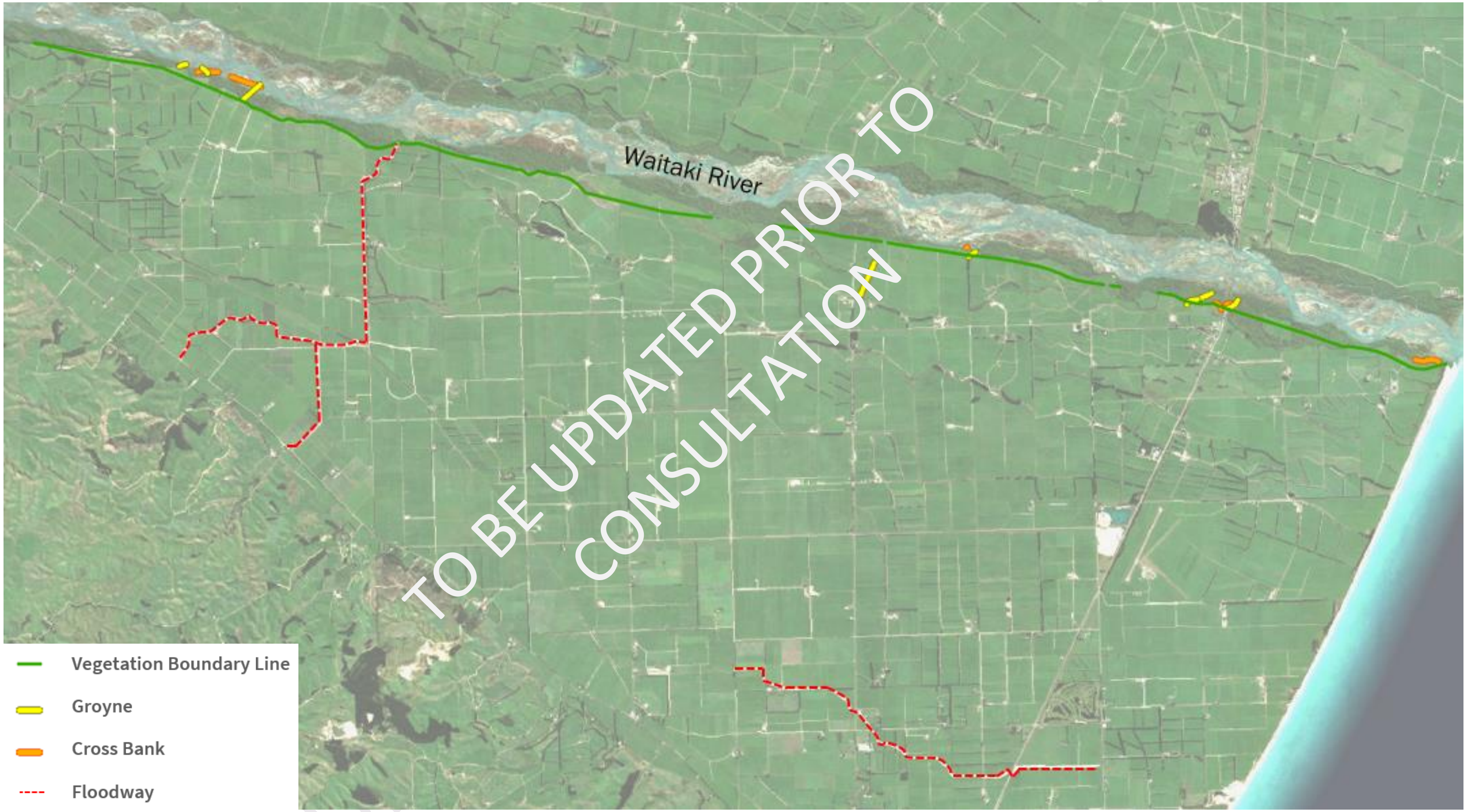
West Taieri Drainage Scheme



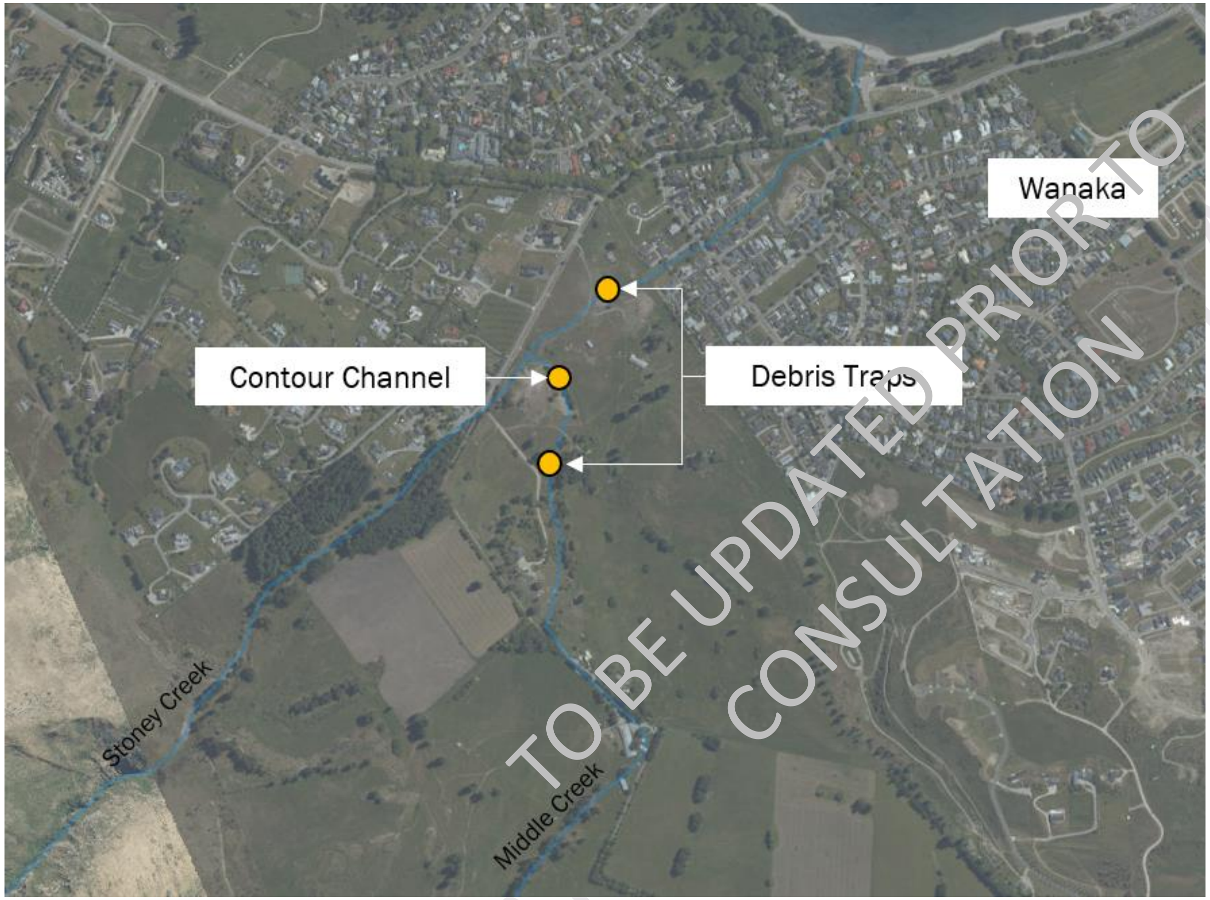
East Taieri Drainage Scheme



Lower Waitaki River Control Scheme



Stoney Creek Flood Protection Scheme



8.5. ORC's strategic and community engagement

Prepared for:	Council
Report No.	GOV2341
Activity:	Governance Report
Author:	Kate Pettit, Senior Adviser Strategic Engagement
Endorsed by:	Amanda Vercoe, General Manager Governance, Culture and Customer
Date:	6 December 2023

PURPOSE

[1] To seek Council direction on the scope of ORC's strategic and community engagement opportunities.

