National Science Challenges

OUR LAND AND WATER

Toitū te Whenua, Toiora te Wai

Data, Insights, and Tools Directory for Regional Councils

Quick reference guide to datasets, decision-making tools, and information from Our Land and Water, for planners, policy makers and land, water, and ecosystem managers in Regional Councils.

December 2024

Our Land and Water Toitū te Whenua, Toiora te Wai

Our Land and Water (Toitū te Whenua, Toiora te Wai) was a mission-led research challenge dedicated to advancing sustainable land and water management practices in Aotearoa New Zealand. Together with farmers, Māori, Regional Councils, catchment groups, and whānau and communities, our research teams sought to add to our collective knowledge to identify new ways of managing our land and water and to provide insights, tools, and models that can support land stewardship and policy decisions.

This guide is designed to make it easy for Regional Council staff to find and use research and tools that relate to their activities and decisions.

Where to from here?

National Science Challenge projects concluded on 30 June 2024.

The data, insights, tools, and research collected and developed over the eight years of Our Land and Water will continue to be valuable resources for decisions affecting our land and water. Our Land and Water information resources will remain freely available via our Figshare group, and at www.ourlandandwater.nz until May 2030. After this date, the National Library will archive the website, ensuring it remains publicly accessible. Separately, many of the tools, data portals, models, and research papers will be available through research partner organisations.

We know that councils, researchers, farming communities, iwi, hapu and tauiwi New Zealanders continue to value the production and productivity of our primary sector, as well as the health of our water and land. We encourage you to continue growing the partnerships that are a legacy of the Our Land and Water National Science Challenge, to work together to identify opportunities to apply our research, and to explore new research opportunities to protect our natural resources for future generations.

I orea te tuatara ka patu ki waho
A problem is solved by continuing to find solutions

How to use this directory

The table overleaf highlights a range of topics and questions that Regional Councils have identified as important. For each topic, we provide research resources that address specific information needs. Resources are listed by number.

Step one: Find the topic that interests you (page 3).
Step two: Look up the resource reference numbers in the directory.

Please note: Most DOI hyperlinks in this document do **not** link to an academic paper. Many Our Land and Water resources are available via Figshare, which allocates a DOI link to plain language resources.

I need to know about…

Effective Land and Water Monitoring	*Resource References*
What areas are most at risk of contaminant transfer from the land to freshwater environments?	1, 2, 3, 4
What can we do to achieve water quality standards?	5, 6, 8, 9, 10, 11, 13, 14, 15, 16, 18
How can we design better freshwater monitoring systems?	12, 15, 17, 18, 20
How can we engage rural communities and catchment groups in monitoring and mitigation actions?	16, 19, 20, 21, 37, 41, 45
What do we know about protecting and managing groundwater health?	12, 14, 17, 22
Sustainable Land Use and Land Use Change	*Resource References*
How can Regional Councils support decisions on land use change?	24, 25, 26, 30, 32, 33, 37, 38
How can we identify appropriate areas for land use change?	2, 3, 23, 25, 26, 27, 30, 31
How can we identify appropriate land use opportunities?	23, 25, 26, 28, 29, 31
What effects will changing land use have on our environment, primary sector, and communities?	10, 27, 28, 29, 30, 37, 38
What te ao Māori approaches can drive changes in farming practice and support alternative decision-making processes (to current economic models)?	26, 34, 35, 41, 43
Supporting Sustainable Farming	*Resource References*
How can we manage land to farm within environmental limits?	5, 6, 7, 19, 30
Land management and climate change adaptation and impacts	23, 25, 27, 30, 36, 37
Connecting with Communities	*Resource References*
How can we engage and work with farming communities to plan for and protect our land and water?	15, 16, 20, 21, 24, 32, 33, 34, 35, 42, 44
How can we support good relationships between urban and rural communities?	16, 24, 36, 38, 39, 40, 42
How can we connect with mana whenua, hapū, and iwi about land use?	25, 41, 43

Resources: Water Quality

1 Current State of Water Contaminants Compared to Bottom Lines

The briefing document summarises research that evaluated the current state of four contaminants (nitrogen, phosphorus, Escherichia coli, and sediment) in rivers, lakes, and estuaries across Aotearoa New Zealand. This was the first assessment of the current state compared to 'bottom lines' for all four contaminants across the whole country.

