Edendale Aquifer Group

Understanding Nitrogen – Foundation project

Photo courtesy of Reimagining the Mataura

Our project

The Edendale Aquifer Group (EAG) was established in 2024 as a sub-group of the Three Rivers Catchment Group to address one of the catchment's most significant environmental challenges: nitrogen losses to groundwater, springs, streams and ultimately the Mataura River. EAG aimed to better understand how nitrogen moves through the Edendale landscape and identify practical ways to reduce its impact on groundwater and the Lower Mataura Floodplain.

The project was designed around four connected workstreams:

- Community engagement and understanding
- Nitrogen mitigation within farm systems
- Edge-of-field mitigations
- Water quality monitoring

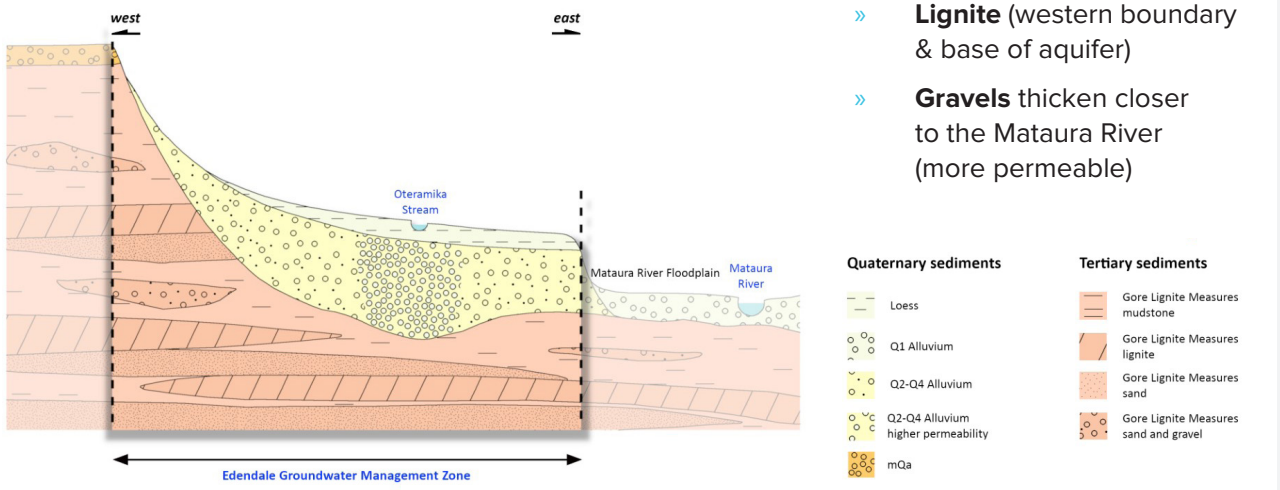
The Foundation project focused on understanding how geology, groundwater movement and land use influence nitrate in the Edendale catchment, and where there are practical opportunities for action. Land and Water Science led the landscape and groundwater assessment using radiometric data and bore information, with the EAG contributing community water-quality data and local knowledge of the catchment. The work brought together local farmers and consultants, DairyNZ, Environment Southland, Fonterra, Resolution and the Reimagining the Mataura Project.

Understanding the Edendale landscape

The geology beneath Edendale plays an important role in determining how water and nitrate move through the catchment.

THE LIGNITE HILLS

The hills to the east of the catchment contain lignite, a carbon-rich material formed from ancient peat deposits. Lignite is carbon rich, which creates conditions that support natural denitrification. This is where microorganisms convert nitrate into nitrogen gas, removing it from the water. As a result, groundwater moving through these areas is likely to have lower nitrate concentrations.



Edendale Geological Setting

THE EDENDALE TERRACE AQUIFER SYSTEM

Nitrate accumulates mainly within the Edendale Terrace itself, particularly where the aquifer gravels are thickest and oxidising conditions limit natural removal. The terrace is made up of layers of gravel and fine silt. When rain falls on the terrace, some of the water infiltrates through the gravel and contributes to groundwater recharge. This groundwater slowly moves east beneath farms and paddocks through the aquifer system. As it moves through the terrace, nitrate from land use can travel with it and accumulate in areas where geology, groundwater movement and land use interact.