[2] To outline the current and future opportunities that can elevate engagement best practices, meeting the needs of ORC staff, stakeholders and Otago's communities.

EXECUTIVE SUMMARY

[3] ORC has set engagement principles and clear commitments to engagement with iwi partners and stakeholders through Significance, Engagement and Māori Participation Policy, *He Mahi Rau Rika (*He Mahi Rau Rika). The focus extends beyond meeting expectations to surpassing them. The *He Mahi Rau Rika* has further potential to serve as a foundational policy underpinning a unified and cohesive organisational approach.

[4] The strategic directions and policies of ORC prioritise wellbeing, recognising the holistic link and interdependent nature of wellbeing, effective engagement, connected communities and a healthy environment.

[5] Community desire, regulatory requirements and the complex landscape of managing the environment, mean that collaboration with communities is now more critical than ever to build shared understandings and solutions.

[6] While successful ORC engagement activities are occurring across the region, challenges persist due to inconsistency in the current approach, reflecting a cycle of reinventing the wheel, with ineffective processes for internal coordination and collaboration, and representation of the diversity in Otago's communities.

[7] An engagement framework will strengthen engagement efforts by providing a cohesive and unified approach for evidence-based, best-practice community engagement. A framework will promote a collective voice, ensure consistency, build organisational capacity and capability, and fortify our reputation and relationships with the community, reinforcing our social license in the engagement space.

[8] Expanding ORC's Diversity, Equity and Inclusion profile, through a variety of mechanisms, will ensure all communities in Otago have access to inclusive and equitable engagement processes.

RECOMMENDATION

That the Council:

1) ***Notes*** *the report.*
2) ***Notes*** *the enhanced engagement approach piloted with strategic stakeholders for the 2024-24 Long-Term Plan.*
3) ***Notes*** *that increased levels of service will be proposed through the draft Long Term Plan 2024-34 process, with the aim of delivering better engagement practices.*

BACKGROUND

[9] ORC's Significance, Engagement and Māori Participation policy, *He Mahi Rau Rika*, outlines engagement principles and clear commitments to engagement with stakeholders. With ORC's aspiration to exceed these expectations, the policy adopts the IAP2 Public Participation Spectrum (IAP2 Public Participation Spectrum) and emphasises intentional community involvement in decision-making by fostering a genuine two-way dialog that supports enduring relationships with communities and stakeholders.

[10] Both ORC's current and forthcoming strategic directions emphasise the importance of effective engagement, aiming to build community trust that enables public participation and well-informed decision-making.

[11] The inaugural Otago Wellbeing Baseline Report (Otago Wellbeing Baseline Report) and subsequent development of ORC's Wellbeing Framework in 2023 provides a conceptualised model of wellbeing and a structured measurement approach, enabling effective monitoring. ORC's draft 2024-2034 strategic directions gives effect to the Wellbeing Framework by acknowledging the holistic link and interrelated nature of community wellbeing and a healthy environment.

[12] Historically, ORC has encountered engagement inefficiencies, both internally and externally, resulting in some ambiguity around the execution of various engagement activities, staff roles and responsibilities, and contributed to a misalignment between ORC's intended messages, actions and outcomes.

[13] In late 2022, ORC commissioned BERL to design a draft community engagement framework (BERL, 2023, Draft Community Engagement Framework), which served as an initial step in understanding and shaping organisation-wide practices. BERL's draft framework provides an informative foundation, signalling a way forward, with further development required to ensure the approach builds internal capacity and capability and accommodations the complexity, diversity and extensive range of engagement activities undertaken by ORC.

DISCUSSION

The importance of effective community engagement

[14] As the intersection of community desire and expectation, regulatory need for effective engagement, and the complexity of environmental management continues to intensify, it is now more important than ever to work alongside communities to forge shared understandings of, and solutions to, the issues we face.

[15] In order to make well-informed decisions that resonate and reflect the needs of our communities and enhance their confidence in the decisions we make, we must foster an environment where communities want to, and can engage with us in an inclusive, transparent and equitable way.

[16] Effective community engagement, characterised by a genuine intention of listening and being influenced by incorporating local knowledge and values into decision-making, builds trust and encourages active participation in the challenges and opportunities communities face. Supporting active citizenship translates to improved decision-making, increasing access to community strengths and resources, yielding more impactful, successful and sustainable outcomes for communities.

[17] An empowered community voice strengthens capacity and capability for leading engaged and purposeful lives, fostering a profound sense of connection and belonging to people and place, enhancing overall satisfaction and wellbeing and strengthening community identity.

[18] Engagement good practice not only elevates the quality of decision-making but contributes significantly to the cultivation and quality of relationships. Nurturing and establishing enduring relationships that are grounded in trust, reciprocity and care, fosters environments for meaning community engagement on future issues.

Community Engagement Challenges

[19] Although ORC staff highly value effective participation practices and a strong culture of shared ownership exists within the organisation, ORC currently lacks an engagement framework which articulates best-practice expectations and guidance. There is also an absence of a cohesive approach to planning, design, delivery and evaluation of engagement activities.

[20] While there are many examples of outstanding engagement practices within ORC, the current approach to engagement is inconsistent, reflects a cycle of reinvesting the wheel on a project-by-project basis, and is scarce in internal coordination and experiential learning processes. There is a necessity to develop an overarching framework that serves as a roadmap for more cohesive planning, cross-organisational coordination and collaboration, and builds the engagement capacity, capability across the organisation to ensure a consistent approach.

[21] Engagement challenges, both for internal and external stakeholders, have been highlighted in ORC commissioned reports (LandPro, 2022, Otago Lakes Management Review; Ahikā, 2022, ICM Collaboration Framework Report), with a range of consistent recommendations on consultation, coordination and collaboration. These include:

- An organisational repository which captures engagement outcomes and feedback, with emphasis on information being used to inform and enhance engagement initiatives.
- Maintaining good engagement through early, robust planning and sufficient resourcing for engagement delivery.
- Effective stakeholder mapping processes which identify the challenges and risk with different stakeholder groups.

- Tailored engagement plans with methods designed to meet the needs of diverse stakeholder groups.
- Employing a variety of engagement tools and approaches to promote inclusivity and equity in practice.