https://doi.org/10.57935/AGR.26002357.v1

Contact: Ton Snelder, LWP

2 Interactive Excess/Mitigation Maps

Interactive maps showing water contaminants in excess of 2020 regulations, and the potential for reduction by 2035 using on-farm mitigation strategies:

- Map of Total Phosphorus Excess and Reduction Potential
- Map of Total Nitrogen Excess and Reduction Potential
- Map of Total Sediment Yield and Reduction Potential

Contact: Rich McDowell, AgResearch

3 Freshwater Improvement Scenario Builder

Visualise the current state of water quality (N, P) at over 900 river monitoring sites, with estimates of "reference" water quality conditions, and the relative contribution of different land uses in the catchment. Develop catchment management scenarios of land mitigation and/or land use change to see how reducing contaminant losses might affect water quality in that catchment.

https://www.monitoringfreshwater.co.nz/scenario-builder

Contact: Olivier Ausseil, Traverse Environmental

4 LandscapeDNA

Interactive map integrating water quality data with map layers such as soil, geology, topography, and land cover, to demonstrate the processes that control the variability of water quality.

https://landscapedna.org/maps/physiographic-environments/family/

Contact: Clint Rissman, Land Water Science

5 Mitigation Strategies

A table outlining 40 mitigation strategies, and their relative cost, effectiveness and response rate, plus co-benefits and limiting factors.

https://ourlandandwater.nz/management-practices-to-improve-water-quality/assets/Mitigation%20Strategies.docx

Contact: Rich McDowell, AgResearch

6 Management Practices to Improve Water Quality

A learning module to help support farmers in creating cost-effective freshwater environment plans using science from Our Land and Water.

https://ourlandandwater.nz/management-practices-to-improve-water-quality/

Contact: Annabel McAleer, Shared Science

7 Actions to include in a Farm Environment Plan

This interactive infographic compiles actions to decrease the loss of contaminants from agricultural land. Mitigation actions can be filtered by five critical issues (N, P, E.coli, sediment, GHGs) and farm system. A pop-up for each action contains data on co-benefits, limiting factors and potential standard measurements.

https://ourlandandwater.nz/fep-actions/

Contact: Rich McDowell, AgResearch

8 Using Cause and Effect Relationships to Enhance Freshwater Management

Using Lake Hayes near Queenstown as a scenario example, the research brief describes how Our Land and Water research can be used to prioritise actions to take on land to prevent and reverse degradation.

https://doi.org/10.57935/AGR.26002801.v1

Contact: Rich McDowell, AgResearch

9 Implementing Te Mana o Te Wai

Supporting iwi, hapū, water users, and decision-makers to understand and implement policy that prioritises Te Mana o te Wai. Tools, guidance, and support for all users of water in Aotearoa where many are struggling to understand and give effect to this mātauranga Māori centred concept.

https://ourlandandwater.nz/project/implementing-te-mana-o-te-wai/

Contact: Tina Porou, Poipoia

10 Assessing the Effectiveness of On-Farm Mitigation Actions

This research summary describes how effective on-farm mitigations have been so far, by comparing losses of nitrogen (N), phosphorus (P) and sediment in 1995 and 2015. It also models what would be possible for future water quality in 2035 if every farm in New Zealand adopted every known mitigation.

https://doi.org/10.57935/AGR.26002780.v1

Contact: Rich McDowell, AgResearch

11 Linking Management Practices to Catchment Water Quality Improvement

The implementation of good management practices (GMPs) on-farm does improve water quality. Over a 20-year monitoring period, 67% of in-stream water quality trends across five catchments were improving, and the levels of most contaminants in water decreased due to farmers implementing GMPs such as improved effluent management and stock exclusion.

https://doi.org/10.1016/j.scitotenv.2023.164963

Contact: Rich McDowell, AgResearch

12 Detecting Reductions of Nitrate-Nitrogen Concentrations in Groundwater

Only 41 % of NZ's water quality monitoring network can detect reductions in nitrate-nitrogen in groundwater with the current standard quarterly sampling after 30 years of monitoring. The percentage of sites increased to 60% with increased monitoring frequency (often weekly) but this required a 100–300% increase in monitoring costs.

