Te Hoiere Project | HAERE, KAKEA TE ARA POKA HOU

Te Hoiere Water Quality Mitigation Effectiveness Monitoring Report

JUNE 2026

PREPARED BY STEFFI HENKEL
Senior Environmental Scientist – Water Quality
Marlborough District Council

Figures & tables

Figure 1 Location of the monitoring sites. Sites shown in the lighter, purple colour are those added following the 2025 review of the programme. Te Hoiere project area is shown in green. 4

Figure 2 Nitrate Nitrogen concentrations at the monitoring sites during three different time periods. The green frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26. 6

Figure 3 Ammoniacal Nitrogen concentrations at the monitoring sites during three different time periods. The green or yellow frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26. 7

Figure 4 Dissolved Reactive Phosphorus concentrations at the monitoring sites during three different time periods. The green or yellow frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26. 8

Figure 5 E. coli concentrations at the monitoring sites during three different time periods. The green or yellow frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26. The 'NPS-FM Median limit' is the national bottom line for median concentrations. 9

Figure 6 Turbidity measurements at the monitoring sites during three different time periods. The green or yellow frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26. The 'NPS-FM median limit' is the national bottom line for median values based on conversion of the limits for the water clarity attribute. 10

Figure 7 Fencing and riparian planting of streams as well as changes in land management practices such as fertiliser use and grazing management have resulted in significant improvements in water quality at monitoring site PLRT-15 (located downstream of this tributary). 12

Executive Summary

Te Hoiere Project is a collaborative, catchment-wide initiative involving different agencies, iwi, community groups, and landowners working together to improve freshwater health. A central goal of the project, Oranga Arawai, is to achieve waterways that are healthy, resilient, and able to support both ecological values and community uses.

To support this goal, significant on-ground actions have been undertaken, including more than 100 kilometres of stream fencing and the planting of over 200,000 riparian plants. These measures are designed to reduce contaminants entering waterways, stabilise streambanks, and improve habitat. This monitoring programme was established to assess whether these efforts are delivering measurable improvements in water quality.

Because regional monitoring programmes are typically focused on larger waterways, this targeted programme concentrates on smaller streams where improvements from mitigation measures are more likely to be detected in shorter timeframes. Nine monitoring sites were selected based on upstream mitigation activities and previous baseline data collected in 2020/21. Following a review in 2025, the network was refined to ensure it continues to provide meaningful and relevant information.

Water quality was monitored monthly and assessed across a range of key indicators, including nutrients (nitrogen and phosphorus), faecal contamination (E. coli), and sediment (turbidity). Results were compared to baseline conditions to determine whether changes have occurred and whether these changes are statistically meaningful.

The monitoring results show encouraging signs of improvement at several sites. The most significant gains were observed at a small tributary in the lower Te Hoiere/Pelorus catchment (PLRT-15), where all measured parameters improved significantly. Similarly, the Rai Valley Stream site (RVS-1) showed improvements across nearly all indicators. These sites share a common feature of extensive upstream fencing and riparian planting, including along smaller tributaries, as well as changes in fertiliser use, stocking rates and grazing management. This demonstrates that coordinated, catchment-wide efforts can lead to substantial water quality benefits.

Additional improvements were observed at several other sites, particularly within the lower Te Hoiere/Pelorus catchment, although these were generally limited to one or two parameters. Five of the nine monitored sites showed reductions in nitrate concentrations, with some now meeting regional water quality targets. Reductions in phosphorus and sediment were also observed at multiple locations, indicating that mitigation measures are helping to reduce nutrient and sediment inputs to waterways.

However, not all sites showed improvement. At some locations, water quality has remained stable despite mitigation efforts. In the Tunapai Stream, this is likely because water quality was already relatively good at baseline, leaving limited scope for measurable improvement. In contrast, the Okaramio River continues to show signs of impact, with monitoring indicating that key sources of contamination are likely located further upstream than the current mitigation areas.

White Pine Creek in Linkwater remains the most degraded site within the monitoring network. Although some earlier improvements were noted, these have not been sustained, highlighting the need for further and potentially more targeted management actions in this catchment.

The results also highlight the influence of natural variability. For example, slight increases in E. coli at some sites may be linked to wetter conditions during the most recent monitoring period, which can increase runoff and temporarily elevate contamination levels. This underscores the importance of long-term monitoring to distinguish between short-term fluctuations and sustained trends.

Overall, the findings of this report demonstrate that meaningful improvements in water quality are achievable, particularly where mitigation measures are applied consistently across entire catchments, including smaller upstream areas. At the same time, the results emphasise that improvements are not uniform and that ongoing effort, adaptive management, and continued monitoring are essential to achieve the long-term vision of healthy and resilient waterways in the Te Hoiere catchment.

Introduction

Te Hoiere Project is a large, catchment-scale initiative that brings together a wide range of agencies, iwi, community groups, and local landowners with a shared commitment to improving the health of waterways across the area. One of the project's key aspirations, known as Oranga Arawai, is to ensure that waterways are healthy and resilient, supporting both ecological values and community wellbeing.