[22] A strong commitment to Diversity, Equity and Inclusion (DEI) in community engagement is crucial to recognising the rich tapestry of Otago's population. Robust DEI mechanisms not only improves public confidence in decision-making, but also enhances organisational resilience, fosters ethically grounded community partnerships, and enhances ORC's reputation and leadership

[23] Creating an inclusive culture in how we work with, and value, our communities enables the diverse community voice to be reflected in Council decision-making. Enabling equal access to participation requires ORC to identify and reduce barriers, particularly with under-represented and less heard groups, and expand into a repertoire of diverse engagement tools that equalise power imbalances, ensure transparency and accountability.

CURRENT AND PLANNED WORK PROGRAMMES

[24] Outlined below is an overview of ORC's current resourcing to strategic engagement, planned work programmes and delivery timeframes. The effective implementation of these initiatives necessitates a change process to enhance organisational engagement maturity and readiness, ensuring organisational capacity and capability building. Identified below are specific components within the work programmes where additional resourcing would fortify capacity, ensuring the effective implementation processes and enhance ambition within the engagement deliverables.

[25] The planned and proposed work programmes take a high-level approach to engagement initiatives, which will be refined and developed further after Council direction.

Current Resourcing to Strategic Engagement

[26] The creation of a standalone role, and the subsequent appointment of a Senior Advisor Strategic Engagement, has expanded ORC's capacity to elevate efforts across the organisation. The role encompasses a range of responsibilities, including:

- Develop and lead a plan of strategic engagement activities and initiatives that support effective and best-practice engagement with ORC's key stakeholders.
- Facilitate and coordinate relationship management with strategic stakeholders.
- Offer guidance and support to ORC teams on evidence-based, best-practice engagement methods.
- Establish and develop a 'centre of excellence' for engagement and consultation to strengthen ORC's collective voice and enhance consistency of engagement practice across the organisation.

[27] Table 1 outlines the current work programme being delivered by the Senior Advisor Strategic Engagement.

Work programme	Status	Output
Refinement of the strategic stakeholder analysis process for the 2024-34 Long-Term Plan engagement process.	Complete	Identification of 34 strategic stakeholders across five groupings: Land users Conservation and restoration Central and Local Government Friends of the Council Community representation
Pilot programme of early engagement with strategic stakeholders as part of the 2024-34 Long-Term Plan engagement process.	In-progress	Current monitoring: 14 survey responses 13 follow-up meetings booked with ELT. 6 welcoming engagement and are engaging in alternative arrangements.
Preliminary exploration of an internal community engagement coordination tool.	In-progress	Identification of opportunity to incorporate and develop into the IRIS NextGen software.
First iteration of an engagement framework and accompanying kete/toolkit.	Under development	Engagement framework Best-practice guidance A practical kete/toolkit Stakeholder analysis processes Engagement methods matrix Monitoring and evaluation processes.

Partnership Engagement

[28] Engagement with mana whenua and māata waka partners is a distinct and specialised workstream currently led by the Manager Executive Advice. While this workstream will be integrated into ORC's organisation-wide approach to engagement, it will maintain a separate piece of work, reflecting our partnership-based approach.

Planned Work Programmes

Community Engagement Hub

[29] The establishment of a 'Community Engagement Hub' represents a strategic initiative to embed ORC's Significance, Engagement and Māori Participation policy, *He Mahi Rau Rika*. The hub is envisioned as a catalyst for cultivating an ingrained culture of authentic and inclusive engagement, emphasising public participation process.

[30] Centralising ORC's engagement framework within the hub, this initiative would aim to provide a wealth of resources geared towards strengthening community engagement efforts. The overarching goal is to enhance organisational capacity and capability, promoting consistency through a unified approach, establish a common language, and weave a values-driven and strategic thread throughout engagement activities. The hub would be designed to instil accountability, responsibility and ownership among internal stakeholders, while providing a more cohesive, equitable and valued engagement practices with external stakeholders.

[31] The planned work programme and delivery of the hub is estimated to be completed by June 2024. Resources within the hub are envisaged to include:

- Best-practice engagement guidelines, practical ketes/toolkits and templates, stakeholder analysis processes, and an engagement methods matrix.
- Processes for monitoring and evaluation of engagement (MEE), providing a means to assess the effectiveness of engagement approaches, enhancing accountability and facilitating experiential learning.
- Inclusion of a 'centre of excellence', offering a platform for a regional, national and international perspective on effective engagement practices. This centre would showcase innovative research, models and approaches to engagement, along with best-practice case studies.
- Facilitating learning and development through a library of webinars, podcasts and bite-size training opportunities.

[32] To further expand ORC's repertoire of diverse engagement tools and support community engagement efforts, community engagement software may be considered and form part of the resources within the community engagement hub.

[33] Supporting the hub's effective implementation, continued development and ensuring ORC staff are supported with the practical application of the framework and practice toolkits relies on either additional resourcing to the engagement space, or a subsequent work programme that extends past the hub's delivery timeframe.

[34] Ensuring the hubs relevance and effectiveness, an internal reference group will be actively involved in its development. This group will serve as a mechanism to guarantee that the framework and accompanying materials meet the diverse needs of ORC's cross-functional teams.

Internal Coordination

[35] Aligned with several review recommendations (LandPro, 2022, Otago Lakes Management Review; Ahikā, 2022, ICM Collaboration Framework Report), the development of an internal coordination tool for engagement stands to provide organisation-wide oversight of all past, present and future engagement activities.

[36] While still in the exploratory stages, an opportunity to develop this tool within the IRIS NextGen software has been identified. Envisaged to incorporate spatial mapping capabilities, this tool is expected to offer a visually informative overview of each engagement, featuring colour-coded indicators denoting its status (past, present,

future), and other relevant details. The potential benefits of this tool are extensive, but include:

- Enhancing cohesion: by promoting joined-up working, the tool would aim to enhance collaboration within ORC.

- Supporting relationship management: the tool could act as a database for fundamental engagement knowledge and information about stakeholders and communities.

- Servicing as a comprehensive repository: acting a repository for engagement planning, design, implementation, outcomes and feedback, the tool could enable the utilisation of information to inform and support new engagement projects.

- Facilitating reporting: the tool will simplify reporting processes on engagement activities.

[37] The estimated delivery timeframe for the development of an internal coordination tool aligns with the implementation of the IRIS NextGen software, predicted for mid-2025.

[38] Collaboration with ORC teams will be crucial in ensuring the tool is fit-for-purpose, meeting the multitude of needs across the organisation.

Diversity, Equity and Inclusion (DEI)

[39] Integrating ORC's values and engagement principles to ensure that the reach and representation of community engagement reflects the diversity of the communities of Otago is a deliberate and purposeful endeavour.

[40] Incorporating diverse voices into decision-making processes fosters a heightened sense of connection, accountability and ownership among the community. Adopting an inclusive approach enhances a sense of individual and community belonging, strengthening ORC's ability to give effect to its strategic directions by building resilient, connected and healthy communities.