https://doi.org/10.1016/j.scitotenv.2024.171759

Contact: Rich McDowell, AgResearch

13 Excluding Livestock from Smaller Streams

Most of the contaminant load in waterways across New Zealand originates from small, steeply sloping streams that, under national regulations, stock can access. Modelling indicates an average of 77% of the national contaminant load (N, P, sediment, and E. coli) comes from exempt streams in flat catchments dominated by pasture.

https://doi.org/10.57935/AGR.26002849.v1

Contact: Rich McDowell, AgResearch

14 Benign Denitrification in Groundwaters

A new way to measure denitrification in groundwater could make analysing groundwater's denitrification capacity more accessible. Identifying the location and efficiency of groundwater denitrification sites can result in more effective nutrient loss regulations, more strategic nitrogen loss mitigation measures and improved land management.

https://doi.org/10.57935/AGR.26002372.v1

Contact: Heather Martindale, Greater Wellington Regional Council

15 Monitoring Freshwater Improvement Actions

These WebApp tools will help freshwater stewards and kaitiaki decide what to measure, where, when, with what technology, and understand how much it will cost. Over time, these monitoring programmes will provide information on successes and failures of past actions. Watch a webinar demonstrating how to use the WebApp here.

https://www.monitoringfreshwater.co.nz

Contact: Olivier Ausseil, Traverse Environmental

16 Healthy Waterways Register

Healthy Waterways is New Zealand's national database for recording and reporting the work being done for our waterways. This register will be used by land holders/managers, kaitiaki, catchment groups and councils to pull together data from across the country. Land, Air, Water Aotearoa (LAWA) will share these stories.

https://healthywaterways.nz/dashboard/

Contact: Kati Doehring, Cawthron Institute

17 Monitoring Freshwater Improvements: Fact sheets

Fact sheets to support the monitoring of: deposited fine sediment, macroinvertebrates, nitrogen, periphyton, phosphorus, turbidity, E.coli, mahinga kai, nitrate, water clarity, chlorophyll a, and cost information.

https://www.monitoringfreshwater.co.nz/factsheets

Contact: Olivier Ausseil, Traverse Environmental

18 Refinement of the Framework for Assessment of Recreational Water Quality

A process for council staff to follow when faecal contamination is identified in freshwater. The framework sets out logical steps to help councils identify contamination sources when E. coli recreational water quality guidelines are exceeded, what can be done to mitigate the contamination, and what to do when the source of faecal pollution can't be identified or mitigation actions don't work.

https://doi.org/10.57935/AGR.26002810.v1

Contact: Meg Devane, ESR

19 Farmer Preferences and Drivers of Decision-Making (Water Quality Actions and Land Use Change)

This report from a survey in the Tukituki catchment highlights the need for a joined-up approach to water quality actions across a catchment. Consideration should be given to the perceived barriers to implementation for farmers as this will help inform water quality mitigation selection, adoption and policy development.

https://doi.org/10.57935/AGR.26001559.v1

Contact: Lee Matheson, PerrinAg

20 Make Your Stream Monitoring Data Count

This national quality assurance framework will support community groups to collect freshwater data of a known quality that are 'fit for purpose'. The framework will also help to increase the visibility and use of the data in freshwater management. Supporting resources are also available from the Wai Connection website.

https://doi.org/10.57935/AGR.26829481.v1

Contact: Juliet Milne, Traverse Environmental

21 Signals for Land Stewards

Signals are information from the environment that either enable or prevent a farmer from moving along a constructive change process. This report outlines a new framework to influence constructive practice change associated with environmental outcomes, particularly water quality.

https://doi.org/10.57935/AGR.26001769.v1

Contact: Denise Bewsell and Kenny Bell, Scarlatti

22 Reference Conditions and Threshold Values for Nitrate-Nitrogen in New Zealand Groundwaters

Management of groundwater quality is assisted by an understanding of reference conditions (the concentration expected in the absence of human impact). Reference conditions for NO_3–N concentration in oxic groundwater was found to be 1.65 ± 0.12, and for anoxic groundwater 0.04 ± 0.01 (using the 80th percentile as the national-scale default threshold).