To help achieve this goal, the project has supported a range of on-the-ground actions. These include fencing more than 100 kilometres of streams to exclude livestock and planting over 200,000 riparian plants along stream margins. Riparian planting refers to the establishment of vegetation alongside waterways, which helps stabilise banks, filter runoff, provide shade, and improve habitat for aquatic life.

While these efforts represent a significant investment, it is important to monitor whether they are successfully improving stream health. Monitoring provides evidence to justify the resources and effort being invested, and it lets landowners and the wider community know whether their actions are making a positive difference. This feedback helps build motivation, trust, and confidence, encouraging similar actions to be taken in other areas. Monitoring also identifies whether additional or different mitigation measures may be needed to achieve the project's aspirations.

Although the council already undertakes regular water quality monitoring through its State of the Environment programme, this network is designed to provide broad regional coverage. As a result, most of these monitoring sites are located on larger rivers and streams. However, research shows that the benefits of mitigation measures, such as fencing and planting, are often detected more quickly in smaller catchments than in larger river systems [3].

To address this, a dedicated monitoring programme was developed specifically for the Te Hoiere Project Area. Initially, nine monitoring sites were selected based on the presence of upstream mitigation measures and information gathered during the 2020/21 baseline study. This targeted approach allows for a more direct assessment of how local actions are influencing stream health.

Following the first reporting of results in 2025 [4], the programme was reviewed to ensure it continues to provide useful and relevant information [7]. Regular review is essential to make the best use of limited funding, while still maintaining continuity in the data collected. At the same time, it is important to recognise that some mitigation measures, such as riparian planting or the introduction of dung beetles, can take several years before their effects become evident in water quality data. Long-term monitoring is therefore critical to capturing these delayed improvements, and sites where mitigation actions have been implemented should not be removed without careful consideration.

As part of the review, monitoring sites that showed little change and were unlikely to see further mitigation in the near future were replaced with new locations. These new sites were selected using the same approach as the original programme, with a preference for locations that had already been monitored during the 2020/21 baseline study to allow for meaningful comparisons over time. Following this process, five sites were replaced, while maintaining a total of nine monitoring sites across the programme

Methodology

Following the review of the monitoring programme in September 2025, the updated monitoring network was implemented, with data collection at the new sites beginning in November 2025. While the network of sites was refined, the monitoring methodology itself has remained consistent. This ensures that results can be compared over time with confidence.

Monitoring is carried out through monthly site visits, regardless of weather conditions. During each visit, water samples are collected and sent to an accredited laboratory (Hill Laboratories) for analysis. Regular, consistent

sampling in all conditions helps provide a representative picture of stream health over time, rather than reflecting only favourable or unfavourable conditions.

The laboratory analyses each sample for a range of key water quality indicators, including:

- pH (a measure of how acidic or alkaline the water is)
- Total Ammoniacal Nitrogen (a form of nitrogen that can be toxic to aquatic life at high levels)
- Nitrite/Nitrate Nitrogen (forms of nitrogen commonly associated with land use and agricultural runoff)
- Nitrate Nitrogen
- Dissolved Reactive Phosphorus (a form of phosphorus readily available for plant growth, which can contribute to algal blooms)
- E. coli (an indicator of faecal contamination and potential health risk for human contact)
- Turbidity (a measure of water clarity, influenced by suspended sediment)

The updated monitoring network consists of four sites that have been monitored since late 2023 and five additional sites that were incorporated into the programme in November 2025. As a result, at the time of this report, the newer sites have a relatively short record, with data available for a seven-month period from November to May.

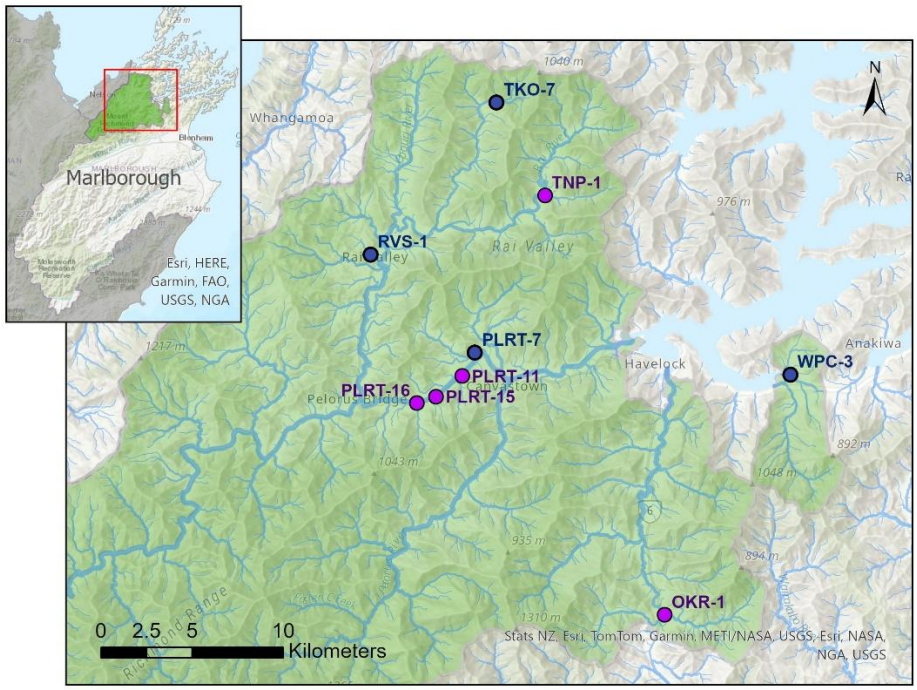


Figure 1 Location of the monitoring sites. Sites shown in the lighter, purple colour are those added following the 2025 review of the programme. Te Hoiere project area is shown in green.