[41] A key initiative to fortify ORC's DEI profile involves amplifying the voices of marginalised and less heard communities. By fostering engagement that is diverse, equitable and inclusive, the decision-making process can better reflect a variety of community perspectives, acknowledges and values peoples lived experience and expertise, and elevates innovation and creativity in response and solutions. Several viable options include:

- Establishment of a youth committee/rōpū: creating a dedicated platform focussed on the voice of the young population.

- Embedding DEI good practice: infusing DEI throughout organisation-wide engagement efforts.

- Strengthening engagement practices: enhancing our mechanisms to capture the voice of marginalised and less heard communities, e.g. disabled, senior and Pacific communities.

- Establishing MOUs/agreements: introducing formal engagement processes with key community representation groups such as Grey Power and Disabled Persons Assembly NZ, to ensure regular engagement and representation.

[42] Commencing in 2024, efforts will be directed towards bolstering ORC's DEI profile. This will be tailored to available resourcing to support this work.

Strategic Engagement

[43] Enhancing ORC's strategic engagement capabilities with key stakeholders to deliver increased value in relationship management is a key priority. While recognising the significance of incorporating stakeholder input into engagement design, potential initiatives for developing an ongoing engagement plan may encompass:

- Tailored engagement approaches that meet individual stakeholder needs.
- The implementation of bi-annual/annual key stakeholder meetings with relationship managers.
- The establishment of a consistent early engagement process for strategic stakeholders as part of the Annual Plan/Long-Term Plan.
- The introduction of an ORC roadshow/grouped stakeholder engagement mini-events.
- Establishing wider reach engagement opportunities, like establishing visibility at Otago university / polytechnic events, or targeted engagement opportunities at industry events, such as Otago Farmers Markets.

[44] ORC also has the potential to leverage its role as a regional industry connector by hosting events that facilitate networking, foster collaboration, and offer valuable learning opportunities to stakeholders.

[45] Building upon the current momentum, the ongoing refinement of consistent and targeted engagement processes tailored for key stakeholders will continue in 2024.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[46] The strategic and community engagement approach aligns with the Council's strategic framework and policy objectives, the Significance, Engagement and Māori Participation Policy *He Mahi Rau Rika*, the current and draft strategic directions, and the Regional Wellbeing Framework.

[47] The IAP2 (International Association for Public Participation) will be used to inform the engagement framework and subsequent materials.

Financial Considerations

[48] Additional FTE and resourcing of initiatives will be discussed as part of the 2024-34 Long-Term Plan process.

Significance and Engagement

[49] The report aligns with the *He Mahi Rau Rika*, ORC's Significance, Engagement and Māori Participation Policy, and recommends that the policy functions as an underpinning document for a unified and cohesive approach to engagement.

[50] The report signals opportunities which will change how ORC approach strategic and community engagement. It considers how ORC can adopt a strategic, consistent, and aligned approach to all its engagement activities, meeting the needs of ORC staff, stakeholders and communities, and introduce new resources which pave the way for best-practice engagement at an organisational wide level.

Legislative and Risk Considerations

[51] The development of an engagement approach must comply with the legislative requirements outlined in the Local Government Act (2002), including the Special Consultative Procedure. Section 716A. This includes:

- Section 10(1)(2) states that one of the purposes of local government is to 'promote the social, economic, environmental, cultural wellbeing of communities in the present and for the future' when making decisions.
- Recognising the diversity of New Zealand communities.

[52] Any development of Monitoring and Evaluation of Engagement process must ensure that the collection of feedback is compliant with Privacy and Information Management Legislation (Privacy Act 2020).

Climate Change Considerations

[53] There are no climate change considerations.

Communications Considerations

[54] As part of the development of an engagement framework or engagement resources, consideration for the need to work in collaboration with the ORC's communication team to carefully navigate and integrate the interdependencies between the communication and engagement spaces.

NEXT STEPS

[55] The Senior Advisor Strategic Engagement role will encompass many of the mentioned work programmes. The following initiatives are planned for delivery over several months:

- Establishment of an internal reference group.
- First draft of a community engagement framework and accompanying kete/toolkit and guidelines.
- Establishment of an ongoing key stakeholder engagement plan.
- Exploration of an internal coordination tool.

ATTACHMENTS

Nil

8.6. Membership Representation Review 2024 - Introduction

Prepared for:	Council
Report No.	GOV2342
Activity:	Governance Report
Author:	Amanda Vercoe, General Manager Governance, Culture and Customer
Endorsed by:	Richard Saunders, Chief Executive
Date:	6 December 2023

PURPOSE

[1] To note that Otago Regional Council is required to undertake a membership representation review under the Local Electoral Act in 2024, and to seek guidance on:

a. How Council wishes to oversee the process of developing options, and
b. Issues of interest that could be included in any potential early engagement with the community.

EXECUTIVE SUMMARY

[2] Under the Local Electoral Act, Council is required to undertake a Membership Representation Review (the Review) every six years. The last review was undertaken in 2018, and no changes were made to the existing constituencies.

[3] The scope of the Review is the representation arrangements for Otago Regional Council, including:

a. Number of electoral subdivisions (constituencies/wards)
b. Boundaries and names of constituencies
c. Number of elected members.

[4] A workshop was led by Electionz.com on 21 November 2023 to outline the process and considerations. The process is prescribed by legislation in terms of the decision-making considerations and milestones. However, it needs local information, data and input to meet the criteria set out in the legislation, including communities of interest, fair representation and effective representation. With this information, proposals will be developed for council workshops and consideration, leading to Council adopting an "initial proposal" for consultation with the community.

[5] This paper seeks Council guidance on whether it would like to establish a Councillor Working Group to oversee the process, including

a. Early engagement
b. Reviewing the research and guiding the development of options
c. Overseeing the refinement of the initial proposal.

[6] The alternative to a Councillor Working Group is engaging with Councillors through full workshops as the process evolves. All decision making would take place at Council Meetings.

[7] This paper also seeks early feedback on issues that Councillors would like to interrogate as part of undertaking the 2024 review. This could be used to target early engagement with the community, which could be a useful input to the development of options for Council consideration. Feedback on issues of interest from the workshop on 21 November included:

   a. The growth in population of the Dunstan Ward and whether the current representation arrangements for this Ward are working in terms of it covering QLDC and CODC district boundaries.
   b. Large geographical areas.

[8] This paper also provides a high-level timeframe for undertaking the review, but this will be refined as the project plan is developed.