https://doi.org/10.1080/03036758.2023.2221034

Contact: Rich McDowell, AgResearch

Resources: Land and Land Use

23 Data Supermarket

A repository of data about the ingredients, food and fibre we can grow in New Zealand, now and in the future under climate change. It includes information about a wide variety of vegetable, fruit, arable, animal, plant and tree crops, plus climate, environmental and economic data. The wide range of datasets provide a broad understanding of the benefits and consequences of many land use opportunities.

https://landuseopportunities.nz/

Contact: Linda Lilburne, Manaaki Whenua Landcare Research

24 Tools for Making Land Use Change Decisions

This learning module shares knowledge on how to help farm businesses make decisions about land use diversification (approx. 75 minutes to complete). It includes guidance on involving a broader group with land use diversification and the tools you can use to support change.

https://ourlandandwater.nz/tools-for-making-land-use-change-decisions

Contact: Annabel McAleer, Shared Science

25 Matarau: Empowering Māori Landowners in Land Use Decisions

Decisions about the future use of whenua are complex and there are a lot of factors to consider. This tool brings together data and information curated for the needs of Māori landowners in one place. The information provided in Matarau is to help Māori landowners get ahead faster and be better informed before moving into land-use feasibility assessments.

https://matarau.nz/

Contact: Nikki Harcourt, Manaaki Whenua Landcare Research

26 Lower Cost Native Restoration of Farmland

The Tīmata Method initiates natural native reforestation using easily propagated and planted nursery crop species and fewer trees per hectare than conventional guidelines.The Tīmata Method lowers the cost of planting and makes more efficient use of time and labour resources. It is particularly suitable for broadscale retirement of steep pastoral land and riparian and wetland margins.

https://doi.org/10.57935/AGR.26002834.v1

Contact: Alison Dewes, Tipu Whenua

27 Scenario Design of NZ Future Agriculture

This model brings together all sectors of production, their market value, land and water use, energy and fertiliser consumptions, and emissions. The model aims to quantify agricultural outputs related to resilience, sustainability and profitability.

https://arcg.is/1qTCPK (includes video tutorial)

Contact: Tom Cochrane, University of Canterbury

28 Worker Requirements by Land Use

This dashboard estimates the number of full-time equivalent staff needed seasonally for different land-use scenarios. It can suggest complementary land uses to smooth out seasonal variance in workforce requirements. A video is available to learn how to use this tool.

https://landftes.scarlatti.co.nz/

Contact: Kenny Bell, Scarlatti

29 Integrated Impact Assessment (IIA) Framework

This easy-to-use assessment tool provides a consistent way to evaluate and explore different scenarios about future regional development. The framework shows the impact of land use changes on economic, social, cultural and environmental indicators.

https://ourlandandwater.nz/outputs/integrated-impact-assessment-framework

Contact: John Saunders, Lincoln University

30 Forestry Catchment Planner

The Forestry Catchment Planner app supports proactive management of forestry impacts. It helps visualise plantation forestry harvesting cycles in 5 regions. For example, landslide and debris flow modelling, plantation forest locations and ages, future of harvesting.

https://www.forestrycatchmentplanner.nz/

Contact: Mark Spencer, GeoInsight

31 Agrivoltaics

Agrivoltaics is the use of land for both food and energy production, with livestock able to graze beneath solar panels. Canterbury, Central Otago and much of the North Island have suitable area. Adding solar panels to sheep and beef farms could improve their profitability, and environmental and animal welfare outcomes.

https://ourlandandwater.nz/resource-finder/?_search=agrivoltaics

Contact: Anna Vaughan, Anna Vaughan Consulting

32 Land Use Options in Waimakariri

The Whitiwhiti Ora project brought farmers and researchers together to co-design an approach to assessing diverse opportunities when considering land-use change. The aim of the project was to enable farmers to make confident decisions that allow the land and its people to prosper. This document shares the process to enable similar decision-making in other places.

https://ourlandandwater.nz/outputs/land-use-options-in-waimakariri/

Contact: Robyn Dynes, AgResearch

33 Taieri Land Use Diversification Opportunities

This website shares a variety of resources produced by a project working with farmers in the Upper Taieri Wai catchment group (Ranfurly, Central Otago) to identify alternative land uses for diversification that fit within their current farming system. It includes a multi-criteria decision support tool (with in-depth instructions on how to use it) and an extensive list of resources for a wide range of diversification options identified by the farmer cohort.