To ensure that comparisons between sites are fair and consistent, only data collected between November and May has been used for all sites in this analysis, even where longer records are available. This approach avoids seasonal bias and allows like-for-like comparisons across both older and newer monitoring locations. However, it also means that there are limitations to the datasets. With less than one year of data used, it can be difficult to confidently distinguish between short-term variability and longer-term trends. As a result, findings for these sites should be interpreted with some caution until a longer record for the newly added sites is established.

To assess whether mitigation measures have influenced water quality, data collected during the 2020/21 baseline monitoring period was compared with data from the most recent monitoring period (2025/26).

Statistical analysis was undertaken using the Wilcoxon signed-rank test, which is a widely used method for comparing paired datasets where the data may not follow a normal distribution [9].

The results of this analysis are expressed using p-values. A p-value represents the probability that an observed difference between two sets of data could have occurred by chance alone. In simple terms, a smaller p-value indicates greater confidence that a real change has occurred, rather than the difference being due to natural variability.

While p-values of less than 0.05 are commonly considered to indicate statistically significant change, this report also includes results with slightly higher p-values as indicators of potential trends. This approach, based on Choquette et al. (2019), aligns with more recent guidance on interpreting environmental monitoring data, where early signals of change can still provide valuable insight, even if uncertainty remains [10].

The interpretation used in this report is as follows:

p-value	Meaning
< 0.05	Highly Likely change in water quality
0.05 – 0.10	Very Likely change in water quality
0.10 – 0.15	Likely change in water quality

By taking this approach, the monitoring programme is able to highlight both clear and emerging trends, supporting informed decision-making while acknowledging the natural variability that is inherent in environmental systems.

Results

The following sections describe each of the key water quality parameters, why they matter for stream health, and the changes observed across the monitoring sites. It is important to recognise that water quality is naturally variable and can change in response to weather, seasonal conditions, and natural processes. To help distinguish between natural variability and human influence, one of the monitoring sites (TKO-7 in the upper Tunakino River) has been selected as a reference site. This site has minimal human impact and provides an indication of natural background conditions against which other sites can be compared.

Nitrate Nitrogen

Nitrate nitrogen is an important nutrient for plant growth. However, when present in excessive amounts in streams, it can lead to the overgrowth of algae. This often appears as thick mats or long, filamentous (stringy) growths that can cover the streambed. Such dense algae growth reduces the quality of habitat for aquatic life compared to the thin films of algae typically found in healthy, forested streams.

At very high concentrations, nitrate can also be directly toxic to aquatic organisms. It interferes with the transport of oxygen within the body, making it difficult for sensitive species to survive [2]. While this effect can also impact human health, effecting oxygen transport in infants and the function of the thyroid [11], aquatic life is generally much more sensitive to nitrate toxicity than humans.

Nitrate typically enters streams through a process known as leaching, where rainfall or irrigation water carries nitrogen from the soil into groundwater, which then flows into streams. The main sources of leached nitrate are cattle urine and fertiliser. In addition, livestock with direct access to streams can contribute nitrogen through animal droppings deposited directly in the water. Measures such as stream fencing help prevent this direct input, while riparian planting can reduce nitrate entering streams by taking up nitrogen from groundwater before it reaches the channel.

The Marlborough Environment Plan (MEP) sets a target for median nitrate nitrogen concentrations of less than 1.0 g/m^3 [8].