RECOMMENDATION

That the Council:

1) ***Notes** this report.*
2) *Option 1*
   a. ***Agrees** to establish a Councillor Working group to oversee the process of developing proposals for the Membership Representation Review.*
   b. ***Delegates** to the Chair to appoint the membership of this Working Group*

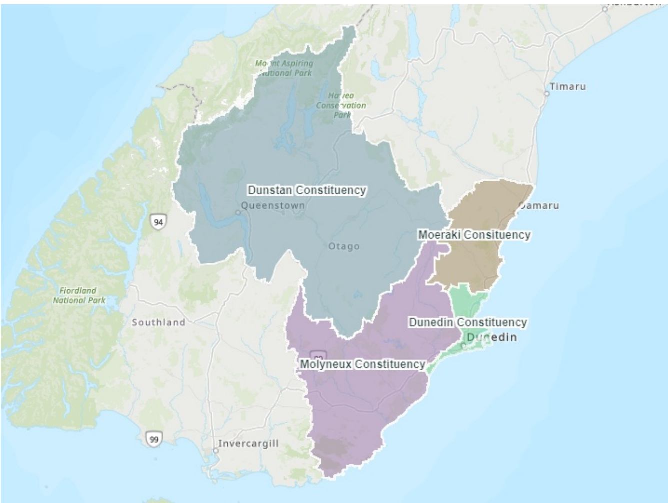
OR

3) *Option 2*
   a. ***Agrees** that oversight of the membership representation review will remain with all of Council, and be done through a series of Council workshops.*

BACKGROUND

[9] Under the Local Electoral Act, Council is required to undertake a Membership Representation Review every six years. The last review was undertaken in 2018 and no changes were made to the existing constituencies.

[10] The representation arrangements for Otago Regional Council currently are:



[11] The attached presentation delivered by Electionz.com on 21 November provides

Constituency	*Population*	*Councillors*	*Ratio*	*%*
Moeraki	*20,400*	*1*	*20,400*	*+9.19%*
Dunstan	*57,400*	*3*	*19,133*	*+2.41%*
Molyneux	*35,600*	*2*	*17,800*	*-4.73%*
Dunedin	*110,800*	*6*	*18,467*	*-1.16%*
Total	***224,200***	***12***	***18,683***	

background to the Review and the key considerations for Council.

[12] The statutory timeframes for undertaking the review are below:

By 31 July 2024	**Last date to resolve Initial Proposal**
By 8 August 2024	Notification of Initial Proposal – open consultation (14 days from resolution)
By 8 September 2024	Public submissions on Initial Proposal close (not less than one month after notification)
By 3 November 2024	Last date for notification of Final Proposal (8 weeks after end of submission period)
By 3 December 2024	Last date for public appeals/objections on Final Proposal
By 10 April 2025	If appeals/objections – last date for LGC determination

DISCUSSION

[13] **Council oversight of the Review**: All decision-making and formal consideration of options would be through full Council workshops and Council meetings. However, Council may wish to put in place a Working Group to oversee and guide the project in between formal milestones. This could include things like:

a. Oversight of potential early engagement approach with territorial authorities, mana whenua, and targeted community engagement for areas of interest
b. Reviewing the research and guiding the development of options
c. Overseeing the refinement of the initial proposal following Council workshops.

[14] **Issues of Interest:** Since the last Review, the population statistics for Otago have shown significant growth in the Dunstan Ward, which means it is now outside of the Local Government Commission's +/- 10 percent rule (where the number of electors per elected member should be within +/-10 percent of the average ration). This is something that was highlighted at the workshop as needing further research.

- 2023 Representation estimates (StatsNZ/LGC)
  - Note: these figures to be used for Representation Review

CONSTITUENCY	Population	Members	Population-member ratio	Difference from quota	% Difference from quota
Dunstan Constituency	78,800	3	26,267	5,050	23.80
Moeraki Constituency	22,300	1	22,300	1,083	5.11
Molyneux Constituency	38,300	2	19,150	-2,067	-9.74
Dunedin Constituency	115,200	6	19,200	-2,017	-9.51
Total	**254,600**	12	21,217		

[15] The other issue highlighted was that Otago is one of the biggest regions and has some big constituencies for the number of elected members. This will also be looked at as part of the Review.

[16] Staff would welcome further feedback from Councillors of issues they would like explored as part of the review.

OPTIONS

Option 1

[17] Establish a Working Group (with the Chair being delegated to appoint the membership of the group).

- Advantages include a smaller group of Councillors being able to provide oversight and guidance throughout the process. There will be greater opportunity for input from elected members right throughout the process.
- Disadvantages include the time commitment for members of the working group, when the first half of 2024 is going to be very intense with Long-term Plan and Land and Water Regional Plan commitments.

Option 2

[18] All matters related to the Review be discussed through full Council workshops and meetings.

- Advantages include all councillors remaining involved equally in the Review process and being able to provide guidance.
- The disadvantage to this option is that there will be fewer opportunities for elected member input through all parts of the process as the availability of time for whole council workshops will be limited.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[19] The Membership Representation Review is a statutory requirement.

Financial Considerations

[20] This review is unbudgeted but can likely be absorbed within the budget of the Governance, Culture and Customer directorate budgets. Early estimate of cost is around $35,000, including consultant help plus advertising for any early engagement. This excludes staff time, which will likely be drawn from the Governance Team, the Communications and Marketing Team and the GIS Team at various points in the process.

Significance and Engagement

[21] This process requires formal consultation under legislation, and may also require early engagement with territorial authorities, mana whenua and targeted parts of the community.

Legislative and Risk Considerations

[22] This Review is required under legislation. Staff will be mindful of Long-term Plan consultation commitments when developing the project plan for the Review, to manage the risk of consultation-fatigue with the community.

Climate Change Considerations

[23] Nil.

Communications Considerations

[24] An engagement and communications plan will be developed for this Review.

NEXT STEPS

[25] To develop a detailed project plan to guide the Review process.

ATTACHMENTS

1. ORC Representation Review 21 Nov 23 FINAL [**8.6.1** - 20 pages]

Representation Review: Overview

Otago Regional Council
21 November 2023

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Why a Representation Review?

- Statutory requirement for all councils under Local Electoral Act 2001
- Reviews current representation structure
- Must be undertaken at least every six years
- Last reviewed in 2018
- New arrangements will apply for elections in 2025 and 2028
- Process and timeline set down in legislation*
- Public consultation and engagement required
- Rights of appeal/objection
- Possible Local Government Commission review and final determination

**Local Electoral Act 2001, Local Government Electoral Legislation Act 2023*

What does the review cover?

Review of all representation arrangements including:

- Number of electoral subdivisions (constituencies)
- Boundaries and names of constituencies
- Number of elected members

(S19I, Local Electoral Act 2001)

Related processes:

- Voting system: FPP or STV
    - August: ORC resolved to change to STV for 2025 and 2028 elections
- Māori representation (optional)