https://www.thewholestory.co.nz/ludo/

Contact: Becks Smith, The Whole Story

34 Pohewa Pae Tawhiti

Guidelines for using the Pohewa Pae Tawhiti framework to support governance groups through a robust guided process that leads to sound decisions around changes in land use. It can be used by trustees, board members, committees of management and/or farmers who are working collectively around land-use decision making.

https://doi.org/10.57935/AGR.26982178.v1

Contact: Tanira Kingi, Scion

35 11 Insights to Co-design Place-based Approaches to Purposeful Change

This document is a brief explanation of 11 insights drawn from 60 local and international examples of communities and agribusinesses working in place-based initiatives to revitalise their places.

https://doi.org/10.57935/AGR.26516113.v1

Contact: Simon Stokes, Simon Stokes Consulting

36 Adapting Aotearoa

A report about closing the gap between how farmers and researchers understand climate adaptation.

https://doi.org/10.60919/NIWA.26482612.v1

Contact: Anita Wreford, Lincoln University

37 Why Pines? Context for research results

This white paper summarises the results of four research programmes that investigated how land uses might change in the future to meet New Zealand's environmental, all of which found a likely increase in pine plantations on land currently used for sheep and beef farming. This demonstrates how water quality policy, climate policy, and market signals could combine to drive a transition that New Zealanders might not want

https://ourlandandwater.nz/whypines

Contact: Bill Kaye-Blake, NZIER

Resources: Community and Whanau

38 **Peri-Urban Potential**

The research investigated innovative ways of making peri-urban whenua (semi-rural land surrounding a town or city) more productive while also benefiting locals, including Māori communities. This page links to a variety of plain-language resources, video and journal articles.

https://ourlandandwater.nz/project/peri-urban-potential/

Contact: Shannon Davies, Lincoln University

39 **Partnering for Change Work Group Process Guide**

Partnering for Change work groups are about rural and urban businesses sharing responsibility for the changes that need to be made to reduce our impact on the environment. By working in small groups, rural and urban businesses can better understand each other, their sustainability efforts, and their motives and barriers to practice change.

https://doi.org/10.57935/AGR.26002894.v1

Contact: Dana Carver, Scarlatti

40 **Farming for Good**

Farming for Good explores our sense of connection with farming in Aotearoa New Zealand. It's about supporting everyday people and leaders across our communities, farming sector and government, to build trust in our food and farming system. It includes the 'Food & Farming People's Panel' documentary featuring Kiwis from across the food system.

https://ourlandandwater.nz/farming-for-good/

Contact: Daniel Eb, Dirt Road Communications

41 **Kaitiaki Intelligence Platforms**

This project website contains reports documenting the environmental intelligence needs of Māori agribusiness collectives and iwi. Recent technological advancements in remote sensing, artificial intelligence, data storage, communication, and decreasing costs have made it possible to build platforms capable of gathering detailed environmental data.

https://www.kaitiakitanga.maori.nz/reports

Contact: John Reid, Earth Quotient

42 **Communicating Effectively with Farmers**

This learning module) will help you learn new approaches to communicating effectively with the rural community, using social science research to understand why people think the way they do and how information you give to a farmer might interact with information and signals from other sources.

https://ourlandandwater.nz/communicating-effectively-with-farmers

Contact: Annabel McAleer, Shared Science

43 **Enabling Te Mana o Te Wai with Cultural Health Assessment Tools**

This analysis of Cultural Health Assessment tools, methods, and frameworks aims to grow understanding about the suitability of each tool to support mana whenua participation in the NOF process.

https://ourlandandwater.nz/outputs/enabling-te-mana-o-te-wai-with-cultural-health-assessment-tools/

Contact: Tina Porou, Poipoia

44 **Communicating Effectively with Farmers**

This guide is for people in communications, science, policy and community roles who want to talk effectively about the future of farming, and land use change in particular, to the public and farming communities.