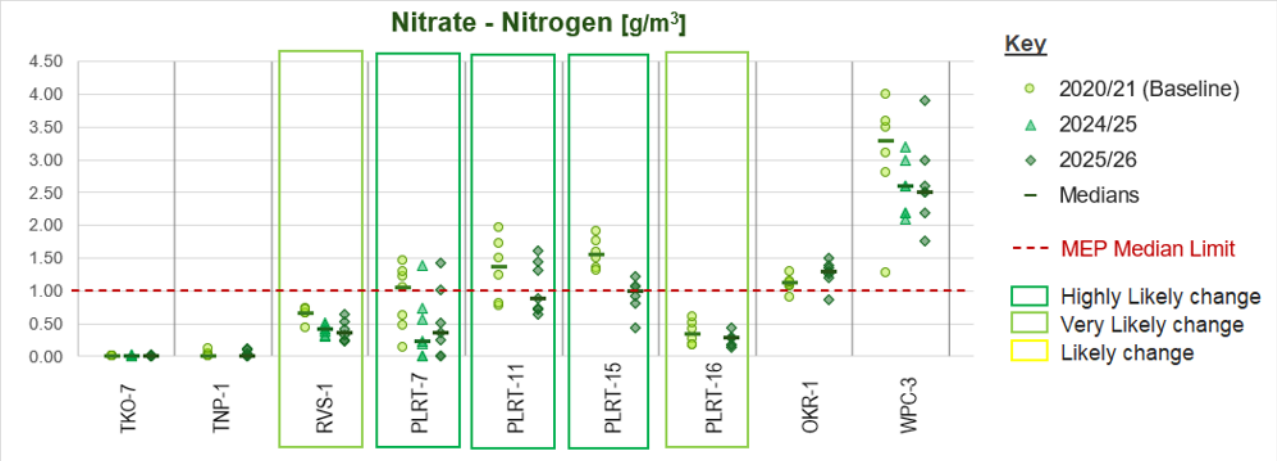


Figure 2 Nitrate Nitrogen concentrations at the monitoring sites during three different time periods. The green frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26.

Across the monitoring network, five of the nine sites showed statistically significant decreases in nitrate concentrations compared to the 2020/21 baseline. These include all monitored streams in the lower Te Hoiere/Pelorus area. At three of these sites, reductions were sufficient to bring median concentrations below the MEP target, indicating a notable improvement in water quality. Fencing and riparian planting of streams was carried out at all of these sites, but changes in fertiliser use, grazing management and stocking rates are the reasons for the greater reduction in nitrate concentrations at some of the monitoring locations (e.g. PLRT-15).

Natural nitrate concentrations are typically very low, as reflected in measurements from the reference site (TKO-7). Similarly low concentrations were observed in the Tunapai Stream (TNP-1), suggesting relatively low levels of human influence in these catchments.

In contrast, the highest nitrate concentrations were recorded at White Pine Creek in Linkwater (WPC-3). Although median concentrations at this site have decreased over time, the change was not statistically significant. Together with the Okaramio River (OKR-1), it is one of only two sites where median nitrate concentrations still exceed the MEP target.

The Rai Valley Stream (RVS-1) also showed a statistically significant reduction in nitrate concentrations. While initial concentrations at this site were not as elevated as at some other locations, the observed improvements indicate a positive trend.

Ammoniacal Nitrogen

Ammoniacal nitrogen is another form of dissolved nitrogen in water, but unlike nitrate, it is typically associated with the breakdown of organic material or conditions where oxygen levels are low. It is often linked to more direct sources of contamination.

Occasional high concentrations, or large fluctuations in ammoniacal nitrogen levels, can indicate the direct input of organic material into waterways. Common sources include livestock access to streams, runoff from critical source areas such as swales and springs, and leaching from stored organic materials such as silage or animal feed. As a result, elevated ammoniacal nitrogen is often an indicator of localised management issues.

High levels of ammoniacal nitrogen can be toxic to aquatic life. It can damage internal organs, affect brain function, and interfere with essential biological processes such as ion regulation and metabolism [1]. The level at which ammoniacal nitrogen becomes toxic depends on factors such as water temperature and pH. As water

temperature was not recorded as part of this monitoring programme, it was not possible to directly compare results with guideline values from national or regional standards.

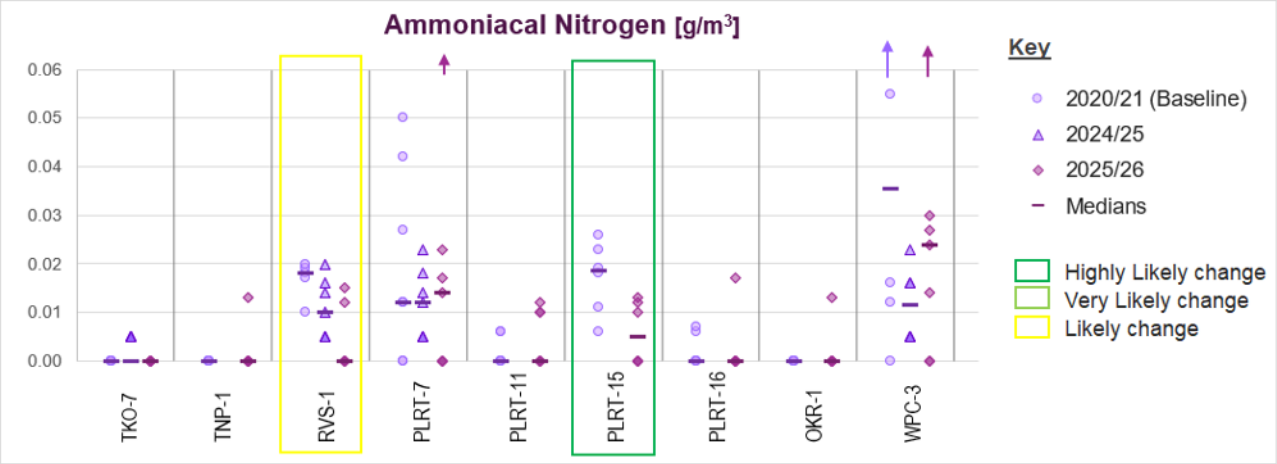


Figure 3 Ammoniacal Nitrogen concentrations at the monitoring sites during three different time periods. The green or yellow frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26.