THE LOWER MATAURA FLOODPLAIN

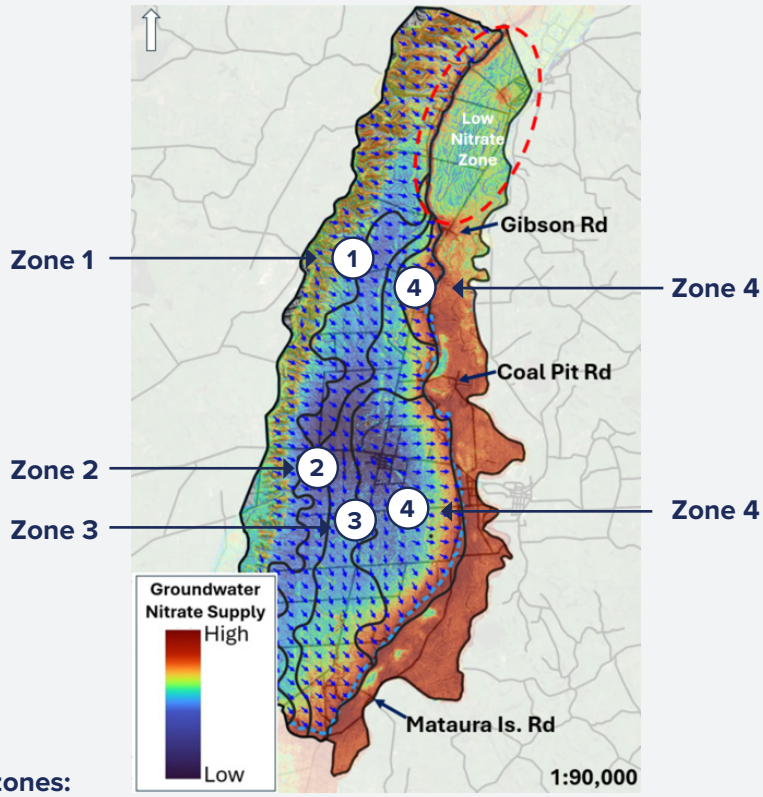
Towards the eastern edge of the terrace, layers of clay and lignite influence groundwater movement. This nitrogen-rich groundwater returns to the surface through springs, seepage areas, groundwater-fed drains and streams across the Lower Mataura Floodplain.

Photo of the lower Mataura Terrace (above the floodplain). Note the black lignite rock, covered by layers of soils and gravel.

This means the geology, groundwater movement and land use across Edendale are all connected. Understanding that connection is important when considering where nitrate losses can be reduced and where edge-of-field mitigation may be most effective.

What did we learn?

The catchment does not behave the same way everywhere. The interaction between geology, groundwater movement and land use influences where nitrate is likely to accumulate and where it may eventually move towards the Lower Mataura Floodplain.



The project identified four broad aquifer zones:

Zone	What we know	Potential nitrate movement
Zone 1	Lignite is close to the surface.	Nitrates are removed naturally underground, having little impact on the Mataura Floodplains.
Zone 2	Lignite is deeper, with more aquifer gravels.	Some nitrate can accumulate, with a relatively small impact on the Lower Mataura Floodplain.
Zone 3	Aquifer gravels are thicker, with greater groundwater volumes.	There is greater potential for nitrate movement through groundwater towards the Lower Mataura Floodplain.
Zone 4	Aquifer gravels are thickest and groundwater volumes are greatest.	There is the greatest potential for nitrate transport and discharge through springs, seepage areas and drains along the terrace edge.

What influences nitrate in the Lower Mataura?

Three key factors influence how much nitrate reaches the Lower Mataura Floodplain:

1. The aquifer zone and groundwater movement

The four aquifer zones have different geology and groundwater characteristics, influencing how nitrate moves through the catchment.