https://doi.org/10.57935/AGR.26002906.v1

Contact: Jess Berentson-Shaw, The Workshop

45 **Where Next for Catchment Groups?**

This report presents recommendations to help bridge the different perspectives of those seeking to establish, work with or fund catchment groups. It is intended to avoid or reduce misalignment. For further discussion on differing perspectives see also Panel on Catchment Groups Reveals a Key Tension.

https://doi.org/10.57935/AGR.26001673.v1

Contact: Ed Challies, University of Canterbury

Working Together: Practical Examples of Research in Action

Regional Councils have partnered with Our Land and Water projects to road-test the data, insights, and tools the Challenge has developed to support them to solve real-world challenges. The following three case studies tell how Regional Councils have successfully applied the research findings to their land and water management/policy.

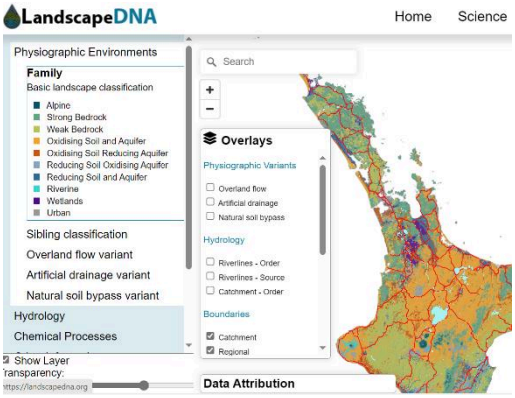
Faecal Contamination: Tasman District Council

Tasman District Council was one of the first councils to use a new ESR-developed framework for identifying sources of *E. coli* when water quality guidelines are exceeded. The framework established a documented process to follow when faecal contamination was identified in groundwater and set out what to do when actions to mitigate pollution don't work. Tasman District Council was finding high levels of microbial contamination in a beach area. Various mitigations had been applied, but water quality measurements still exceeded guidelines. By following the framework, the Tasman District Council decided the logical next step was additional sampling to investigate historical sources.

The framework supports these outcomes by streamlining and clarifing decision-making, reducing the workload burden on staff. Ultimately, this should contribute to safer recreational swimming and improved water quality.

Access the Faecal Contamination Framework.

Physiographic Science for Maps, Models, and Monitoring



Since 2019, physiographic science, developed by the Physiographic Environments of New Zealand programme, has been helping Northland Regional Council build better maps, models, and monitoring networks.

The information has supported scientists at Northland Regional Council to deepen their understanding of the most important drivers of water quality variation in the region. Manas Chakraborty, freshwater scientist at Northland Regional Council, describes the physiographic maps as a useful "cheat sheet" that creates clarity on how the region's landscape attributes contribute to water quality. "For example, high *E.coli* could be explained by high run-off risk and artificial drainage on highly erodible land with intensive land use," says Manas.

In the future, Northland Regional Council hopes to be able to use a refined model at farm scale to identify the right mitigations in the right places for better water quality outcomes.

Read the Northland Regional Council Case Study or access the LandscapeDNA tool.

Te Mana o Te Wai in Te Tauihu: A combined response

Environmental managers from eight Te Tauihu iwi co-designed a freshwater management framework with the region's three unitary councils, implementing Te Mana o Te Wai research. The Pou Taiao (iwi environmental managers) built a new platform for partnership, Te Puna Kōrero ki Te Tauihu, to enable multi-council collaboration.

"It changed how we talked to councils about projects, not just Te Mana o te Wai," says Rowena Cudby, Pou Taiao, Environmental Manager, Te Runanga o Ngāti Rārua. "We now consider and discuss everything from the issue itself to the time frames, resourcing, iwi internal capability and capacity." The councils have agreed that processes for joint planning and decision making with iwi need to change for successful policy implementation to occur. Read about this research in action.

More information

Discover the outcomes of Our Land and Water

Explore the 900+ tools and resources developed for all the different groups who care for our water

Learn more with Our Land and Water's free online courses

Find a DOI citation for all our resources (even the non-academic ones)

FAQs about the end of Our Land and Water

Thank you to all who participated in and used Our Land and Water research. We hope it will continue to support you to make changes that improve the health of our land, water and people.

OUR LAND AND WATER | Toitū te Whenua, Tolora te Wai | National SCIENCE Challenges