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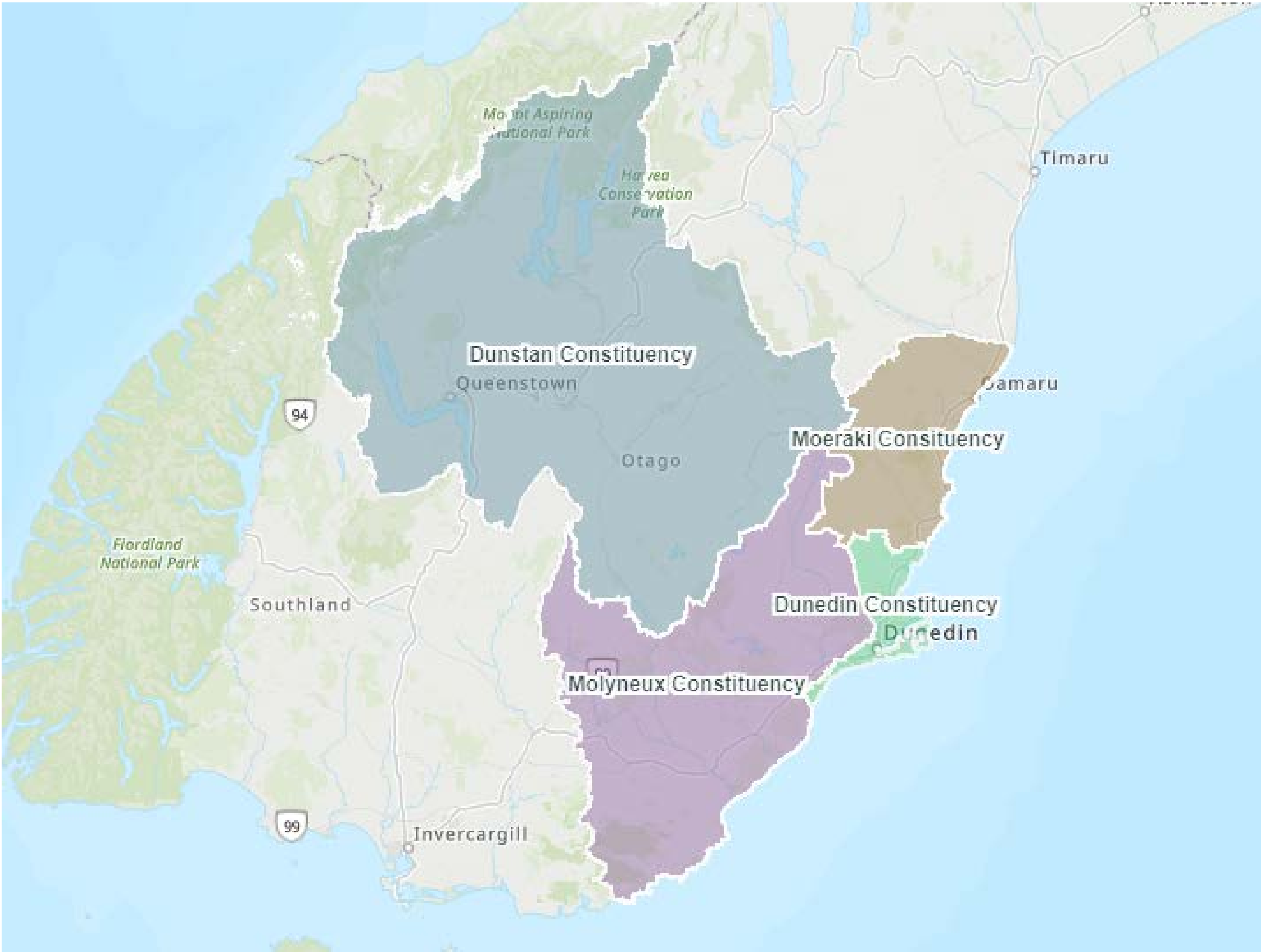
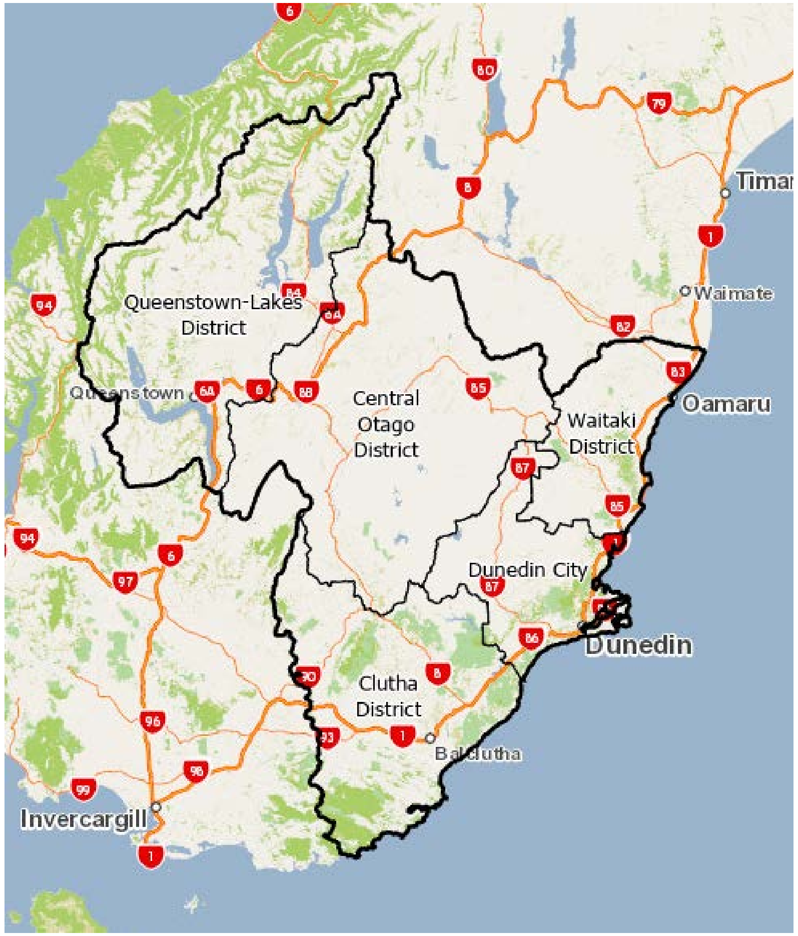
Current representation arrangements

- Otago Regional Council comprises 12 councillors
- 12 councillors elected from four constituencies:
  - Dunstan 3
  - Moeraki 1
  - Molyneux 2
  - Dunedin 6
- Representation model unchanged from previous reviews (2012, 2018)


Timaru
Dunstan Constituency
Queenstown
94
Otago
Moeraki Consituency
Fiordland
National Park
Southland
Dunedin Constituency
Molyneux Constituency
99
Invercargill

Territorial authorities



Queenstown Lakes District

Central Otago District ®

Waitaki District ®

Dunedin City

Clutha District ®

® Undertaking Representation Review

Electoral system

- Single Transferable Vote (STV)
  - Council resolved in August 2023 to change from First Past the Post (FPP) to Single Transferable Vote (STV) electoral system
  - Right to demand a poll notified
  - Requires demand signed by 5% of eligible electors
  - Last date for demand for 2025 elections: 11 December 2023

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Stages of Representation Review

- Preparation and information gathering, eg
  - Population changes/trends
  - Changes in settlement, transport, development
- Preliminary engagement
  - Not a formal/statutory process
  - Seek community feedback on current system, possible changes
  - Explore views on aspects of fair and effective representation
  - Consider alongside other data and research
  - Can consider alternative options/scenarios
  - Informs council's decision making on Initial Proposal
- Initial proposal (by July 2024)
  - One proposal: must set out all representation requirements
    - constituencies, boundaries, number of members etc
  - Formal consultation process, open for one month
  - Submissions received
  - Council holds hearings and deliberations
  - Informs council's decision making on Final Proposal