Most monitoring sites recorded very low ammoniacal nitrogen concentrations. This includes the reference site (TKO-7), as well as the Tunapai Stream (TNP-1) and the Okaramio River (OKR-1).

Of the sites that exhibited higher concentrations, two showed statistically significant reductions over time. At both sites, median concentrations decreased by more than 70%. At Rai Valley Stream (RVS-1), median concentrations have reduced to below the laboratory detection limit, indicating a substantial improvement. At site PLRT-15, a small tributary of the lower Te Hoiere/Pelorus River, concentrations also decreased but remain slightly elevated.

Two sites continue to show consistently elevated ammoniacal nitrogen concentrations: PLRT-7 in the lower Te Hoiere/Pelorus area and White Pine Creek (WPC-3) in Linkwater. At WPC-3, concentrations decreased during the 2024/25 period, suggesting some improvement, but have since returned to higher levels in recent months. This pattern indicates that while some progress may have been made, ongoing sources of contamination are still influencing water quality at this site.

Dissolved Reactive Phosphorus (DRP)

Phosphorus is another key nutrient that supports plant growth in aquatic environments. Dissolved Reactive Phosphorus (DRP) is the form most readily available for uptake by plants and algae. As with nitrogen, elevated phosphorus levels can lead to excessive algal growth, which can smother streambeds and reduce habitat quality for aquatic organisms.

The most common sources of phosphorus in waterways are animal waste and soil erosion. Unlike nitrate, phosphorus tends to bind strongly to sediment, meaning it is less likely to leach into groundwater. Instead, it is often transported into streams attached to soil particles during rainfall events or when stream banks and bare ground are eroded. However, phosphorus can still leach from large stores of organic material, such as silage, if these are not managed appropriately. Additionally, livestock droppings deposited into streams also release phosphorus.

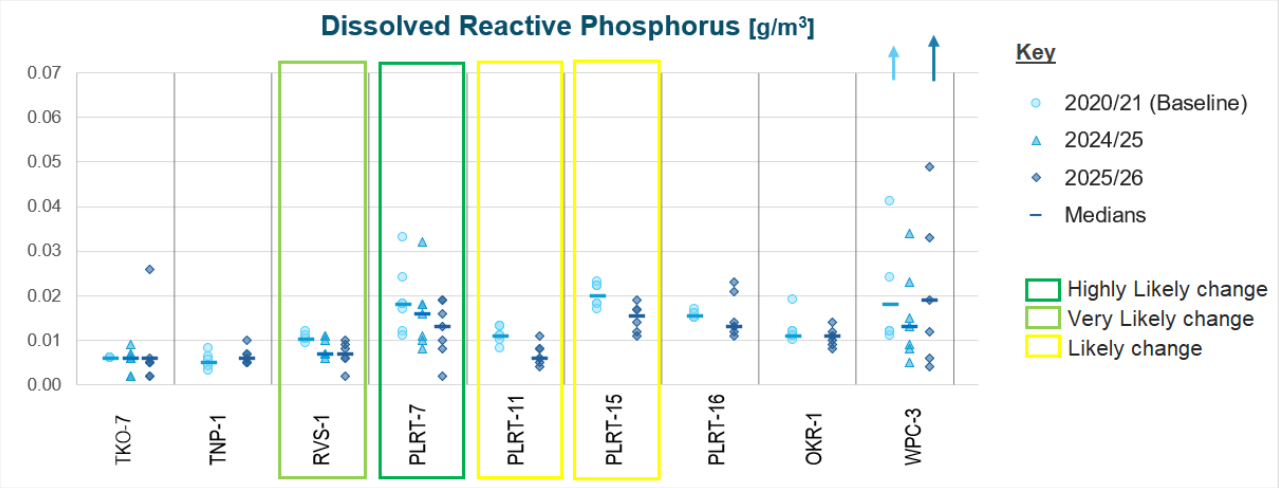


Figure 4 Dissolved Reactive Phosphorus concentrations at the monitoring sites during three different time periods. The green or yellow frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26.

Slightly elevated DRP concentrations at the reference site (TKO-7) indicate that some phosphorus is naturally present in the catchment due to its underlying geology. This highlights the importance of considering natural background levels when interpreting monitoring results.

Statistically significant decreases in DRP concentrations were observed at four of the monitoring sites, including Rai Valley Stream (RVS-1) and several locations in the lower Te Hoiere/Pelorus catchment. Reductions in median concentrations ranged from 22% to 45%, with the largest improvement recorded at site PLRT-11. These changes suggest that mitigation measures such as fencing, planting, and erosion control are helping to reduce phosphorus inputs.

In contrast, the highest DRP concentrations during the most recent monitoring period (2025/26) were again recorded at White Pine Creek (WPC-3) in Linkwater. At this site, no significant change in DRP concentrations has been observed since the 2020/21 baseline, indicating that phosphorus sources remain active and may require further targeted management.