2. Natural nitrate removal

Natural processes, including denitrification associated with areas of lignite, can remove nitrate before groundwater reaches the floodplain.

3. Land use and nitrogen losses

The amount of nitrogen entering the soil and groundwater system influences the amount of nitrate available to move through the catchment.

What about Ota and Oteramika Creeks?

Ota and Oteramika Creeks sit above the groundwater table. Soil water, tile drains and runoff are the main sources of flow, meaning these streams are not influenced by nitrate in the groundwater in the same way as the streams connected into the Lower Mataura Floodplain, including the Clear and Ives Creeks.

Turning understanding into action

The project used what was learned about the Edendale landscape to explore practical ways to reduce nitrate losses and intercept nitrate before it reaches the Lower Mataura Floodplain.

1. Reducing nitrate losses at source

Working alongside DairyNZ, EAG developed five farm-system case studies exploring practical options for reducing nitrogen losses, including:

- plantain systems
- lower nitrogen systems
- fertiliser management
- stocking rate adjustments
- combinations of these approaches

The case studies provide examples of different approaches dairy farmers can consider within their own farm systems.

2. Intercepting and treating groundwater

The project identified priority areas for edge-of-field mitigation, particularly where groundwater from Zones 3 and 4 moves towards the Lower Mataura Floodplain.

Two pilot wetlands were developed using different approaches:

- a wetland incorporating a woodchip bioreactor
- an enhanced existing duck pond converted into a treatment wetland.

These projects provided an opportunity to explore how wetlands and other edge-of-field approaches could be used to intercept and treat groundwater in areas where nitrate movement is a concern.

Enhanced existing duck pond converted into a treatment wetland.

The Nitrate Prioritisation Tool

One of the project's key outputs is the Nitrate Prioritisation Tool, developed by Land & Water Science in collaboration with the EAG committee.

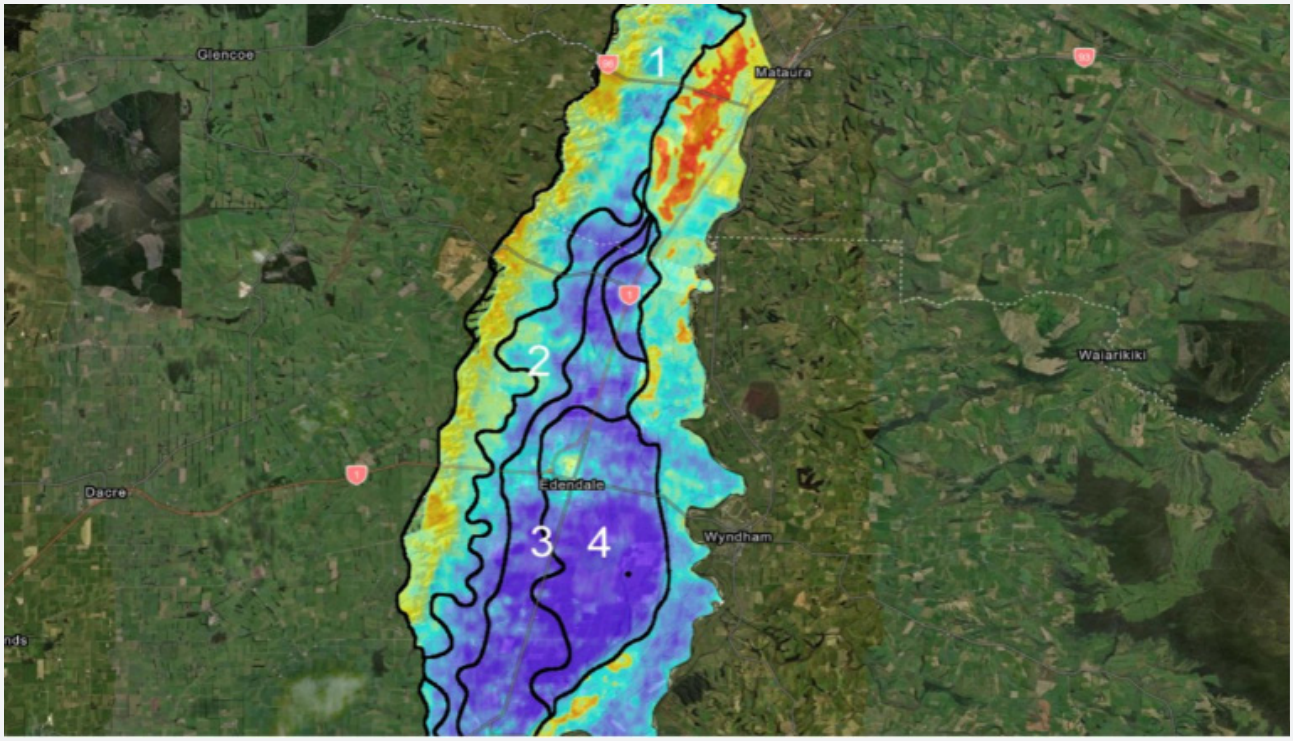
This virtual mapping tool brings together local information to show how the landscape and groundwater system can influence nitrate movement across the catchment.