Stages of Representation Review *cont.*

- Final Proposal (by November 2024)
  - May be same as Initial Proposal, or different
  - Not subject to consultation – but open to appeals and objections
  - **Appeals** may be made only by those who submitted to Initial Proposal
  - **Objections** may be made by anyone – but only if Final Proposal differs from Initial Proposal
  - Referral to Local Government Commission if required

- Referral to Local Government Commission (if required)
  - If appeals or objections are received
  - If non-compliant with +/-10% provision
  - LGC holds hearings
  - LGC makes final determination (by April 2025)

Key principles

Three key concepts:

- Communities of interest
    - Identify what communities of interest exist across the district
    - Relevant to determining the number and boundaries of constituencies
- Effective representation of communities of interest
    - What’s the best structure to maintain access and representation that recognises these communities of interest
    - Relevant to determining number of members
- Fair representation of electors
    - +/- 10% requirement: Population of each constituency, divided by number elected members, must be within +/- 10% of the population of the district, divided by total number of elected members
    - Relevant for ensuring equality of representation per member

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Communities of interest

No fixed definition, but consider these dimensions:

- Perceptual – a sense of belonging and identity with an area
- Functional – how people relate to the practical everyday living aspects of a place: services, facilities, recreation, transport
- Political – does it make sense in terms of political representation

Characteristics to consider:

- sense of community identity and belonging
- distinctive physical and topographical features (eg mountains, hills, rivers)
- similarities in economic or social activities carried out in the area
- similarities in the demographic, socio-economic and/or ethnic characteristics of the residents of a community
- distinct local history of the area
- the rohe or takiwā of local iwi and hapū
- For regional councils – district/TA boundaries may be relevant

Dependence on shared facilities and services in an area, including:

- schools, recreational and cultural facilities
- retail and service outlets
- transport and communication links

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Effective representation

Effective representation is not defined in the Act, but the LGC sees this as requiring consideration of factors including:

- the appropriate total number of elected members

Other factors to be considered when determining effective representation:

- avoiding arrangements that may create barriers to participation, such as at elections by not recognising residents' familiarity and identity with an area
- not splitting recognised communities of interest between electoral subdivisions
- not grouping together two or more communities of interest that share few commonalities of interest
- accessibility, size and configuration of an area including access to elected members and vice versa.

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Fair representation and the +/- 10% rule

Membership of constituencies … is required to provide approximate population equality per member, that is, all votes are of approximately equal value (referred to as the '+/-10% rule') unless there are good (prescribed) reasons to depart from this requirement.

[LGC Guidelines 5.29]

> "… *the population of each ward or constituency or subdivision, divided by the number of members to be elected by that ward or constituency or subdivision, produces a figure no more than 10% greater or smaller than the population of the district or … community divided by the total number of elected members (other than members elected by the electors of a territorial authority as a whole, if any, and the mayor, if any).*
>
> [LEA 2001, s.19V]

- Does not apply between General and Māori constituencies

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+/- 10% rule

- Representation Review 2018/19 – final proposal as adopted

Constituency	Population	Councillors	Ratio	%
Moeraki	*20,400*	*1*	*20,400*	*+9.19%*
Dunstan	*57,400*	*3*	*19,133*	*+2.41%*
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Dunedin	*110,800*	*6*	*18,467*	*-1.16%*
Total	***224,200***	***12***	***18,683***	

- All constituencies compliant with +/- 10% requirement

+/- 10% rule (2023)

- 2023 Representation estimates (StatsNZ/LGC)
  - Note: these figures to be used for Representation Review

CONSTITUENCY	Population	Members	Population-member ratio	Difference from quota	% Difference from quota
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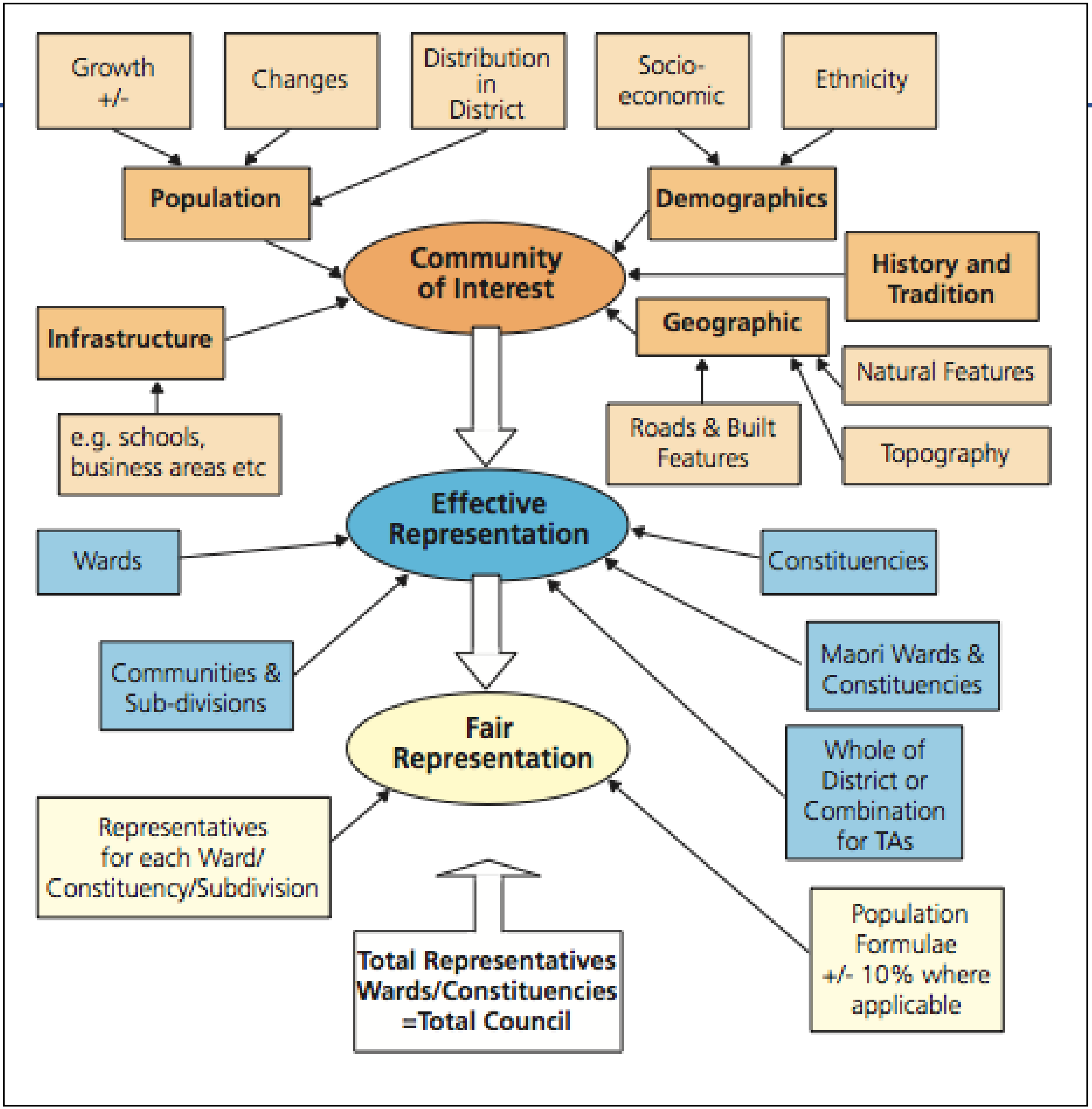
Dunedin Constituency	115,200	6	19,200	-2,017	-9.51
Total	**254,600**	12	21,217		