E. coli

E. coli bacteria are used as an indicator of faecal contamination in water. Their presence is directly linked to animal waste, which can enter waterways either through surface runoff during rainfall or irrigation, or through livestock having direct access to streams and surrounding critical source areas such as drains, swales, and springs.

The National Policy Statement for Freshwater Management (NPS-FM) sets a national bottom line of 130 E. coli per 100 millilitres (mL) for the median value[1] [9]. Where concentrations exceed this level, improvements are required to reduce the risk to human health and ecosystem integrity.

[1] There are four different limits for the E. coli attribute in the in the National Policy Statement for Freshwater Management 2020, the median limit is one of them.

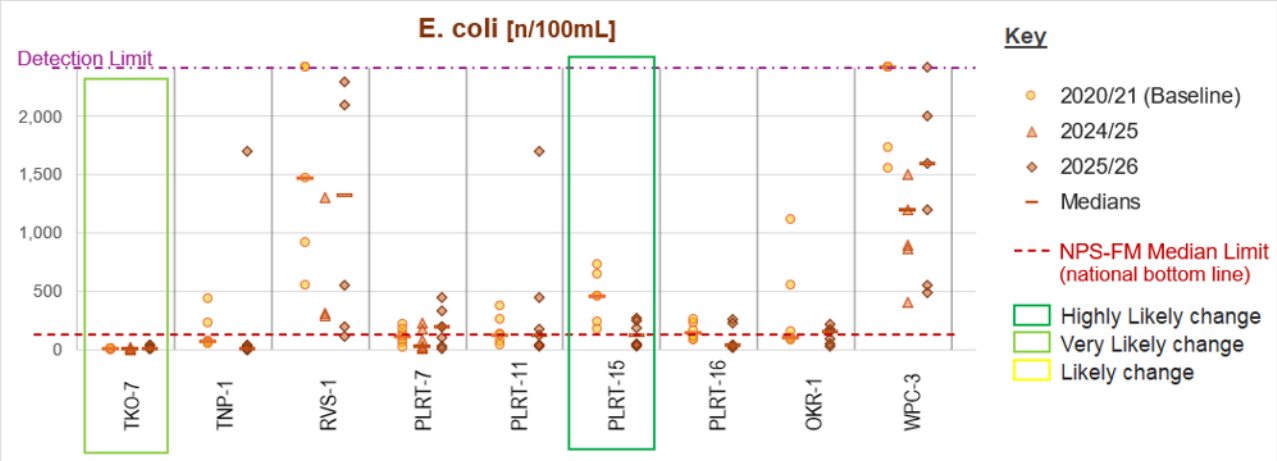


Figure 5 E. coli concentrations at the monitoring sites during three different time periods. The green or yellow frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26. The 'NPS-FM Median limit' is the national bottom line for median concentrations.

Several of the monitored sites recorded median E. coli concentrations above this national bottom line. The highest levels were observed at Rai Valley Stream (RVS-1) and White Pine Creek (WPC-3), indicating ongoing faecal inputs in these catchments.

Interestingly, the analysis showed a small but statistically significant increase in E. coli concentrations at the reference site (TKO-7), which has minimal human influence. This suggests that environmental factors, such as increased rainfall and runoff during the most recent monitoring period, may have contributed to higher background levels. When this occurs, it can make it more difficult to clearly detect improvements resulting from mitigation measures, as natural conditions may temporarily mask these effects.

Consistent with this, slight increases in E. coli were also observed at sites PLRT-7 and OKR-1, although these changes were not statistically significant. Despite this, there are clear signs of improvement at some locations. At site PLRT-15 in the lower Te Hoiere/Pelorus catchment, E. coli levels decreased significantly, with a 74% reduction in the median concentration. This represents a substantial improvement in water quality and indicates that mitigation efforts in this area are having a positive effect.

Turbidity

Turbidity is a measure of how clear or cloudy the water is and is commonly used as an indicator of the amount of suspended sediment in a stream. While turbidity itself is not a pollutant, it reflects the presence of fine particles in the water, which can have a range of ecological effects.

Sediment in waterways typically originates from the erosion of stream banks, exposed soils, and degraded land areas. Once sediment has settled on the streambed, it can also be re-suspended during high flows, contributing to elevated turbidity.

High levels of fine sediment can reduce water clarity, making it more difficult for visual predators such as trout to catch their prey. However, in the Te Hoiere catchment, the most significant impact occurs when sediment settles onto the streambed or accumulates in the estuary. Fine sediment can clog the spaces between larger stones, which are important habitats for aquatic insects and small fish, and are critical for the successful development of eggs for many species.

Turbidity is measured in Nephelometric Turbidity Units (NTU), which is a technical unit based on how light passes through the water. For context, in the Te Hoiere area, water typically begins to appear visibly unclear when turbidity exceeds about 3 to 4 NTU.

Under the NPS-FM, the relevant attribute for sediment is water clarity. Through parallel monitoring of turbidity and water clarity in the Te Hoiere catchment, it has been possible to convert national water clarity thresholds

into an equivalent turbidity value. This establishes a national bottom line equivalent of 1.3 NTU for median turbidity, above which improvements are required.