The tool combines information including:

- stream and bore data
- community water quality testing
- groundwater information
- landscape characteristics

The Nitrate Prioritisation Tool helps connect the science of the catchment with practical decisions on the farm. Farmers can use the tool to:

- understand groundwater movement across their property
- identify areas where reducing nitrate losses may have the greatest impact
- explore potential locations for edge-of-field mitigation such as wetlands or bioreactors



Soil Zone Nitrate Removal Interactive Map and Edendale Aquifer Zones Map: it provides an estimate of the soils nitrate removal potential. Dark blue areas have the lowest potential to remove nitrate and consequently the highest potential to leach. Dark red areas have the highest potential to remove nitrate and the lowest potential to leach.

What could farmers do next?

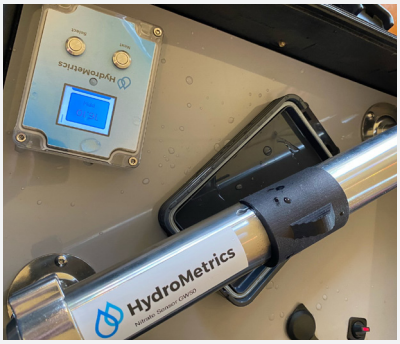
Every part of the catchment is different. Understanding how water and nitrate move through the landscape can help ensure the right action is considered in the right place.

Farmers interested in exploring opportunities on their property can:

INVESTIGATE

Investigate areas on your property that may be suitable for wetlands, bio filters or other edge of field mitigations such as wet areas, spring heads or low producing land.

TEST



Use the community UV nitrate tester drop in days to understand the nitrate levels in bores, springs and waterways on your farm. The Group has a Hydrometrics UV nitrate tester available for community use, and has already carried out extensive water testing across bores, creeks, drains and springs throughout the catchment. Get in touch with the EAG committee to find out about the next testing session, or to have your own water tested.

REDUCE AT SOURCE

Consider options that lower nitrogen losses at the farm, such as plantain, fertiliser management or stocking rate changes. Combinations tend to work best.

EXPLORE

Use the Nitrate Prioritisation Tool to understand where there may be opportunities to reduce nitrate losses or position edge of field mitigations (such as wetlands) to achieve the greatest benefit.

WORK TOGETHER

Work with the EAG committee, local council, industry representatives and advisors to explore practical options and identify the right approach for the property. The EAG committee is happy to support farmers interested in exploring the opportunities on their farms.

The Foundation Project has built a stronger understanding of the Edendale landscape, helping guide future action to support productive farming and improved water quality.

The key takeaway

The Foundation Project has built a stronger understanding of how geology, groundwater movement and land use interact across the Edendale catchment.

This knowledge can help farmers and the wider community understand where nitrate is moving, where natural nitrate removal occurs and where practical action may have the greatest potential benefit.

The goal is not one solution for the whole catchment. It is understanding the right action for the right place.

For more information, email **edendaleaquifergroup@gmail.com** or contact your local Thriving Southland Catchment Group Coordinator.