- Dunstan constituency now outside +/- 10% margin



Growth +/-
Changes
Distribution in District
Socio-economic
Ethnicity
Population
Demographics
Community of Interest
History and Tradition
Infrastructure
Geographic
Natural Features
e.g. schools, business areas etc
Roads & Built Features
Topography
Effective Representation
Wards
Constituencies
Communities & Sub-divisions
Maori Wards & Constituencies
Fair Representation
Whole of District or Combination for TAs
Representatives for each Ward/ Constituency/Subdivision
Total Representatives Wards/Constituencies =Total Council
Population Formulae +/- 10% where applicable

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Māori Representation: Māori constituencies

Māori constituencies are a mechanism that helps ensure effective representation from different communities, and provide a voice for Māori at the council table.

- Provision for Māori constituencies introduced in the Local Electoral Act 2001.
- First Māori constituency introduced by Bay of Plenty Regional Council (under separate legislation) in 2001.
- ORC discussed this at Mana to Mana on 21 August, feeling that the current arrangement of iwi representatives appointed to committees is working. Based on this, no decision paper being taken to Council for 2023.

Note: there are also other ways by which councils can provide for Māori participation, eg

- *appointed or co-opted members to Council (non-voting)*
- *appointments to committees (voting)*
- *advisory boards or liaison committees*
- *Partnership agreement/MOU*
- *regular hui etc.*

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Key dates

Note: Local Government Electoral Legislation Act 2023: Amended dates in red

Electoral system	
By 12 September **2023**	Resolution on electoral system FPP/STV (optional)
By 19 September	Public notice of electoral system (mandatory*) *except where binding poll already in place
Māori representation	
By 23 November	Resolution on Māori Representation (optional)
Representation Review	
From 20 December 2023	Earliest date to resolve Initial Proposal
By 31 July **2024**	Last date to resolve Initial Proposal
By 8 August	Notification of Initial Proposal – open consultation (14 days from resolution)
By 8 September	Public submissions on Initial Proposal close (not less than one month after notification)
By 3 November	Last date for notification of Final Proposal (8 weeks after end of submission period)
By 3 December	Last date for public appeals/objections on Final Proposal
By 10 April **2025**	If appeals/objections – last date for LGC determination

Getting started – next steps

- Setting up structures
  - Council oversight: options include
    - governance for decisions and oversight – Council
    - development of proposals – Councillor Working Group
  - Internal project team (council staff) to support and advise on process
- Work programme
  - Identify any issues to be further researched
  - Provide guidance to staff on areas to explore further in preliminary engagement
  - Consider how best to seek community views and participation
  - Develop engagement plan and focus for preliminary engagement
  - Establish ongoing work programme including workshops etc

Following this workshop, a paper to Council will follow to formalise the process and timetable.

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Thank You

Questions?

9.1. Recommendations of Environmental Implementation Committee

Resolution

That the Council adopts the resolutions of the 8 November 2023 Environmental Implementation Committee.

Report	Resolution	Resolution #	Mover/Seconder
9.4 Large Funding Requests	1. Recommends that the Council endorse the approach of having a fund which supports large scale funding requests which sits alongside the ECO Fund and incentives funding schemes currently in place at Otago Regional Council (Option 1). 2. Recommends that the Council endorse the criteria as detailed in the Eligibility and Assessment criteria section of this report (Option 1). 3. Recommends that the Council notes the ECO Fund and incentives funding schemes available for 2024. 4. Recommends that the Council retains the current application and evaluation processes and criteria for the ECO Fund and Incentives funding schemes.	EIC23-114	Cr Robertson/Cr Sommerville

9.2. Recommendations of the Public and Active Transport Committee
Resolution

That the Council adopts the recommendations of the 11 September 2023 Public and Active Transport Committee.

Report	Resolution	Res#	Mover/ Seconder
8.4 Dunedin Fares and Frequency Business Case	***Recommends that Council Endorses*** *the Shaping Future Dunedin Transport Fares and Frequencies Single Stage Business Case, October 2023 preferred option 16(b) 50c fares, as the basis for staff to prepare the Dunedin Public Transport network improvements investment programme for the Regional Land Transport Plan 2024-2034.*	PAT23-121	Cr Weir/Cr Forbes
8.5 Security for Dunedin Public Transport	***Recommends to Council the approval*** *to the extension of the Bus Hub and On-bus security trial to 30 June 2024 at a cost of ~$126,000 (OPTIONS, [29] a.)*	PAT23-122	Cr Weir/Cr Forbes

The general subject of each matter to be considered while the public is excluded, the reason for passing this resolution in relation to each matter, and the specific grounds under section 48(1) of the Local Government Official Information and Meetings Act 1987 for the passing of this resolution are as follows:

General subject of each matter to be considered	Reason for passing this resolution in relation to each matter	Ground(s) under section 48(1) for the passing of this resolution
1.1 Confidential Minutes of 22 November 2023	To protect the privacy of natural persons, including that of deceased natural persons – Section 7(2)(a)	Section 48(1)(a); Subject to subsection (3), a local authority may by resolution exclude the public from the whole or any part of the proceedings of any meeting only on 1 or more of the following grounds: (a) that the public conduct of the whole or the relevant part of the proceedings of the meeting would be likely to result in the disclosure of information for which good reason for withholding would exist.
2.1 Port Otago Resolution in Lieu of Annual Shareholders Meeting	To protect the privacy of natural persons, including that of deceased natural persons – Section 7(2)(a) To enable any local authority holding the information to carry out, without prejudice or disadvantage, commercial activities – Section 7(2)(h)	
2.2 Property Resolutions	To protect information where the making available of the information—would be likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information – Section 7(2)(b)(ii) To enable any local authority holding the information to carry out, without prejudice or disadvantage, commercial activities – Section 7(2)(h) To enable any local authority holding the information to carry on without prejudice or disadvantage, negotiations	

	(including commercial and industrial negotiations) – Section 7(2)(i)	
2.3 Approval to Notify the Draft Dunedin City Future Development Strategy	To protect information which is subject to an obligation of confidence or which any person has been or could be compelled to provide under the authority of any enactment, where the making available of the information— would be likely to prejudice the supply of similar information, or information from the same source, and it is in the public interest that such information should continue to be supplied – Section 7(2)(c)(i) To prevent the disclosure or use of official information for improper gain or improper advantage – Section 7(2)(j)	

This resolution is made in reliance on section 48(1)(a) of the Local Government Official Information and Meetings Act 1987 and the particular interest or interests protected by section 6 or section 7 of that Act or section 6 or section 7 or section 9 of the Official Information Act 1982, as the case may require, which would be prejudiced by the holding of the whole or the relevant part of the proceedings of the meeting in public.