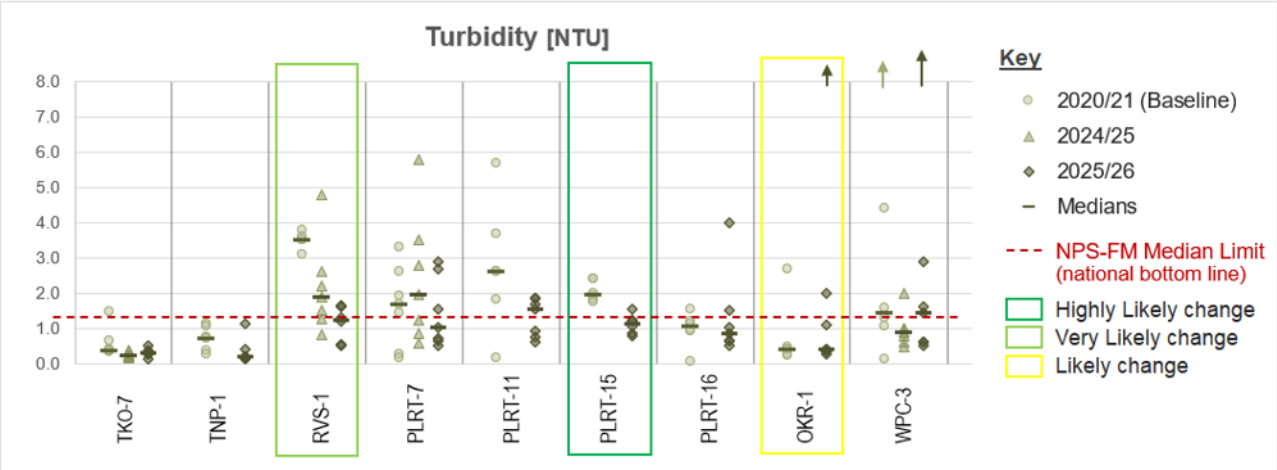


Figure 6 Turbidity measurements at the monitoring sites during three different time periods. The green or yellow frames show sites with statistically significant changes between the baseline monitoring in 2020/21 and the most recent monitoring period of 2025/26. The 'NPS-FM median limit' is the national bottom line for median values based on conversion of the limits for the water clarity attribute.

Measurements at the reference site (TKO-7), where the catchment is largely covered in native bush, show that turbidity is naturally low. It is important to note that very high turbidity can still occur during flood events, but these conditions were not captured during routine monthly sampling.

During the 2020/21 baseline monitoring, several sites recorded median turbidity values above the national bottom line. In the most recent monitoring period (2025/26), this has improved, with only two sites still exceeding the threshold, and only by a small margin.

Despite this overall improvement, statistically significant changes were detected at only three sites. Rai Valley Stream (RVS-1) and site PLRT-15 both showed substantial reductions in turbidity, with decreases ranging from 42% to 64%. The largest reduction was observed at RVS-1, indicating a notable improvement in sediment control.

In contrast, site OKR-1 showed a small increase in turbidity of around 5%. While this change is relatively minor, it highlights that not all sites are improving and that ongoing management efforts may be required in some areas.

Discussion

Overall, the monitoring results show a mixed but encouraging picture, with clear evidence that targeted mitigation measures can lead to meaningful improvements in water quality.

The most notable improvements were observed at site PLRT-15, a small tributary of the lower Te Hoiere/Pelorus River. This site showed statistically significant improvements across all parameters assessed in this report, indicating a strong and consistent positive response. Similarly, the Rai Valley Stream site (RVS-1), located near the Rai Valley township, showed statistically significant improvements in all parameters except E. coli. These results highlight substantial gains in water quality at both sites.

A key factor linking these two sites is the extent of mitigation work carried out upstream. Both catchments have undergone extensive stream fencing and riparian planting, including in smaller tributaries and headwater areas. This suggests that comprehensive, catchment-wide approaches, rather than isolated actions, are particularly effective in improving stream health.

Additional improvements were observed at several other sites in the lower Te Hoiere/Pelorus catchment, including PLRT-7, PLRT-11, and PLRT-16, where statistically significant changes were recorded for one or two parameters. While these changes are more limited in scope, they still indicate positive trends and demonstrate that progress is being made across multiple parts of the catchment.

In contrast, three sites did not show statistically significant improvements over the monitoring period. At the Tunapai Stream site (TNP-1), this is likely due to the fact that water quality was already relatively good during the baseline monitoring period in 2020/21. As a result, there may be limited scope for further measurable improvement, even though fencing and planting have been implemented upstream.

At the Okaramio River site (OKR-1), water quality remains moderately impacted and has not shown improvement despite mitigation efforts in the lower reaches. Data collected during the 2020/21 baseline study from an upstream monitoring location suggest that key sources of contamination are located further upstream. This indicates that additional mitigation efforts will need to be extended into these upper parts of the catchment to achieve noticeable improvements downstream.

White Pine Creek in Linkwater (WPC-3) continues to exhibit the poorest overall water quality among the monitored sites. Although some improvements were identified in earlier analysis during the 2024/25 period, these have not been sustained in the most recent data. This suggests that while initial changes in land management practices may have had some positive effect, further and potentially more targeted actions will be required to achieve lasting improvements at this site.

Taken together, the results from sites such as PLRT-15 and RVS-1 demonstrate that significant water quality improvements are achievable when mitigation measures such as fencing and riparian planting are applied at scale and across entire catchments, including smaller upstream tributaries. On the two farms on which PLRT-15 and RVS-1 are located, additional mitigation measures such as changes in fertiliser regime (i.e. exclusive use of crushed mussel shells and bio liquid) as well as changes to stocking rates and grazing management have significantly contributed to the positive changes observed. These findings reinforce the importance of a coordinated, catchment-wide approach to land and water management in order to achieve the long-term goal of healthy and resilient waterways.



Figure 7 Fencing and riparian planting of streams as well as changes in land management practices such as fertiliser use and grazing management have resulted in significant improvements in water quality at monitoring site PLRT-15 (located downstream of this tributary).

Natural variability in water quality is an important factor to consider when interpreting the results of this monitoring programme. Stream conditions can change markedly in response to rainfall, seasonal patterns, and flow conditions. For example, wetter periods can increase surface runoff, which in turn can carry higher loads of contaminants such as sediment, nutrients, and faecal matter into waterways. This can lead to short-term increases in measured concentrations, even at sites where mitigation measures are in place. The observed increases in E. coli at some sites during the most recent monitoring period, including at the reference site with minimal human influence, suggest that climatic conditions may have contributed to elevated background levels.

These natural fluctuations can make it more difficult to clearly detect the effects of mitigation measures over shorter timeframes, as improvements may be temporarily masked by environmental conditions. As a result, apparent increases or lack of change in some parameters do not necessarily indicate that mitigation efforts are

ineffective. Instead, they highlight the need to interpret monitoring data within the context of broader environmental conditions.

This reinforces the importance of long-term monitoring. By collecting data over multiple years and across a range of climatic conditions, it becomes possible to distinguish between short-term variability and sustained trends in water quality. Long-term datasets provide greater confidence in identifying whether observed changes are the result of management actions or natural variation, and they are essential for guiding adaptive management to achieve the long-term goal of healthy and resilient waterways.

Another important consideration is the time required for riparian planting to become fully effective. Newly planted vegetation does not immediately deliver the full range of benefits expected for stream health. It can take several years for plants to establish, grow, and develop the root systems needed to stabilise streambanks, as well as the canopy cover required to provide shade and reduce water temperatures. Similarly, the ability of riparian vegetation to filter contaminants such as nutrients and sediment from overland flow and shallow groundwater improves gradually as plant density and maturity increase.

As a result, the full water quality benefits of riparian planting may not be observable within the early years of monitoring. In some cases, only limited or no change may be detected in the short term, even where planting has been carried out. This lag between implementation and measurable outcomes further reinforces the importance of long-term monitoring. Continued data collection over extended periods allows these delayed effects to be captured and provides a more accurate assessment of the true effectiveness of mitigation measures over time.

References

1. ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 2: Aquatic Ecosystems – Rationale and Background Information, Environment and Conservation Council & Agriculture and Resource Councils of Australia and New Zealand.
2. ANZG (2025) Toxicant default guideline values for aquatic ecosystem protection: Nitrate in freshwater, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, CC BY 4.0, Australian and New Zealand governments and Australian state and territory governments, Canberra, ACT, Australia
3. Ausseil O et al. (2021) Measuring the benefits of management actions: Mitigation effectiveness Monitoring Design, Proof of Concept development phase. Our Land and Water National Science Challenge, New Zealand.
4. Choquette, A.F et al. (2019) Tracking Changes in Nutrient Delivery to Western Lake Erie: Approaches to Compensate for Variability and Trends in Streamflow. Journal of Great Lakes Research, 45: 21–39.
5. Henkel (2021) Influences of Land use on Water Quality in the Te Hoiere Catchment Restoration Project Area – 2021 Baseline. MDC Report No: 21-008.
6. Henkel (2025) Te Hoiere Water Quality Mitigation Effectiveness Monitoring Report – June 2025. MDC Report prepared for the Te Hoiere Project.
7. Henkel (2025) Te Hoiere Mitigation Effectiveness Monitoring Review. Unpublished MDC Report prepared for the Te Hoiere Project.
8. MDC (2016) Marlborough Environment Plan – operative in parts.
9. NZ Government (2020) National Policy Statement for Freshwater Management; updated Dec 2025.
10. Okoye K and Hosseini S (2024) R Programming – Statistical Data Analysis in Research. Springer Books.
11. Snelder T et al. (2021) Guidance for the analysis of temporal trends in environmental data. MBIE Envirolink Report prepared for Horizons Regional Council. NIWA Report No.: 2021017WN
12. WHO (2016) Nitrate and Nitrite in Drinking-water. WHO Guidelines for Drinking-water Quality.